
AEIf

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aelf core team

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WELCOME TO AELF'S OFFICIAL DOCUMENTATION.

This site is where we centralize our guides, documents and api references. Wether you're a dApp developer looking to build some awesome apps on top of AElf or simply just interested in seeing what a running node looks like, this place is for you!

As of today the documentation is correct but still a work in progress so we invite you to frequently visit and discover any new content.

OVERVIEW

Developer documentation is designed to provide developers with guidelines, documents, and API references. It is helpful for developers who want to build DApps on aelf and develop contracts. New users can also get to know things like how nodes run from this documentation.

This documentation is still updated, so you are encouraged to frequently visit this site to check the new content.

What is aelf

aelf is an excellent one-stop solution for Web3 DApps, built upon a cloud-native, high-performance, next-gen blockchain system. With its various infrastructures and developer tools that underpin Web3, applications in aelf ecosystem can run in a secure, fast, smooth, and cost-efficient manner.

With its well-developed infrastructures for Web3 applications like DeFi and Metaverse, aelf provides Web3 users and developers with a fast, smooth, and low-cost experience, further lowering the bar. aelf will be an integral part of the metaverse and the convenient entrance to that world for everyone.

To learn more about aelf infrastructure, please refer to [aelf Whitepaper](#).

To learn more about aelf governance, please refer to [aelf Economic and Governance Whitepaper](#).

Why aelf?

aelf is a high-performance, cloud-native, layer-1 blockchain network with its Mainnet nodes running on different cloud-computing data centers. It provides a high-speed running environment for smart contracts and enables the execution of contracts in parallel and smart contract microservitization running on server clusters. Its MainChain and multi-SideChains architecture supports efficient indexing within the network and guarantees almost unlimited scalability. The built-in cross-chain design facilitates ultra-fast interaction of data. The innovative hybrid of shared SideChain and exclusive SideChain greatly lowers the cost for developers and users and further enhances the overall network performance.

DEVELOPMENT ENVIRONMENT

3.1 Install

Before you get started with the tutorials, you need to install the following tools and frameworks.

For most of these dependencies, we provide command line instructions for macOS, Linux Ubuntu 18, and Windows. In case any problems occur or if you have more complex needs, please leave a message on GitHub and we will handle it ASAP.

3.1.1 macOS

Configure Environment

You can install and set up the development environment on macOS computers with either Intel or Apple M1 processors. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a macOS device, please make sure that your computer meets these basic requirements:

- Operating system version is 10.7 Lion or higher.
- At least a 2Ghz processor, 3Ghz recommended.
- At least 8 GB RAM, 16 GB recommended.
- No less than 10 GB of available space.
- Broadband internet connection.

Support for Apple M1

If you use a macOS computer with an Apple M1 chip, you need to install Apple Rosetta. Open the Terminal on your computer and execute this command, Please be patient while the command is executed.

```
/usr/sbin/softwareupdate --install-rosetta --agree-to-license
```

Install Homebrew

In most cases, you should use Homebrew to install and manage packages on macOS devices. If Homebrew is not installed on your local computer yet, you should download and install it before you continue.

To install Homebrew:

1. Open Terminal.
2. Execute this command to install Homebrew:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/HEAD/
↵install.sh)"
```

3. Execute this command to check if Homebrew is installed:

```
brew --version
```

The following output suggests successful installation:

```
Homebrew 3.3.1
Homebrew/homebrew-core (git revision c6c488fbc0f; last commit 2021-10-30)
Homebrew/homebrew-cask (git revision 66bab33b26; last commit 2021-10-30)
```

Environment Update

Execute this command to update your environment:

```
brew update
```

You will see output like this.

```
You have xx outdated formula installed.
You can upgrade it with brew upgrade
or list it with brew outdated.
```

You can execute the following command to upgrade or skip to the installation of Git.

```
brew upgrade
```

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. Execute this command in Terminal:

```
brew install git
```

2. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version xx.xx.xx
```

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK (Installers - x64 recommended for macOS devices with Intel processors; Installers - Arm64 recommended for macOS devices with M1 chips).

1. Download and install [.NET 6.0](#) which is currently used in aelf's repo.
2. Please reopen Terminal after the installation is done.
3. Execute this command to check if .NET is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. Execute this command to install protoBuf:

```
brew install protobuf
```

If it shows error `Permission denied @ apply2files`, then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chown -R $(whoami) $(brew --prefix)/*
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

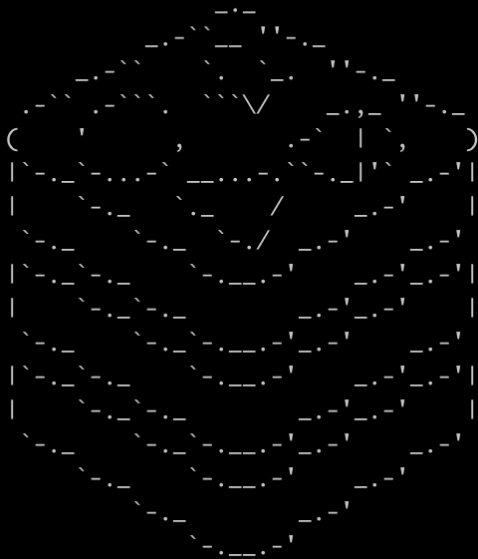
```
brew install redis
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

```
[...] redis-server  
60154:C 31 Oct 16:40:37.991 # o000o000o000o Redis is starting o000o000o000o  
60154:C 31 Oct 16:40:37.991 # Redis version=4.0.8, bits=64, commit=00000000, modified=0,  
pid=60154, just started  
60154:C 31 Oct 16:40:37.991 # Warning: no config file specified, using the default config  
. In order to specify a config file use redis-server /path/to/redis.conf
```



```
Redis 4.0.8 (00000000/0) 64 bit  
  
Running in standalone mode  
Port: 6379  
PID: 60154  
  
http://redis.io
```

Install Nodejs

1. Execute this command to install Nodejs:

```
brew install node
```

2. Execute this command to check if Nodejs is installed:

```
npm --version
```

The following output suggests successful installation:

6.14.8

3.1.2 Linux

Configure Environment

You can install and set up the development environment on computers running 64-bit Linux. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a Linux device, please make sure that your computer meets these basic requirements:

- Ubuntu 18.
- Broadband internet connection.

Update Environment

Execute this command to update your environment, Please be patient while the command is executed:

```
sudo apt-get update
```

The following output suggests successful update:

```
Fetchd 25.0 MB in 3s (8,574 kB/s)
Reading package lists... Done
```

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. Open the terminal.
2. Execute this command to install Git:

```
sudo apt-get install git -y
```

3. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version 2.17.1
```

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK.

1. Execute the following commands to install .NET 6.0.

1. Execute this command to download .NET packages:

```
wget https://packages.microsoft.com/config/ubuntu/22.04/packages-microsoft-prod.  
↪deb -O packages-microsoft-prod.deb
```

2. Execute this command to unzip .NET packages:

```
sudo dpkg -i packages-microsoft-prod.deb  
  
rm packages-microsoft-prod.deb
```

3. Execute this command to install .NET:

```
sudo apt-get update && \  
  
sudo apt-get install -y dotnet-sdk-6.0
```

2. Execute this command to check if .NET 6.0 is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

Before you start the installation, please check the directory you use and execute the following commands to install.

1. Execute the following commands to install protoBuf.

1. Execute this command to download protoBuf packages:

```
curl -OL https://github.com/google/protobuf/releases/download/v21.9/protoc-21.9-  
↪linux-x86_64.zip
```

2. Execute this command to unzip protoBuf packages:

```
unzip protoc-21.9-linux-x86_64.zip -d protoc3
```

3. Execute these commands to install protoBuf:

```
sudo mv protoc3/bin/* /usr/local/bin/  
  
sudo mv protoc3/include/* /usr/local/include/  
  
sudo chown ${USER} /usr/local/bin/protoc  
  
sudo chown -R ${USER} /usr/local/include/google
```


2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

```
sudo apt-get install redis -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

```
Server initialized  
Ready to accept connections
```

You can open a new terminal and use redis-cli to start Redis command line. The command below can be used to clear Redis cache (be careful to use it):

```
flushall
```

Install Nodejs

1. Execute these commands to install Nodejs:

```
curl -fsSL https://deb.nodesource.com/setup_14.x | sudo -E bash -  
  
sudo apt-get install -y nodejs
```

2. Execute this command to check if Nodejs is installed:

```
npm --version
```

The following output suggests successful installation:

```
6.14.8
```

3.1.3 Windows

Configure Environment

You can install and set up the development environment on computers running Windows 10 or higher. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a Windows device, please make sure that your computer meets these basic requirements:

- Operating system version is Windows 10 or higher.
- Broadband internet connection.

Install Chocolatey (Recommended)

Chocolatey is an open-source package manager for Windows software that makes installation simpler, like Homebrew for Linux and macOS. If you don't want to install it, please use the provided download links for each software to complete their installation.

1. Open **cmd** or **PowerShell** as administrator (Press Win + x).
2. Execute the following commands in order and enter y to install Chocolatey, Please be patient while the command is executed:

```
Set-ExecutionPolicy AllSigned

Set-ExecutionPolicy Bypass -Scope Process

Set-ExecutionPolicy Bypass -Scope Process -Force; iex ((New-Object System.Net.
↪WebClient).DownloadString('https://chocolatey.org/install.ps1'))

Set-ExecutionPolicy RemoteSigned
```

3. Execute this command to check if Chocolatey is installed:

```
choco
```

The following output suggests successful installation:

```
Chocolatey vx.x.x
```

If it shows The term 'choco' is not recognized as the name of a cmdlet, function, script file, or operable program, then there is a permission issue with PowerShell. To solve it:

- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the **ChocolateyInstall** variable is in **System variables**, and its default value is the Chocolatey installation path C:\Program Files\Chocolatey. If you don't find it, click New System Variable to manually add it.

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. You can download Git through this link or execute this command in cmd or PowerShell:

```
choco install git -y
```

2. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version xx.xx.xx
```

If it shows The term 'git' is not recognized as the name of a cmdlet, function, script file, or operable program, you can:

- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the Git variable is in **Path** in **System variables**, and its default value is the Git installation path C:\Program Files\git. If you don't find it, click **New System Variable** to manually add it.

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK (Installers - x64 recommended for Windows devices).

1. Download and install [.NET 6.0](#) which is currently used in aelf's repo.
2. Please reopen cmd or PowerShell after the installation is done.
3. Execute this command to check if .NET is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. You can download protoBuf through this link or execute this command in cmd or PowerShell:

```
choco install protoc --version=3.11.4 -y  
choco install unzip -y
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

libprotoc 3.21.9

Install Redis

1. You can download Redis through MicroSoftArchive-Redis or execute this command in cmd or PowerShell:

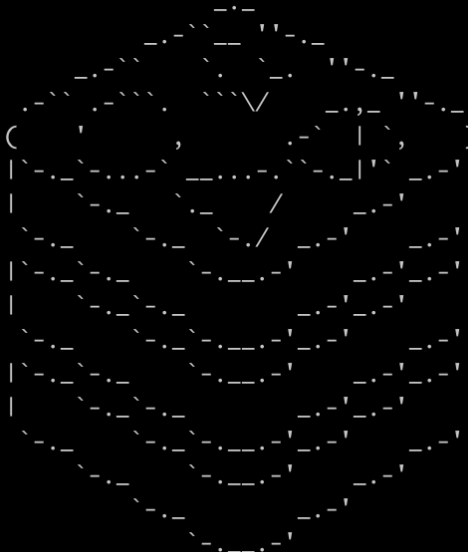
```
choco install redis-64 -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

memurai

The following output suggests Redis is installed and a Redis instance is started:

```
[root@redis ~]# redis-server
60154:C 31 Oct 16:40:37.991 # oOoOoOoOoOoOo Redis is starting oOoOoOoOoOoOo
60154:C 31 Oct 16:40:37.991 # Redis version=4.0.8, bits=64, commit=00000000, modified=0,
pid=60154, just started
60154:C 31 Oct 16:40:37.991 # Warning: no config file specified, using the default config
. In order to specify a config file use redis-server /path/to/redis.conf
```



```
Redis 4.0.8 (00000000/0) 64 bit

Running in standalone mode
Port: 6379
PID: 60154

http://redis.io
```

Install Nodejs

1. You can download Nodejs through Node.js or execute this command in cmd or PowerShell:

```
choco install nodejs -y
```

2. Execute this command to check if Nodejs is installed:

```
npm --version
```

The following output suggests successful installation:

```
6.14.8
```

If it shows The term 'npm' is not recognized as the name of a cmdlet, function, script file, or operable program, you can:

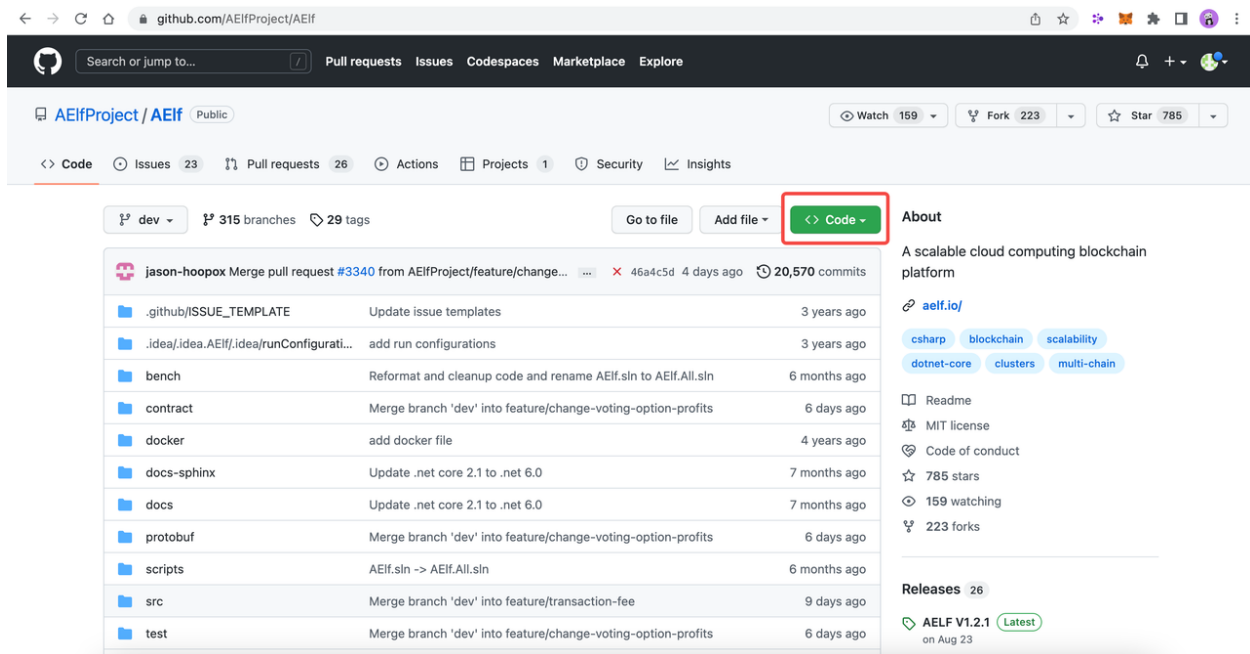
- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the Nodejs variable is in **Path** in **System variables**, and its default value is the Nodejs installation path C:\Program Files\nodejs. If you don't find it, click **New System Variable** to manually add it.

3.1.4 Codespaces

A codespace is an instant development environment that's hosted in the cloud. It provides users with general-purpose programming languages and tooling through containers. You can install and set up the development environment in Codespaces. This will take 10-20 minutes. Please be patient while the command is executed.

Basic Environment Configurations

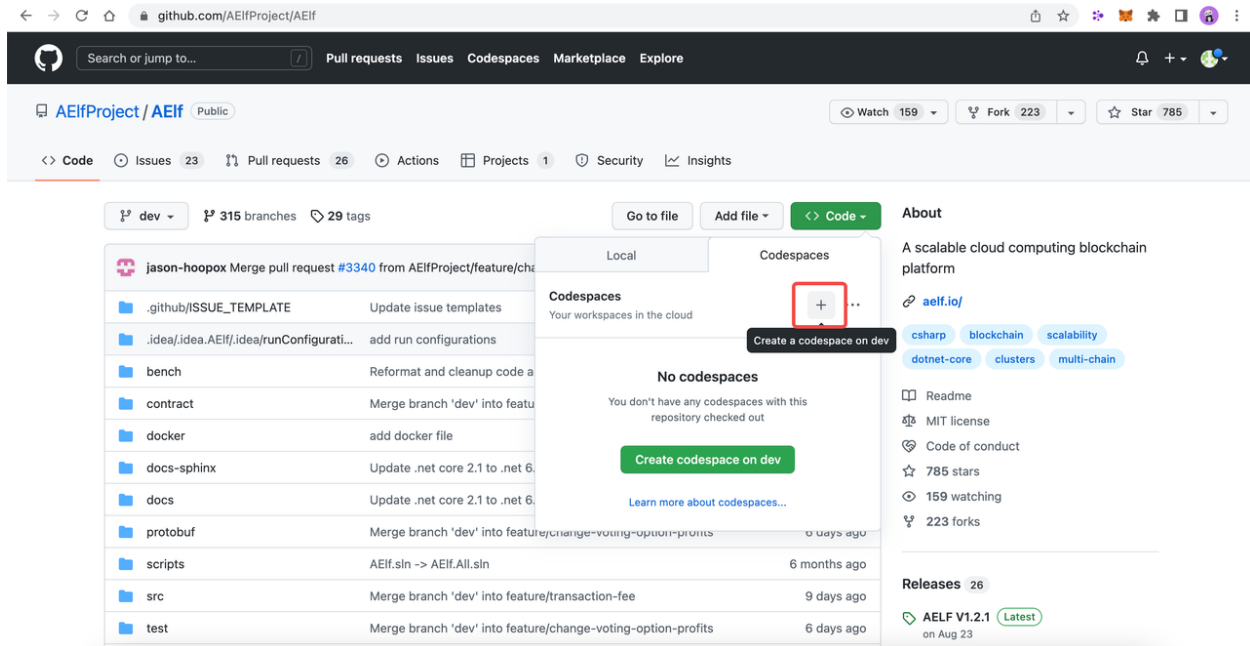
1. Visit [AElfProject / AElf](#) via a browser.
2. Click the green **Code** button on the top right.



3. Select Codespaces and click +.

Then a new tab will be opened that shows the Codespaces interface. After the page is loaded, you will see:

- The left side displays all the content in this repo.
- The upper right side is where you can write code or view text.



- The lower right side is a terminal where you can build and run code (If the terminal doesn't open by default, you can click the hamburger menu on the top left and select Terminal -> New Terminal, or press control + shift + ` on your keyboard).

Currently, Codespaces have completed the configuration for part of the environments, yet there are some you need to manually configure.

At the time of writing, Codespaces have done the configuration for git and nodejs. You can type the following commands to check their versions:

```
# git version 2.25.1
git --version

# 8.19.2
npm --version
```

Update Environment

Execute this command to update your environment:

```
sudo apt-get update
```

The following output suggests successful update:

```
Fetchd 25.0 MB in 3s (8,574 kB/s)
Reading package lists... Done
```

Install .NET SDK

.NET SDK 7.0 is used in this repo. Hence, you need to reinstall v6.0 otherwise there will be building issues.

1. Execute this command to check if v7.0 is used:

```
# 7.0.100
dotnet --version
```

If there is v7.0, execute this command to delete it:

```
sudo rm -rf /home/codespace/.dotnet/*
```

2. Execute this command to reinstall v6.0:

```
wget https://packages.microsoft.com/config/ubuntu/22.04/packages-microsoft-prod.deb
↪-O packages-microsoft-prod.deb

sudo dpkg -i packages-microsoft-prod.deb

rm packages-microsoft-prod.deb

sudo apt-get update && \

sudo apt-get install -y dotnet-sdk-6.0
```

3. Restart bash after the installation and execute this command to check if v6.0 is installed:

```
# 6.0.403
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. Execute this command to install protoBuf:

```
curl -OL https://github.com/google/protobuf/releases/download/v21.9/protoc-21.9-
↪linux-x86_64.zip
unzip protoc-21.9-linux-x86_64.zip -d protoc3

sudo mv protoc3/bin/* /usr/local/bin/

sudo mv protoc3/include/* /usr/local/include/

sudo chown ${USER} /usr/local/bin/protoc

sudo chown -R ${USER} /usr/local/include/google
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

```
sudo apt-get install redis -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

```
Server initialized  
Ready to accept connections
```

What's Next

If you have already installed the tools and frameworks above, you can skip this step. For info about contract deployment and nodes running, please read the following:

[Smart contracts](#)

[Node](#)

3.2 Node

If you already know something about aelf blockchain and want to get deeply involved, you can proceed with the following and run your own node.

If you are a beginner or you want to deploy contracts onto aelf, please click [here](#) to learn more.

Why Should I Run a Node

- Full node: A full node stores the complete blockchain data and you can view all the info. It also enables you to deploy DApps and contracts on aelf or interact with its contracts.
- BP: To run a full node that produces blocks, the node needs to participate in the election. If ranked among the top $2N+1$ ($N=8$ in the first year and increases by 1 every year. Currently the threshold is 17), it can get involved in the governance of aelf.

Next, we will show you how to deploy nodes.

3.2.1 Single Node

macOS

Follow this doc to run an aelf single node on a macOS device and this will take around 20 minutes to complete.

Install aelf-command

Execute this command to install aelf-command:

```
npm i aelf-command -g
```

The following output suggests successful installation:

```
+ aelf-command@0.1.44
added 314 packages from 208 contributors in 25.958s
```

Besides, you might see warnings like this due to differences in system configuration. Please ignore it.

```
% npm i aelf-command -g
npm WARN deprecated debug@4.1.1: Debug versions >=3.2.0 <3.2.7 || >=4 <4.3.1 have a low-severity ReDos regression when used in a Node.js environment. It is recommended you upgrade to 3.2.7 or 4.3.1. (https://github.com/visionmedia/debug/issues/797)
npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is known to be problematic. See https://v8.dev/blog/math-random for details.

changed 324 packages in 39s

35 packages are looking for funding
  run `npm fund` for details
```

If it shows error Permission denied @ apply2files, then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chmod 755 /usr/local/lib/node_modules
```

Clone and Build aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command to create a directory:

```
mkdir ~/Desktop/Code
```

2. Execute this command to change the directory:

```
cd ~/Desktop/Code
```

3. Execute this command to clone aelf's code:

```
git clone https://github.com/AElfProject/AElf.git
```

4. Execute this command to change to aelf's directory:

```
cd AElf
```

5. Execute this command to restore aelf's files:

```
dotnet restore AElf.All.sln
```

6. Execute this command to build aelf's code (this will take several minutes):

```
dotnet build AElf.All.sln
```

The following output suggests successful building:

```
xx Warning(s)
  0 Error(s)

Time Elapsed 00:15:59.77
```

If contract_csharp_plugin fails to be called, it may be because you don't have Rosetta 2 installed. Please execute this command and then retry:

```
/usr/sbin/softwareupdate --install-rosetta --agree-to-license
```

Create an aelf Account

Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz
↪hip mad surround recall
AElf [Info]: Private Key        :
↪4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
↪04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9
AElf [Info]: Address            : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in /Users/{username}/.local/share/aelf/keys/.

Please make sure you remember the account data or the json file's location.

You will be required to set a password (referred to as * here):

```
Enter a password: *****
Confirm password: *****
```

For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

Run a Single Node

A single node runs aelf blockchain on one node. It is usually used to test the execution of contracts only.

1. Execute this command to start a Redis instance (skip this step if redis-server is already started):

```
redis-server
```

2. Open another Terminal and execute this command to change to aelf's directory:

```
cd ~/Desktop/Code/AElf
```

3. Execute this command to change to the AElf.Launcher directory:

```
cd src/AElf.Launcher
```

4. Modify the appsettings.json file: for novices, you can go to desktop -> Code -> AElf -> src -> AElf.Launcher and open the appsettings.json file in the editor to modify it (or, if you are familiar with Linux commands, you can run the `vim appsettings.json` command and modify the file in the command-line interface).

Find the account data you just created using `aelf-command create`.

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz
→ hip mad surround recall
AElf [Info]: Private Key        :
→ 4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
→ 04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9
AElf [Info]: Address            : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

Fill in the `NodeAccount` and `NodeAccountPassword` under `Account` using the `Address` and `password` you set in `appsettings.json`:

```
"Account": {
  "NodeAccount": "",
  "NodeAccountPassword": ""
}
```

It may look like this when you complete it:

```
"Account": {
  "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
  "NodeAccountPassword": "*****"
},
```

Fill in the `InitialMineList` under `Consensus` using `Public Key`:

```
"Consensus": {
  "InitialMinerList": [],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}
```

It may look like this when you complete it (make sure to add “”):

```
"Consensus": {
  "InitialMinerList": [
    ↪ "04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b",
    ↪ ],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}
```

If the IP and port for Redis have been changed, you can modify them under ConnectionStrings in appsettings.json (skip this step if they are not changed):

```
"ConnectionStrings": {
  "BlockchainDb": "redis://localhost:6379?db=1",
  "StateDb": "redis://localhost:6379?db=1"
}
```

5. Execute `dotnet run`:

```
sudo dotnet run
```

The following output suggests successful execution:

```
2022-11-29 16:07:44,554 [.NET ThreadPool Worker] INFO AElf.Kernel.
↪ SmartContractExecution.Application.BlockExecutionResultProcessingService - Attach
↪ blocks to best chain, best chain hash:
↪ "f396756945d9bb883f81827ab36fcb0533d3c66f7062269700e49b74895*****", height: 177
```

If you want to check the node's block height and other block info, you can visit [this page](#) where you can access the API docs and interact with this single node.

To shut the node down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```

Linux and Codespaces

Follow this doc to run an aelf single node in Linux and Codespaces and this will take around 20 minutes to complete.

Install aelf-command

Execute this command to install aelf-command:

```
npm i aelf-command -g
```

The following output suggests successful installation:

```
+ aelf-command@0.1.44
added 314 packages from 208 contributors in 25.958s
```

You might see warnings like this due to differences in system configuration. Please ignore it:

```
% npm i aelf-command -g
npm WARN deprecated debug@4.1.1: Debug versions >=3.2.0 <3.2.7 || >=4 <4.3.1 have a low-severity ReDos regression when used in a Node.js environment. It is recommended you upgrade to 3.2.7 or 4.3.1. (https://github.com/visionmedia/debug/issues/797)
npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is known to be problematic. See https://v8.dev/blog/math-random for details.

changed 324 packages in 39s

35 packages are looking for funding
  run `npm fund` for details
```

Clone and Build aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command to create a directory:

```
mkdir ~/Desktop/Code
```

2. Execute this command to change the directory:

```
cd ~/Desktop/Code
```

3. Execute this command to clone aelf's code:

```
git clone https://github.com/AElfProject/AElf.git
```

4. Execute this command to change to aelf's directory:

```
cd AElf
```

5. Execute this command to restore aelf's files:

```
dotnet restore AElf.All.sln
```

6. Execute this command to build aelf's code (this will take several minutes):

```
dotnet build AElf.All.sln
```

The following output suggests successful building:

```
xx Warning(s)
  0 Error(s)

Time Elapsed 00:15:59.77
```

Create an aelf Account

Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :  
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz_  
↪hip mad surround recall  
AElf [Info]: Private Key        :_  
↪4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****  
AElf [Info]: Public Key         :_  
↪04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9_  
AElf [Info]: Address           : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in /root/.local/share/aelf/keys/.

Please make sure you remember the account data or the json file's location.

You will be required to set a password (referred to as * here):

```
Enter a password: *****  
Confirm password: *****
```

For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

Run a Single Node

A single node runs aelf blockchain on one node. It is usually used to test the execution of contracts only.

1. Execute this command to start a Redis instance (skip this step if redis-server is already started):

```
redis-server
```

2. Open another Terminal and execute this command to change to aelf's directory:

```
cd ~/Desktop/Code/AElf
```

3. Execute this command to change to the AElf.Launcher directory:

```
cd src/AElf.Launcher
```

4. Modify the appsettings.json file: for novices, you can go to desktop -> Code -> AElf -> src -> AElf.Launcher and open the appsettings.json file in the editor to modify it (or, if you are familiar with Linux commands, you can run the vim appsettings.json command and modify the file in the command-line interface).

Find the account data you just created using aelf-command create.

```
AElf [Info]: Your wallet info is :  
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz_  
↪hip mad surround recall
```

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```

AElf [Info]: Private Key           : ↵
↪ 4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key           : ↵
↪ 04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9
AElf [Info]: Address              : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****

```

Fill in the NodeAccount and NodeAccountPassword under Account using the Address and password you set in appsettings.json:

```

"Account": {
  "NodeAccount": "",
  "NodeAccountPassword": ""
}

```

It may look like this when you complete it:

```

"Account": {
  "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
  "NodeAccountPassword": "*****"
},

```

Fill in the InitialMineList under Consensus using Public Key:

```

"Consensus": {
  "InitialMinerList": [],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}

```

It may look like this when you complete it (make sure to add ""):

```

"Consensus": {
  "InitialMinerList": [
↪ "04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9",
↪ ""],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}

```

If the IP and port for Redis have been changed, you can modify them under ConnectionStrings in appsettings.json (skip this step if they are not changed):

```

"ConnectionStrings": {
  "BlockchainDb": "redis://localhost:6379?db=1",
  "StateDb": "redis://localhost:6379?db=1"
}

```

Save the changes and keep them in the AElf.Launcher directory.

5. Execute dotnet run:

```
sudo dotnet run
```

The following output suggests successful execution:

```
2022-11-29 16:07:44,554 [.NET ThreadPool Worker] INFO AElf.Kernel.  
↪SmartContractExecution.Application.BlockExecutionResultProcessingService - Attach_  
↪blocks to best chain, best chain hash:  
↪"f396756945d9bb883f81827ab36fcb0533d3c66f7062269700e49b74895*****", height: 177
```

If you want to check the node's block height and other block info, you can visit [this page](#) where you can access the API docs and interact with this single node.

To shut the node down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```

Windows

Follow this doc to run an aelf single node on a Windows device and this will take around 20 minutes to complete.

Install aelf-command

Execute npm command to install aelf-command:

```
npm i aelf-command -g
```

The following output suggests successful installation:

```
+ aelf-command@0.1.44  
added 314 packages from 208 contributors in 25.958s
```

You might see warnings like this due to differences in system configuration. Please ignore it:

```
% npm i aelf-command -g  
npm WARN deprecated debug@4.1.1: Debug versions >=3.2.0 <3.2.7 || >=4 <4.3.1 have a low-severity ReDos regression  
when used in a Node.js environment. It is recommended you upgrade to 3.2.7 or 4.3.1. (https://github.com/visionm  
edia/debug/issues/797)  
npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in  
certain circumstances, which is known to be problematic. See https://v8.dev/blog/math-random for details.  
  
changed 324 packages in 39s  
  
35 packages are looking for funding  
run `npm fund` for details
```


Clone and Build aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command in cmd or PowerShell to create a directory:

```
mkdir C:/Users/${username}/Desktop/Code
```

2. Execute this command to change the directory:

```
cd C:/Users/${username}/Desktop/Code
```

3. Execute this command to clone aelf's code:

```
git clone https://github.com/AElfProject/AElf.git
```

4. Execute this command to change to aelf's directory:

```
cd AElf
```

5. Execute this command to restore aelf's files:

```
dotnet restore AElf.All.sln
```

6. Execute this command to build aelf's code (this will take several minutes):

```
dotnet build AElf.All.sln
```

The following output suggests successful building:

```
xx Warning(s)
  0 Error(s)

Time Elapsed 00:15:59.77
```

Create an aelf Account

Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz
→ hip mad surround recall
AElf [Info]: Private Key        :
→ 4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
→ 04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9
AElf [Info]: Address            : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored locally.

Please make sure you remember the account data or the json file's location.

You will be required to set a password (referred to as * here):

```
Enter a password: *****
Confirm password: *****
```

For the sake of convenience, you are encouraged to keep this cmd or PowerShell on the account info interface and open another cmd or PowerShell to continue the following.

Run a Single Node

A single node runs aelf blockchain on one node. It is usually used to test the execution of contracts only.

1. Execute this command to start a Redis instance (skip this step if redis-server is already started):

```
redis-server
```

2. Open another cmd or PowerShell and execute this command to change to aelf's directory:

```
cd C:/Users/${username}/Desktop/Code
```

3. Execute this command to change to the AElf.Launcher directory:

```
cd src/AElf.Launcher
```

4. Modify the appsettings.json file: for novices, you can go to desktop -> Code -> AElf -> src -> AElf.Launcher and open the appsettings.json file in the editor to modify it (or you can run the start appsettings.json command and open the appsettings.json file in the editor).

Find the account data you just created using aelf-command create.

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition buzz
->hip mad surround recall
AElf [Info]: Private Key        :
->4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
->04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b9
AElf [Info]: Address           : 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

Fill in the NodeAccount and NodeAccountPassword under Account using the Address and password you set in appsettings.json:

```
"Account": {
  "NodeAccount": "",
  "NodeAccountPassword": ""
}
```

It may look like this when you complete it:

```
"Account": {
  "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
  "NodeAccountPassword": "*****"
},
```

Fill in the InitialMineList under Consensus using Public Key:

```
"Consensus": {
  "InitialMinerList": [],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}
```

It may look like this when you complete it (make sure to add “”):

```
"Consensus": {
  "InitialMinerList": [
    ↪ "04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dabdc0b",
    ↪ ],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}
```

If the IP and port for Redis have been changed, you can modify them under ConnectionStrings in appsettings.json (skip this step if they are not changed):

```
"ConnectionStrings": {
  "BlockchainDb": "redis://localhost:6379?db=1",
  "StateDb": "redis://localhost:6379?db=1"
}
```

Save the changes and keep them in the AElf.Launcher directory.

```
"ConnectionStrings": {
  "BlockchainDb": "redis://localhost:6379?db=1",
  "StateDb": "redis://localhost:6379?db=1"
}
```

5. Execute dotnet run:

```
sudo dotnet run
```

The following output suggests successful execution:

```
2022-11-29 16:07:44,554 [.NET ThreadPool Worker] INFO AElf.Kernel.
↪ SmartContractExecution.Application.BlockExecutionResultProcessingService - Attach_
↪ blocks to best chain, best chain hash:
↪ "f396756945d9bb883f81827ab36fcb0533d3c66f7062269700e49b74895*****", height: 177
```

If you want to check the node's block height and other block info, you can visit [this page](#) where you can access the API docs and interact with this single node.

To shut the node down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```

3.2.2 Multi Nodes

macOS

Follow this doc to run aelf multi-nodes on a macOS device and this will take around 20 minutes to complete.

Run Multi-Nodes

This tutorial will guide you through how to run three nodes.

Publish aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command to create a directory:

```
mkdir ~/Desktop/Out
```

2. Execute this command to change the directory:

```
cd ~/Desktop/Code/AElf
```

3. Execute this command to publish aelf's code (this will take several minutes):

```
sudo dotnet publish AElf.All.sln /p:NoBuild=false --configuration Debug -o ~/Desktop/Out
```

Configure Three Nodes

1. Execute this command three times to create three accounts: A, B, and C.

```
aelf-command create
```

Please make sure you remember their Public Keys and Addresses.

Create a directory for node configuration. This tutorial uses a directory on the desktop for reference.

2. Execute this command to create a directory:

```
mkdir ~/Desktop/Config
```

3. Execute this command to change the directory:

```
cd ~/Desktop/Config
```

4. Execute this command to create three new directories: bp1, bp2, and bp3 in the "Config" directory and create their respective "keys" directories.

```
mkdir -p ~/Desktop/Config/bp1/keys
```

```
mkdir -p ~/Desktop/Config/bp2/keys
```

```
mkdir -p ~/Desktop/Config/bp3/keys
```

5. Copy account A, B, and C from /Users/{username}/.local/share/aelf/keys/ to bp1/keys, bp2/keys, and bp3/keys respectively (If you can't find .local, you can use cmd + shift + g in Finder to designate the directories).
6. Execute this command to create appsettings.json files and appsettings.MainChain.MainNet.json files in directories bp1, bp2, and bp3:

```
cd ~/Desktop/Config/bp1;touch appsettings.json;touch appsettings.MainChain.MainNet.json
```

```
cd ~/Desktop/Config/bp2;touch appsettings.json;touch appsettings.MainChain.MainNet.json
```

```
cd ~/Desktop/Config/bp3;touch appsettings.json;touch appsettings.MainChain.MainNet.json
```

For appsettings.json:

```
{
  "Logging": {
    "LogLevel": {
      "Default": "Debug"
    }
  },
  "AllowedHosts": "*",
  "CorsOrigins": "*",
  "ConnectionStrings": {
    "BlockchainDb": "redis://localhost:6379?db=1",
    "StateDb": "redis://localhost:6379?db=1"
  },
  "ChainId": "AELF",
  "IsMainChain" : true,
  "NetType": "MainNet",
  "Account": {
    "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
    "NodeAccountPassword": "*****"
  },
  "Network": {
    "BootNodes": [],
    "ListeningPort": 7001,
    "NetAllowed": "",
    "NetWhitelist": []
  },
  "Kestrel": {
    "Endpoints": {
      "Http": {
        "Url": "http://*:8001/"
      }
    }
  },
  "Runner": {
```

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```

    "BlackList": [],
    "WhiteList": []
  },
  "DeployServiceUrl": "",
  "Consensus": {
    "InitialMinerList" : [
      ↪ "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34acf87526d
      ↪ ",
      ↪ "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88048698629
      ↪ ",
      ↪ "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545cc5c03826b
      ↪ "
    ],
    "MiningInterval" : 4000,
    "StartTimestamp": 0,
    "PeriodSeconds": 120
  },
  "BackgroundJobWorker":{
    "JobPollPeriod": 1
  }
}

```

For appsettings.MainChain.MainNet.json:

```

{
  "ChainId": "AELF",
  "TokenInitial": {
    "Symbol": "ELF",
    "Name": "elf token",
    "TotalSupply": 10000000000,
    "Decimals": 2,
    "IsBurnable": true,
    "DividendPoolRatio": 0.2
  },
  "ElectionInitial": {
    "LockForElection": 100000,
    "TimeEachTerm": 2,
    "BaseTimeUnit": 2,
    "MinimumLockTime": 1,
    "MaximumLockTime": 2000
  }
}

```

7. Modify the appsettings.json files in directory bp1, bp2, and bp3 as instructed:
 1. Change the numbers following db= in BlockchainDb and StateDb under ConnectionStrings:
 1. bp1: redis://localhost:6379?db=1
 2. bp2: redis://localhost:6379?db=2
 3. bp3: redis://localhost:6379?db=3

2. Replace `NodeAccount` and `NodeAccountPassword` under `Account` with `Address` and `password` in account A, B, and C.
3. Fill in all three `InitialMineList` under `Consensus` using account A, B, and C's Public Key, keys separated with ,:

```
"Consensus": {
  "InitialMineList" : [
    ↪ "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34",
    ↪ ",
    ↪ "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88",
    ↪ ",
    ↪ "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545c",
    ↪ "
  ],
```

4. In bp1, `BootNodes` is blank and `ListeningPort` is 7001. In bp2, `BootNodes` is 127.0.0.1:7001 (make sure to add ""), and `ListeningPort` is 7002. In bp3, `BootNodes` are 127.0.0.1:7001 and 127.0.0.1:7002 (make sure to add "" and separate them with ,) and `ListeningPort` is 7003.
5. Change the port numbers in `Kestrel-Endpoints-Http-Url` to 8001, 8002, and 8003 respectively (to ensure there is no conflict of ports).

8. Execute this command to start a Redis instance:

```
redis-server
```

Run Three Nodes

In this tutorial, code is published in `~/Desktop/Out` and the three nodes are configured in `~/Desktop/Config`.

Use `redis-server` to start a Redis instance.

We recommend you open three new Terminals to monitor the nodes' operation.

Execute this command to launch node 1:

```
cd ~/Desktop/Config/bp1;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 2:

```
cd ~/Desktop/Config/bp2;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 3:

```
cd ~/Desktop/Config/bp3;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

The three nodes run successfully if all Terminals show the following output:

```
2022-11-30 20:51:04,163 [.NET ThreadPool Worker] INFO AElf.Kernel.Miner.Application.
↪ MiningService - Generated block: { id:
↪ "12f519e1601dd9f755a186b1370fd12696a8c080ea04465dad*****2463", height: 25 },
```

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```
↪previous: 5308de83c3585dbb4a097a9187a3b2f9b8584db4889d428484ca3e4df09e2860, executed.  
↪transactions: 2, not executed transactions 0
```

To shut the nodes down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```

Linux and Codespaces

Follow this doc to run aelf multi-nodes in Linux and Codespaces and this will take around 20 minutes to complete.

Run Multi-Nodes

This tutorial will guide you through how to run three nodes.

Publish aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command to create a directory:

```
mkdir ~/Desktop/Code
```

2. Execute this command to change the directory:

```
cd ~/Desktop/Code/AElf
```

3. Execute this command to publish aelf's code (this will take several minutes):

```
sudo dotnet publish AElf.All.sln /p:NoBuild=false --configuration Debug -o ~/Desktop/Out
```

Configure Three Nodes

1. Execute this command three times to create three accounts: A, B, and C.

```
aelf-command create
```

Please make sure you remember their Public Keys and Addresses.

Create a directory for node configuration. This tutorial uses a directory on the desktop for reference.

2. Execute this command to create a directory:

```
mkdir ~/Desktop/Config
```

3. Execute this command to change the directory:

```
cd ~/Desktop/Config
```


4. Execute this command to create three new directories: bp1, bp2, and bp3 in the “Config” directory and create their respective “keys” directories.

```
mkdir -p ~/Desktop/Config/bp1/keys
mkdir -p ~/Desktop/Config/bp2/keys
mkdir -p ~/Desktop/Config/bp3/keys
```

5. Copy account A, B, and C from /root/.local/share/aelf/keys/ to bp1/keys, bp2/keys, and bp3/keys respectively (If you can't find .local, you can use cmd + shift + g in Finder to designate the directories).
6. Execute this command to create appsettings.json files and appsettings.MainChain.MainNet.json files in directories bp1, bp2, and bp3:

```
cd ~/Desktop/Config/bp1;touch appsettings.json;touch appsettings.MainChain.MainNet.json
cd ~/Desktop/Config/bp2;touch appsettings.json;touch appsettings.MainChain.MainNet.json
cd ~/Desktop/Config/bp3;touch appsettings.json;touch appsettings.MainChain.MainNet.json
```

Copy the following templates to each file:

For appsettings.json:

```
{
  "Logging": {
    "LogLevel": {
      "Default": "Debug"
    }
  },
  "AllowedHosts": "*",
  "CorsOrigins": "*",
  "ConnectionStrings": {
    "BlockchainDb": "redis://localhost:6379?db=1",
    "StateDb": "redis://localhost:6379?db=1"
  },
  "ChainId": "AELF",
  "IsMainChain" : true,
  "NetType": "MainNet",
  "Account": {
    "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
    "NodeAccountPassword": "*****"
  },
  "Network": {
    "BootNodes": [],
    "ListeningPort": 7001,
    "NetAllowed": "",
    "NetWhitelist": []
  },
  "Kestrel": {
    "EndPoints": {
      "Http": {
        "Url": "http://*:8001/"
      }
    }
  }
}
```

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```

    }
  },
  "Runner": {
    "BlackList": [],
    "WhiteList": []
  },
  "DeployServiceUrl": "",
  "Consensus": {
    "InitialMinerList" : [
      ↪ "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34acf87526d
      ↪ ",
      ↪ "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88048698629
      ↪ ",
      ↪ "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545cc5c03826b
      ↪ "
    ],
    "MiningInterval" : 4000,
    "StartTimestamp": 0,
    "PeriodSeconds": 120
  },
  "BackgroundJobWorker":{
    "JobPollPeriod": 1
  }
}

```

For appsettings.MainChain.MainNet.json:

```

{
  "ChainId": "AELF",
  "TokenInitial": {
    "Symbol": "ELF",
    "Name": "elf token",
    "TotalSupply": 10000000000,
    "Decimals": 2,
    "IsBurnable": true,
    "DividendPoolRatio": 0.2
  },
  "ElectionInitial": {
    "LockForElection": 100000,
    "TimeEachTerm": 2,
    "BaseTimeUnit": 2,
    "MinimumLockTime": 1,
    "MaximumLockTime": 2000
  }
}

```

7. Modify the appsettings.json files in directory bp1, bp2, and bp3 as instructed:

1. Change the numbers following db= in BlockchainDb and StateDb under ConnectionStrings:

1. bp1: redis://localhost:6379?db=1

2. bp2: redis://localhost:6379?db=2
3. bp3: redis://localhost:6379?db=3
2. Replace NodeAccount and NodeAccountPassword under Account with Address and password in account A, B, and C.
3. Fill in all three InitialMineList under Consensus using account A, B, and C's Public Key, keys separated with , :

```
"Consensus": {
  "InitialMinerList" : [
    ↪ "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34",
    ↪ ",
    ↪ "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88",
    ↪ ",
    ↪ "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545c",
    ↪ "
  ],
```

4. In bp1, BootNodes is blank and ListeningPort is 7001. In bp2, BootNodes is 127.0.0.1:7001 (make sure to add “”), and ListeningPort is 7002. In bp3, BootNodes are 127.0.0.1:7001 and 127.0.0.1:7002 (make sure to add “” and separate them with ,) and ListeningPort is 7003.
5. Change the port numbers in Kestrel-Endpoints-Http-Url to 8001, 8002, and 8003 respectively (to ensure there is no conflict of ports).
8. Execute this command to start a Redis instance:

```
redis-server
```

Run Three Nodes

In this tutorial, code is published in ~/Desktop/Out and the three nodes are configured in ~/Desktop/Config.

Use `redis-server` to start a Redis instance.

We recommend you open three new Terminals to monitor the nodes' operation.

Execute this command to launch node 1:

```
cd ~/Desktop/Config/bp1;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 2:

```
cd ~/Desktop/Config/bp2;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 3:

```
cd ~/Desktop/Config/bp3;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

The three nodes run successfully if all Terminals show the following output:

```
2022-11-30 20:51:04,163 [.NET ThreadPool Worker] INFO AElf.Kernel.Miner.Application.  
↪MiningService - Generated block: { id:  
↪"12f519e1601dd9f755a186b1370fd12696a8c080ea04465dad*****2463", height: 25 },  
↪previous: 5308de83c3585dbb4a097a9187a3b2f9b8584db4889d428484ca3e4df09e2860, executed,  
↪transactions: 2, not executed transactions 0
```

To shut the nodes down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```

Windows

Follow this doc to run aelf multi-nodes on a Windows device and this will take around 20 minutes to complete.

Run Multi-Nodes

This tutorial will guide you through how to run three nodes.

Publish aelf's Code

Create a directory. This tutorial uses a directory on the desktop for reference.

1. Execute this command to create a directory:

```
mkdir C:/Users/${username}/Desktop/Out
```

2. Execute this command to change the directory:

```
cd C:/Users/${username}/Desktop/Code/AElf
```

3. Execute this command to publish aelf's code (this will take several minutes):

Note: Be sure to replace \${username} here with your user name.

```
sudo dotnet publish AElf.All.sln /p:NoBuild=false --configuration Debug -o C:/Users/${  
↪username}/Desktop/Out
```

Configure Three Nodes

1. Execute this command three times to create three accounts: A, B, and C.

```
aelf-command create
```

Please make sure you remember their Public Keys and Addresses.

Create a directory for node configuration. This tutorial uses a directory on the desktop for reference.

2. Execute this command to create a directory:

```
mkdir C:/Users/${username}/Desktop/Config
```

- Execute this command to change the directory:

```
cd C:/Users/${username}/Desktop/Config
```

- Execute this command to create three new directories: bp1, bp2, and bp3 in the “Config” directory and create their respective “keys” directories.

```
mkdir -p C:/Users/${username}/Desktop/Config/bp1/keys
```

```
mkdir -p C:/Users/${username}/Desktop/Config/bp2/keys
```

```
mkdir -p C:/Users/${username}/Desktop/Config/bp3/keys
```

- Copy account A, B, and C from their json files to bp1/keys, bp2/keys, and bp3/keys respectively.
- Execute this command to create appsettings.json files and appsettings.MainChain.MainNet.json files in directories bp1, bp2, and bp3:

```
cd C:/Users/${username}/Desktop/Config/bp1;touch appsettings.json;touch appsettings.
↪MainChain.MainNet.json
```

```
cd C:/Users/${username}/Desktop/Config/bp2;touch appsettings.json;touch appsettings.
↪MainChain.MainNet.json
```

```
cd C:/Users/${username}/Desktop/Config/bp3;touch appsettings.json;touch appsettings.
↪MainChain.MainNet.json
```

Copy the following templates to each file:

For appsettings.json:

```
{
  "Logging": {
    "LogLevel": {
      "Default": "Debug"
    }
  },
  "AllowedHosts": "*",
  "CorsOrigins": "*",
  "ConnectionStrings": {
    "BlockchainDb": "redis://localhost:6379?db=1",
    "StateDb": "redis://localhost:6379?db=1"
  },
  "ChainId": "AELF",
  "IsMainChain": true,
  "NetType": "MainNet",
  "Account": {
    "NodeAccount": "21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****",
    "NodeAccountPassword": "*****"
  },
  "Network": {
    "BootNodes": [],
```

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```

    "ListeningPort": 7001,
    "NetAllowed": "",
    "NetWhitelist": []
  },
  "Kestrel": {
    "Endpoints": {
      "Http": {
        "Url": "http://*:8001/"
      }
    }
  },
  "Runner": {
    "BlackList": [],
    "WhiteList": []
  },
  "DeployServiceUrl": "",
  "Consensus": {
    "InitialMinerList" : [
      "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34acf87526d",
      "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88048698629",
      "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545cc5c03826b",
    ],
    "MiningInterval" : 4000,
    "StartTimestamp": 0,
    "PeriodSeconds": 120
  },
  "BackgroundJobWorker":{
    "JobPollPeriod": 1
  }
}

```

For appsettings.MainChain.MainNet.json:

```

{
  "ChainId": "AELF",
  "TokenInitial": {
    "Symbol": "ELF",
    "Name": "elf token",
    "TotalSupply": 10000000000,
    "Decimals": 2,
    "IsBurnable": true,
    "DividendPoolRatio": 0.2
  },
  "ElectionInitial": {
    "LockForElection": 100000,
    "TimeEachTerm": 2,

```

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```

    "BaseTimeUnit": 2,
    "MinimumLockTime": 1,
    "MaximumLockTime": 2000
  }
}

```

7. Modify the appsettings.json files in directory bp1, bp2, and bp3 as instructed:

1. Change the numbers following db= in BlockchainDb and StateDb under ConnectionStrings:

1. bp1: redis://localhost:6379?db=1
2. bp2: redis://localhost:6379?db=2
3. bp3: redis://localhost:6379?db=3

2. Replace NodeAccount and NodeAccountPassword under Account with Address and password in account A, B, and C.

3. Fill in all three InitialMineList under Consensus using account A, B, and C's Public Key, keys separated with ,:

```

"Consensus": {
  "InitialMinerList" : [
    "04884d9563b3b67a589e2b9b47794fcfb3e15fa494053088dd0dc8a909dd72bfd24c43b0e2303d631683acaed34",
    "045670526219d73154847b1e9367be9af293601793c9f7e34a96336650c9c1104a4aac9aaee960af00e775dcd88",
    "046a5913eae5fee3da9ee33604119f025a0ad45575dfed1257eff5da2c24e629845b1e1a131c5da8751971d545c"
  ],

```

4. In bp1, BootNodes is blank and ListeningPort is 7001. In bp2, BootNodes is 127.0.0.1:7001 (make sure to add ""), and ListeningPort is 7002. In bp3, BootNodes are 127.0.0.1:7001 and 127.0.0.1:7002 (make sure to add "" and separate them with ,) and ListeningPort is 7003.

5. Change the port numbers in Kestrel-Endpoints-Http-Url to 8001, 8002, and 8003 respectively (to ensure there is no conflict of ports).

8. Execute this command to start a Redis instance:

```
redis-server
```

Run Three Nodes

In this tutorial, code is published in C:/Users/\${username}/Desktop/Out and the three nodes are configured in C:/Users/\${username}/Desktop/Config.

Use redis-server to start a Redis instance.

We recommend you open three new terminals to monitor the nodes' operation.

Execute this command to launch node 1:

```
cd ~/Desktop/Config/bp1;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 2:

```
cd ~/Desktop/Config/bp2;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

Execute this command to launch node 3:

```
cd ~/Desktop/Config/bp3;dotnet ~/Desktop/Out/AElf.Launcher.dll
```

The three nodes run successfully if all Terminals show the following output:

```
2022-11-30 20:51:04,163 [.NET ThreadPool Worker] INFO AElf.Kernel.Miner.Application.  
  ↳MiningService - Generated block: { id:  
  ↳"12f519e1601dd9f755a186b1370fd12696a8c080ea04465dad*****2463", height: 25 },  
  ↳previous: 5308de83c3585dbb4a097a9187a3b2f9b8584db4889d428484ca3e4df09e2860, executed,  
  ↳transactions: 2, not executed transactions 0
```

To shut the nodes down, please use control + c on your keyboard.

If you don't want to save the data, you can execute this command to delete all:

```
redis-cli flushall
```


SMART CONTRACTS

4.1 Smart contracts Overview

This section provides the knowledge you need to write smart contracts, and it will take you approximately 40 minutes to complete the entire tutorial. You can follow the instructions, along with the examples, to learn how to set up the development environment using C# and AElf-developer-tools. The instructions will guide you through the development, testing, and deployment/update of smart contracts. There are two types of smart contract deployment/update: one that requires approval from a BP and the other that does not. You can find in the tutorials the scenarios in which each type is applicable.

The core of blockchain platforms can be viewed as a distributed multi-tenant database that stores the status of all the smart contracts deployed on it. Once deployed, each smart contract will have its unique address. The address will be used to query the execution status of the contract and can serve as an identifier for status queries and updates. The contract code defines the details of these and updates, to be specific, how to check whether an account has permission to operate them and how the operation is completed.

4.2 Development Environment

Before you begin the tutorials, you need to install the following tools and frameworks.

Please note that if you are solely interested in learning smart contract development, you only need to install the .NET SDK. Other tools are used to start aelf nodes, publish contracts, and more. The installation of these tools is optional, and you can install them as needed.

For most of these dependencies, we provide command-line instructions for macOS, Linux (Ubuntu 18), and Windows. If you encounter any issues or have more complex requirements, please leave a message on GitHub, and we will address them as soon as possible.

4.2.1 macOS

Configure Environment

You can install and set up the development environment on macOS computers with either Intel or Apple M1/M2 processors. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a macOS device, please make sure that your computer meets these basic requirements:

- Operating system version is 10.7 Lion or higher.
- At least a 2Ghz processor, 3Ghz recommended.
- At least 8 GB RAM, 16 GB recommended.
- No less than 10 GB of available space.
- Broadband internet connection.

Support for Apple M1

If you use a macOS computer with an Apple M1 chip, you need to install Apple Rosetta. Open the Terminal on your computer and execute this command, Please be patient while the command is executed.

```
/usr/sbin/softwareupdate --install-rosetta --agree-to-license
```

Install Homebrew

In most cases, you should use Homebrew to install and manage packages on macOS devices. If Homebrew is not installed on your local computer yet, you should download and install it before you continue.

To install Homebrew:

1. Open Terminal.
2. Execute this command to install Homebrew:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/HEAD/
↪install.sh)"
```

3. Execute this command to check if Homebrew is installed:

```
brew --version
```

The following output suggests successful installation:

```
Homebrew 3.3.1
Homebrew/homebrew-core (git revision c6c488fbc0f; last commit 2021-10-30)
Homebrew/homebrew-cask (git revision 66bab33b26; last commit 2021-10-30)
```

Environment Update

Execute this command to update your environment:

```
brew update
```

You will see output like this.

```
You have xx outdated formula installed.  
You can upgrade it with brew upgrade  
or list it with brew outdated.
```

You can execute the following command to upgrade or skip to the installation of Git.

```
brew upgrade
```

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. Execute this command in Terminal:

```
brew install git
```

2. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version xx.xx.xx
```

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK (Installers - x64 recommended for macOS devices with Intel processors; Installers - Arm64 recommended for macOS devices with M1 chips).

1. Download and install **.NET 6.0** which is currently used in aelf's repo.
2. Please reopen Terminal after the installation is done.
3. Execute this command to check if .NET is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. Execute this command to install protoBuf:

```
brew install protobuf
```

If it shows error `Permission denied @ apply2files`, then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chown -R $(whoami) $(brew --prefix)/*
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

```
brew install redis
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

Install Nodejs

1. Execute this command to install Nodejs:

```
brew install node
```

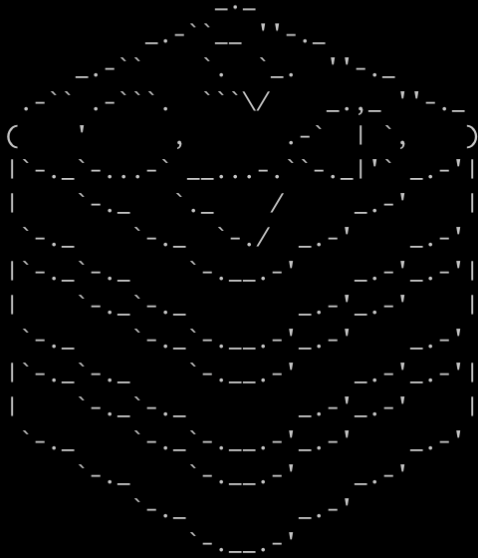
2. Execute this command to check if Nodejs is installed:

```
npm --version
```

The following output suggests successful installation:

```
6.14.8
```

```
[...] redis-server  
60154:C 31 Oct 16:40:37.991 # oOoOoOoOoOoOo Redis is starting oOoOoOoOoOoOo  
60154:C 31 Oct 16:40:37.991 # Redis version=4.0.8, bits=64, commit=00000000, modified=0,  
pid=60154, just started  
60154:C 31 Oct 16:40:37.991 # Warning: no config file specified, using the default config  
. In order to specify a config file use redis-server /path/to/redis.conf
```



```
Redis 4.0.8 (00000000/0) 64 bit  
  
Running in standalone mode  
Port: 6379  
PID: 60154  
  
http://redis.io
```

Install aelf-command

1. Execute this command to install aelf-command:

```
npm i aelf-command -g
```

2. If it shows error **Permission denied @ apply2files** , then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chmod 755 /usr/local/lib/node_modules
```

Create an aelf Account

1. Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition
↳buzz hip mad surround recall
AElf [Info]: Private Key        :
↳4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
```

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```
↪04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dab0
AElf [Info]: Address :↵
↪21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

2. You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in /Users/{username}/.local/share/aelf/keys/.

Please make sure you remember the account data or the json file's location.

3. You will be required to set a password (referred to as * here):

```
Enter a password: *****
Confirm password: *****
```

For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

4.2.2 Linux

Configure Environment

You can install and set up the development environment on computers running 64-bit Linux. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a Linux device, please make sure that your computer meets these basic requirements:

- Ubuntu 18.
- Broadband internet connection.

Update Environment

Execute this command to update your environment, Please be patient while the command is executed:

```
sudo apt-get update
```

The following output suggests successful update:

```
Fetches 25.0 MB in 3s (8,574 kB/s)
Reading package lists... Done
```

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. Open the terminal.
2. Execute this command to install Git:

```
sudo apt-get install git -y
```

3. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version 2.17.1
```

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK.

1. Execute the following commands to install .NET 6.0.
 1. Execute this command to download .NET packages:

```
wget https://packages.microsoft.com/config/ubuntu/22.04/packages-microsoft-prod.  
deb -O packages-microsoft-prod.deb
```

2. Execute this command to unzip .NET packages:

```
sudo dpkg -i packages-microsoft-prod.deb  
  
rm packages-microsoft-prod.deb
```

3. Execute this command to install .NET:

```
sudo apt-get update && \  
  
sudo apt-get install -y dotnet-sdk-6.0
```

2. Execute this command to check if .NET 6.0 is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

Before you start the installation, please check the directory you use and execute the following commands to install.

1. Execute the following commands to install protoBuf.
 1. Execute this command to download protoBuf packages:

```
curl -OL https://github.com/google/protobuf/releases/download/v21.9/protoc-21.9-  
linux-x86_64.zip
```

2. Execute this command to unzip protoBuf packages:

```
unzip protoc-21.9-linux-x86_64.zip -d protoc3
```

3. Execute these commands to install protoBuf:

```
sudo mv protoc3/bin/* /usr/local/bin/  
  
sudo mv protoc3/include/* /usr/local/include/  
  
sudo chown ${USER} /usr/local/bin/protoc  
  
sudo chown -R ${USER} /usr/local/include/google
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

```
sudo apt-get install redis -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

```
Server initialized  
Ready to accept connections
```

You can open a new terminal and use redis-cli to start Redis command line. The command below can be used to clear Redis cache (be careful to use it):

```
flushall
```


Install Nodejs

1. Execute these commands to install Nodejs:

```
curl -fsSL https://deb.nodesource.com/setup_14.x | sudo -E bash -
sudo apt-get install -y nodejs
```

2. Execute this command to check if Nodejs is installed:

```
npm --version
```

The following output suggests successful installation:

```
6.14.8
```

Install aelf-command

1. Execute this command to install aelf-command:

```
npm i aelf-command -g
```

2. If it shows error `Permission denied @ apply2files`, then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chmod 755 /usr/local/lib/node_modules
```

Create an aelf Account

1. Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition_
↳ buzz hip mad surround recall
AElf [Info]: Private Key        : _
↳ 4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         : _
↳ 04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dab0
AElf [Info]: Address            : _
↳ 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

2. You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in `/Users/{username}/.local/share/aelf/keys/`.

Please make sure you remember the account data or the json file's location.

3. You will be required to set a password (referred to as * here):

Enter a password: *****
Confirm password: *****

For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

4.2.3 Windows

Configure Environment

You can install and set up the development environment on computers running Windows 10 or higher. This will take 10-20 minutes.

Before You Start

Before you install and set up the development environment on a Windows device, please make sure that your computer meets these basic requirements:

- Operating system version is Windows 10 or higher.
- Broadband internet connection.

Install Chocolatey (Recommended)

Chocolatey is an open-source package manager for Windows software that makes installation simpler, like Homebrew for Linux and macOS. If you don't want to install it, please use the provided download links for each software to complete their installation.

1. Open **cmd** or **PowerShell** as administrator (Press Win + x).
2. Execute the following commands in order and enter y to install Chocolatey, Please be patient while the command is executed:

```
Set-ExecutionPolicy AllSigned

Set-ExecutionPolicy Bypass -Scope Process

Set-ExecutionPolicy Bypass -Scope Process -Force; iex ((New-Object System.Net.
↪WebClient).DownloadString('https://chocolatey.org/install.ps1'))

Set-ExecutionPolicy RemoteSigned
```

3. Execute this command to check if Chocolatey is installed:

```
choco
```

The following output suggests successful installation:

```
Chocolatey vx.x.x
```

If it showsThe term 'choco' is not recognized as the name of a cmdlet, function, script file, or operable program, then there is a permission issue with PowerShell. To solve it:

- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the **ChocolateyInstall** variable is in **System variables**, and its default value is the Chocolatey installation path C:\Program Files\Chocolatey. If you don't find it, click New System Variable to manually add it.

Install Git

If you want to use our customized smart contract development environment or to run a node, you need to clone aelf's repo (download source code). As aelf's code is hosted on GitHub, you need to install **Git** first.

1. You can download Git through this link or execute this command in cmd or PowerShell:

```
choco install git -y
```

2. Execute this command to check if Git is installed:

```
git --version
```

The following output suggests successful installation:

```
git version xx.xx.xx
```

If it shows The term 'git' is not recognized as the name of a cmdlet, function, script file, or operable program, you can:

- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the Git variable is in **Path** in **System variables**, and its default value is the Git installation path C:\Program Files\git. If you don't find it, click **New System Variable** to manually add it.

Install .NET SDK

As aelf is mostly developed with .NET Core, you need to download and install .NET Core SDK (Installers - x64 recommended for Windows devices).

1. Download and install [.NET 6.0](#) which is currently used in aelf's repo.
2. Please reopen cmd or PowerShell after the installation is done.
3. Execute this command to check if .NET is installed:

```
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. You can download protoBuf through this link or execute this command in cmd or PowerShell:

```
choco install protoc --version=3.11.4 -y  
choco install unzip -y
```

2. Execute this command to check if protoBuf is installed:

```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. You can download Redis through MicroSoftArchive-Redis or execute this command in cmd or PowerShell:

```
choco install redis-64 -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
memurai
```

The following output suggests Redis is installed and a Redis instance is started:

Install Nodejs

1. You can download Nodejs through Node.js or execute this command in cmd or PowerShell:

```
choco install nodejs -y
```

2. Execute this command to check if Nodejs is installed:

```
npm --version
```

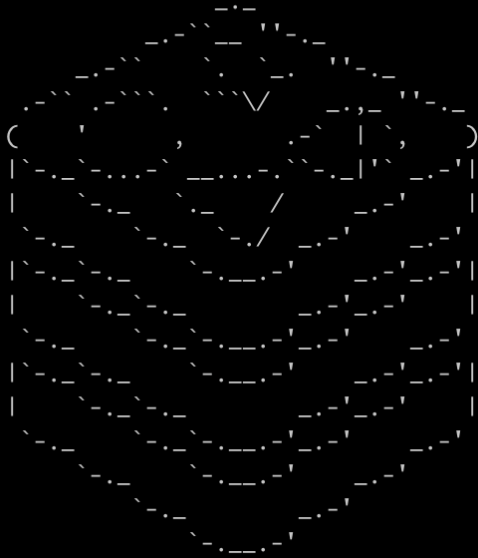
The following output suggests successful installation:

```
6.14.8
```

If it shows The term 'npm' is not recognized as the name of a cmdlet, function, script file, or operable program, you can:

- **Right-click** the computer icon and select **Properties**.
- Click **Advanced** in **System Properties** and select **Environment Variables** on the bottom right.
- Check if the Nodejs variable is in **Path** in **System variables**, and its default value is the Nodejs installation path C:\Program Files\nodejs. If you don't find it, click **New System Variable** to manually add it.

```
[...] redis-server  
60154:C 31 Oct 16:40:37.991 # oOoOoOoOoOoOo Redis is starting oOoOoOoOoOoOo  
60154:C 31 Oct 16:40:37.991 # Redis version=4.0.8, bits=64, commit=00000000, modified=0,  
pid=60154, just started  
60154:C 31 Oct 16:40:37.991 # Warning: no config file specified, using the default config  
. In order to specify a config file use redis-server /path/to/redis.conf
```



```
Redis 4.0.8 (00000000/0) 64 bit  
  
Running in standalone mode  
Port: 6379  
PID: 60154  
  
http://redis.io
```

Install aelf-command

1. Execute this command to install aelf-command:

```
npm i aelf-command -g
```

2. If it shows error `Permission denied @ apply2files`, then there is a permission issue. You can solve it using the following command and then redo the installation with the above command:

```
sudo chmod 755 /usr/local/lib/node_modules
```

Create an aelf Account

1. Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :  
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition_  
└─buzz hip mad surround recall  
AElf [Info]: Private Key        :_  
└─4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****  
AElf [Info]: Public Key         :_
```

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```
→04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dab
AElf [Info]: Address :
→21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

2. You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in /Users/{username}/.local/share/aelf/keys/.

Please make sure you remember the account data or the json file's location.

3. You will be required to set a password (referred to as * here):

```
Enter a password: *****
Confirm password: *****
```

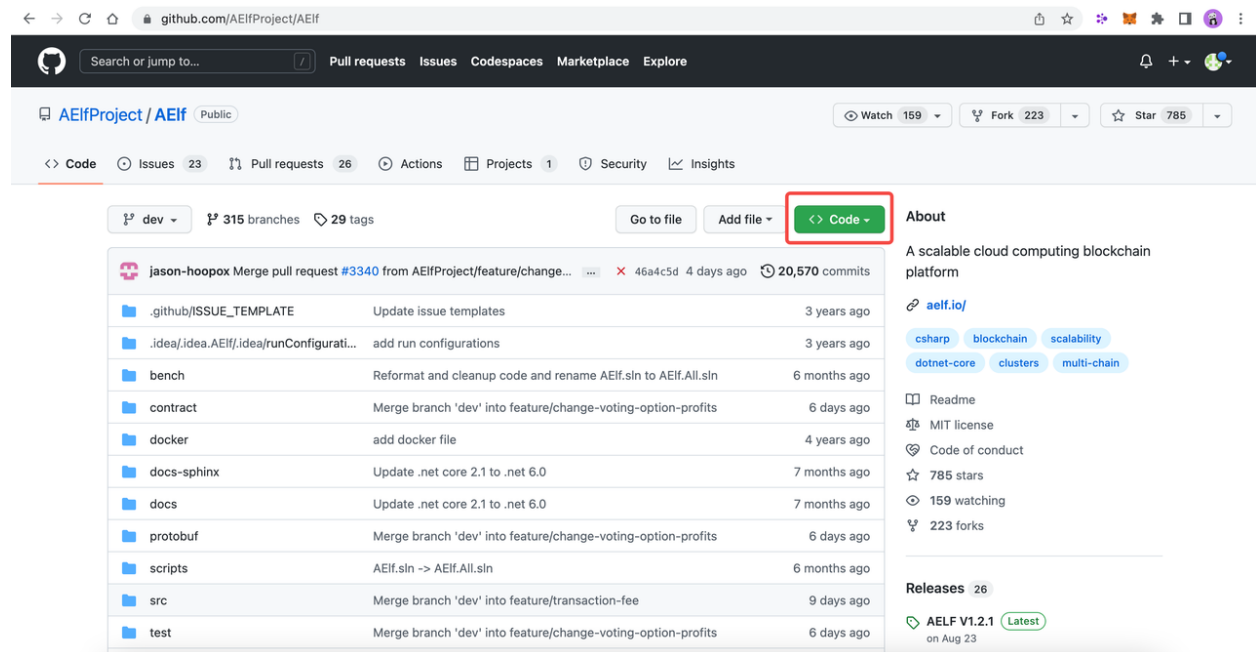
For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

4.2.4 Codespaces

A codespace is an instant development environment that's hosted in the cloud. It provides users with general-purpose programming languages and tooling through containers. You can install and set up the development environment in Codespaces. This will take 10-20 minutes. Please be patient while the command is executed.

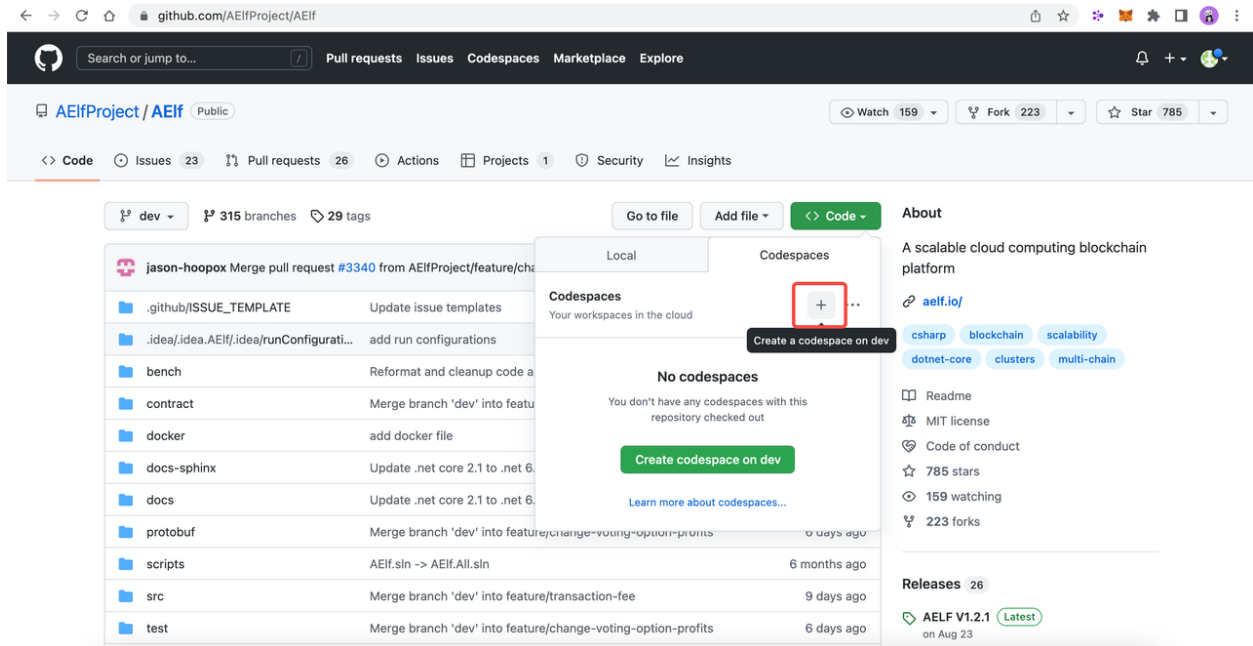
Basic Environment Configurations

1. Visit [AElfProject / AElf](#) via a browser.
2. Click the green **Code** button on the top right.



3. Select Codespaces and click +.

Then a new tab will be opened that shows the Codespaces interface. After the page is loaded, you will see:



- The left side displays all the content in this repo.
- The upper right side is where you can write code or view text.
- The lower right side is a terminal where you can build and run code (If the terminal doesn't open by default, you can click the hamburger menu on the top left and select Terminal -> New Terminal, or press control + shift + ` on your keyboard).

Currently, Codespaces have completed the configuration for part of the environments, yet there are some you need to manually configure.

At the time of writing, Codespaces have done the configuration for git and nodejs. You can type the following commands to check their versions:

```
# git version 2.25.1
git --version

# 8.19.2
npm --version
```

Update Environment

Execute this command to update your environment:

```
sudo apt-get update
```

The following output suggests successful update:

```
Fetches 25.0 MB in 3s (8,574 kB/s)
Reading package lists... Done
```

Install .NET SDK

.NET SDK 7.0 is used in this repo. Hence, you need to reinstall v6.0 otherwise there will be building issues.

1. Execute this command to check if v7.0 is used:

```
# 7.0.100
dotnet --version
```

If there is v7.0, execute this command to delete it:

```
sudo rm -rf /home/codespace/.dotnet/*
```

2. Execute this command to reinstall v6.0:

```
wget https://packages.microsoft.com/config/ubuntu/22.04/packages-microsoft-prod.deb_
↪-O packages-microsoft-prod.deb

sudo dpkg -i packages-microsoft-prod.deb

rm packages-microsoft-prod.deb

sudo apt-get update && \

sudo apt-get install -y dotnet-sdk-6.0
```

3. Restart bash after the installation and execute this command to check if v6.0 is installed:

```
# 6.0.403
dotnet --version
```

The following output suggests successful installation:

```
6.0.403
```

Install protoBuf

1. Execute this command to install protoBuf:

```
curl -OL https://github.com/google/protobuf/releases/download/v21.9/protoc-21.9-
↪linux-x86_64.zip
unzip protoc-21.9-linux-x86_64.zip -d protoc3

sudo mv protoc3/bin/* /usr/local/bin/

sudo mv protoc3/include/* /usr/local/include/

sudo chown ${USER} /usr/local/bin/protoc

sudo chown -R ${USER} /usr/local/include/google
```

2. Execute this command to check if protoBuf is installed:


```
protoc --version
```

The following output suggests successful installation:

```
libprotoc 3.21.9
```

Install Redis

1. Execute this command to install Redis:

```
sudo apt-get install redis -y
```

2. Execute this command to start a Redis instance and check if Redis is installed:

```
redis-server
```

The following output suggests Redis is installed and a Redis instance is started:

```
Server initialized
Ready to accept connections
```

Install aelf-command

Execute npm command to install aelf-command:

```
npm i aelf-command -g
```

Create an aelf Account

1. Execute this command:

```
aelf-command create
```

An aelf account will be automatically created and you will see info like:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : mirror among battle muffin cattle plunge tuition
↪ buzz hip mad surround recall
AElf [Info]: Private Key        :
↪ 4bf625afea60e21aa5afcab5ea682b3dfb614941245698632d72a09ae13*****
AElf [Info]: Public Key         :
↪ 04f9bb56a9eca921bd494e677307f0279c98f1d2ed6bdeaa6dd256878272eabd14e91ec61469d2a32ce5e63205930dab0
AElf [Info]: Address            :
↪ 21qciGwcaowwBttKMjMk86AW6WajhcodSHytY1vCyZb7p*****
```

2. You will then be asked whether you want the account data stored as a json file. Enter y to confirm and the file will be stored in /Users/{username}/.local/share/aelf/keys/.

Please make sure you remember the account data or the json file's location.

3. You will be required to set a password (referred to as * here):

```
Enter a password: *****
Confirm password: *****
```

For the sake of convenience, you are encouraged to keep this Terminal on the account info interface and open another Terminal to continue the following.

4.3 Developing Smart Contracts

This article will guide you on how to develop a smart contract, and it uses the **GreeterContract** as an example. With the concepts presented in this article, you will be able to create your own basic contract.

Steps for developing smart contracts

The following content will walk you through the basics of writing a smart contract; this process contains essentially five steps:

- **Install template:** Install the aelf smart contract templates locally using the dotnet command.
- **Initialize project:** Build the project structure and generate the base contract code from the proto definition using the dotnet command.
- **Define the contract:** The methods and types required in your contract should be defined in a protobuf file following the typical protobuf syntax.
- **Implement contract code:** Implement the logic for the contract methods.
- **Testing smart contracts:** Unit tests for contracts.

The Greeter contract is a very simple contract that exposes an `AddGreeters` method to add a new greeter to `GreeterList`, and a `GetGreeters` method to get all of greeters.

4.3.1 Install template

Installing a template means downloading templates from the NuGet repository to your local environment and installing them locally. Run the following command to install it.

```
dotnet new install AElf.ContractTemplates
```

After installation, you can use `dotnet new uninstall` to verify the presence of this template locally.

```
Currently installed items:
  AElf.ContractTemplates
    Version: 1.0.0-alpha
    Details:
      Author: AElf
      NuGetSource: https://api.nuget.org/v3/index.json
    Templates:
      AElf Contract (aelf) C#
    Uninstall Command:
      dotnet new uninstall AElf.ContractTemplates
```

If you can see this result, it indicates that the template installation was successful. This information shows the template name, version, and other details.

4.3.2 Initialize project

After installing, we need to initialize the project. Initializing the project is like creating a specific contract project based on the template. This process is similar to using the `new()` method in OOP to create an instance of a class.

Using `dotnet new` command to create a specific contract project. We can create custom contract projects based on the template using `-n` and `-N` options. And `-n` stands for contract name, `-N` stands for namespace.

Run the following command, you can create a contract project that named `GreeterContract`. In this case, the contract name will be `GreeterContract`. And the namespace of the project will be `AElf.Contracts.Greeter`.

```
dotnet new aelf -n GreeterContract -N AElf.Contracts.Greeter
```

After running `dotnet new` command, we can get a new project generated base on template. The project structure is as follows.

```
.
├── src
│   ├── GreeterContract.cs
│   ├── GreeterContract.csproj
│   ├── GreeterContractState.cs
│   └── Protobuf
│       ├── contract
│       │   └── hello_world_contract.proto
│       └── message
│           └── authority_info.proto
├── test
│   ├── GreeterContract.Tests.csproj
│   ├── GreeterContractTests.cs
│   ├── Protobuf
│   │   ├── message
│   │   │   └── authority_info.proto
│   │   └── stub
│   │       └── hello_world_contract.proto
│   └── _Setup.cs
```

The src folder

The **src** folder contains several protobuf files used to describe smart contract methods and data structures. It also includes specific implementations of smart contract methods and definition files for managing contract state in communication with the blockchain. For example, `GreeterContractState.cs` is one such file.

```
src
├── GreeterContract.cs
├── GreeterContract.csproj
├── GreeterContractState.cs
└── Protobuf
```

The test folder

Similarly, the **test** folder contains a proto subfolder, along with a setup file used to establish the unit testing environment for blockchain smart contracts. It defines test module classes and a base test class, facilitating context loading, stub class retrieval, and stub acquisition methods. These classes and methods are employed in unit tests to conduct various tests on the smart contract.

```
test
├── _Setup.cs
├── GreeterContract.Tests.csproj
├── GreeterContractTests.cs
└── Protobuf
```

4.3.3 Defining the contract

AElf defines smart contracts as services that are implemented using gRPC and Protobuf. These definitions are placed in the proto files and do not contain logic. The proto files are used to generate C# classes that will be used to implement the logic and state of the contract.

In the Protobuf folder, different subfolders are used to store various definition proto files. If a corresponding folder does not exist, you can create one yourself. In this context, only the contract and message directories are used. Here's a breakdown of the Protobuf content under the src folder:

- **contract**: The contract folder is used to store definition proto file of contract.
- **message**: The proto files under the message folder are used to define common properties for import and use by other proto files.
- **reference**: The reference folder is used to store the proto files of the referenced contract.
- **base**: The base folder is used to store the basic proto files, such as ACS (aelf standard contract) proto files.

```
src
├── Protobuf
│   ├── contract
│   │   └── hello_world_contract.proto
│   └── message
│       └── authority_info.proto
```

The **hello_world_contract.proto** file is used as a template for the HelloWorld contract. First, we need to delete this proto file. Next, we will create a new **greeter_contract.proto** file, which will be used for the GreeterContract contract. Let's explore how to write definitions in the proto file.

```
syntax = "proto3";

import "aelf/options.proto";
import "google/protobuf/empty.proto";
import "google/protobuf/wrappers.proto";
// The namespace of this class
option csharp_namespace = "AElf.Contracts.Greeter";

service GreeterContract {
    // The name of the state class the smart contract is going to use to access blockchain_
    ↪state
    option (aelf.csharp_state) = "AElf.Contracts.Greeter.GreeterContractState";
```

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```

// Actions (methods that modify contract state)
// Stores the value in contract state
rpc AddGreeters (google.protobuf.StringValue) returns (google.protobuf.Empty) {
}

// Views (methods that don't modify contract state)
// Get the value stored from contract state
rpc GetGreeters (google.protobuf.Empty) returns (GreeterList) {
    option (aelf.is_view) = true;
}
}
message GreeterList {
    repeated string greeter = 1;
}

```

The complete contract definition consists of three main parts:

- Imports: These are the dependencies of your contract.
- Service definitions: These define the methods of your contract.
- Types: These are custom-defined types used by the contract.

Now, let's take a closer look at these three different parts.

Syntax, imports and namespace

```

syntax = "proto3";

import "aelf/options.proto";
import "google/protobuf/empty.proto";
import "google/protobuf/wrappers.proto";
// The namespace of this class
option csharp_namespace = "AElf.Contracts.Greeter";

```

The first line specifies the syntax used in this protobuf file. We recommend using proto3 for your contracts. Next, you will notice that this contract specifies some imports. Let's briefly describe them:

- aelf/options.proto: Contracts can use aelf specific options. This file contains the definitions, including options like is_view that we will use later.
- empty.proto, wrappers.proto: These are proto files imported directly from the protobuf library. They are useful for defining things like an empty return value and wrappers around common types, such as strings.

The last line specifies an option that determines the target namespace of the generated code. In this case, the generated code will be placed in the **AElf.Contracts.Greeter** namespace.

Service definitions

```
service GreeterContract {  
  // The name of the state class the smart contract is going to use to access blockchain_  
  ↪ state  
  option (aelf.cssharp_state) = "AElf.Contracts.Greeter.GreeterContractState";  
  
  // Actions (methods that modify contract state)  
  // Stores the value in contract state  
  rpc AddGreeters (google.protobuf.StringValue) returns (google.protobuf.Empty) {  
  }  
  
  // Views (methods that don't modify contract state)  
  // Get the value stored from contract state  
  rpc GetGreeters (google.protobuf.Empty) returns (GreeterList) {  
    option (aelf.is_view) = true;  
  }  
}
```

In the first line, we use the `aelf.cssharp_state` option to specify the full name of the state class. This indicates that the state of the contract should be defined in the `GreeterContractState` class under the `AElf.Contracts.Greeter` namespace.

Next, an action method is defined: `AddGreeters`. A contract method is composed of three parts: the method name, the input argument type(s), and the output type. For instance, `AddGreeters` specifies that it requires a `google.protobuf.StringValue` input type, indicating that this method takes an argument, and the output type will be `google.protobuf.Empty`.

The service also defines a view method: `GetGreeters`. This method is exclusively used to query the contract state and has no side effects on the state. The definition of `GetGreeters` uses the `aelf.is_view` option to designate it as a view method.

To summarize:

- Use `google.protobuf.Empty` to specify that a method takes no arguments (import `google/protobuf/empty.proto`).
- Use `google.protobuf.StringValue` to handle strings (import `google/protobuf/wrappers.proto`).
- Use the `aelf.is_view` option to create a view method (import `aelf/options.proto`).
- Use the `aelf.cssharp_state` option to specify the namespace of your contract's state (import `aelf/options.proto`).

Custom types

```
message GreeterList {  
  repeated string greeter = 1;  
}
```

A brief summary follows:

- Use **repeated** to denote a collection of items of the same type.

4.3.4 Implement contract code

After defining the contract's structure and methods, you need to execute the dotnet build command within the src folder. This will recompile the proto files and generate updated C# code. You should repeat this command every time you make changes to the contract's structure to ensure the code is up to date.

Currently, you can extend the generated code to implement the contract's logic. There are two key files involved:

- GreeterContract: This file contains the actual implementation logic. It inherits from the contract base generated by the proto files.
- GreeterContractState: This is the state class that holds properties for reading and writing the contract's state. It inherits the ContractState class from the C# SDK.

```
using AElf.Sdk.CSharp;
using Google.Protobuf.WellKnownTypes;

namespace AElf.Contracts.Greeter
{
    // Contract class must inherit the base class generated from the proto file
    public class GreeterContract : GreeterContractContainer.GreeterContractBase
    {
        // A method that modifies the contract state
        public override Empty AddGreeters(StringValue input)
        {
            // Should not greet to empty string or white space.
            Assert(!string.IsNullOrEmpty(input.Value), "Invalid name.");

            // State.GreetedList.Value is null if not initialized.
            var greeterList = State.GreeterList.Value ?? new GreeterList();

            // Add input.Value to State.GreetedList.Value if it's new to this list.
            if (!greeterList.Greeter.Contains(input.Value))
            {
                greeterList.Greeter.Add(input.Value);
            }

            // Update State.GreetedList.Value by setting it's value directly.
            State.GreeterList.Value = greeterList;

            return new Empty();
        }

        // A method that read the contract state
        public override GreeterList GetGreeters(Empty input)
        {
            return State.GreeterList.Value ?? new GreeterList();
        }
    }
}
```

```
using AElf.Sdk.CSharp.State;

namespace AElf.Contracts.Greeter
{
```

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```
public class GreeterContractState : ContractState
{
    public SingletonState<GreeterList> GreeterList { get; set; }
}
```

Asserting

```
Assert(!string.IsNullOrEmpty(input.Value), "Invalid name.");
```

When writing a smart contract, it is often useful and recommended to validate the input. AElf smart contracts can utilize the `Assert` method defined in the base smart contract class to implement this pattern. For example, in the above method, validation checks if the input string is null or consists only of white spaces. If this condition evaluates to false, the transaction execution will be terminated.

Saving and reading state

```
State.GreeterList.Value = greeterList;
...
var greeterList = State.GreeterList.Value;
```

From within the contract methods, you can easily save and read the contract's state using the `State` property of the contract. In this context, the `State` property refers to the `GreeterContractState` class. The first line is used to save the input value to the state, while the second line is used to retrieve the value from the state.

Contract state

As a reminder, here is the state definition in the contract where we specify the name of the class and its type, along with the custom type `GreeterList`:

```
public class GreeterContractState : ContractState
{
    public SingletonState<GreeterList> GreeterList { get; set; }
}
```

The `aelf.csharp_state` option allows the contract author to specify the namespace and class name for the state. To implement a state class, you need to inherit from the `ContractState` class provided by the C# SDK. When defining properties under the state, we follow a generic approach:

- To save and read a single object: use `SingletonState<ClassType>`.
- To save and read a key-value pair: use `MappedState<KeyClassType, ValueClassType>`.

After becoming familiar with all state usages, you can also use `StringState` as an alternative to `SingletonState<ClassType>`.

4.3.5 Testing smart contracts

This tutorial will demonstrate how to test the GreeterContract for reference.

AElf.ContractTestKit is a testing framework designed specifically for testing aelf smart contracts. With this framework, you can simulate the execution of a transaction by constructing a stub of a smart contract and utilize the methods provided by the Stub instance (corresponding to the contract's Action methods) for executing transactions and queries (corresponding to the Views methods of the contract) to obtain transaction execution results in the test case.

As you can observe, the test code is located within the test folder. Typically, this test folder contains a project file (.csproj) and at least two .cs files. The project file serves as a standard C# xUnit test project file, with additional references included as needed.

```
test
├── GreeterContract.Tests.csproj
├── GreeterContractTests.cs
├── Protobuf
│   ├── message
│   │   └── authority_info.proto
│   └── stub
│       └── hello_world_contract.proto
└── _Setup.cs
```

Steps of testing smart contracts The testing process closely mirrors the development process and generally consists of the following steps:

- **Defining the contract:** All the required methods and types for your contract should be defined in a protobuf file. These definitions are identical to those in the src folder, and you can simply copy them to the test folder.
- **Setting up the testing context:** To conduct local contract testing, it's essential to simulate the execution of a transaction by creating a stub. In this step, you will configure the necessary context and stub components needed for testing.
- **Implementing contract unit test code:** Create the logic for unit test methods, which will test the contract's functionality and ensure it works as expected.

Defining the contract

The Protobuf folder within the test directory serves a similar purpose to the src directory but with slightly different folder names. For the Protobuf section within the test folder, the following applies:

- **message:** The proto files contained in the message folder are used to define common properties that can be imported and utilized by other proto files.
- **stub:** The stub folder houses contract proto files dedicated to unit testing. Additionally, it may contain other proto files that this test proto file depends on and imports.

```
test
├── Protobuf
│   ├── message
│   │   └── authority_info.proto
│   └── stub
│       └── hello_world_contract.proto
```

You can copy the necessary proto files from the src folder and paste them into the stub folder. It's important to ensure that contract proto files from the src folder and any dependent proto files are correctly placed in the stub directory.

Setting up testing context

To locally test contract methods, you need to establish the context required for testing. This process primarily involves obtaining the stub for the contract. Below is the content of the `_Setup.cs` file:

```
using AElf.Cryptography.ECDSA;
using AElf.Testing.TestBase;

namespace AElf.Contracts.Greeter
{
    // The Module class load the context required for unit testing
    public class Module : ContractTestModule<GreeterContract>
    {
    }

    // The TestBase class inherit ContractTestBase class, it defines Stub classes and
    // gets instances required for unit testing
    public class TestBase : ContractTestBase<Module>
    {
        // The Stub class for unit testing
        internal readonly GreeterContractContainer.GreeterContractStub
        GreeterContractStub;

        // A key pair that can be used to interact with the contract instance
        private ECKeypair DefaultKeyPair => Accounts[0].KeyPair;

        public TestBase()
        {
            GreeterContractStub = GetGreeterContractContractStub(DefaultKeyPair);
        }

        private GreeterContractContainer.GreeterContractStub
        GetGreeterContractContractStub(ECKeypair senderKeyPair)
        {
            return GetTester<GreeterContractContainer.GreeterContractStub>
            (ContractAddress, senderKeyPair);
        }
    }
}
```

In this code, `TestBase` inherits `ContractTestBase<Module>` and defines a contract stub within the class. It also obtains a key pair from the `AElf.ContractTestKit` framework. In the constructor, the address and key pair parameters are provided, and the `GetTester` method is used to retrieve the contract stub.

Implement contract unit test code

Now comes the easy part: the test class only needs to inherit from `TestBase`. Once you've done that, you can proceed to write the unit test implementations you require.

In this section, you can use the `AddGreetersTest` method to save a message to the state. Following that, you can call the `GetGreeters` method to retrieve the message from the state. Finally, you can compare the retrieved message with the originally input message to verify whether the values match.

```
using System.Threading.Tasks;
using Google.Protobuf.WellKnownTypes;
using Shouldly;
```

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```

using Xunit;

namespace AElf.Contracts.Greeter
{
    // This class is unit test class, and it inherit TestBase. Write your unit test code.
    ↪ inside it
    public class GreeterContractTests : TestBase
    {
        [Fact]
        public async Task AddGreetersTest()
        {
            // Arrange
            var user1 = new StringValue { Value = "Tom" };
            var user2 = new StringValue { Value = "Jerry" };
            var expectList = new GreeterList();
            expectList.Greeter.Add(user1.Value);
            expectList.Greeter.Add(user2.Value);

            // Act
            await GreeterContractStub.AddGreeters.SendAsync(user1);
            await GreeterContractStub.AddGreeters.SendAsync(user2);

            // Assert
            var greeterList = await GreeterContractStub.GetGreeters.CallAsync(new
            ↪ Empty());
            greeterList.ShouldBe(expectList);
        }
    }
}

```

4.4 Deploying/Updating Contracts(BP Approval Required)

Contracts deployment/update can be done by 2 means: one is via aelf explorer while the other is via aelf-command. Before you start deploying/updating, please make sure that you have installed npm and aelf-command. If you haven't completed it, please follow the [Deployment Environment](#) here.

4.4.1 Overview

In the following 3 situations, the contract updating process must be initiated by the BP and the contracts can only be updated after having obtained the BPs' approval.

1. Upgrading the system contracts on MainChain.
2. Upgrading the system contracts on exclusive SideChains.
3. Upgrading the system contracts on shared SideChains.

System contracts can only be deployed in the Genesis block. Once the blockchain is launched, it will only support contract updates and new system contract deployments will not be accepted. This document only describes the pipeline of contract deployment on aelf Mainnet, that is, when `ContractDeploymentAuthorityRequired` is true.

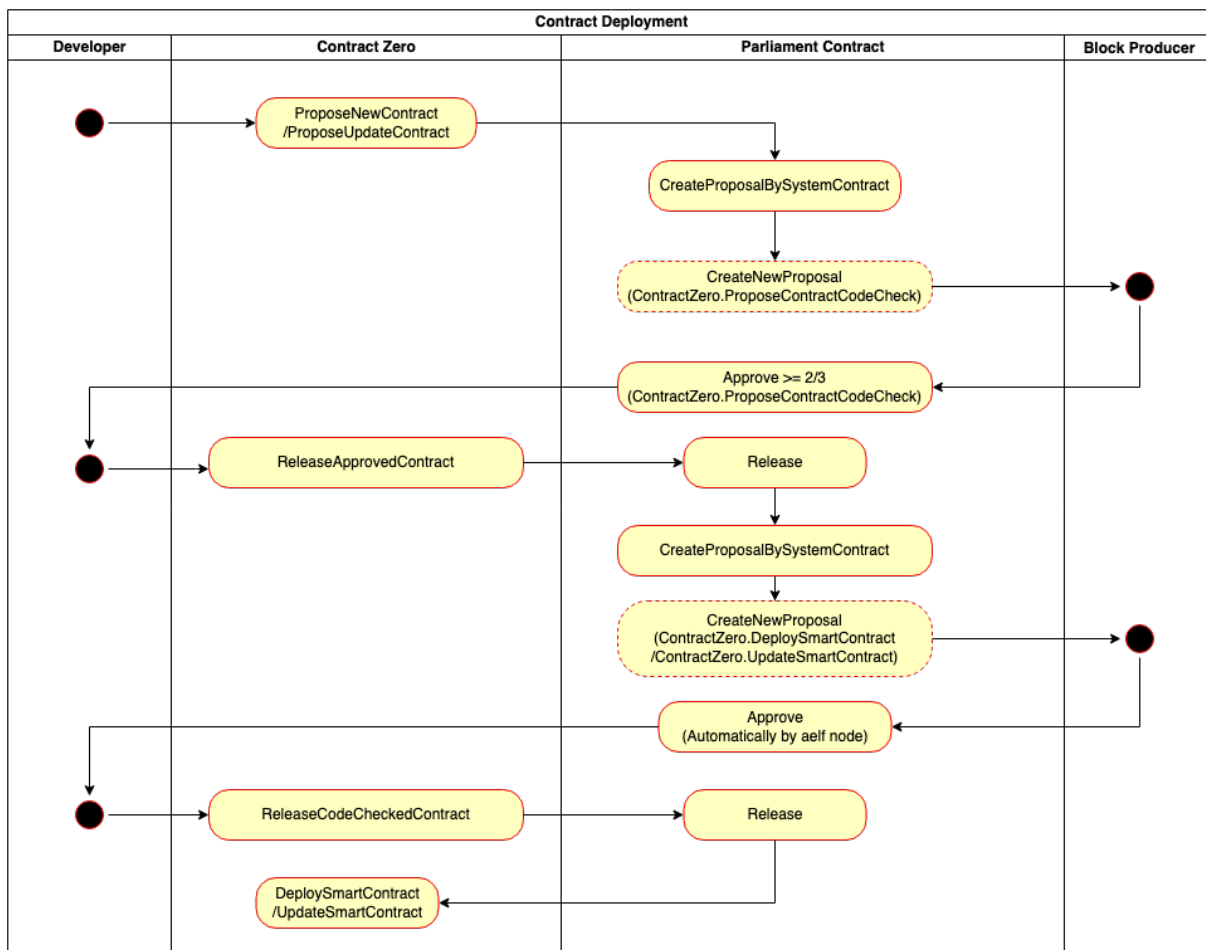
4.4.2 Deploy / Update through aelf Explorer

Notes: This doc only illustrates the procedure of contract deployment/ update on AElf Mainnet, that is, when `ContractDeploymentAuthorityRequired` is true. Please make sure that you have created an AElf wallet and possessed around 100 ELF before you start deploying/updating. When `ContractDeploymentAuthorityRequired` is false, you can directly complete deployment and upgrade via `DeploySmartContract` and `UpdateSmartContract` in Contract Zero.

Click [here](#) to learn contract deployment through aelf Explorer.

4.4.3 Deploy / Update through aelf-command

This section will walk you through the procedure of contract deployment / update through aelf-command.



Developer: ProposeNewContract / ProposeUpdateContract**Contract Deployment**

- The developer initiates the `ProposeNewContract` transaction.
- A `ProposeContractCodeCheck` proposal will be created and the BPs will be asked to check the code.
- If no less than $\frac{2}{3}$ of BPs (rounding down) + 1 vote in favour of the proposal, the developer needs to manually release the approved proposal and the system will create a `CodeCheck` proposal for automatic code check. If the proposal is denied, the deployment will be terminated.

Contract Update

- The developer initiates the `ProposeUpdateContract` transaction.
- A `ProposeContractCodeCheck` proposal will be created and the BPs will be asked to check the code.
- If no less than $\frac{2}{3}$ of BPs (rounding down) + 1 vote in favour of the proposal, the developer needs to manually release the approved proposal and the system will create a `CodeCheck` proposal for automatic code check. If the proposal fails, the update will be terminated.

BP: Parliament.Approve

- BPs manually approve the `ProposeContractCodeCheck` proposal, agreeing to check the contract code.
- A proposal will be approved only if all the following conditions are met:
 - No less than $\frac{2}{3}$ (rounding down) + 1 of the total votes are in favour;
 - No more than 10% of the total votes are against;
 - No more than 10% of the total votes are abstention;
 - At least 80% of the BPs participate in voting.

Developer: ReleaseApprovedContract

- If no less than $\frac{2}{3}$ of BPs (rounding down) + 1 approve the proposal, the developer needs to initiate a `ReleaseApprovedContract` transaction to release the proposal.
- A `CodeCheck` proposal will be created for automatic code check, which is used to let BPs automatically check the code (an event will be raised and handled on-chain, and code check will be executed).

BP: Parliament.ApproveMultiProposals (automatic)

- BPs automatically complete the contract code check. If the code passes the check, an `ApproveMultiProposals` transaction will be initiated via the system, and that means the `CodeCheck` proposal is approved. If the code fails to pass the check, the deployment/update will be terminated.

Developer: ReleaseCodeCheckedContract

- The developer initiates the `ReleaseCodeCheckedContract` transaction to release the `CodeCheck` proposal. The `DeploySmartContract/ UpdateSmartContractmethod` will be executed and then contract deployment/update is done.

4.5 Deploying/Updating Contracts(No BP Approval Required)

Contracts deployment/update can be done by 2 means: one is via aelf explorer while the other is via aelf-command. Before you start deploying/updating, please make sure that you have installed npm and aelf-command. If you haven't completed it, please follow the [Deployment Environment](#) here.

4.5.1 Overview

In the following 6 situations, you can choose to deploy/update contracts without BPs' approval. Please note that for different conditions, the requirement for initiators differs.

1. Deploying user contracts on shared SideChains, can be initiated by users or BPs.
2. Updating user contracts on shared SideChains, can only be initiated by contract creators.
3. Deploying user contracts on exclusive SideChains, can only be initiated by SideChain creators.
4. Updating user contracts on exclusive SideChains, can only be initiated by contract creators.
5. Deploying user contracts on MainChain, can only be initiated by BPs (The recommended contract deployment is on SideChains and we strongly encourage you to not deploy on MainChain).
6. Updating user contracts on MainChain, can only be initiated by contract creators.

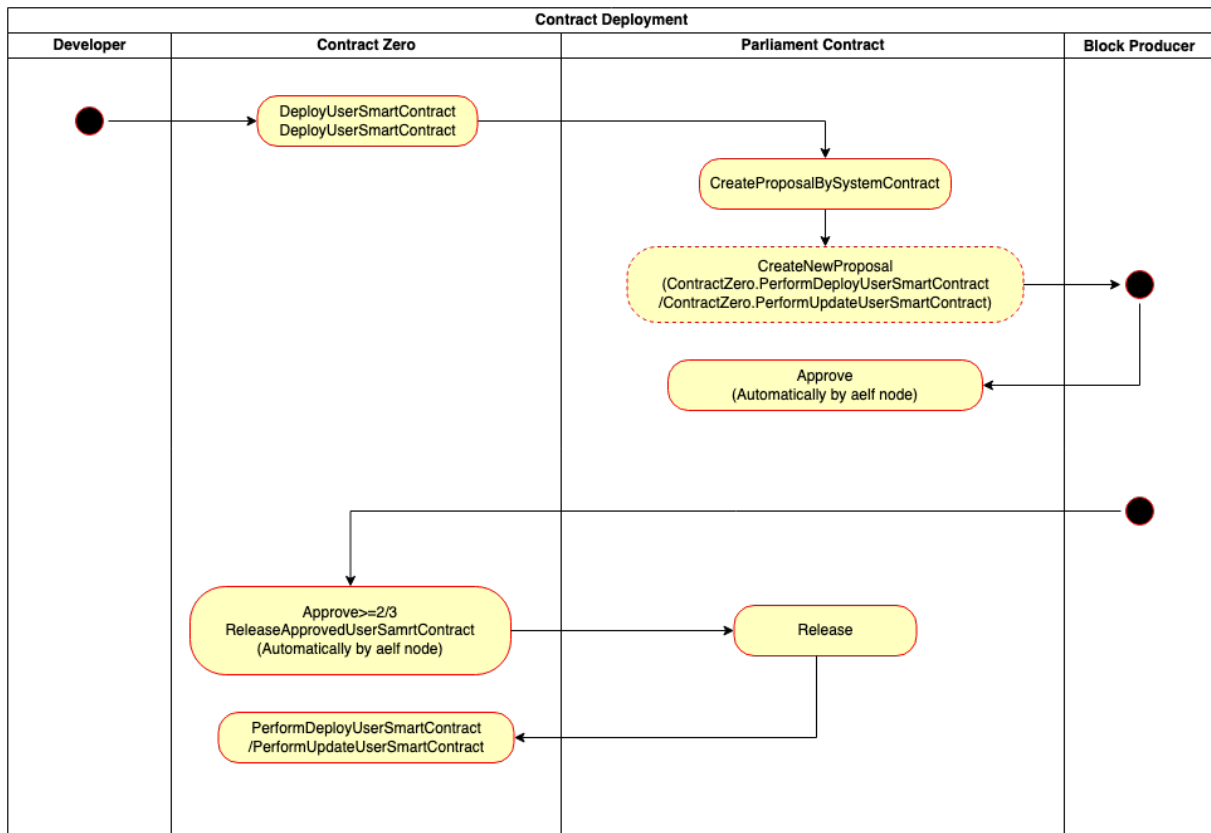
User contracts here refer to non-system contracts. Please note that the prerequisite for successful deployments/updates is that your contracts have implemented the ACS12 standards.

Compared with the procedure where BP approval is required, for no-approval-needed contract deployment/update, developers only need to initiate 1 transaction in the entire process.

Developer: DeployUserSmartContract / UpdateUserSmartContract

Contract Deployment

- The developer initiates the `DeployUserSmartContract` transaction.
- A `CodeCheck` proposal will be created and the BPs will be asked to check the code.
- The transaction returns `CodeHash` of the contract deployment.



Contract Update

- The developer initiates the `UpdateUserSmartContract` transaction.
- A `CodeCheck` proposal will be created and the BPs will be asked to check the code.

BP: `Parliament.ApproveMultiProposals` (automatic)

- BPs automatically complete the contract code check. If the code passes the check, an `ApproveMultiProposals` transaction will be initiated via the system, and that means the `CodeCheck` proposal is approved.

BP: `ReleaseApprovedUserSmartContract` (automatic)

- Once the automatic code check passes by no less than 2/3 of BPs (rounding down) + 1, BPs will release the `CodeCheck` proposal by initiating the `ReleaseApprovedUserSmartContract` transaction. They will execute the `PerformDeployUserSmartContract` method and then contract deployment/update is done.
- If the code check fails to pass, the deployment/update will be terminated.

Developer: `GetSmartContractRegistrationByCodeHash`

In the case of contract deployment/update, the developer can get the deployed/updated contract address through this method:

- Use the `CodeHash` returned in the `DeployUserSmartContract/UpdateUserSmartContract` transaction to check the address of the deployed contract through `GetSmartContractRegistrationByCodeHash`.
- Since contract deployment/update requires BPs to complete code checks, the result can only be obtained after at least one round of block production.

If errors exist in the contract deployment/update transaction, the first transaction will fail and info about the error can be obtained by checking the transaction results.

If the contract deployment/update transaction is executed yet the deployed/updated contract address can not be checked through `GetSmartContractRegistrationByCodeHash` after 10 minutes, please troubleshoot the problem from the following aspects:

- Whether the contract has implemented the ACS12 standards;
- Whether the contract development scaffold is the latest version.

BECOMING A BP

5.1 Introduction

To work as a BP, you need to run a full node and participate in the election. The total number of BPs (Block Producers) in aelf network is set at $2N+1$ where N starts from 8 in 2022 and increases by 1 each year. If your node ranks among the top $2N+1$ in the [election](#), you are qualified to participate in block production and aelf governance. This tutorial will guide you through the procedure of becoming a BP.

5.2 Operations

The process of becoming a BP is as follows:

1. Set up nodes.
2. Participate in BP election using nodes.

Note:

- Voters stake ELF tokens to vote for their preferred nodes.
- Outcome of election:
 1. Block Producer - elected based on top $2N+1$
 2. Candidate Nodes - elected based on top $5*(2N+1)$
 3. Nodes

5.2.1 Set up nodes

aelf currently doesn't have light nodes, it means that all the nodes users set up are full nodes. You can click [here](#) to learn how to set up a full node.

Note: Since you want to become a BP, you need to run individual nodes for both MainChain AELF and all the SideChains.

5.2.2 Participate in BP election

You need to stake 100,000 ELF in order to participate in the node election. Please make sure that you are not low on balance.

You can enter the [Governance](#) page, click the “Become a candidate node” button, and stake 100,000 ELF to join the node election.

5.2.3 Users vote for nodes

Users can visit [this site](#) and vote for candidate nodes at Governance - Vote - Node Table.

The top $2N+1$ nodes become BPs, and the top $5*(2N+1)$ nodes become candidate nodes, where N starts from 8 in 2022 and increases by 1 each year.

5.2.4 BPs are elected

BPs are elected every seven days and the change of terms starts at 7:23 (UTC) every Thursday. If your node receives enough votes to rank top $2N+1$ of all candidate nodes in the election, it will automatically become a BP in the next term. If ranking between top $2N+1$ and top $5*(2N+1)$, it will become a candidate node. You can check the current elected BPs in real-time on the [election](#) page.

5.2.5 Simulate in the local environment

If you want to try setting up a node and running as a BP in your local environment, please follow the [instructions](#) to simulate it in the local.

5.3 Simulation in the local environment

5.3.1 Set up a full node

When you simulate setting up BP nodes in the local environment, the BP election mechanism won't be triggered if you only set up a single node, which means the node can't become a BP. Hence, you need to set up at least three nodes in the local environment.

Please note: The term that aelf's BPs are elected is every 7 days. To make this tutorial concise and easy to follow, it will change the configuration of the term to 120s. You will find and follow the instructions in the following guide.

1. Find the appsettings.json file in `/.../ src / AElf.Launcher` and you will see the code below:

```
"Consensus": {
  "InitialMinerList": ["04884d9563b3b67a5*****0cba710d956718*****"],
  "MiningInterval": 4000,
  "StartTimestamp": 0,
  "PeriodSeconds": 604800,
  "MinerIncreaseInterval": 31536000
}
```

2. Configure the Public Key of the three nodes and separate them with , like this:

```
"InitialMinerList" : [
  "04884d9563b3b67a5*****526dd489e3805211cba710d956718*****",
  "045670526219d7315*****8629891b0617ab605e646ae78961c*****",
  "046a5913eae5fee3d*****3826beb2b7109b5141679a1927338*****"
],
```

3. Change "PeriodSeconds": 604800 to "PeriodSeconds": 120 and the election term will be changed to 2 minutes.
4. If you have set up nodes and produced blocks before, please shut down your nodes and delete all Redis data via command, the instructions of which can be found in [Multi-Nodes](#) . After that, you can restart your multi-nodes again.

5.3.2 Become a candidate node

You need to stake 100,000 ELF in order to participate in the node election. Please make sure that you are not low on balance.

1. Execute this command to check if you have enough balance in the node. All the ELF tokens generated in the local environment are stored in the first node address that you configured in InitialMinerList in step 1, i.e. "Set up a full node".

Please note: In the following demonstration, we will be using the address Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC and its public key is 04eed00eb009ccd283798e3...828270f77c6ef267905. You need to replace it with your own address when you operate it.

```
aelf-command call AElf.ContractNames.Token GetBalance '{"symbol": "ELF", "owner":
↪ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC"}'
```

When the command is executed, you will see info like this and balance here refers to the balance in this address.

```
Result:
{
  "symbol": "ELF",
  "owner": "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC",
  "balance": "100000000000000"
}
```

2. Skip this step if the balance is greater than 100,005 ELF. While if it's not, you can transfer 100,005 ELF, where 100,000 will be used for staking and the remaining used to pay transaction fees. You can use the following command to transfer:

```
aelf-command send AElf.ContractNames.Token Transfer '{"symbol": "ELF", "to":
↪ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC", "amount": "100000000000000"}'
```

After that, you can run the command in step 1 to check the balance.

3. Execute this command so that the full node announces that it will join the node election and appoints an admin:

```
aelf-command send AElf.ContractNames.Election AnnounceElection '{"value":
↪ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC"}' -a
↪ Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC
```

4. Execute this command to check the candidate node's info:

```
aelf-command call AElf.ContractNames.Election GetCandidateInformation '{"value":
↪ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a
↪"}'
```

When the command is executed, you will see that the public key of the full node is on the candidate list, meaning it's a candidate node.

```
Result:
{
  "terms": [],
  "pubkey":
↪ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a
↪",
  "producedBlocks": "0",
  "missedTimeSlots": "0",
  "continualAppointmentCount": "0",
  "announcementTransactionId":
↪ "8cc8eb5de35e390e4f7964bbdc7edc433498b041647761361903c6165b9f8659",
  "isCurrentCandidate": true
}
```

5.3.3 Users vote for nodes

1. Execute this command to create a user account to simulate voting:

```
aelf-command create
```

The account info is as follows:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : walnut market museum play grunt chuckle hybrid_
↪accuse relief misery share meadow
AElf [Info]: Private Key        :_
↪919a220fac2d80e674a256f2367ac840845f344269f4dcdd56d37460de17f947
AElf [Info]: Public Key         :_
↪04794948de40ffda2a6c884d7e6a99bb8e42b8b96b9ee5cc4545da3a1d5f7725eec93de62ddbfb598ef6f04fe52aa310a
AElf [Info]: Address            : ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei
```

2. Execute this command to transfer some tokens to it for voting purposes (2000 ELF is used here for demonstration).

```
aelf-command send AElf.ContractNames.Token Transfer '{"symbol": "ELF", "to":
↪ "ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei", "amount": "2000000000000"}'
```

3. Execute this command to check the balance of this newly-created account:

```
aelf-command call AElf.ContractNames.Token GetBalance '{"symbol": "ELF", "owner":
↪ "ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei"}'
```

The result shows that it has a balance of 2000 ELF, meaning the tokens have been received.

```
Result:
{
```

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```

    "symbol": "ELF",
    "owner": "ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei",
    "balance": "200000000000"
  }

```

4. Execute this command to vote for the candidate node via the election contract (20 ELF is used here for demonstration). `candidatePubkey` is the public key of the candidate node:

```

aelf-command send AElf.ContractNames.Election Vote '{"candidatePubkey":
↪ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a
↪ ", "amount": 2000000000, "endTimeStamp": {"seconds": 1600271999, "nanos": 999000}}' -a
↪ ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei

```

5. Execute this command to check the number of votes the candidate received:

```

aelf-command call AElf.ContractNames.Election GetCandidateVote '{"value":
↪ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a
↪ }'

```

After it's executed, the result will be as follows. Here, the full node has received 20 ELF as votes.

```

Result:
{
  "obtainedActiveVotingRecordIds": [
    "172375e9cee303ce60361aa73d7326920706553e80f4485f97ffefdb904486f1"
  ],
  "obtainedWithdrawnVotingRecordIds": [],
  "obtainedActiveVotingRecords": [],
  "obtainedWithdrawnVotesRecords": [],
  "obtainedActiveVotedVotesAmount": "20000000000",
  "allObtainedVotedVotesAmount": "20000000000",
  "pubkey":
↪ "BO7QDrAJzNKDeY44Yngc69Je1qRkHg4bfQ47a1kCUEBnn8TcDtyd4Wa9YwxyVRiKmurfyDL9rggoJw93xu8meQU=
↪ "
}

```

5.3.4 Become a BP

The top $2N+1$ candidate nodes will automatically be elected as BPs in the next term. A list of the public keys of the current BPs' can be obtained via the consensus contract.

Execute this command:

```

aelf-command call AElf.ContractNames.Consensus GetCurrentMinerPubkeyList '{}'

```

Info of the current BPs will be returned:

```

Result:
{
  "pubkeys": [
↪ "0499d3bb14337961c4d338b9729f46b20de8a49ed38e260a5c19a18da569462b44b820e206df8e848185dac6c139f05392c2

```

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```
→ " ,  
→ "048397dfd9e1035fdd7260329d9492d88824f42917c156aef93fd7c2e3ab73b636f482b8ceb5cb435c556bfa067445a86e6f  
→ " ,  
→ "041cc962a51e7bbdd829a8855eca8a03fda708fdf31969251321cb31edadd564bf3c6e7ab31b4c1f49f0f206be81dbe68a75  
→ " ,  
→ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea  
→ "  
  ]  
}
```

5.3.5 Add more BPs

You can repeat steps 1-4 to add more BPs, but you don't need to edit the configuration file `appsettings.json` in step 1 again. When the number of genesis nodes and candidate nodes exceeds the maximum number of BPs, the candidate nodes will gradually replace the genesis nodes and the replaced genesis nodes can't participate in node election again. After all the genesis nodes are replaced, they will have fulfilled their duty of starting aelf Mainnet.

If you have learned about how to become a BP, you can proceed with the following docs for contract deployment and DApp development guide.

AELF BLOCKCHAIN BOOT SEQUENCE

This section mainly explains how the AElf Blockchain starts from the initial nodes, and gradually replaces the initial nodes with true production nodes through elections, thus completing the complete process of AElf Blockchain startup.

6.1 Start initial nodes

We need to start at least one or more initial nodes to start the AElf Blockchain, and 1-5 initial nodes are recommended.

In the Getting Started section, we described the steps to start multiple nodes, you can follow the *Running multi-nodes with Docker* to complete the initial nodes startup (this section also takes the example of starting three initial nodes).

Since the default period of election time is 604800 seconds(7 days), if you want to see the result of the election more quickly, modify the configuration file appsettings.json before starting the boot nodes to set the PeriodSeconds to smaller:

```
{
  "Consensus": {
    "PeriodSeconds": 604800
  },
}
```

6.2 Run full node

6.2.1 Create an account for the full node:

```
aelf-command create
```

```
AElf [Info]: Your wallet info is :
```

```
AElf [Info]: Mnemonic           : major clap hurdle hammer push slogan ranch quantum
```

```
↪reunion hope enroll repeat
```

```
AElf [Info]: Private Key       : 
```

```
↪2229945cf294431183fd1d8101e27b17a1a590d3a1f7f2b9299850b24262ed8a
```

```
AElf [Info]: Public Key        : 
```

```
↪04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aead
```

```
AElf [Info]: Address           : Q3t34SAEsxAQrSQidTRzDonWNTpPSTgH8bqu8pQUGCSWRPdRC
```

6.2.2 Start full node:

The startup steps for the full node are similar to the initial node startup, but the configuration file section notes that the InitialMinerList needs to be consistent with the initial node:

```
{
  "InitialMinerList" : [
    ↪ "0499d3bb14337961c4d338b9729f46b20de8a49ed38e260a5c19a18da569462b44b820e206df8e848185dac6c139f05392c2",
    ↪ ",
    ↪ "048397dfd9e1035fdd7260329d9492d88824f42917c156aef93fd7c2e3ab73b636f482b8ceb5cb435c556bfa067445a86e6f",
    ↪ ",
    ↪ "041cc962a51e7bbdd829a8855eca8a03fda708fdf31969251321cb31edadd564bf3c6e7ab31b4c1f49f0f206be81dbe68a75",
    ↪ "
  ],
}
```

6.2.3 Full node started successfully:

By checking the current node state, it can be seen that the full node is synchronizing, and the BestChainHeight and the LastIrreversibleBlockHeight are growing up. After catching up with the height of the initial node, the subsequent steps can be carried out.

```
aelf-command get-chain-status

{
  "ChainId": "AELF",
  "Branches": {
    "fb749177c2f43db8c7d73ea050240b9f870c40584f044b13e7ec146c460b0eff": 2449
  },
  "NotLinkedBlocks": {},
  "LongestChainHeight": 2449,
  "LongestChainHash": "fb749177c2f43db8c7d73ea050240b9f870c40584f044b13e7ec146c460b0eff",
  "GenesisBlockHash": "ea9c0b026bd638ceb38323eb71174814c95333e39c62936a38c4e01a8f18062e",
  "GenesisContractAddress": "pykr77ft9UUKJZLVq15wCH8PinBSjVRQ12sD1Ayq92mKFsJ1i",
  "LastIrreversibleBlockHash":
    ↪ "66638f538038bd56357f3cf205424e7393c5966830ef0d16a75d4a117847e0bc",
  "LastIrreversibleBlockHeight": 2446,
  "BestChainHash": "fb749177c2f43db8c7d73ea050240b9f870c40584f044b13e7ec146c460b0eff",
  "BestChainHeight": 2449
}
```


6.3 Be a candidate node

Full nodes need to call Election contract to become candidate nodes. The nodes need to mortgage 10W ELF to participate in the election, please make sure that the account of the nodes has enough tokens.

To facilitate the quick demonstration, we directly transfer the token from the first initial node account to the full node account:

```
aelf-command send AElf.ContractNames.Token Transfer '{"symbol": "ELF", "to":
→ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC", "amount": "20000000000000"}'
```

By checking the balance of the full node account, we can see that the full node account has enough tokens, 20W ELF:

```
aelf-command call AElf.ContractNames.Token GetBalance '{"symbol": "ELF", "owner":
→ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC"}'
```

Result:

```
{
  "symbol": "ELF",
  "owner": "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC",
  "balance": "20000000000000"
}
```

Full node announces election with admin specified in params:

```
aelf-command send AElf.ContractNames.Election AnnounceElection '{"value":
→ "Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC"}' -a_
→ Q3t34SAEsxAQrSQidTRzDonWNTpSTgH8bqu8pQUGCSWRPdRC
```

By inquiring candidate information, we can see the full node is already candidates:

```
aelf-command call AElf.ContractNames.Election GetCandidateInformation '{"value":
→ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea
→"}'
```

Result:

```
{
  "terms": [],
  "pubkey":
→ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea",
  "producedBlocks": "0",
  "missedTimeSlots": "0",
  "continualAppointmentCount": "0",
  "announcementTransactionId":
→ "8cc8eb5de35e390e4f7964bbdc7edc433498b041647761361903c6165b9f8659",
  "isCurrentCandidate": true
}
```

6.4 User vote election

For the simulated user voting scenario, we create a user account:

```
aelf-command create
```

```
AElf [Info]: Your wallet info is :
```

```
AElf [Info]: Mnemonic           : walnut market museum play grunt chuckle hybrid accuse_
```

```
↪relief misery share meadow
```

```
AElf [Info]: Private Key        :_
```

```
↪919a220fac2d80e674a256f2367ac840845f344269f4dcdd56d37460de17f947
```

```
AElf [Info]: Public Key         :_
```

```
↪04794948de40ffda2a6c884d7e6a99bb8e42b8b96b9ee5cc4545da3a1d5f7725eec93de62ddbfb598ef6f04fe52aa310acc7d
```

```
AElf [Info]: Address           : ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei
```

After the user account is created successfully, we will first trnsfer some tokens to the account for voting.

```
aelf-command send AElf.ContractNames.Token Transfer '{"symbol": "ELF", "to":  
↪"ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei", "amount": "200000000000"}'
```

Confirm the tokens has been received:

```
aelf-command call AElf.ContractNames.Token GetBalance '{"symbol": "ELF", "owner":  
↪"ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei"}'
```

Result:

```
{  
  "symbol": "ELF",  
  "owner": "ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei",  
  "balance": "200000000000"  
}
```

Users vote on candidate nodes through the election contract.

```
aelf-command send AElf.ContractNames.Election Vote '{"candidatePubkey":  
↪"04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea  
↪", "amount": "2000000000", "endTimestamp": {"seconds": 1600271999, "nanos": 999000}}' -a_  
↪ZBBPU7DMVQ72YBQNmaKTDPKaAkHNzzA3naH5B6kE7cBm8g1ei
```

By inquiring the votes of candidates, we can see that the full node has successfully obtained 20 votes.

```
aelf-command call AElf.ContractNames.Election GetCandidateVote '{"value":  
↪"04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea  
↪"}'
```

Result:

```
{  
  "obtainedActiveVotingRecordIds": [  
    "172375e9cee303ce60361aa73d7326920706553e80f4485f97ffefdb904486f1"  
  ],  
  "obtainedWithdrawnVotingRecordIds": [],  
  "obtainedActiveVotingRecords": [],  
  "obtainedWithdrawnVotesRecords": [],  
  "obtainedActiveVotedVotesAmount": "20000000000",  
}
```

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```

    "allObtainedVotedVotesAmount": "2000000000",
    "pubkey":
    ↪ "B07QDrAJzNKDeY44Yngc69Je1qRkHg4bfQ47a1kCUEBnn8TcDtyd4Wa9YwxyVRiKmurfyDL9rggoJw93xu8meQU=
    ↪ "
  }

```

6.5 Become production node

At the next election, the candidate nodes with votes in the first 17 are automatically elected as production nodes, and the current production node list can be viewed through consensus contracts.

Quantity 17 is the default maximum production node quantity, which can be modified by proposal. Please refer to the Consensus and Proposal Contract API for details.

```

aelf-command call AElf.ContractNames.Consensus GetCurrentMinerPubkeyList '{}'

Result:
{
  "pubkeys": [
    ↪ "0499d3bb14337961c4d338b9729f46b20de8a49ed38e260a5c19a18da569462b44b820e206df8e848185dac6c139f05392c2
    ↪ ",
    ↪ "048397dfd9e1035fdd7260329d9492d88824f42917c156aef93fd7c2e3ab73b636f482b8ceb5cb435c556bfa067445a86e6f
    ↪ ",
    ↪ "041cc962a51e7bbdd829a8855eca8a03fda708fdf31969251321cb31edadd564bf3c6e7ab31b4c1f49f0f206be81dbe68a75
    ↪ ",
    ↪ "04eed00eb009ccd283798e3862781cebd25ed6a4641e0e1b7d0e3b6b59025040679fc4dc0edc9de166bd630c7255188a9aea
    ↪ "
  ]
}

```

6.6 Add more production nodes

Repeat steps 2-4 to add more production nodes. When the number of initial nodes plus the number of candidate nodes exceeds the maximum number of production node, the replacement will replace the initial nodes step by step, and the replaced initial nodes are not allowed to run for election again. At this time, the initial node has completed its responsibility of starting AElf Blockchain.

HOW TO JOIN THE TESTNET

There's two ways to run a AElf node: you can either use Docker (recommended method) or run the binaries available on Github. Before you jump into the guides and tutorials you'll need to install the following tools and frameworks. For most of these dependencies we provide ready-to-use command line instructions. In case of problems or if you have more complex needs, we provide more information in the *Environment setup* section.

Summary of the steps to set up a node:

1. Execute the snapshot download script and load the snapshot into the database.
2. Download our template setting files and docker run script.
3. Modify the appsettings according to your needs.
4. Run and check the node.

Minimum Configuration:

- c5.large instance with 2 vCPU, 4GiB RAM, 800GiB hard drive, and 5 Mbps bandwidth
- N2 instance with 2 vCPU, 4GiB RAM, 800GiB hard drive, and 5 Mbps bandwidth

Recommended Configuration:

- c5.xlarge instance with 4 vCPU, 8GiB RAM, 800GiB hard drive, and 100 Mbps bandwidth
- N2 instance with 4 vCPU, 8GiB RAM, 800GiB hard drive, and 100 Mbps bandwidth

Please note: If you are running Testnet node for the purpose of testing or DApp deployment in the test environment, aelf recommends running SideChain node only. If you want to run multiple nodes on both MainChain and SideChain, it's suggested to use the same configuration for all your nodes.

Note: any server you use to run a node should be time synced via NTP. Failing to do this will prevent your node from syncing.

7.1 Setup the database

We currently support two key-value databases to store our nodes data: Redis and SSDB, but for the testnet we only provide snapshots for SSDB. We will configure two SSDB instances, one for chain database and one for the state database (run these on different machines for better performances).

7.1.1 Import the snapshot data

After you've finished setting up the database, download the latest snapshots. The following gives you the template for the download URL, but you have to specify the snapshot date. We recommend you get the latest.

Restore the chain database from snapshot:

```
>> mkdir snapshot
>> cd snapshot

## fetch the snapshot download script
>> curl -O -s https://aelf-node.s3-ap-southeast-1.amazonaws.com/snapshot/testnet/
↳download-mainchain-db.sh

## execute the script, you can optionally specify a date by appending "yyyymmdd" as
↳parameter
>> sh download-mainchain-db.sh

## chain database: decompress and load the chain database snapshot
>> tar xvzf aelf-testnet-mainchain-chaindb-*.tar.gz
>> stop your chain database instance (ssdb server)
>> cp -r aelf-testnet-mainchain-chaindb-*/ /path/to/install/chaindb/ssdb/var/
>> start your chain database instance
>> enter ssdb console (ssdb-cli) use the "info" command to confirm that the data has
↳been imported)

## state database : decompress and load the state database
>> tar xvzf aelf-testnet-mainchain-statedb-*.tar.gz
>> stop your state database instance (ssdb server)
>> cp -r aelf-testnet-mainchain-statedb-*/ /path/to/install/statedb/ssdb/var/
>> start your state database instance
>> enter ssdb console (ssdb-cli) use the "info" command to confirm that the data has
↳been imported)
```

7.2 Node configuration

7.2.1 Generating the nodes account

This section explains how to generate an account for the node. First you need to install the aelf-command npm package. Open a terminal and enter the following command to install aelf-command:

```
>> npm i -g aelf-command
```

After installing the package, you can use the following command to create an account/key-pair:

```
>> aelf-command create
```

The command prompts for a password, enter it and don't forget it. The output of the command should look something like this:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : term jar tourist monitor melody tourist catch sad
```

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```

↪ankle disagree great adult
AElf [Info]: Private Key           : ↪
↪34192c729751bd6ac0a5f18926d74255112464b471aec499064d5d1e5b8ff3ce
AElf [Info]: Public Key           : ↪
↪04904e51a944ab13b031cb4fead8caa6c027b09661dc5550ee258ef5c5e78d949b1082636dc8e27f20bc427b25b99a1cadac4
AElf [Info]: Address              : 29KM437eJRRuTfvhsB8QAsyVvi8mmyN9Wqqame6TsJhrqXbeWd
? Save account info into a file? Yes
? Enter a password: *****
? Confirm password: *****
✓ Account info has been saved to "/usr/local/share/aelf/keys/
↪29KM437eJRRuTfvhsB8QAsyVvi8mmyN9Wqqame6TsJhrqXbeWd.json"

```

In the next steps of the tutorial you will need the Public Key and the Address for the account you just created. You'll notice the last line of the commands output will show you the path to the newly created key. The aelf directory is the data directory (datadir) and this is where the node will read the keys from.

Note that a more detailed section about the cli can be found [command line interface](#).

7.2.2 Prepare node configuration

```

## download the settings template and docker script
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.0.0-rc1/
↪aelf-testnet-mainchain.zip
>> unzip aelf-testnet-mainchain.zip
>> mv aelf-testnet-mainchain /opt/aelf-node

```

Update the appsetting.json file with your account. This will require the information printed during the creation of the account. Open the appsettings.json file and edit the following sections.

The account/key-pair associated with the node we are going to run:

```

{
  "Account": {
    "NodeAccount": "2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H",
    "NodeAccountPassword": "*****"
  }
}

```

You also have to configure the database connection strings (port/db number):

```

{
  "ConnectionStrings": {
    "BlockchainDb": "redis://your chain database server ip address:port",
    "StateDb": "redis://your state database server ip address:port"
  },
}

```

If you use docker to run the node and it is on the same server as the database, please do not use 127.0.0.1 as the database monitoring ip.

Next add the testnet mainchain nodes as peer (bootnode peers):

```
{
  "Network": {
    "BootNodes": [
      "xxx.xxx.xxx:6800",
      "..."
    ],
    "ListeningPort": 6800
  }
}
```

Note: if both side nodeVersion>=1.4.0, nodes will connect to each other by grpc stream and will transfer data via grpc stream.

Note: if your infrastructure is behind a firewall you need to open the P2P listening port of the node. You also need to configure your listening ip and port for the side chain connections in `appsettings.MainChain.TestNet.json`:

```
{
  "CrossChain": {
    "Grpc": {
      "LocalServerPort": 5000,
    }
  },
}
```

7.3 Running a full node with Docker

To run the node with Docker, enter the following commands:

```
## pull AElf's image and navigate to the template folder to execute the start script
>> docker pull aelf/node:testnet-v1.6.0
>> cd /opt/aelf-node
>> sh aelf-node.sh start aelf/node:testnet-v1.6.0
```

to stop the node you can run:

```
>> sh aelf-node.sh stop
```

7.4 Running a full node with the binary release

Most of AElf is developed with dotnet core, so to run the binaries you will need to download and install the .NET Core SDK before you start: [Download .NET Core 6.0](#). For now AElf depends on version 6.0 of the SDK, on the provided link find the download for your platform, and install it.

Get the latest release with the following commands:

```
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.0.0-rc1/
↪ aelf.zip
>> unzip aelf.zip
>> mv aelf /opt/aelf-node/
```

Enter the configuration folder and run the node:


```
>> cd /opt/aelf-node
>> dotnet aelf/AElf.Launcher.dll
```

7.5 Running a full node with the source

The most convenient way is to directly use docker or the binary packages, but if you want you can compile from source code. First make sure the code version is consistent (current is release AELF v1.0.0), and secondly make sure to compile on a Ubuntu Linux machine (we recommend Ubuntu 18.04.2 LTS) and have dotnet core SDK version 6.0 installed. This is because different platforms or compilers will cause the dll hashes to be inconsistent with the current chain.

7.6 Check the node

You now should have a node that's running, to check this run the following command that will query the node for its current block height:

```
aelf-command get-blk-height -e http://your node ip address:port
```

7.7 Run side-chains

This section explains how to set up a side-chain node, you will have to repeat these steps for all side chains (currently only one is running):

1. Fetch the appsettings and the docker run script.
2. Download and restore the snapshot data with the URLs provided below (steps are the same as in A - Setup the database).
3. Run the side-chain node.

Running a side chain is very much like running a mainchain node, only configuration will change. Here you can find the instructions for sidechain1:

```
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.0.0-rc1/
↪ aelf-testnet-sidechain1.zip
>> unzip aelf-testnet-sidechain1.zip
>> mv aelf-testnet-sidechain1 /opt/aelf-node
```

In order for a sidechain to connect to a mainchain node you need to modify the `appsettings.SideChain.TestNet.json` with your node information.

```
{
  "CrossChain": {
    "Grpc": {
      "ParentChainServerPort": 5000,
      "ParentChainServerIp": "your mainchain ip address",
      "ListeningPort": 5001,
    },
    "ParentChainId": "AELF"
  }
}
```

Here you can find the snapshot data for the only current side-chain running, optionally you can specify the date, but we recommend you get the latest:

```
>> curl -O -s https://aelf-node.s3-ap-southeast-1.amazonaws.com/snapshot/testnet/  
↪download-sidechain1-db.sh
```

Here you can find the list of templates folders (appsettings and docker run script) for the side-chain:

```
wget https://github.com/AElfProject/AElf/releases/download/v1.0.0-rc1/aelf-testnet-  
↪sidechain1.zip
```

Each side chain has its own P2P network, add the testnet sidechain nodes as peer:

```
bootnode → ["xxx.xxxx.xxx.xxx:6800", "..."]
```

```
{  
  "Network": {  
    "BootNodes": [  
      "Add the right boot node according sidechain"  
    ],  
    "ListeningPort": 6800  
  }  
}
```

HOW TO JOIN THE MAINNET

There's two ways to run a AElf node: you can either use Docker (recommended method) or run the binaries available on Github. Before you jump into the guides and tutorials you'll need to install the following tools and frameworks. For most of these dependencies we provide ready-to-use command line instructions. In case of problems or if you have more complex needs, we provide more information in the *Environment setup* section.

Summary of the steps to set up a node:

1. Execute the snapshot download script and load the snapshot into the database.
2. Download our template setting files and docker run script.
3. Modify the appsettings according to your needs.
4. Run and check the node.

The configuration requirements for BP and a full node are as follows:

Minimum Configuration:

- c5.xlarge instance with 4 vCPU, 8GiB RAM, 1TB hard drive, and 5 Mbps bandwidth
- N2 instance with 4 vCPU, 8GiB RAM, 1TB hard drive, and 5 Mbps bandwidth

Recommended Configuration:

- c5.2xlarge instance with 8 vCPU, 16GiB RAM, 1TB hard drive, and 100 Mbps bandwidth
- N2 instance with 8 vCPU, 16GiB RAM, 1TB hard drive, and 100 Mbps bandwidth

Please note:

- If you want to run a full node that doesn't participate in block production and governance, there is no requirement on how many nodes you should run.
- If you want to become a BP, however, you need to run individual nodes for both MainChain AELF and all the SideChains.

Note: any server you use to run a node should be time synced via NTP. Failing to do this will prevent your node from syncing.

8.1 Setup the database

We currently support two key-value databases to store our nodes data: Redis and SSDB, but for the mainnet we only provide snapshots for SSDB. We will configure two SSDB instances, one for chain database and one for the state database (run these on different machines for better performances).

8.1.1 Import the snapshot data

After you've finished setting up the database, download the latest snapshots. The following gives you the template for the download URL, but you have to specify the snapshot date. We recommend you get the latest.

Restore the chain database from snapshot:

```
>> mkdir snapshot
>> cd snapshot

## fetch the snapshot download script
>> curl -O -s https://aelf-backup.s3.ap-northeast-2.amazonaws.com/snapshot/mainnet/
↳download-mainchain-db.sh

## execute the script, you can optionally specify a date by appending "yyyymmdd" as
↳parameter
>> sh download-mainchain-db.sh

## chain database: decompress and load the chain database snapshot
>> tar xvfz aelf-mainnet-mainchain-chaindb-*.tar.gz
>> stop your chain database instance (ssdb server)
>> cp -r aelf-mainnet-mainchain-chaindb-*/ /path/to/install/chaindb/ssdb/var/
>> start your chain database instance
>> enter ssdb console (ssdb-cli) use the "info" command to confirm that the data has
↳been imported)

## state database : decompress and load the state database
>> tar xvfz aelf-mainnet-mainchain-statedb-*.tar.gz
>> stop your state database instance (ssdb server)
>> cp -r aelf-mainnet-mainchain-statedb-*/ /path/to/install/statedb/ssdb/var/
>> start your state database instance
>> enter ssdb console (ssdb-cli) use the "info" command to confirm that the data has
↳been imported)
```

8.2 Node configuration

8.2.1 Generating the nodes account

This section explains how to generate an account for the node. First you need to install the aelf-command npm package. Open a terminal and enter the following command to install aelf-command:

```
>> npm i -g aelf-command
```

After installing the package, you can use the following command to create an account/key-pair:

```
>> aelf-command create
```

The command prompts for a password, enter it and don't forget it. The output of the command should look something like this:

```
AElf [Info]: Your wallet info is :
AElf [Info]: Mnemonic           : term jar tourist monitor melody tourist catch sad_
↪ankle disagree great adult
AElf [Info]: Private Key        :_
↪34192c729751bd6ac0a5f18926d74255112464b471aec499064d5d1e5b8ff3ce
AElf [Info]: Public Key         :_
↪04904e51a944ab13b031cb4fead8caa6c027b09661dc5550ee258ef5c5e78d949b1082636dc8e27f20bc427b25b99a1cadac4
AElf [Info]: Address            : 29KM437eJRRuTfvhsB8QAsyVvi8mmyN9Wqqame6TsJhrqXbeWd
? Save account info into a file? Yes
? Enter a password: *****
? Confirm password: *****
✓ Account info has been saved to "/usr/local/share/aelf/keys/
↪29KM437eJRRuTfvhsB8QAsyVvi8mmyN9Wqqame6TsJhrqXbeWd.json"
```

In the next steps of the tutorial you will need the Public Key and the Address for the account you just created. You'll notice the last line of the commands output will show you the path to the newly created key. The aelf directory is the data directory (datadir) and this is where the node will read the keys from.

Note that a more detailed section about the cli can be found [command line interface](#).

8.2.2 Prepare node configuration

```
## download the settings template and docker script
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.6.0/aelf-
↪mainnet-mainchain.zip
>> unzip aelf-mainnet-mainchain.zip
>> mv aelf-mainnet-mainchain /opt/aelf-node
```

Update the appsetting.json file with your account. This will require the information printed during the creation of the account. Open the appsettings.json file and edit the following sections.

The account/key-pair associated with the node we are going to run:

```
{
  "Account": {
    "NodeAccount": "2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H",
    "NodeAccountPassword": "*****"
  }
}
```

You also have to configure the database connection strings (port/db number):

```
{
  "ConnectionStrings": {
    "BlockchainDb": "redis://your chain database server ip address:port",
    "StateDb": "redis://your state database server ip address:port"
  },
}
```

If you use docker to run the node and it is on the same server as the database, please do not use 127.0.0.1 as the database monitoring ip.

Next add the mainnet mainchain nodes as peer (bootnode peers):

```
{
  "Network": {
    "BootNodes": [
      "xxx.xxx.xxx.xxx:6800",
      "...",
    ],
    "ListeningPort": 6800
  }
}
```

Note: if both side nodeVersion>=1.4.0, nodes will connect to each other by grpc stream and will transfer data via grpc stream.

Note: if your infrastructure is behind a firewall you need to open the P2P listening port of the node. You also need to configure your listening ip and port for the side chain connections in `appsettings.MainChain.MainNet.json`:

```
{
  "CrossChain": {
    "Grpc": {
      "LocalServerPort": 5000,
    }
  },
}
```

8.3 Running a full node with Docker

To run the node with Docker, enter the following commands:

```
## pull AElf's image and navigate to the template folder to execute the start script
>> docker pull aelf/node:mainnet-v1.6.0
>> cd /opt/aelf-node
>> sh aelf-node.sh start aelf/node:mainnet-v1.6.0
```

to stop the node you can run:

```
>> sh aelf-node.sh stop
```

8.4 Running a full node with the binary release

Most of AElf is developed with dotnet core, so to run the binaries you will need to download and install the .NET Core SDK before you start: [Download .NET Core 6.0](#). For now AElf depends on version 6.0 of the SDK, on the provided link find the download for your platform, and install it.

Get the latest release with the following commands:

```
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.6.0/aelf.zip
>> unzip aelf.zip
>> mv aelf /opt/aelf-node/
```

Enter the configuration folder and run the node:

```
>> cd /opt/aelf-node
>> dotnet aelf/AElf.Launcher.dll
```

8.5 Running a full node with the source

The most convenient way is to directly use docker or the binary packages, but if you want you can compile from source code. First make sure the code version is consistent (current is release AELF v1.6.0), and secondly make sure to compile on a Ubuntu Linux machine (we recommend Ubuntu 18.04.2 LTS) and have dotnet core SDK version 6.0 installed. This is because different platforms or compilers will cause the dll hashes to be inconsistent with the current chain.

8.6 Check the node

You now should have a node that's running, to check this run the following command that will query the node for its current block height:

```
aelf-command get-blk-height -e http://your node ip address:port
```

8.7 Run side-chains

This section explains how to set up a side-chain node, you will have to repeat these steps for all side chains (currently only one is running):

1. Fetch the appsettings and the docker run script.
2. Download and restore the snapshot data with the URLs provided below (steps are the same as in Setup the database).
3. Run the side-chain node.

Running a side chain is very much like running a mainchain node, only configuration will change. Here you can find the instructions for sidechain1:

```
>> cd /tmp/ && wget https://github.com/AElfProject/AElf/releases/download/v1.6.0/aelf-
  ↪mainnet-sidechain1.zip
>> unzip aelf-mainnet-sidechain1.zip
>> mv aelf-mainnet-sidechain1 /opt/aelf-node
```

In order for a sidechain to connect to a mainchain node you need to modify the `appsettings.SideChain.MainNet.json` with your node information.

```
{
  "CrossChain": {
    "Grpc": {
```

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```

        "ParentChainServerPort": 5001,
        "ParentChainServerIp": "your mainchain ip address",
        "ListeningPort": 5011,
    },
    "ParentChainId": "AELF",
    "Economic": {
        "SymbolListToPayTxFee": "WRITE,READ,STORAGE,TRAFFIC",
        "SymbolListToPayRental": "CPU,RAM,DISK,NET"
    }
}
}

```

Here you can find the snapshot data for the only current side-chain running, optionally you can specify the date, but we recommend you get the latest:

```
>> curl -O -s https://aelf-backup.s3.ap-northeast-2.amazonaws.com/snapshot/mainnet/
↪download-sidechain-db.sh
```

Here you can find the list of templates folders (appsettings and docker run script) for the side-chain:

```
wget https://github.com/AElfProject/AElf/releases/download/v1.6.0/aelf-mainnet-
↪sidechain1.zip
```

Each side chain has its own P2P network, add the mainnet sidechain nodes as peer:

```
bootnode → ["xxx.xxxx.xxx.xxx:6800", "..."]
```

```

{
  "Network": {
    "BootNodes": [
      "Add the right boot node according sidechain"
    ],
    "ListeningPort": 6800
  }
}

```


RUNNING A SIDE CHAIN

9.1 Requesting the creation of a side chain

Side chains can be created in the AELF ecosystem to enable scalability. This part is going to introduce these periods in detail.

9.1.1 Side chain creation api

Anyone can request the side chain creation in the AELF ecosystem. The proposer/creator of a new side chain will need to request the creation of the side chain through the cross-chain contract on the main-chain. The request contains different fields that will determine the type of side chain that will be created.

This section show the API to use in order to propose the creation of a side chain. The fields that are in the `SideChainCreationRequest` will determine the type of side chain that is created. For more api details, you can follow the `RequestSideChainCreation` in *Crosschain contract*.

A new proposal about the side chain creation would be created and the event `ProposalCreated` containing proposal id would be fired. A parliament organization which is specified since the chain launched is going to approve this proposal in 24 hours(refer to *Parliament contract* for detail). Proposer is able to release the side chain creation request with proposal id once the proposal can be released. Refer `ReleaseSideChainCreation` in *Crosschain contract*.

New side chain would be created and the event `SideChainCreatedEvent` containing chain id would be fired.

Side chain node can be launched since it is already created on main chain. Side chain id from the creation result should be configured correctly before launching the side chain node. Please make sure cross chain communication context is correctly set, because side chain node is going to request main chain node for chain initialization data. For more details, check *side chain node running* tutorial.

9.1.2 Side chain types

Two types of side-chain's currently exist: **exclusive** or **shared**. An **exclusive** side-chain is a type of dedicated side-chain (as opposed to shared) that allows developers to choose the transaction fee model and set the transaction fee price. The creator has exclusive use of this side-chain. For example, only creator of this **exclusive** side-chain can propose to deploy a new contract.

9.1.3 Pay for Side chain

Indexing fee

Indexing fee, literally, is paid for the side chain indexing. You can specify the indexing fee price and prepayments amount when you request side chain creation. *Cross chain contract* is going to charge your prepayments once the side chain created and pay the miner who indexes the side chain block every time.

Resource fee

Developers of an exclusive side-chain pay the producers for running it by paying CPU, RAM, DISK, NET resource tokens: this model is called *charge-by-time*. The amount side chain creator must share with the producers is set after creation of the chain. The **exclusive** side-chain is priced according to the time used. The unit price of the fee is determined through negotiation between the production node and the developer.

See [Economic whitepaper - 4.3 Sidechain Developer Charging Model](#) for more information.

9.1.4 Simple demo for side chain creation request

When a user (usually a developer) feels the need to create a new side chain on AElf he must call the cross-chain contract and request a side chain creation. After requested, parliament organization members will either approve this creation or reject it. If the request is approved, the developer must then release the proposal.

Throughout this tutorial we'll give step-by-step code snippets that use the [aelf-js-sdk](#) to create a new side chain, the full script will be given at the end of the tutorial.

This creation of a side chain (logical, on-chain creation) is done in four steps:

- the developer must *allow/approve* some tokens to the cross-chain contract of the main chain.
- the developer calls the cross-chain contract of the main chain, to *request* the creation.
- the parliament organization members must *approve* this request.
- finally the developer must *release* the request to finalize the creation.

Keep in mind that this is just the logical on-chain creation of the side chain. After the side chain is released there's extra steps needed for it to be a fully functional blockchain, including the producers running the side chain's nodes.

Set-up

If you want to test the creation process you will need a producer node running and the following:

- you need a key-pair (account) created, this will be your Producer (in this tutorial we also use the producer to create the creation request).
- the node needs to be configured with an API endpoint, account and miner list that correspond to what is in the script.

The following snippet shows constants and initialization code used in the script:

```
const AElf = require('aelf-sdk');
const Wallet = AElf.wallet;

const { sha256 } = AElf.utils;
```

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```

// set the private key of the block producer.
// REPLACE
const defaultPrivateKey =
  ↪ 'e119487fea0658badc42f089fbaa56de23d8c0e8d999c5f76ac12ad8ae897d76';
const defaultPrivateKeyAddress = 'HEtBQStfqu53cHVC3PxJU6iGP3RGxiNUfQGvAPTjfrF3ZWH3U';

// load the wallet associated with your block producers account.
const wallet = Wallet.getWalletByPrivateKey(defaultPrivateKey);

// API link to the node
// REPLACE
const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:1234'));

// names of the contracts that will be used.
const tokenContractName = 'AElf.ContractNames.Token';
const parliamentContractName = 'AElf.ContractNames.Parliament';
const crossChainContractName = 'AElf.ContractNames.CrossChain';

...

const createSideChain = async () => {
  // check the chain status to make sure the node is running
  const chainStatus = await aelf.chain.getChainStatus({sync: true});
  const genesisContract = await aelf.chain.contractAt(chainStatus.
  ↪ GenesisContractAddress, wallet)
    .catch((err) => {
      console.log(err);
    });

  // get the addresses of the contracts that we'll need to call
  const tokenContractAddress = await genesisContract.GetContractAddressByName.
  ↪ call(sha256(tokenContractName));
  const parliamentContractAddress = await genesisContract.GetContractAddressByName.
  ↪ call(sha256(parliamentContractName));
  const crossChainContractAddress = await genesisContract.GetContractAddressByName.
  ↪ call(sha256(crossChainContractName));

  // build the aelf-sdk contract instance objects
  const parliamentContract = await aelf.chain.contractAt(parliamentContractAddress, ↪
  ↪ wallet);
  const tokenContract = await aelf.chain.contractAt(tokenContractAddress, wallet);
  const crossChainContract = await aelf.chain.contractAt(crossChainContractAddress, ↪
  ↪ wallet);

  ...
}

```

When running the script, the **createSideChain** will be executed and automatically will run through the full process of creating the side chain.

Creation of the side chain

Set the Allowance.

First the developer must approve some ELF tokens for use by the cross-chain contract.

```
var setAllowance = async function(tokenContract, crossChainContractAddress)
{
    // set some allowance to the cross-chain contract
    const approvalResult = await tokenContract.Approve({
        symbol: 'ELF',
        spender: crossChainContractAddress,
        amount: 20000
    });

    let approveTransactionResult = await pollMining(approvalResult.TransactionId);
}
```

Creation request

In order to request a side chain creation the developer must call **RequestSideChainCreation** on the cross-chain contract, this will create a proposal with the **Parliament** contract. After calling this method, a **ProposalCreated** log will be created in which the **ProposalId** be found. This ID will enable the producers to approve it.

```
rpc RequestSideChainCreation(SideChainCreationRequest) returns (google.protobuf.Empty){}

message SideChainCreationRequest {
    // The cross chain indexing price.
    int64 indexing_price = 1;
    // Initial locked balance for a new side chain.
    int64 locked_token_amount = 2;
    // Creator privilege boolean flag: True if chain creator privilege preserved,
    // otherwise false.
    bool is_privilege_preserved = 3;
    // Side chain token information.
    SideChainTokenCreationRequest side_chain_token_creation_request = 4;
    // A list of accounts and amounts that will be issued when the chain starts.
    repeated SideChainTokenInitialIssue side_chain_token_initial_issue_list = 5;
    // The initial rent resources.
    map<string, int32> initial_resource_amount = 6;
}

message SideChainTokenCreationRequest{
    // Token symbol of the side chain to be created
    string side_chain_token_symbol = 1;
    // Token name of the side chain to be created
    string side_chain_token_name = 2;
    // Token total supply of the side chain to be created
    int64 side_chain_token_total_supply = 3;
    // Token decimals of the side chain to be created
    int32 side_chain_token_decimals = 4;
}
```

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```

message SideChainTokenInitialIssue{
    // The account that will be issued.
    aelf.Address address = 1;
    // The amount that will be issued.
    int64 amount = 2;
}

```

In order for the creation request to succeed, some assertions must pass:

- the Sender can only have one pending request at any time.
- the locked_token_amount cannot be lower than the indexing price.
- if **is_privilege_preserved** is true, which means it requests **exclusive** side chain, the token initial issue list cannot be empty and all with an **amount** greater than 0.
- if **is_privilege_preserved** is true, which means it requests **exclusive** side chain, the **initial_resource_amount** must contain all resource tokens of the chain and the value must be greater than 0.
- the allowance approved to cross chain contract from the proposer (Sender of the transaction) cannot be lower than the **locked_token_amount**.
- no need to provide data about side chain token if **is_privilege_preserved** is false, and side chain token won't be created even you provide token info.

```

const sideChainCreationRequestTx = await crossChainContract.RequestSideChainCreation({
    indexingPrice: 1,
    lockedTokenAmount: '20000',
    isPrivilegePreserved: true,
    sideChainTokenCreationRequest: {
        sideChainTokenDecimals: 8,
        sideChainTokenName: 'SCATokenName',
        sideChainTokenSymbol: 'SCA',
        sideChainTokenTotalSupply: '1000000000000000000',
    },
    sideChainTokenInitialIssueList: [
        {
            address: '28Y8JA1i2cN6oHvdv7EraXJr9a1gY6D1PpJXw9QtRMRwKcBQMK',
            amount: '1000000000000000000'
        }
    ],
    initialResourceAmount: { CPU: 2, RAM: 4, DISK: 512, NET: 1024 },
});

let sideChainCreationRequestTxResult = await pollMining(sideChainCreationRequestTx.
↳TransactionId);

// deserialize the log to get the proposal's ID.
let deserializedLogs = parliamentContract.
↳deserializeLog(sideChainCreationRequestTxResult.Logs, 'ProposalCreated');

```

The last line will print the proposal ID and this is what will be used for approving by the producers.

Approval from producers

This is where the parliament organization members approve the proposal:

```
var proposalApproveTx = await parliamentContract.Approve(deserializedLogs[0].proposalId);
await pollMining(proposalApproveTx.TransactionId);
```

Note: when calling **Approve** it will be the *Sender* of the transaction that approves. Here the script is set to use the key of one parliament organization member, see full script at the end.

Release

This part of the script releases the proposal:

```
var releaseResult = await crossChainContract.ReleaseSideChainCreation({
  proposalId: deserializedLogs[0].proposalId
});

let releaseTxResult = await pollMining(releaseResult.TransactionId);

// Parse the logs to get the chain id.
let sideChainCreationEvent = crossChainContract.deserializeLog(releaseTxResult.Logs,
  ↪ 'SideChainCreatedEvent');
```

This is the last step involved in creating a side chain, after this the chain id of the new side chain is accessible in the **SideChainCreatedEvent** event log.

Full script

This section presents the full script. Remember that in order to run successfully, a node must be running, configured with one producer. The configured producer must match the **defaultPrivateKey** and **defaultPrivateKeyAddress** of the script.

Also, notice that this script by default tries to connect to the node's API at the following address <http://127.0.0.1:1234>, if your node is listening on a different address you have to modify the address.

If you haven't already installed it, you need the aelf-sdk:

```
npm install aelf-sdk
```

You can simply run the script from anywhere:

```
node sideChainProposal.js
```

sideChainProposal.js:

```
const AElf = require('aelf-sdk');
const Wallet = AElf.wallet;

const { sha256 } = AElf.utils;

// set the private key of the block producer
const defaultPrivateKey =
```

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```

→ 'e119487fea0658badc42f089fbaa56de23d8c0e8d999c5f76ac12ad8ae897d76';
const defaultPrivateKeyAddress = 'HEtBQStfqu53cHVC3PxJU6iGP3RGxiNUfQGvAPTjfrF3ZWH3U';

const wallet = Wallet.getWalletByPrivateKey(defaultPrivateKey);

// link to the node
const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:8000'));

if (!aelf.isConnected()) {
    console.log('Could not connect to the node.');
```

```

}

const tokenContractName = 'AElf.ContractNames.Token';
const parliamentContractName = 'AElf.ContractNames.Parliament';
const crossChainContractName = 'AElf.ContractNames.CrossChain';
```

```

var pollMining = async function(transactionId) {
    console.log(`>>> Waiting for ${transactionId} the transaction to be mined.`);

    for (i = 0; i < 10; i++) {
        const currentResult = await aelf.chain.getTxResult(transactionId);
        // console.log('transaction status: ' + currentResult.Status);

        if (currentResult.Status === 'MINED')
            return currentResult;

        await new Promise(resolve => setTimeout(resolve, 2000))
            .catch(function () {
                console.log("Promise Rejected");
            });
    }
}
```

```

var setAllowance = async function(tokenContract, crossChainContractAddress)
{
    console.log(`\n>>>> Setting allowance for the cross-chain contract.`);

    // set some allowance to the cross-chain contract
    const approvalResult = await tokenContract.Approve({
        symbol: 'ELF',
        spender: crossChainContractAddress,
        amount: 20000
    });

    await pollMining(approvalResult.TransactionId);
}
```

```

var checkAllowance = async function(tokenContract, owner, spender)
{
    console.log(`\n>>>> Checking the cross-chain contract's allowance`);

    const checkAllowanceTx = await tokenContract.GetAllowance.call({
```

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```

        symbol: 'ELF',
        owner: owner,
        spender: spender
    });

    console.log(`>> allowance to the cross-chain contract: ${checkAllowanceTx.allowance}
↳ ${checkAllowanceTx.symbol}`);
}

const createSideChain = async () => {

    // get the status of the chain in order to get the genesis contract address
    console.log('Starting side chain creation script\n');

    const chainStatus = await aelf.chain.getChainStatus({sync: true});
    const genesisContract = await aelf.chain.contractAt(chainStatus.
↳ GenesisContractAddress, wallet)
        .catch((err) => {
            console.log(err);
        });

    // get the addresses of the contracts that we'll need to call
    const tokenContractAddress = await genesisContract.GetContractAddressByName.
↳ call(sha256(tokenContractName));
    const parliamentContractAddress = await genesisContract.GetContractAddressByName.
↳ call(sha256(parliamentContractName));
    const crossChainContractAddress = await genesisContract.GetContractAddressByName.
↳ call(sha256(crossChainContractName));

    // build the aelf-sdk contract object
    const parliamentContract = await aelf.chain.contractAt(parliamentContractAddress,
↳ wallet);
    const tokenContract = await aelf.chain.contractAt(tokenContractAddress, wallet);
    const crossChainContract = await aelf.chain.contractAt(crossChainContractAddress,
↳ wallet);

    // 1. set and check the allowance, spender is the cross-chain contract
    await setAllowance(tokenContract, crossChainContractAddress);
    await checkAllowance(tokenContract, defaultPrivateKeyAddress,
↳ crossChainContractAddress);

    // 2. request the creation of the side chain with the cross=chain contract
    console.log(`\n>>> Requesting the side chain creation.`);
    const sideChainCreationRequestTx = await crossChainContract.RequestSideChainCreation(
↳ {
        indexingPrice: 1,
        lockedTokenAmount: '20000',
        isPrivilegePreserved: true,
        sideChainTokenCreationRequest: {
            sideChainTokenDecimals: 8,
            sideChainTokenName: 'SCATokenName',

```

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```

        sideChainTokenSymbol: 'SCA',
        sideChainTokenTotalSupply: '1000000000000000000',
    },
    sideChainTokenInitialIssueList: [
        {
            address: '28Y8JA1i2cN6oHvdv7EraXJr9a1gY6D1PpJXw9QtRMRwKcBQMK',
            amount: '10000000000000000'
        }
    ],
    initialResourceAmount: { CPU: 2, RAM: 4, DISK: 512, NET: 1024 },
});

let sideChainCreationRequestTxResult = await pollMining(sideChainCreationRequestTx.
↳ TransactionId);

// deserialize the log to get the proposal's ID.
let deserializedLogs = parliamentContract.
↳ deserializeLog(sideChainCreationRequestTxResult.Logs, 'ProposalCreated');
    console.log(`>> side chain creation request proposal id ${JSON.
↳ stringify(deserializedLogs[0].proposalId)}`);

// 3. Approve the proposal
console.log(`\n>>>> Approving the proposal.`);

var proposalApproveTx = await parliamentContract.Approve(deserializedLogs[0].
↳ proposalId);
    await pollMining(proposalApproveTx.TransactionId);

// 3. Release the side chain
console.log(`\n>>>> Release the side chain.`);

var releaseResult = await crossChainContract.ReleaseSideChainCreation({
    proposalId: deserializedLogs[0].proposalId
});

let releaseTxResult = await pollMining(releaseResult.TransactionId);

// Parse the logs to get the chain id.
let sideChainCreationEvent = crossChainContract.deserializeLog(releaseTxResult.Logs,
↳ 'SideChainCreatedEvent');
    console.log('Chain chain created : ');
    console.log(sideChainCreationEvent);
};

createSideChain().then(() => {console.log('Done.')});

```

9.2 Running a side chain (after its release)

This tutorial will explain how to run a side chain node after it has been *approved* by the producers and *released* by the creator. After the creation of the side chain, the producers need to run a side chain node.

A side chain node is usually very similar to a main-chain node because both are based on AElf software and have common modules. The main difference is the configuration which varies depending on if the node is a side chain or not.

Note: this tutorial assumes the following:

- you already have a main-chain node running.
- the creation of the side chain has already been approved and released.

It's also **important** to know that the key-pair (account) used for mining on the side chain must be the **same** as the one you use for on the main-chain node. Said in another way both production nodes need to be launched with the **same** key-pair.

Note: for more information about the side chain creation, refer to the document in the [request-side-chain section](#).

9.2.1 Side chain configuration

Two configuration files must be placed in the configuration folder of the side chain, this is also the folder from which you will launch the node:

- appsettings.json
- appsettings.SideChain.MainNet.json

After the *release* of the side chain creation request, the **ChainId** of the new side chain will be accessible in the **SideChainCreatedEvent** logged by the transaction that released.

In this example, we will set up the side chain node with **tDVV** (1866392 converted to base58) as it's chain id, connecting to Redis' **db2**. The web API port is **1235**. Don't forget to change the **account**, **password** and **initial miner**.

If at the time of launching the side chain the P2P addresses of the other peers is known, they should be added to the bootnodes in the configuration of the side chain.

In **appsettings.json** change the following configuration sections:

```
{
  "ChainId": "tDVV",
  "ChainType": "SideChain",
  "NetType": "MainNet",
  "ConnectionStrings": {
    "BlockchainDb": "redis://localhost:6379?db=2",
    "StateDb": "redis://localhost:6379?db=2"
  },
  "Account": {
    "NodeAccount": "YOUR PRODUCER ACCOUNT",
    "NodeAccountPassword": "YOUR PRODUCER PASSWORD"
  },
  "Kestrel": {
    "EndPoints": {
      "Http": {
        "Url": "http://*:1235/"
      }
    }
  }
}
```

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```

    }
  },
  "Consensus": {
    "MiningInterval": 4000,
    "StartTimestamp": 0
  },
}

```

In `appsettings.SideChain.MainNet.json` change the following configuration sections:

```

{
  "CrossChain": {
    "Grpc": {
      "ParentChainServerPort": 5010,
      "ListeningPort": 5000,
      "ParentChainServerIp": "127.0.0.1"
    },
    "ParentChainId": "AELF",
  }
}

```

Change **ParentChainServerIp** and **ParentChainServerPort** depending on the listening address of your mainchain node.

9.2.2 Launch the side chain node

Open a terminal and navigate to the folder where you created the configuration for the side chain.

```
dotnet ../AElf.Launcher.dll
```

You can try out a few commands from another terminal to check if everything is fine, for example:

```
aelf-command get-blk-height -e http://127.0.0.1:1235
```


RUNNING AELF ON THE CLOUD

This section provides resources for AElf on the cloud.

10.1 Getting started with Google cloud

This guide will run you through the steps required to run an AElf node on Google cloud (click the images for a more detailed view).

First go to the [Google Cloud Market Place](#) and search for “aelf blockchain for enterprise”, find the image and select it, this will direct you to the image’s page.

The screenshot shows the Google Cloud Marketplace interface. At the top, there's a blue header with 'Google Cloud Platform', 'AElf Public', a search bar, and various icons. Below the header, the main content area features a large card for 'aelf Blockchain for Enterprise'. The card includes the AElf logo, the text 'aelf Blockchain for Enterprise', 'AELF PTE. LTD', 'Estimated costs: \$50.24/month', and 'Versatile Business Blockchain powered by Cloud Computing'. A prominent blue button labeled 'LAUNCH ON COMPUTE ENGINE' is visible. Below the card, there's a sidebar on the left with details: 'Runs on Google Compute Engine', 'Type Single VM', 'Last updated 10/28/19, 2:52 PM', 'Category Databases Developer stacks', and 'Version'. The main content area below the card has an 'Overview' section describing AElf Enterprise as a one-stop blockchain solution, and an 'About AELF PTE. LTD' section stating that AElf is a versatile business blockchain platform powered by cloud computing.

Click on the “LAUNCH ON COMPUTE ENGINE”. This should bring you to the following deployment page:

Google Cloud Platform

AEIf Public

←

New aelf Blockchain for Enterprise deployment

EXIT PREVIEW

⚠

Your current project may have limited quota. If your deployment fails, change the 'project' query parameter in this page's URL to a project with a higher quota.

Deployment name

aelf-enterprise-1

Zone

us-west1-a

Machine type

2 vCPUs

7.5 GB memory

Customize

Upgrade your account to create instances with up to 96 cores

Boot Disk

Boot disk type

SSD Persistent Disk

Boot disk size in GB

10

Networking

Network interfaces

default default (10.138.0.0/20)

+ Add network interface

You have reached the maximum number of one network interface

More

☐ I accept the [GCP Marketplace Terms of Service](#).

Deploy

aelf

aelf Blockchain for Enterprise overview

Solution provided by AELF PTE. LTD

\$50.24 per month estimated

Effective hourly rate \$0.069 (730 hours per month)

Details

Software

Operating System

Ubuntu (18.04)

Terms of Service

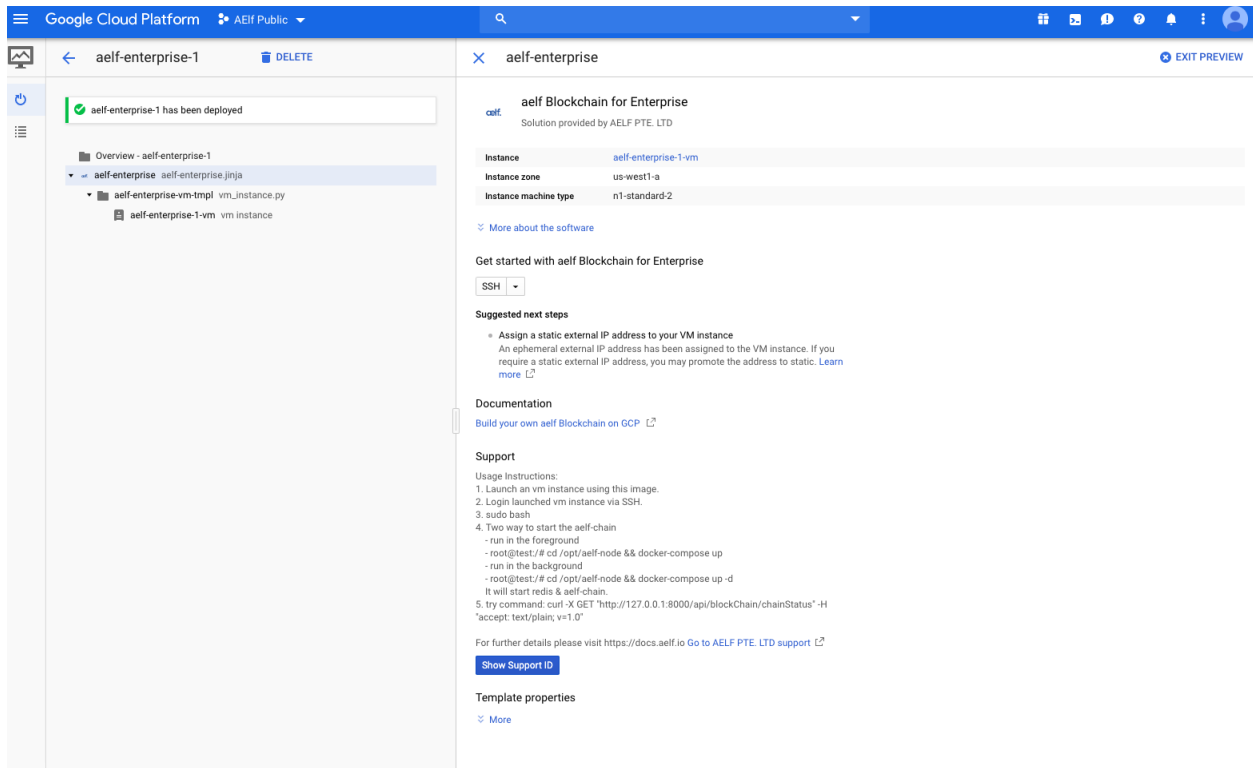
The software or service you are about to use is not a Google product. By deploying the software or accessing the service you are agreeing to comply with the [AELF PTE. LTD terms of service](#), [GCP Marketplace terms of service](#) and the terms of any third party software licenses related to the software or service. Please review these licenses carefully for details about any obligations you may have related to the software or service. To the limited extent an open source software license related to the software or service expressly supersedes the GCP Marketplace Terms of Service, that open source software license governs your use of that software or service.

By using this product, you understand that certain account and usage information may be shared with AELF PTE. LTD for the purposes of sales attribution, performance analysis, and support.

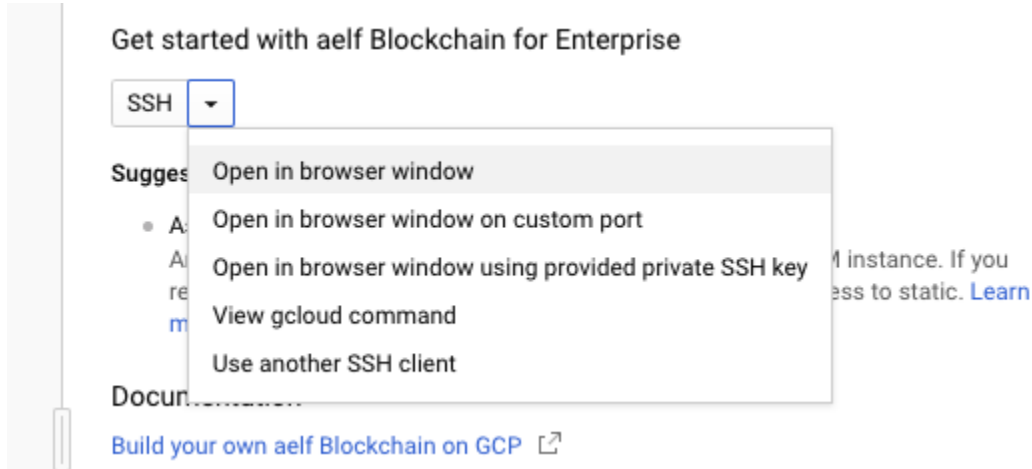
Google is providing this software or service "as-is" and any support for this software or service will be provided by AELF PTE. LTD under their terms of service.

You can keep the default settings, they are sufficient to get started. If you're satisfied with the settings, just click "DEPLOY" (bottom left of the page).

This will bring you to the deployment page (wait a short moment for the instance to load), when finished you should see deployment information about the instance:



Next, login to the launched VM instance via SSH. To start the easiest way is to login to the instance directly from this deployment page. To do this click the SSH drop down and select “Open in browser window”:



After loading the session, you'll get a shell to the deployed instance where you can run the chain itself.

First you'll need to execute `sudo bash` to elevate your privileges. Next, start the chain with one of the following commands (for this tutorial we'll use the second method): - either run it in the foreground: `-bash root@test:/# cd /opt/aelf-node && docker-compose up`

- or run it in the background: `-bash root@test:/# cd /opt/aelf-node && docker-compose up -d`

These commands will start redis and an AElf node (the command prints 'done' when finished).

```
ubuntu@test:/opt/aelf-node$ sudo docker-compose up -d
sudo: unable to resolve host test
Creating aelf-node_redis_1_1c73bb0fe27b ... done
Creating aelf-node_aelf-node_1_b673d69e0560 ... done
```

Finally to verify that the node is correctly working, enter the following command that will send an http request to the node in order to get the current status of the chain:

```
curl -X GET "http://127.0.0.1:8001/api/blockChain/chainStatus" -H "accept: text/plain;v=1.0"
```

```
ubuntu@test:/opt/aelf-node$ curl -X GET "http://127.0.0.1:8001/api/blockChain/chainStatus" -H "accept: text/plain; v=1.0"
{"ChainId": "AELF", "Branches": {"3f41068dea72676a4de567b0098ae1bf5708d63e0d32e2745210b366a6dc0265": 6727, "NotLinkedBlocks": {}}, "LongestChainHeight": 6727, "LongestChainHash": "3f41068dea72676a4de567b0098ae1bf5708d63e0d32e2745210b366a6dc0265", "GenesisBlockHash": "32472fa4f6a04f31f6d1c6303e7d69c496da016900559d4873a0e4c731c9f9bf", "GenesisContractAddress": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8", "LastIrreversibleBlockHash": "f89761efcf8f9f8c369ead32fd97ff9115bc2db5cbfaa600e7bcbc2cefa2ba", "LastIrreversibleBlockHeight": 6703, "BestChainHash": "3f41068dea72676a4de567b0098ae1bf5708d63e0d32e2745210b366a6dc0265", "BestChainHeight": 6727}
```

If everything is working normally you should be able to see the chain increase by repeating the last command.

SMART CONTRACT DEVELOPING DEMOS

11.1 Bingo Game

11.1.1 Requirement Analysis

Basic Requirement

Only one ruleUsers can bet a certain amount of ELF on Bingo contract, and then users will gain more ELF or to lose all ELF bet before in the expected time.

For users, operation steps are as follows:

1. Send an Approve transaction by Token Contract to grant Bingo Contract amount of ELF.
2. Bet by Bingo Contract, and the outcome will be unveiled in the expected time.
3. After a certain time, or after the block height is reached, the user can use the Bingo contract to query the results, and at the same time, the Bingo contract will transfer a certain amount of ELF to the user (If the amount at this time is greater than the bet amount, it means that the user won; vice versa).

11.1.2 API List

In summary, two basic APIs are needed:

1. Play, corresponding to step 2;
2. Bingo, corresponding to step 3.

In order to make the Bingo contract a more complete DApp contract, two additional Action methods are added:

1. Register, which creates a file for users, can save the registration time and user's eigenvalues (these eigenvalues participate in the calculation of the random number used in the Bingo game);
2. Quit, which deletes users' file.

In addition, there are some View methods for querying information only:

1. GetAward, which allows users to query the award information of a bet;
2. GetPlayerInformation, used to query player's information.

| Method | Parameters | Return | function |
|----------------------|---------------------------------------|---|------------------------------|
| Register | Empty | Empty | register player information |
| Quit | Empty | Empty | delete player information |
| Play | Int64Value amount you debt | Int64Value the resulting block height | debt |
| Bingo | Hash the transaction id of Play | Empty True indicates win | query the game's result |
| GetAward | Hash the transaction id of Play | Int64Value award | query the amount of award |
| GetPlayerInformation | Address player's address | Player- Information | query player's information |

11.1.3 Write Contract

create and initialize project

Begin by creating a new folder named BingoGame. Then execute the following commands to create and initialize the contract project.

```
mkdir BingoGame
cd BingoGame
```

```
dotnet new aelf -n BingoGameContract -N AElf.Contracts.BingoGame
```

After a successful execution, you will find src and test directories within the BingoGame directory. Upon opening these folders, you will discover the contract module and test case module for the BingoGame contract.

Define Proto

Based on the API list in the requirements analysis, the bingo_contract.proto file is as follows:

```
syntax = "proto3";
import "aelf/core.proto";
import "aelf/options.proto";
import "google/protobuf/empty.proto";
import "google/protobuf/wrappers.proto";
import "google/protobuf/timestamp.proto";
option csharp_namespace = "AElf.Contracts.BingoContract";
service BingoContract {
    option (aelf.csharp_state) = "AElf.Contracts.BingoContract.BingoContractState";

    // Actions
    rpc Register (google.protobuf.Empty) returns (google.protobuf.Empty) {
    }
    rpc Play (google.protobuf.Int64Value) returns (google.protobuf.Int64Value) {
    }
```

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```

    }
    rpc Bingo (aelf.Hash) returns (google.protobuf.BoolValue) {
    }
    rpc Quit (google.protobuf.Empty) returns (google.protobuf.Empty) {
    }

    // Views
    rpc GetAward (aelf.Hash) returns (google.protobuf.Int64Value) {
        option (aelf.is_view) = true;
    }
    rpc GetPlayerInformation (aelf.Address) returns (PlayerInformation) {
        option (aelf.is_view) = true;
    }
}

message PlayerInformation {
    aelf.Hash seed = 1;
    repeated BoutInformation bouts = 2;
    google.protobuf.Timestamp register_time = 3;
}

message BoutInformation {
    int64 play_block_height = 1;
    int64 amount = 2;
    int64 award = 3;
    bool is_complete = 4;
    aelf.Hash play_id = 5;
    int64 bingo_block_height = 6;
}

```

Begin by removing the `hello_world_contract.proto` file. Subsequently, generate a new proto file and define its content. Ensure that the proto files for contracts, references, and base are stored in separate directories. Adhere to the following guidelines, and create any necessary folders if they do not already exist.

For Protobuf files under the **src** folder:

- contract: The contract folder is used to store the definition proto files for your contract.
- message: The proto files under the message folder are utilized to define common properties that can be imported and used by other proto files.
- reference: The reference folder is dedicated to storing proto files for contracts that are referenced by your contract.
- base: Within the base folder, you store basic proto files, such as ACS (AElf standard contract) proto files.

For Protobuf files under the **test** folder:

- contract: The contract folder is used to store definition proto files for both your contract and any referenced contracts.
- message: Similar to the message folder in the src directory, this folder is used to define common properties for import and use by other proto files.
- base: The base folder houses basic proto files, including ACS proto files, just like in the src directory.

Contract Implementation

Here only talk about the general idea of the Action method, specifically need to turn the code:

<https://github.com/AElfProject/aelf-boilerplate/blob/dev/chain/contract/AElf.Contracts.BingoGameContract/BingoGameContract.cs>

Register & Quit

Register

- Determine the Seed of the user, Seed is a hash value, participating in the calculation of the random number, each user is different, so as to ensure that different users get different results on the same height;
- Record the user's registration time.

QuitJust delete the user's information.

Play & Bingo

Play

- Use TransferFrom to deduct the user's bet amount;
- At the same time add a round (Bout) for the user, when the Bout is initialized, record three messages 1.PlayId, the transaction Id of this transaction, is used to uniquely identify the Bout (see BoutInformation for its data structure in the Proto definition);
- AmountRecord the amount of the bet 3.Record the height of the block in which the Play transaction is packaged.

Bingo

- **Find the corresponding Bout according to PlayId, if the current block**
height is greater than PlayBlockHeight + number of nodes * 8, you can get the result that you win or lose;
- **Use the current height and the user's Seed to calculate a random**
number, and then treat the hash value as a bit Array, each of which is added to get a number ranging from 0 to 256.
- **Whether the number is divisible by 2 determines the user wins or**
loses;
- **The range of this number determines the amount of win/loss for the**
user, see the note of GetKind method for details.

11.1.4 Write Test

Due to the token transfer involved in this test, it's essential to construct not only the stub for the Bingo contract but also the stub for the Token contract. Please ensure that the Token contract proto file is located in the stub directory.

```
test
├── Protobuf
│   ├── message
│   │   └── authority_info.proto
│   └── stub
│       ├── bingo_game_contract.proto
│       └── token_contract.proto
```

Then you can write test code directly in the Test method of BingoContractTest. Prepare the two stubs mentioned above:

```
// Get a stub for testing.
var keyPair = SampleECKeypairs.KeyPairs[0];
var stub = GetBingoContractStub(keyPair);
var tokenStub = GetTester<TokenContractContainer.TokenContractStub>(
    GetAddress(TokenSmartContractAddressNameProvider.StringName), keyPair);
```

The stub is the stub of the bingo contract, and the tokenStub is the stub of the token contract.

In the unit test, the keyPair account is given a large amount of ELF by default, and the bingo contract needs a certain bonus pool to run, so first let the account transfer ELF to the bingo contract:

```
// Prepare awards.
await tokenStub.Transfer.SendAsync(new TransferInput
{
    To = DAppContractAddress,
    Symbol = "ELF",
    Amount = 100_00000000
});
```

Then you can start using the BingoGame contract. Register

```
await stub.Register.SendAsync(new Empty());
```

After registration, take a look at PlayInformation:

```
// Now I have player information.
var address = Address.FromPublicKey(keyPair.PublicKey);
{
    var playerInformation = await stub.GetPlayerInformation.CallAsync(address);
    playerInformation.Seed.Value.ShouldNotBeEmpty();
    playerInformation.RegisterTime.ShouldNotBeNull();
}
```

Bet, but before you can bet, you need to Approve the bingo contract:

```
// Play.
await tokenStub.Approve.SendAsync(new ApproveInput
{
    Spender = DAppContractAddress,
    Symbol = "ELF",
    Amount = 10000
});
await stub.Play.SendAsync(new Int64Value {Value = 10000});
```

See if Bout is generated after betting.

```
Hash playId;
{
    var playerInformation = await stub.GetPlayerInformation.CallAsync(address);
    playerInformation.Bouts.ShouldNotBeEmpty();
    playId = playerInformation.Bouts.First().PlayId;
}
```

Since the outcome requires eight blocks, you need send seven invalid transactions (these transactions will fail, but the block height will increase) :

```
// Mine 7 more blocks.
for (var i = 0; i < 7; i++)
{
    await stub.Bingo.SendWithExceptionAsync(playId);
}
```

Last check the award, and that the award amount is greater than 0 indicates you win.

```
await stub.Bingo.SendAsync(playId);
var award = await stub.GetAward.CallAsync(playId);
award.Value.ShouldNotBe(0);
```

CONSENSUS

12.1 Overview

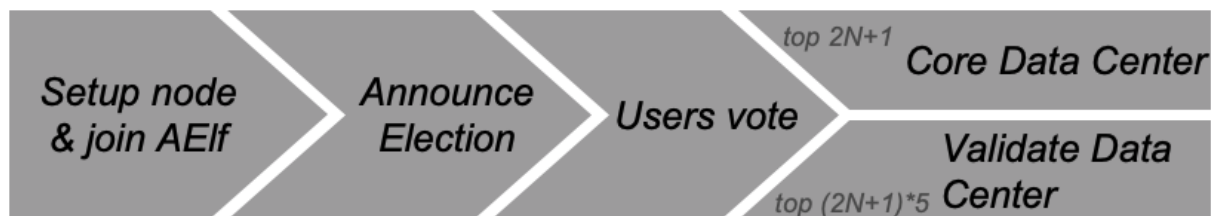
The process of reaching consensus is an essential part of every blockchain, since it's what determines which transactions get included in the block and in what order. A stable and efficient Block formation mechanism is the foundation of the AElf system. The operation and maintenance of AElf is more complicated than Bitcoin and Ethereum, because AElf Block formation requires the Main Chain to record information from Side Chains, and AElf is designed to provide cloud-based enterprise services in a more complex structure. In addition, miners need to update information from multiple parallel Chains. The Main Chain will adopt AEDPoS consensus to ensure high frequency and predictability of Block formation, which will improve user experience.

In an AElf blockchain, consensus protocol is split into two parts: election and scheduling. Election is the process that determines **who** gets to produce and scheduling decides on the **when**.

12.1.1 Core Data Center

Core Data Centers aka Miners or Block Producers, act as members of parliament in the world of AElf blockchain.

The AElf blockchain delegates $2N+1$ Core Data Centers. N starts with 8 and increases by 1 every year.



N starts at 8 and increases by 1 each year

These nodes in the AElf system enforce all of consensus rules of AElf. The purpose of these delegated mining nodes is to enable transaction relay, transaction confirmation, packaging blocks and data transfer. As AElf adopts multi-Side Chain architecture, Core Data Centers have to work as miners for some Side Chains. $2N+1$ nodes will go through a randomized order calculation each week.

All the Core Data Centers are elected by the ELF token holders. Electors can lock their ELF tokens to vote to one Validate Data Center, thus enhance the competitiveness of certain Validate Data Center in the election process.

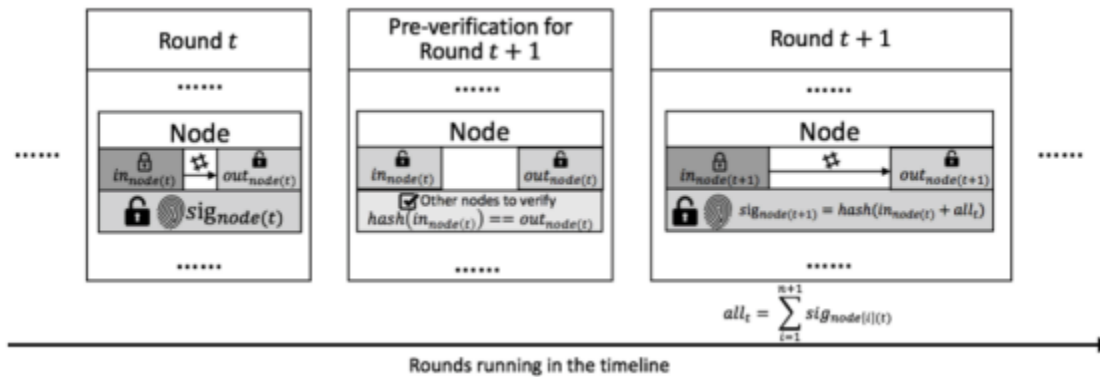
12.1.2 Validate Data Center

In the AElf blockchain, everyone can lock an amount of ELF tokens to announce himself joining the election. Among all the nodes who announced joining election, top $(2N+1)*5$ nodes will become Validate Data Center. N starts with 8 and increases by 1 every year.

12.2 AEDPoS Process

12.2.1 Round

The AElf blockchain is running along the timeline within processing units we call a “round”.



In a round, one node (Core Data Center) will produce one block each time, while one node will have one extra transaction at the end of the round.

Each mining node has three main properties in a specific round t :

- Private key, **in_node(t)**, which is a value inputted from the mining node and kept privately by the mining node itself in round t . It will become public after all block generations in round t are completed;
- Public key, **out_node(t)**, which is the hash value of **in_node(t)**. Every node in the aelf network can look up this value at any time;
- Signature, **sig_node(t)**, which is a value generated by the mining node itself in the first round. After the first round, it can only be calculated once the previous round is completed. It is used as the signature of this mining node in this round and it is also opened to public at all times like the **out_node(t)**.

12.2.2 Main Processes

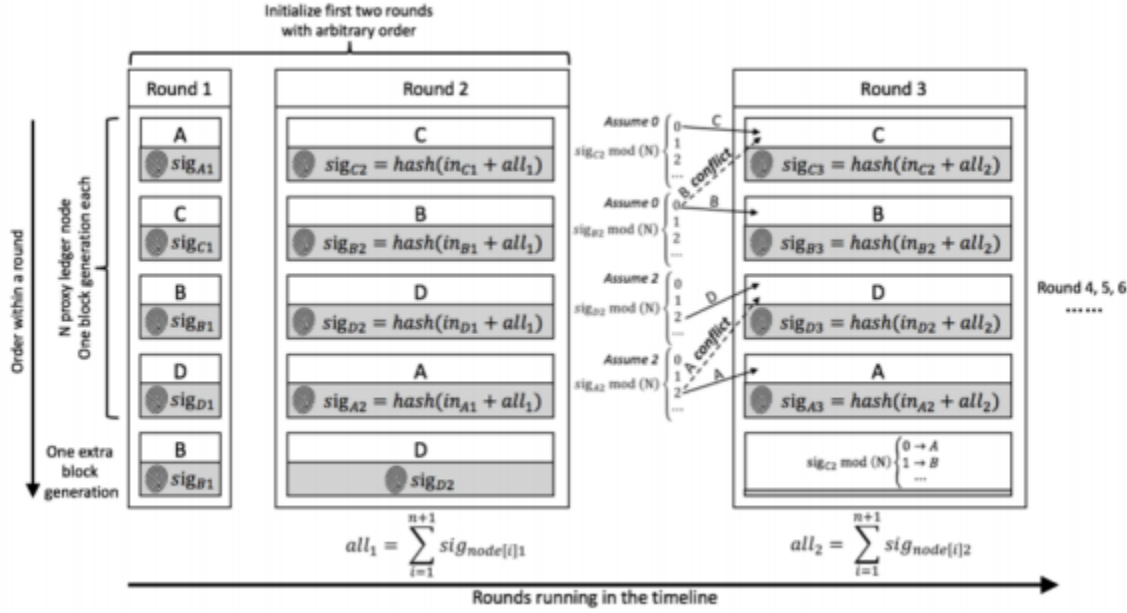
Pre-Verification

Before a node starts its block generation in round $(t+1)$, it has to have its status verified in round t . In round $(t+1)$, **in_node(t)** is already published as public, and **out_node(t)** can be queried at any time. So to verify the status of in round, other nodes can check $hash(in_node(t)) = out_node(t)$.

Order Calculation

In each round N , Core Data Centers have $(N+1)$ block generation time slots, each time slot have 1 to 8 blocks generation based on current running status in the AElf blockchain.

In the first round, the ordering of block generations as well as the signature (**sig**) for each node are totally arbitrary.



In the second round, the block generations are again arbitrarily ordered. However, from the second round, the signature

$$all_t = \sum_{i=1}^{n+1} sig_{node[i]}(t)$$

will be calculated by $sig_node(t+1) = hash(in_node(t) + all_t)$ where the node is processing the i -th transaction in round t .

here $node[i][t]$, means

From round 3, the ordering within a round is generated from the ordering and the node signature from the previous round.

In round $(t+1)$, we traverse the signature of nodes at round t in order. The ordering of a node in $(t+1)$ is calculated by

$$sig_{node(i)} mod(N) = \begin{cases} 0, & \text{first place} \\ 1, & \text{second place} \\ 2, & \text{third place} \\ \dots & \\ n-1, & n^{th} \text{ place} \end{cases}$$

For cases of conflict, i.e. results pointed to places which are not empty, we point the node to the next available place. If the node conflict is at the n -th place, we will find the available place from the first place.

The node that processes the one extra transaction is calculated from the signature of the node in first place of the previous round.

$$sig_{node[0](t) \bmod(N)} = \begin{cases} 0, & A \\ 1, & B \\ 2, & C \\ \dots & \end{cases}$$

sig_node[0][t] is decided by:

- all the signatures from previous round (**t-1**);
- the **in** value of itself in round (**t-1**);
- which node generate the extra block.

So it can only be calculated after the previous round (**t-1**) completed. Moreover, as it needs all the signatures from the previous round and the **in** value is input by each node independently, there is no way to control the ordering. The extra block generation is used to increase the randomness. In general, we create a random system that relies on extra inputs from outside. Based on the assumption that no node can know all other nodes' inputs in a specific round, no one node could control the ordering.

If one node cannot generate a block in round **t**, it also cannot input **in** its for this round. In such a case, the previous **in** will be used. Since all mining nodes are voted to be reliable nodes, such a situation should not happen often. Even if this situation does happen, the above-mentioned strategy is more than sufficient at dealing with it.

Every node only has a certain time **T** seconds to process transactions. Under the present network condition, **T=4** is a reasonable time consideration, meaning that every node only has 4 seconds to process transactions and submit the result to the network. Any delegate who fails to submit within 4 seconds is considered to be abandoning the block. If a delegate failed two times consecutively, there will be a window period calculated as **W** hours (**W=2^N**, **N** stands for the number of failure) for that node.

In the systematic design, aelf defines that only one node generates blocks within a certain period. Therefore, it is unlikely for a fork to happen in an environment where mining nodes are working under good connectivity. If multiple orphan node groups occur due to network problems, the system will adopt the longest chain since that is 19 the chain that most likely comes from the orphan node group with largest number of mining nodes. If a vicious node mines in two forked Blockchains simultaneously to attack the network, that node would be voted out of the entire network.

AEDPoS mining nodes are elected in a way that resembles representative democracy. The elected nodes decide how to hand out bonuses to the other mining nodes and stakeholders.

12.3 Irreversible Block

Which means there're always some block links (a block height to its hash value) can never be reversible.

The block link currently is double confirmed by the AEDPoS mechanism during the Round changes.

13.1 Introduction

The role that the network layer plays in AElf is very important, it maintains active and healthy connections to other peers of the network and is of course the medium through which nodes communicate and follow the chain protocol. The network layer also implements interfaces for higher-level logic like the synchronization code and also exposes some functionality for the node operator to administer and monitor network operations.

The design goals when designing AElf's network layer was to avoid "reinventing the wheel" and keep things as simply possible, we ended up choosing gRPC to implement the connections in AElf. Also, it was important to isolate the actual implementation (the framework used) from the contract (the interfaces exposed to the higher-level layers) to make it possible to switch implementation in the future without breaking anything.

13.2 Architecture

This section will present a summary of the different layers that are involved in network interactions.

The network is split into 3 different layers/projects, namely:

- AElf.OS
 - Defines event handles related to the network.
 - Defines background workers related to the network.
- AElf.OS.Core.Network
 - Defines service layer exposed to higher levels.
 - Contains the definitions of the infrastructure layer.
 - Defines the component, types.
- AElf.OS.Network.Grpc
 - The implementation of the infrastructure layer.
 - Launches events defined in the core
 - Low-level functionality: serialization, buffering, retrying...

13.2.1 AElf.OS

At the AElf.OS layer, the network monitors events of interest to the network through event handlers, such as kernel layer transaction verification, block packaging, block execution success, and discovery of new libs. The handler will call NetworkService to broadcast this information to its connected peer. And it will run background workers to process network tasks regularly.

Currently, the AElf.OS layer handles those events related to the network:

- Transaction Accepted Eventthe event that the transaction pool receives the transaction and passes verification
- Block Mined Eventwhen the current node is BP, the event that the block packaging is completed.
- Block Accepted Eventthe event that the node successfully executes the block.
- New Irreversible Block Found Eventthe event that the chain found the new irreversible block.

Currently, the AElf.OS layer will periodically process the following tasks.

- Peer health check: regularly check whether the connected peer is healthy and remove the abnormally connected peer.
- Peer retry connection: peer with abnormal connection will try to reconnect.
- Network node discovery: regularly discover more available nodes through the network.

13.2.2 AElf.OS.Core.Network

AElf.OS.Core.Network is the core module of the networkcontains services(service layer exposed to higher levels (OS)) and definitions (abstraction of the Infrastructure layer).

- Application layer implementation:
 - NetworkService: this service exposes and implements functionality that is used by higher layers like the sync and RPC modules. It takes care of the following:
 - * sending/receiving: it implements the functionality to request a block(s) or broadcast items to peers by using an IPeerPool to select peers. This pool contains references to all the peers that are currently connected.
 - * handling network exceptions: the lower-level library that implements the Network layer is expected to throw a NetworkException when something went wrong during a request.
- Infrastructure layer implementation and definition:
 - IPeerPool/PeerPool: manages active connections to peers.
 - IPeer: an active connection to a peer. The interface defines the obvious request/response methods, it exposes a method for the NetworkService to try and wait for recovery after some network failure. It contains a method for getting metrics associated with the peer. You can also access information about the peer itself (ready for requesting, IP, etc.).
 - IAElfNetworkServer: manages the lifecycle of the network layer, implements listening for connections, it is the component that accepts connections. For now, it is expected that this component launches NetworkInitializationFinishedEvent when the connection to the boot nodes is finished.
- Definitions of types (network_types.proto and partial).
- Defines the event that should be launched from the infrastructure layer's implementation.

13.2.3 AElf.OS.Network.Grpc

The AElf.OS.Network.Grpc layer is the network infrastructure layer that we implement using the gRPC framework.

- GrpcPeer implemented the interface IPeer defined by the AElf.OS.Core.Network layer
- GrpcStreamPeer: implemented the interface IPeer defined by the AElf.OS.Core.Network layer, nodeversion \geq 1.4.0 will use this impl to replace GrpcPeer for client side
- GrpcStreamBackPeer: implemented the interface IPeer defined by the AElf.OS.Core.Network layer, nodeversion \geq 1.4.0 will use this impl to replace GrpcPeer for server side
- GrpcNetworkServer: implemented the interface IAElfNetworkServer defined by the AElf.OS.Core.Network layer
- GrpcServerService: implemented network service interfaces, including interfaces between nodes and data exchange.
- Extra functionality:
 - Serializing requests/deserializing responses (protobuf).
 - Some form of request/response mechanism for peers (optionally with the timeout, retry, etc).
 - Authentication.

In fact, gRPC is not the only option. Someone could if they wanted to replace the gRPC stack with a low-level socket API (like the one provided by the dotnet framework) and re-implement the needed functionality. As long as the contract (the interface) is respected, any suitable framework can be used if needed.

13.3 Protocol

Each node implements the network interface protocol defined by AElf to ensure normal operation and data synchronization between nodes.

13.3.1 Connection

DoHandshake

When a node wants to connect with the current node, the current node receives the handshake information of the target node through the interface DoHandshake. After the current node verifies the handshake information, it returns the verification result and the handshake information of the current node to the target node.

The handshake information, in addition to being used in the verification of the connection process, will also record the status of the other party's chain after the connection is successful, such as the current height, Lib height, etc.

```
rpc DoHandshake (HandshakeRequest) returns (HandshakeReply) {}
```

- Handshake Message

```
message Handshake {
    HandshakeData handshake_data = 1;
    bytes signature = 2;
    bytes session_id = 3;
}
```

- handshake_data: the data of handshake.

- signature: the signature of handshake data.
- session_id: randomly generated ids when nodes connect.

- HandshakeData Message

```
message HandshakeData {  
    int32 chain_id = 1;  
    int32 version = 2;  
    int32 listening_port = 3;  
    bytes pubkey = 4;  
    aelf.Hash best_chain_hash = 5;  
    int64 best_chain_height = 6;  
    aelf.Hash last_irreversible_block_hash = 7;  
    int64 last_irreversible_block_height = 8;  
    google.protobuf.Timestamp time = 9;  
}
```

- chain_id: the id of current chain.
- version: current version of the network.
- listening_port: the port number at which the current node network is listening.
- pubkey: the public key of the current node used by the receiver to verify the data signature.
- best_chain_hash: the latest block hash of the best branch.
- best_chain_height: the latest block height of the best branch.
- last_irreversible_block_hash: the hash of the last irreversible block.
- last_irreversible_block_height: the height of the last irreversible block.
- time: the time of handshake.

- HandshakeRequest Message

```
message HandshakeRequest {  
    Handshake handshake = 1;  
}
```

- handshake: complete handshake information, including handshake data and signature.

- HandshakeReply Message

```
message HandshakeReply {  
    Handshake handshake = 1;  
    HandshakeError error = 2;  
}
```

- handshake: complete handshake information, including handshake data and signature.
- error: handshake error enum.

- HandshakeError Enum

```
enum HandshakeError {  
    HANDSHAKE_OK = 0;  
    CHAIN_MISMATCH = 1;  
    PROTOCOL_MISMATCH = 2;
```

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```

    WRONG_SIGNATURE = 3;
    REPEATED_CONNECTION = 4;
    CONNECTION_REFUSED = 5;
    INVALID_CONNECTION = 6;
    SIGNATURE_TIMEOUT = 7;
}

```

- HANDSHAKE_OK: indicate no error actually; the default value.
- CHAIN_MISMATCH: the chain ID does not match.
- PROTOCOL_MISMATCH: the network version does not match.
- WRONG_SIGNATURE: the signature cannot be verified.
- REPEATED_CONNECTION: multiple connection requests were sent by the same peer.
- CONNECTION_REFUSED: peer actively rejects the connection, either because the other party's connection pool is slow or because you have been added to the other party's blacklist.
- INVALID_CONNECTION: connection error, possibly due to network instability, causing the request to fail during the connection.
- SIGNATURE_TIMEOUT: the signature data has timed out.

```
rpc RequestByStream (stream StreamMessage) returns (stream StreamMessage) {}
```

- StreamMessage Message

```

message StreamMessage {
    StreamType stream_type = 1;
    MessageType message_type = 2;
    string request_id = 3;
    bytes message = 4;
    map<string, string> meta = 5;
}

```

- stream_type: the message is request or reply.
- message_type: message body type.
- request_id: id of the request.
- message: message that is encode by protobuf.
- meta: meta message of this request.

- MessageType Enum

```

enum MessageType {
    ANY = 0;

    HAND_SHAKE = 1;
    PING = 2;
    CONFIRM_HAND_SHAKE = 3;
    HEALTH_CHECK = 4;
    REQUEST_BLOCK = 5;
    REQUEST_BLOCKS = 6;
}

```

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```

    GET_NODES = 7;

    BLOCK_BROADCAST = 8;
    TRANSACTION_BROADCAST = 9;
    ANNOUNCEMENT_BROADCAST = 10;
    LIB_ANNOUNCEMENT_BROADCAST = 11;
    DISCONNECT = 12;
}

```

- HAND_SHAKE: this message is a handshake request.
- PING: this message is a ping request.
- CONFIRM_HAND_SHAKE: this message is a confirm handshake reply.
- HEALTH_CHECK: this message is a health check request or reply.
- REQUEST_BLOCK: this message is a request block request or reply.
- REQUEST_BLOCKS: this message is a request blocks request or reply.
- GET_NODES: this message is a get nodes request or reply.
- BLOCK_BROADCAST: this message is a block broadcast request or reply.
- TRANSACTION_BROADCAST: this message is a transaction broadcast request or reply.
- ANNOUNCEMENT_BROADCAST: this message is a announcement broadcast request or reply.
- LIB_ANNOUNCEMENT_BROADCAST: this message is a lib announcement broadcast request or reply.
- DISCONNECT: this message is a disconnect request or reply.

- StreamType Enum

```

enum StreamType {
    UNKNOWN = 0;
    REQUEST = 1;
    REPLY = 2;
}

```

- REQUEST: this is a request.
- REPLY: this is reply.

3.1.2 ConfirmHandshake

When the target node verifies that it has passed the current node's handshake message, it sends the handshake confirmation message again.

```
rpc ConfirmHandshake (ConfirmHandshakeRequest) returns (VoidReply) {}
```

```

message ConfirmHandshakeRequest {
}

```


13.3.2 Broadcasting

BlockBroadcastStream

The interface BlockCastStream is used to receive information about the block and its complete transaction after the BP node has packaged the block.

```
rpc BlockBroadcastStream (stream BlockWithTransactions) returns (VoidReply) {}
```

```
message BlockWithTransactions {
  aelf.BlockHeader header = 1;
  repeated aelf.Transaction transactions = 2;
}
```

- header:
- transactions:

TransactionBroadcastStream

TransactionBroadcastStream used to receive other nodes forward transaction information.

```
rpc TransactionBroadcastStream (stream aelf.Transaction) returns (VoidReply) {}
```

AnnouncementBroadcastStream

Interface AnnouncementBroadcastStream used to receive other nodes perform block after block information broadcast.

```
rpc AnnouncementBroadcastStream (stream BlockAnnouncement) returns (VoidReply) {}
```

```
message BlockAnnouncement {
  aelf.Hash block_hash = 1;
  int64 block_height = 2;
}
```

- block_hash: the announced block hash.
- block_height: the announced block height.

LibAnnouncementBroadcastStream

Interface LibAnnouncementBroadcastStream used to receive other nodes Lib changed Lib latest information broadcast.

```
rpc LibAnnouncementBroadcastStream (stream LibAnnouncement) returns (VoidReply) {}
```

```
message LibAnnouncement{
  aelf.Hash lib_hash = 1;
  int64 lib_height = 2;
}
```

- lib_hash: the announced last irreversible block hash.
- lib_height: the announced last irreversible block height.

13.3.3 Block Request

RequestBlock

The interface RequestBlock requests a single block in response to other nodes. Normally, the node receives block information packaged and broadcast by BP. However, if the block is not received for some other reason. The node may also receive BlockAnnouncement messages that are broadcast after the block has been executed by other nodes, so that the complete block information can be obtained by calling the RequestBlock interface of other peers.

```
rpc RequestBlock (BlockRequest) returns (BlockReply) {}
```

- BlockRequest Message

```
message BlockRequest {  
    aelf.Hash hash = 1;  
}
```

- hash: the block hash that you want to request.

- BlockReply Message

```
message BlockReply {  
    string error = 1;  
    BlockWithTransactions block = 2;  
}
```

- error: error message.
- block: the requested block, including complete block and transactions information.

RequestBlocks

The interface RequestBlock requests blocks in bulk in response to other nodes. When a node forks or falls behind, the node synchronizes blocks by bulk fetching a specified number of blocks to the RequestBlocks interface through which the target node is called.

```
rpc RequestBlocks (BlocksRequest) returns (BlockList) {}
```

- BlocksRequest Message

```
message BlocksRequest {  
    aelf.Hash previous_block_hash = 1;  
    int32 count = 2;  
}
```

- previous_block_hash: the previous block hash of the request blocks, and the result does not contain this block.
- count: the number of blocks you want to request.

- BlockList Message

```
message BlockList {  
    repeated BlockWithTransactions blocks = 1;  
}
```

- blocks: the requested blocks, including complete blocks and transactions information.

13.3.4 Peer Management

Ping

Interface Ping is used between nodes to verify that each other's network is available.

```
rpc Ping (PingRequest) returns (PongReply) {}
```

```
message PingRequest {  
}
```

```
message PongReply {  
}
```

CheckHealth

The interface CheckHealth is invoked for other nodes' health checks, and each node periodically traverses the available peers in its own Peer Pool to send health check requests and retries or disconnects if an exception in the Peer state is found.

```
rpc CheckHealth (HealthCheckRequest) returns (HealthCheckReply) {}
```

```
message HealthCheckRequest {  
}
```

```
message HealthCheckReply {  
}
```


ADDRESS

14.1 Overview

The changes of the state of an AElf blockchain are driven by the execution of transactions. An Address can identify one of the participants of a transaction, that is, either transaction sender or destination. The sender is marked as From in a transaction, and the destination is marked as To.

Actually, From can be a User Address, a Contract Address, or a Virtual Address, but To can only be a Contract Address, which means the transaction sender wants to construct a transaction to execute a certain method in that Smart Contract.

Here are some further explanations of all kinds of Address in an AElf blockchain.

14.2 User Address

User Address is generated from one key pair instance. One key pair is possessed by a real user of this AElf blockchain.

This is the definition of interface `IAElfAsymmetricCipherKeyPair`.

```
public interface IAElfAsymmetricCipherKeyPair
{
    byte[] PrivateKey { get; }
    byte[] PublicKey { get; }
}
```

Currently, in AElf blockchain, we use `ECKeypair` to implement this interface, just like most of other blockchain systems. Users can use *aelf-command* tool to generate themselves a valid `ECKeypair`, thus generate a unique User Address.

User can easily create a key pair with **command line tool** with the **create** command.

```
aelf-command create
```

Creation will be successful after you provide a valid password. When creating the key-pair (that we sometimes refer to as the “account”) it will generate a file with the “.json” extension. This file will contain the public and private key and will be encrypted with the password you provided before.

If you are writing a dApp you can also use the following method in the *js-sdk*, it is based on [bip39](#) for generating a deterministic key pair with a “mnemonic sentence” :

```
import Aelf from 'aelf-sdk';
Aelf.wallet.createNewWallet();
```

This will return an object containing the mnemonic used, the key-pair and the address. In AElf we usually encode the address in base58. This address is derived from the public, we calculate it as the first 30 bytes of the double sha256 hash. The AElf js-sdk provides the following, that returns the address:

```
import Aelf from 'aelf-sdk';
const address = aelf.wallet.getAddressFromPubKey(pubKey);
```

Finally here is the Protobuf message we use for representing an address, it is often used by other types to represent addresses:

```
option csharp_namespace = "AElf.Types";
message Address
{
    bytes value = 1;
}
```

Also, the structure of Hash is very similar to Address.

14.3 Contract Address

Contract Address can identify a Smart Contract in an AElf blockchain. The Contract Address is calculated with chain id and a serial number during the deployment of related Smart Contract.

```
private static Address BuildContractAddress(Hash chainId, long serialNumber)
{
    var hash = HashHelper.ConcatAndCompute(chainId, HashHelper.
    ↪ComputeFrom(serialNumber));
    return Address.FromBytes(hash.ToByteArray());
}
public static Address BuildContractAddress(int chainId, long serialNumber)
{
    return BuildContractAddress(HashHelper.ComputeFrom(chainId), serialNumber);
}
```

14.4 Contract Virtual Address

As an extended function, every contract can be added with a Hash value based on its Address, then it can obtain unlimited virtual Addresses, this newly created address is called **Virtual Address**.

For example, the account transfer in AElf blockchain is to send the **Transfer** transaction to the MultiToken contract along with the parameters of the recipient, transfer currency and amount, etc. One account transfer involves the sender and recipient, and both parties are identified by the Address. In this situation, the Virtual Address, which is created by Address and Hash algorithm, can be either party of the account transfer like the normal Address for the user or contract. What's more, Virtual Address can only be controlled by the primary contract, this enables the contract to custody transactions or fundings independently for every user.

In essence, the characteristic of Virtual Address is a unique identification. As a result, the Virtual Address, which is generated by a business action on this contract, is reliable to be used for token transferring.

OVERVIEW

Transactions ultimately are what will change the state of the blockchain by calling methods on smart contracts. A transaction is either sent to the node via RPC or received from the network. When broadcasting a transaction and if valid it will be eventually included in a block. When this block is received and executed by the node, it will potential change the state of contracts.

15.1 Smart Contract

In AElf blockchain, smart contracts contains a set of **state** definitions and a set of methods which aiming at modifying these **states**.

15.2 Action & View

In AElf blockchain, there are two types of smart contract methods, actions and views. Action methods will actually modify the state of one contract if a related transaction has included in a block and executed successfully. View methods cannot modify the state of this contract in any case.

Developers can claim a action method in proto file like this:

```
rpc Vote (VoteInput) returns (google.protobuf.Empty) {  
}
```

And claim a view method like this:

```
rpc GetVotingResult (GetVotingResultInput) returns (VotingResult) {  
    option (aelf.is_view) = true;  
}
```

15.3 Transaction Instance

Here's the defination of the Transaction.

```
option csharp_namespace = "AElf.Types";  
  
message Transaction {  
    Address from = 1;  
    Address to = 2;
```

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```
int64 ref_block_number = 3;
bytes ref_block_prefix = 4;
string method_name = 5;
bytes params = 6;
bytes signature = 10000;
}
```

In the js sdk, there are multiple methods to work with transactions. One important method is the **getTransaction** method that will build a transaction object for you:

```
import Aelf from 'aelf-sdk';
var rawTxn = proto.getTransaction('65dDNxzc35jESiidFXN5JV8Z7pCwaFnepuYQToNefSgqk9'
  ↪ '65dDNxzc35jESiidFXN5JV8Z7pCwaFnepuYQToNefSgqk9', 'SomeMethod', encodedParams);
```

This will build the transaction to the contract at address “65dDNxzc35jESiidFXN5JV8Z7pCwaFnepuYQToNefSgqk9” that will call **SomeMethod** with encoded params.

15.3.1 From

The address of the sender of a transaction.

Note that the **From** is not currently useful because we derive it from the signature.

15.3.2 To

The address of the contract when calling a contract.

15.3.3 MethodName

The name of a method in the smart contract at the **To** address.

15.3.4 Params

The parameters to pass to the aforementioned method.

15.3.5 Signature

When signing a transaction it’s actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix.

You can use the js-sdk to sign the transaction with the following method:

```
import Aelf from 'aelf-sdk';
var txn = Aelf.wallet.signTransaction(rawTxn, wallet.keyPair);
```


15.3.6 RefBlockNumber & RefBlockPrefix

These two fields measure whether this transaction has expired. The transaction will be discarded if it is too old.

15.4 Transaction Id

The unique identity of a transaction. Transaction Id consists of a cryptographic hash of the instance basic fields, excluding signature.

Note that the Transaction Id of transactions will be the same if the sender broadcasted several transactions with the same origin data, and then these transactions will be regarded as one transaction even though broadcasting several times.

15.4.1 Verify

One transaction now is verified by the node before forwarding this transaction to other nodes. If the transaction execution is failed, the node won't forward this transaction nor package this transaction to the producing block.

We have several transaction validation providers such as:

- BasicTransactionValidationProvider. To verify the transaction signature and size.
- TransactionExecutionValidationProvider. To pre-execute this transaction before forwarding this transaction or really packaging this transaction to new block.
- TransactionMethodValidationProvider. To prevent transaction which call view-only contract method from packaging to new block.

15.4.2 Execution

In AElf, the transaction is executed via .net reflection mechanism.

Besides, we have some transaction execution plugins in AElf main net. The execution plugins contain pre-execution plugins and post-execution plugins.

- FeeChargePreExecutionPlugin. This plugin is for charging method fees from transaction sender.
- MethodCallingThresholdPreExecutionPlugin. This plugin is for checking the calling threshold of a specific contract or contract method.
- ResourceConsumptionPostExecutePlugin. This plugin is for charging resource tokens from called contract after transaction execution (thus we can know how much resource tokens are cost during the execution.)

15.4.3 TransactionResult

Data structure of TransactionResult:

```
message TransactionResourceInfo {
    repeated aelf.ScopedStatePath write_paths = 1;
    repeated aelf.ScopedStatePath read_paths = 2;
    ParallelType parallel_type = 3;
    aelf.Hash transaction_id = 4;
    aelf.Hash contract_hash = 5;
    bool is_nonparallel_contract_code = 6;
}
```


16.1 Application pattern

We follow generally accepted good practices when it comes to programming, especially those practices that make sense to our project. Some practices are related to C# and others are more general to OOP principles (like SOLID, DRY...).

Even though it's unusual for blockchain projects, we follow a domain driven design (DDD) approach to our development style. Part of the reason for this is that one of our main frameworks follows this approach and since the framework is a good fit for our needs, it's natural that we take the same design philosophy.

A few key points concerning DDD:

- traditionally, four layers: presentation, application, domain and infrastructure.
- presentation for us corresponds to any type of dApp.
- application represents exposed services mapped to the different domains.
- domain represents the specific events related to our blockchain system and also domain objects.
- finally infra are the third party libraries we use for database, networking...

We also have a Github issue where we list some of the [coding standards](#) that we follow while developing AElf.

16.1.1 Frameworks and libraries:

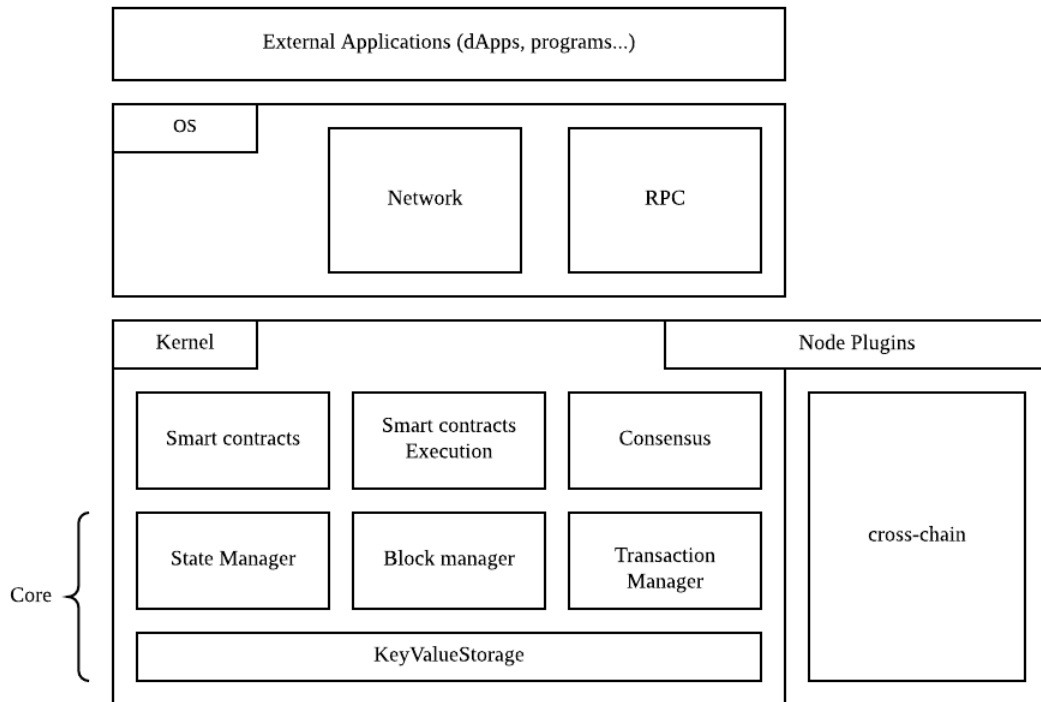
The main programming language used to code and build AElf is C# and is built with the dotnet core framework. It's a choice that was made due to the excellent performances observed with the framework. Dotnet core also comes with the benefit of being cross platform, at least for the three main ones that are Windows, MacOS and Linux. Dotnet core also is a dynamic and open source framework and comes with many advantages of current modern development patterns and is backed by big actors in the IT space.

At a higher level we use an application framework named [ABP](#). From a functional point of view, a blockchain node is a set of endpoints, like RPC, P2P and cross-chain and some higher level protocol on top of this. So ABP is a natural fit for this, because it offers a framework for building these types of applications.

We use the XUnit framework for our unit tests. We also have some custom made frameworks for testing smart contracts.

For lower level, we use gRPC for the cross-chain and p2p network communication. Besides for gRPC, we also use Protobuf for serialization purposes.

16.2 Design principles:



The above diagram shows the conceptual structure of the node and the separation between OS and Kernel.

16.2.1 OS

The OS layer implements the application and infrastructure layer for the network. It also implements the high level handlers for network events and job, like for example synchronizing the chain in reaction to a block announcement. The OS layer also contains the RPC implementation for the exposed API.

Kernel

The kernel contains the smart contract and execution primitives and definitions. The kernel also defines the components necessary for accessing the blockchain's data. Various managers will use the storage layer to access the underlying database.

The kernel also defines the notion of plugins. The diagram show that the side chain modules are implemented as plugins.

Structure of the project:

To help follow AElf's structure this section will present you with an overview of the solution.

Conceptually, AElf is built on two main layers: OS and Kernel. The OS contains the high level definition for a node and the endpoints like RPC and p2p, whereas the kernel mainly contains logic and definitions for smart contracts and consensus.

AElf has a native runtime for smart contracts which is implemented in C# and for contracts written in C#. The implementation is the AElf.Runtime.CSharp.* projects.

A big part of AElf is the side chain framework. It is mainly implemented in the AElf.CrossChain namespace and defines the main abstractions in the **core** project and an implementation with grpc in the AElf.Crosschain.Grpc project.

The AElf.Test solution folder contains all the tests, coverage of the main functional aspects must be at a maximum to ensure the quality of our system.

Finally there are other projects that implement either libraries we use, like the crypto library and others for infrastructure like the database library, that are not as important but are still worth looking into.

16.2.2 Jobs and event handlers

Event handlers implement the logic that reacts to external in internal events. They are in a certain sense the higher levels of the application (they are called by the framework in purely domain agnostic way). An event handler, mostly using other services will influence the state of the chain.

16.2.3 Modules

We currently base our architecture on modules that get wired together at runtime. Any new module must inherit **AElfModule**.

Give the need to implement a new module, it usually follows the following steps: 1. Write the event handler or the job. 2. implement the interface and create manager or infrastructure layer interface that is needed. 3. implement the infrastructure layer interface in the same project in it do not need add dependency. 4. implement the infrastructure layer interface in another project, if it need third party dependency, for example, you can add GRPC / MongoDB / MySQL in the new project.

Example: the p2p network module.

The networking code is defined amongst 2 modules: **CoreOSAEElfModule** and **GrpcNetworkModule**. The OS core defines the application service (used by other components of the node) and also implements it since it is application/domain logic. Whereas the infrastructure layer (like the server endpoint), is defined in the OS core modules but is implemented in another project that relies on a third party - gRPC in this case.

16.2.4 Testing

When writing a new component, event handler, method... It's important for AElf's quality to consider the corresponding unit test. As said previously we have a solution-wide test folder where we place all the tests.

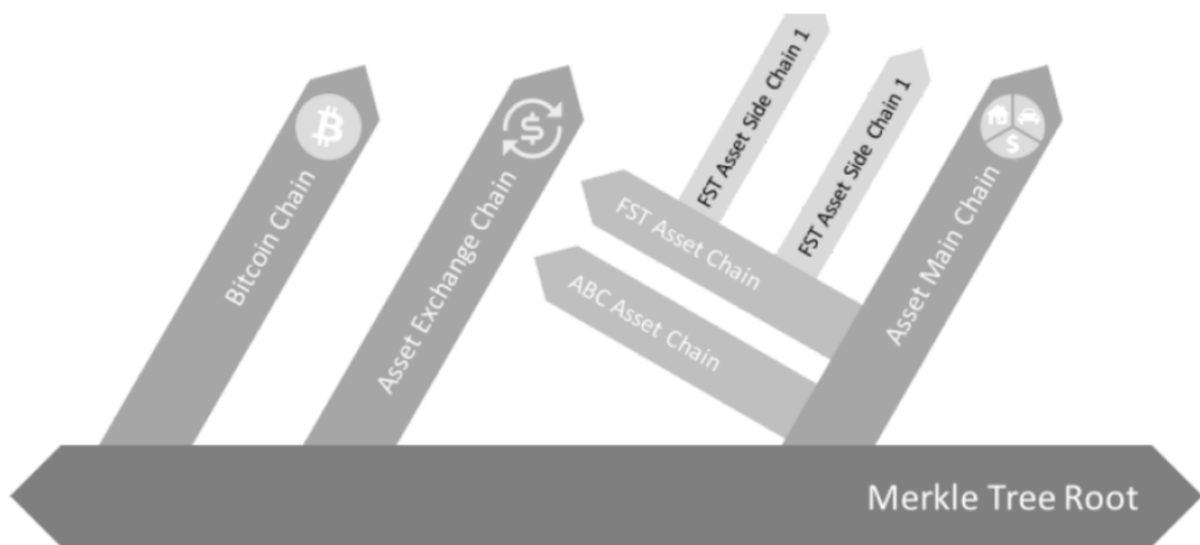
CROSS CHAIN

17.1 Introduction

One of the major issues with current blockchain systems is scalability. Mainly because of **congestion problems** of current blockchains, the problem is that when a single chain needs to sequentially order and process transactions, in the event of a popular dApp taking up a lot of resources, it has negative side effects on other dApps.

This is why AElf side chains were introduced in the initial design. It's envisioned that one side-chain is responsible for handling one or more similar business scenarios, distributing different tasks on multiple chains and improving the overall processing efficiency.

The main idea is that the side-chains are **independent** and **specialized** to ensure that the dapps running on them can perform efficiently and smoothly. A network link will exist between main-chain node and side-chain nodes, but the communication is indirectly done through what's called a Merkle root.



The diagram above illustrates the conceptual idea behind side chains.

Side chains are isolated but still need a way to interact with each other for this AElf introduces a communication mechanism through **merkle roots** and **indexing** to enable cross chain verification scenarios.

The following sections of this documentation will give you an overview of the architecture of AElf's side chains. There will also be a guide explaining how to set up a main-chain and a side chain node.

17.2 Overview

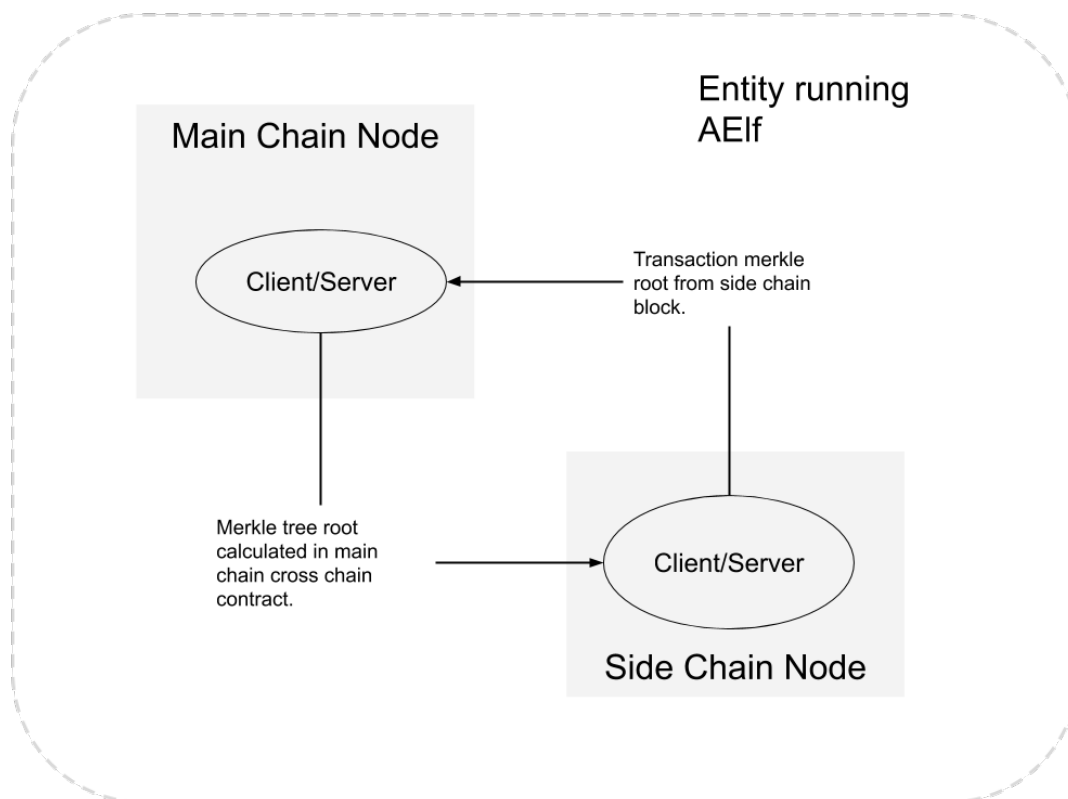
Conceptually a side chain node and main chain node are similar, they are both independent blockchains, with their own peer-to-peer network and possibly their own ecosystem. It is even possible to have this setup on multiple levels. In terms of peer-to-peer networks, all side chains work in parallel to each other but they are linked to a main chain node through a cross-chain communication mechanism.

Through this link, messages are exchanged and indexing is performed to ensure that transactions from the main-chain or other side chains are verifiable in the side chain. Implementers can use AElf libraries and frameworks to build chains.

One important aspect is the key role that the main chain plays, because its main purpose is to index the side chains. Only the main chain indexes data about all the side chains. Side chains are independent and do not have knowledge about each other. This means that when they need to verify what happened in other chains, they need the main chain as a bridge to provide the cross chain verification information.

17.2.1 Node level architecture

In the current architecture, both the side chain node and the main chain node has one server and exactly one client. This is the base for AElf's two-way communication between main chain and side chains. Both the server and the client are implemented as a node plugins (a node has a collection of plugins). Interaction (listening and requesting) can start when both the nodes have started.



The diagram above illustrates two nodes run by an entity: one main chain node and one side chain node. Note that the nodes don't have to be in the same physical location.

Side chain lifetime

Side chain lifetime involves the following steps.

- Request side chain creation.
- Wait for accept on main chain.
- Start and initialize side chain and it will be indexed by main chain automatically.
- It is allowed to do cross chain verification iff side chain is indexed correctly.

Communication

When the side chain node starts it will initiate a number of different communications, here are the main points of the protocol:

- When the side chain node is started for the first time it will request the main chain node for a chain initialization context.
- After initialization the side chain is launched and will perform a handshake with main chain node to signal that it is ready to be indexed.
- During the indexing process, the information of irreversible blocks will be exchanged between side chain and main chain. The main chain will write the final result in block which is calculated with the cross chain data from all side chains. Side chain is also recording the data in contract from main chain.

AElf provides the cross chain communication implementation with grpc.

```
rpc RequestIndexingFromParentChain (CrossChainRequest) returns (stream acs7.  
  ↳ParentChainBlockData) {}  
rpc RequestIndexingFromSideChain (CrossChainRequest) returns (stream acs7.  
  ↳SideChainBlockData) {}
```

Cache

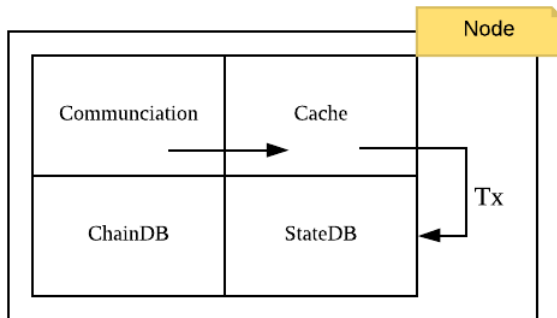
For effective indexing, a cache layer is used to store cross chain data received from remote nodes, and make it available and correct. Cross chain data is cached by chain id and block height with a count limit. The cache layer can give the data if cached when the node needs it. So cache layer decouples the communication part and node running logic.

Cross chain contract

Apart from the data in block, most cross chain data will be stored by the cross chain contract. Cross chain data cached by the node is packed in transaction during the mining process and the calculated result is stored by the contract. Actually, the cross chain data in the block is the side chain indexing result of calculations in this contract. Only with data in this contract can cross chain verification work correctly.

Data flow

Conceptually the node is like described in the following diagram. Main/Side chain node gets the cross chain data from the other side and put it in the local memory. Indexing transaction will be packed by miner and cross chain data would go into State through Crosschain Contract.



17.3 Cross chain verification

Verification is the key feature that enables side chains. Because side chains do not have direct knowledge about other side chains, they need a way to verify information from other chains. Side chains need the ability to verify that a transaction was included in another side chains block.

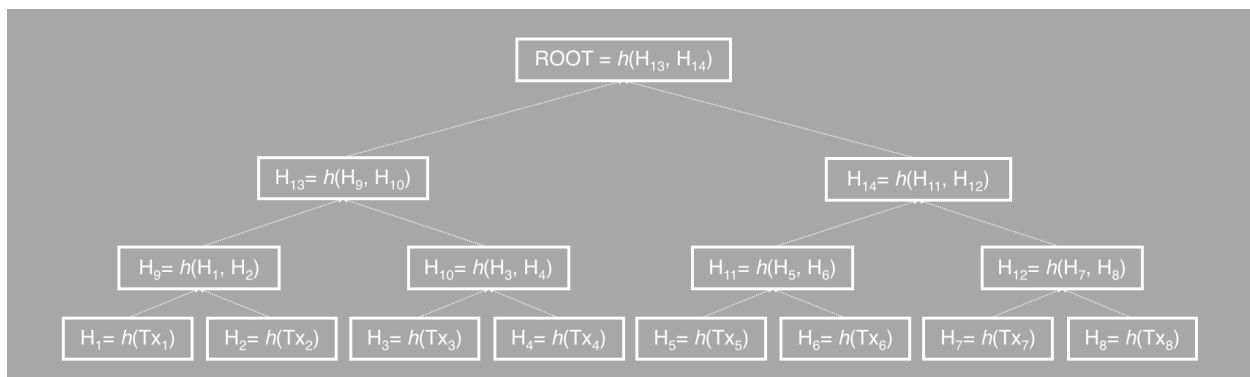
17.3.1 Indexing

The role of the main chain node is to index all the side chains blocks. This way it knows exactly the current state of all the side chains. Side chains also index main chain blocks and this is how they can gain knowledge about the inclusion of transactions in other chains.

Indexing is a continuous process, the main chain is permanently gathering information from the side chains and the side chains are permanently getting information from the main chain. When a side chain wants to verify a transaction from another side chain it must wait until the correct main chain block has been indexed.

17.3.2 Merkle tree

Merkle tree is a basic binary tree structure. For cross-chain in AElf, leaf value is the hash from transaction data. Node value (which is not a leaf node) is the hash calculated from its children values until to the tree root.

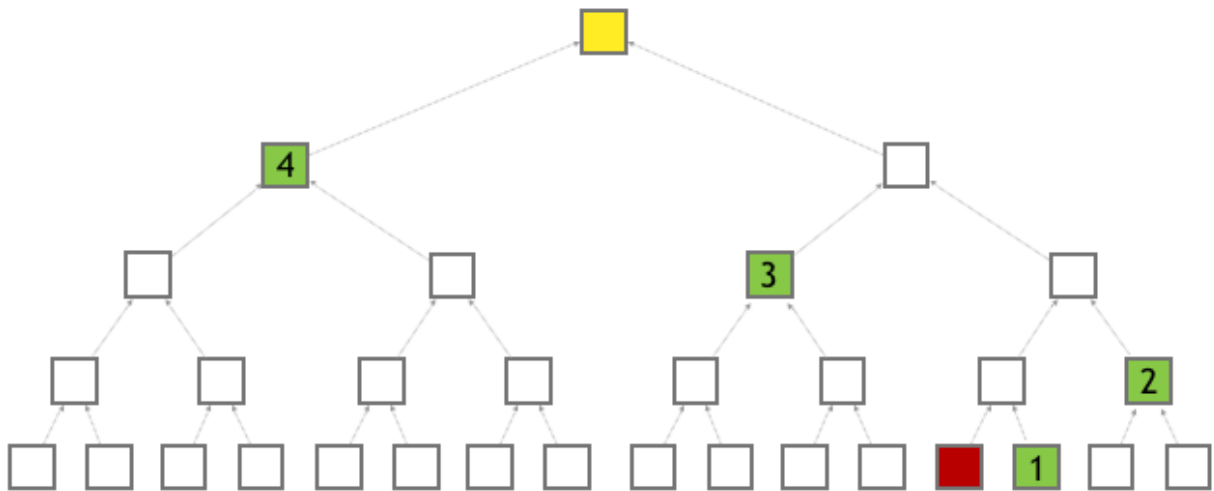


17.3.3 Merkle root

When a transaction gets included in a side chain's block the block will also include a merkle root of the transactions of this block. This root is local to this side chain's blockchain and by itself of little value to other side chains because they follow a different protocol. So communication between side chains goes through the main chain in the form of a merkle path. During indexing process, main chain is going to calculate the root with the data from side chains, and side chains in turn get the root in future indexing. This root is used for final check in cross chain transaction verification.

17.3.4 Merkle path

Merkle path is the node collection for one leaf node to calculate with to the root. Correct merkle path is necessary to complete any work related to cross chain verification. For the transaction **tx** from chain **A**, you need the whole merkle path root for **tx** to calculate the final root if you want to verify the existence of this transaction on other chains, and verify the root by checking whether it is equal to the one obtained from indexing before.



17.4 Cross chain verify

This section will explain how to verify a transaction across chains. It assumes a side chain is already deployed and been indexed by the main-chain.

17.4.1 Send a transaction

Any transaction with status **Mined** can be verified, the only pre-condition is that the transaction was indexed.

17.4.2 Verify the transaction

There's basically two scenarios that can be considered:

- verifying a main-chain transaction.
- verifying a side-chain transaction.

```
rpc VerifyTransaction (VerifyTransactionInput) returns (google.protobuf.BoolValue) {
    option (aelf.is_view) = true;
}

message VerifyTransactionInput {
    aelf.Hash transaction_id = 1;
    aelf.MerklePath path = 2;
    int64 parent_chain_height = 3;
    int32 verified_chain_id = 4;
}
```

VerifyTransaction is the view method of the cross-chain contract and that will be used to perform the verification. It returns whether the transaction was mined and indexed by the destination chain. This method will be used in both scenarios, what differs is the input:

Verify a main-chain tx

Verifying a main-chain transaction on a side chain, you can call **VerifyTransaction** on the side-chain with the following input values:

- parent_chain_height - the height of the block, on the main-chain, in which the transaction was packed.
- transaction_id - the ID of the transaction that you want to verify.
- path - the merkle path from the main-chain's web api with the **GetMerklePathByTransactionIdAsync** with the ID of the transaction.
- verified_chain_id - the source chainId, here the main chain's.

You can get the MerklePath of transaction in one block which packed it by chain's web api with the **GetMerklePathByTransactionIdAsync** (See [web api reference](#)).

Verify a side-chain tx

First, you also need the query result of **GetMerklePathByTransactionIdAsync**, just like verification for a main-chain tx.

And then if you want to verify a a side-chain transaction, you need to get the **CrossChainMerkleProofContext** of this tx from the source chain. You can try the **GetBoundParentChainHeightAndMerklePathByHeight** method of **Crosschain** contract.

The input of this api is the height of block which packed the transaction. And it will return merkle proof context

```
rpc GetBoundParentChainHeightAndMerklePathByHeight (google.protobuf.Int64Value) returns
↳ (CrossChainMerkleProofContext) {
    option (aelf.is_view) = true;
}

message CrossChainMerkleProofContext {
```

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```

int64 bound_parent_chain_height = 1;
aelf.MerklePath merkle_path_from_parent_chain = 2;
}

```

With the result returned by above api, you can call **VerifyTransaction** on the target chain with the following input values:

- transaction_id - the ID of the transaction that you want to verify.
- parent_chain_height - use the **bound_parent_chain_height** field of **CrossChainMerkleProofContext** .
- path - the concatenation of 2 merkle paths, in order:
 - the merkle path of the transaction, use the web api method **GetMerklePathByTransactionIdAsync**.
 - use the **merkle_path_from_parent_chain** field from the **CrossChainMerkleProofContext** object.
- verified_chain_id - the source chainId, here the side chain on which the transaction was mined.

17.5 Cross chain transfer

Cross chain transfer is one of mostly used cases when it comes to cross chain verification. AElf already supports cross chain transfer functionality in contract. This section will explain how to transfer tokens across chains. It assumes a side chain is already deployed and been indexed by the main chain.

The transfer will always use the same contract methods and the following two steps: - initiate the transfer - receive the tokens

17.5.1 Prepare

Few preparing steps are required before cross chain transfer, which is to be done only once for one chain. Just ignore this preparing part if already completed.

Let's say that you want to transfer token FOO from chain A to chain B. Note that please make sure you are already clear about how cross chain transaction verification works before you start. Any input contains **MerklePath** in the following steps means the cross chain verification processing is needed. See [cross chain verification](#) for more details.

- Validate Token Contract address on chain A.

Send transaction *tx_1* to Genesis Contract with method **ValidateSystemContractAddress**. You should provide **system_contract_hash_name** and address of Token Contract . *tx_1* would be packed in block successfully.

```

rpc ValidateSystemContractAddress(ValidateSystemContractAddressInput) returns(
  ↳(google.protobuf.Empty){}

message ValidateSystemContractAddressInput {
  aelf.Hash system_contract_hash_name = 1;
  aelf.Address address = 2;
}

```

- Register token contract address of chain A on chain B.

Create a proposal, which is proposed to **RegisterCrossChainTokenContractAddress**, for the default parliament organization (check [Parliament contract](#) for more details) on chain B. Apart from cross chain verification context, you should also provide the origin data of *tx_1* and Token Contract address on chain A.

```
rpc RegisterCrossChainTokenContractAddress_
  (RegisterCrossChainTokenContractAddressInput) returns (google.protobuf.Empty) {}

message RegisterCrossChainTokenContractAddressInput{
  int32 from_chain_id = 1;
  int64 parent_chain_height = 2;
  bytes transaction_bytes = 3;
  aelf.MerklePath merkle_path = 4;
  aelf.Address token_contract_address = 5;
}
```

- Validate TokenInfo of *FOO* on chain *A*.

Send transaction *tx_2* to Token Contract with method `ValidateTokenInfoExists` on chain *A*. You should provide TokenInfo of *FOO*. *tx_2* would be packed in block successfully.

```
rpc ValidateTokenInfoExists(ValidateTokenInfoExistsInput) returns (google.protobuf.
  Empty){}

message ValidateTokenInfoExistsInput{
  string symbol = 1;
  string token_name = 2;
  int64 total_supply = 3;
  int32 decimals = 4;
  aelf.Address issuer = 5;
  bool is_burnable = 6;
  int32 issue_chain_id = 7;
}
```

- Create token *FOO* on chain *B*.

Send transaction *tx_3* to Token Contract with method `CrossChainCreateToken` on chain *B*. You should provide the origin data of *tx_2* and cross chain verification context of *tx_2*.

```
rpc CrossChainCreateToken(CrossChainCreateTokenInput) returns (google.protobuf.
  Empty) {}

message CrossChainCreateTokenInput {
  int32 from_chain_id = 1;
  int64 parent_chain_height = 2;
  bytes transaction_bytes = 3;
  aelf.MerklePath merkle_path = 4;
}
```

17.5.2 Initiate the transfer

On the token contract of source chain, it's the `CrossChainTransfer` method that is used to trigger the transfer:

```
rpc CrossChainTransfer (CrossChainTransferInput) returns (google.protobuf.Empty) { }

message CrossChainTransferInput {
    aelf.Address to = 1;
    string symbol = 2;
    sint64 amount = 3;
    string memo = 4;
    int32 to_chain_id = 5;
    int32 issue_chain_id = 6;
}
```

The fields of the input:

- **to** - the target address to receive token
- **symbol** - symbol of token to be transferred
- **amount** - amount of token to be transferred
- **memo** - memo field in this transfer
- **to_chain_id** - destination chain id on which the tokens will be received
- **issue_chain_id** - the chain on which the token was issued

17.5.3 Receive on the destination chain

On the destination chain tokens need to be received, it's the `CrossChainReceiveToken` method that is used to trigger the reception:

```
rpc CrossChainReceiveToken (CrossChainReceiveTokenInput) returns (google.protobuf.Empty)
↪{ }

message CrossChainReceiveTokenInput {
    int32 from_chain_id = 1;
    int64 parent_chain_height = 2;
    bytes transfer_transaction_bytes = 3;
    aelf.MerklePath merkle_path = 4;
}

rpc GetBoundParentChainHeightAndMerklePathByHeight (aelf.Int64Value) returns
↪(CrossChainMerkleProofContext) {
    option (aelf.is_view) = true;
}

message CrossChainMerkleProofContext {
    int64 bound_parent_chain_height = 1;
    aelf.MerklePath merkle_path_from_parent_chain = 2;
}
```

Let's review the fields of the input

- **from_chain_id**

the source chain id on which cross chain transfer launched

- **parent_chain_height**

- for the case of transfer from main chain to side chain: this **parent_chain_height** is the height of the block on the main chain that contains the **CrossChainTransfer** transaction.
- for the case of transfer from side chain to side chain or side chain to main-chain: this **parent_chain_height** is the result of **GetBoundParentChainHeightAndMerklePathByHeight** (input is the height of the *CrossChainTransfer*, see [cross chain verification](#)) - accessible in the **bound_parent_chain_height** field.

- **transfer_transaction_bytes**

the serialized form of the **CrossChainTransfer** transaction.

- **merkle_path**

You should get this from the source chain but merkle path data construction differs among cases.

- for the case of transfer from main chain to side chain
 - * only need the merkle path from the main chain's web api **GetMerklePathByTransactionIdAsync** (**CrossChainTransfer** transaction ID as input).
- for the case of transfer from side chain to side chain or from side chain to main chain
 - * the merkle path from the source chain's web api **GetMerklePathByTransactionIdAsync** (**CrossChainTransfer** transaction ID as input).
 - * the output of **GetBoundParentChainHeightAndMerklePathByHeight** method in **Cross chain Contract** (**CrossChainTransfer** transaction's block height as input). The path nodes are in the **merkle_path_from_parent_chain** field of the **CrossChainMerkleProofContext** object.
 - * Concat above two merkle path.

SMART CONTRACT

18.1 Smart contract architecture

At its core, a blockchain platform can be viewed as a distributed multi-tenant database that holds the state of all the smart contracts deployed on it. After deployment, each smart contract will have a unique address. The address is used to scope the state and as the identifier for state queries and updates. The methods defined in the smart contract code provides the permission checks and logics for queries and updates.

In aelf, a smart contract essentially has three parts: the interface, the state, and the business logic.

1. **the interface** - aelf supports smart contracts coded in multiple languages. Protobuf format is adopted as the cross-language definition of the contract.
2. **the state** - the language specific SDK provides some prototypes for the state of different types, after the definition of properties of certain prototype, developers could query and update *state database* via accessing the properties directly.
3. **the business logic** - aelf provides protobuf plugins to generate the smart contract skeleton from the contract's proto definition. Developers just need to fill the logics for each method by override.

Smart contracts in AElf are spread across the Kernel, the runtime and the SDK. The kernel defines the fundamental components and infrastructure associated with smart contracts. It also defines the abstractions for execution. Smart contract also heavily rely on the runtime modules and the sdk project.

Smart contracts, along with the blockchain's data, form the heart of a blockchain system. They define through some predefined logic how and according to what rules the state of the blockchain is modified.

A smart contract is a collection of methods that each act upon a particular set of state variables.

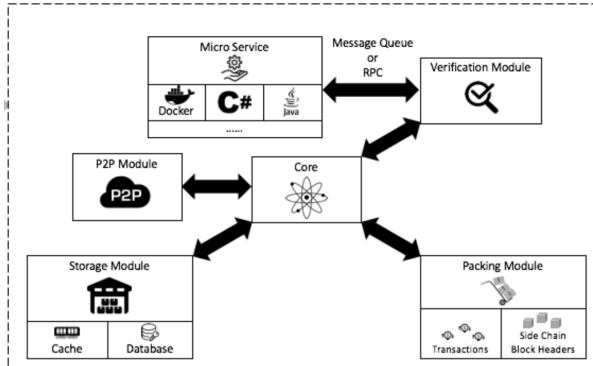
Transactions trigger the logic contained in smart contracts. If a user of the blockchain wants to modify some state, he needs to build a transaction that will call a specific method on some contract. When the transaction is included in a block and this block is executed, the modifications will be executed.

Smart contracts are a part of what makes dApps possible. They implement a part of the business layer: the part that gets included in the blockchain.

What follows in this section will give you a general overview of how AElf implements smart contracts. The other sections will walk you through different notions more specifically.

18.1.1 Architecture overview

In AElf, Smart Contracts are defined like micro-services. This makes Smart Contracts independent of specific programming languages. This implies, for example, that our Consensus Protocol essentially becomes a service because it is defined through Smart Contract.



As showed in the diagram above, smart contracts functionality is defined within the kernel. The kernel defines the fundamental components and infrastructure associated with establishing smart contracts as a service: * SDK abstracts - high-level entities that provide a hook for smart contract services to interact with the chain. * Execution - high-level primitives defined for execution

18.1.2 Chain interactions

Smart contract need to interact with the chain and have access to contextual information. For this AElf defines a bridge and a bridge host. Usually the programming SDK corresponding to the specific language will implement features to communicate with/through the bridge.

One of the major functionalities provided by the bridge is the ability to provide contextual information to the smart contract being executed. Here are a few: the **Self** field represents the address of the current contract being called. the **Sender** is the address that sent the transaction that executed the contract, and **Origin** is the address that signed the transaction. Sometimes **Sender** and **Origin** are equal. the **OriginTransactionId** is the ID of the transaction fetch from transaction pool or generated by the current miner, and **TransactionId** is the Id of the transaction is executing, which means this transaction could be an inline one.

The bridge also exposes extra functionality: contracts can fire **Events**, which are in a way similar to logging. contracts can call a method on another contract in a read-only manner. Any state change will not be persisted to the blockchain. Send inline - this actually creates a transaction to call another method. As opposed to calling the changes to the state - if any - will be persisted.

State

The main point of a smart contract is to read and/or modify state. The language SDK's implement state helpers and through the bridge's **StateProvider**.

18.1.3 Runtime and execution

When a block's transactions are executed, every transaction will generate a trace. Amongst other things, it contains: the return value of the called method, this can be anything defined in protobuf format and is defined in the service definition. error outputs, if execution encountered a problem. the results from inner calls in **InlineTraces** field. the **Logs** field will contain the events launched from the called method.

18.1.4 Sdk

AElf comes with a native C# SDK that gives smart contract developers the necessary tools to develop smart contracts in C#. It contains helpers to communicate with the bridge. By using the SDK, you can also take advantage of the type infrastructure defined in the library: **ContractState**: an interface that is implemented by a class that is destined to be containers for the state field. **MappedState**: a base type that defines **collections** a key-value mapping, generic subclasses are available to enable multi-key scenarios. **SingletonState**: this defines **non-collection** types with a

Any developer or company can develop an sdk and a runtime for a specific language by creating an adapter to communicate with the bridge through gRPC.

18.2 Smart contract service

When writing a smart contract in AElf the first thing that need to be done is to define it so it can then be generate by our tools. AElf contracts are defined as services that are currently defined and generated with gRPC and protobuf.

As an example, here is part of the definition of our multi-token contract. Each functionality will be explained more in detail in their respective sections. Note that for simplicity, the contract has been simplified to show only the essential.

```
syntax = "proto3";

package token;
option csharp_namespace = "AElf.Contracts.MultiToken.Messages";

service TokenContract {
    option (aelf.csharp_state) = "AElf.Contracts.MultiToken.TokenContractState";

    // Actions
    rpc Create (CreateInput) returns (google.protobuf.Empty) { }
    rpc Transfer (TransferInput) returns (google.protobuf.Empty) { }

    // Views
    rpc GetBalance (GetBalanceInput) returns (GetBalanceOutput) {
        option (aelf.is_view) = true;
    }
}
```

For the service we have two different types of methods:

- Actions - these are normal smart contract methods that take input and output and usually modify the state of the chain.
- Views - these methods are special in the sense that they do not modify the state of the chain. They are usually used in some way to query the value of the contracts state.

```
rpc Create (CreateInput) returns (google.protobuf.Empty) { }
```

The services takes a protobuf message as input and also returns a protobuf message as output. Note that here it returns a special message - `google.protobuf.Empty` - that signifies returning nothing. As a convention we append `Input` to any protobuf type that is destined to be a parameter to a service.

18.2.1 View option

```
rpc GetBalance (GetBalanceInput) returns (GetBalanceOutput) {  
    option (aelf.is_view) = true;  
}
```

This service is annotated with a view option. This signifies that this is a readonly method and will not modify the state.

18.3 Smart contract events

18.3.1 Event option

During the execution, Events are used internally to represent events that have happened during the execution of a smart contract. The event will be logged in the transaction traces logs (a collection of `LogEvents`).

```
message Transferred {  
    option (aelf.is_event) = true;  
    aelf.Address from = 1 [(aelf.is_indexed) = true];  
    aelf.Address to = 2 [(aelf.is_indexed) = true];  
    string symbol = 3 [(aelf.is_indexed) = true];  
    sint64 amount = 4;  
    string memo = 5;  
}
```

Notice the `option (aelf.is_event) = true;` line which indicates that the **Transferred** message is destined to be an event.

The following code demonstrates how to fire the event in a contract:

```
Context.Fire(new Transferred()  
{  
    From = from,  
    To = to,  
    ...  
});
```

External code to the contract can monitor this after the execution of the transaction.

18.4 Smart contract messages

Here we define the concept of the message as defined by the protobuf language. We heavily use these messages to call smart contracts and serializing their state. The following is the definition of a simple message:

```
message CreateInput {
    string symbol = 1;
    sint64 totalSupply = 2;
    sint32 decimals = 3;
}
```

Here we see a message with three fields of type string, sint64 and sint32. In the message, you can use any type supported by protobuf, including composite messages, where one of your messages contains another message.

For message and service definitions, we use the **proto3** version of the protobuf language. You probably won't need to use most of the features that are provided, but here's the [full reference](#) for the language.

18.5 Development Requirements and Restrictions

There are several requirements and restrictions for a contract to be deployable that are classified into below categories:

18.5.1 Contract Project Requirements

Project Properties

- It is necessary to add a contract proto file to the contract directory of your contract project. This step ensures that the contract's DLL will undergo post-processing by AElf's contract patcher, enabling it to perform the necessary injections required for code checks during deployment. Failure to do so will result in a deployment failure

```
src
├── Protobuf
│   └── contract
│       └── hello_world_contract.proto
```

- It is required to enable `CheckForOverflowUnderflow` for both Release and Debug mode so that your contract will use arithmetic operators that will throw `OverflowException` if there is any overflow. This is to ensure that execution will not continue in case of an overflow in your contract and result with unpredictable output.

```
<PropertyGroup Condition=" '$(Configuration)' == 'Debug' ">
  <CheckForOverflowUnderflow>true</CheckForOverflowUnderflow>
</PropertyGroup>

<PropertyGroup Condition=" '$(Configuration)' == 'Release' ">
  <CheckForOverflowUnderflow>true</CheckForOverflowUnderflow>
</PropertyGroup>
```

If your contract contains any unchecked arithmetic operators, deployment will fail.

18.5.2 Contract Class Structure

Below restrictions are put in place to simplify code checks during deployment:

- Only 1 inheritance is allowed from `ContractBase` which is generated by the contract plugin as a nested type in `ContractContainer` and only 1 inheritance will be allowed from `CSharpSmartContract`. If there are multiple inheritances from `ContractBase` or `CSharpSmartContract`, code deployment will fail.
- Only 1 inheritance will be allowed from `ContractState`. Similar to above, if there are multiple inheritance from `AEIlf.Sdk.ContractState`, code check will fail.
- The type inherited from `ContractState` should be the element type of `CSharpSmartContract` generic instance type, otherwise code check will fail.

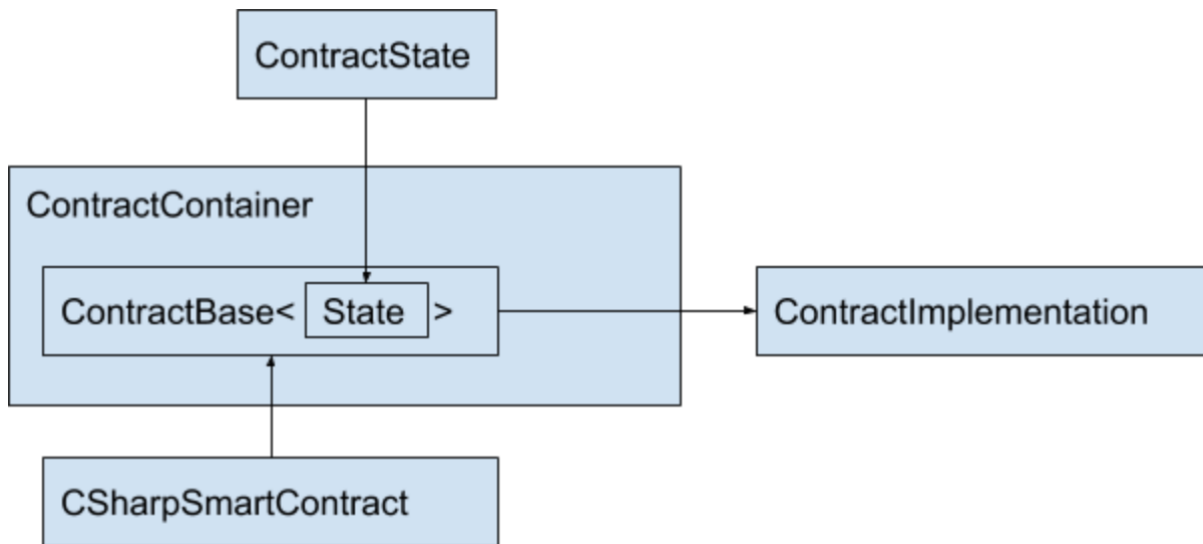


Fig. 1: Contract Class Structure

Limitations on Field Usage

In Contract Implementation Class

- Initial value for non-readonly, non-constant fields is not allowed. (Applied to all static / non-static fields) The reason is, their value will be reset to 0 or null after first execution and their initial value will be lost.

Allowed:

```
class MyContract : MyContractBase
{
    int test;
    static const int test = 2;
}
```

Not Allowed:

```
class MyContract : MyContractBase
{
```

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```
! int test = 2;
}
```

```
class MyContract : MyContractBase
{
    int test;

    public MyContract
    {
        ! test = 2;
    }
}
```

- Only primitive types, or one of below types are allowed for readonly / constant fields:

| Type |
|--------------------------|
| All Primitive Types |
| Marshaller<T> |
| Method<T, T> |
| MessageParser<T> |
| FieldCodec<T> |
| MapField<T, T> |
| ReadOnlyCollection<T> |
| ReadOnlyDictionary<T, T> |

* T can only be primitive type

In Non-Contract Classes (For classes that don't inherit from ContractBase<T>)

- Initial value for non-readonly, non-constant fields is not allowed for static fields. The reason is, their value will be reset to 0 or null after first execution and their initial value will be lost.

Allowed:

```
class AnyClass
{
    static int test;
}
```

Not Allowed:

```
class AnyClass
{
    ! static int test = 2;
}
```

```
class AnyClass
{
    static int test;
```

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```

public AnyClass
{
!   test = 2;
}
}

```

Exception Case: Fields with FileDescriptor types. This is due to protobuf generated code. There are static fields FileDescriptor type fields generated by protobuf code and these fields don't have readonly modifier. We allow such fields only if they are FileDescriptor type and write access to these fields are only allowed from the constructor of the type where descriptor field is declared.

Allowed:

```

public class TestType
{
    private static FileDescriptor test;

    public class TestType
    {
        test = ...
    }
}

```

Not Allowed:

```

public class TestType
{
    private static FileDescriptor test;

    public TestType
    {
        test = ...
    }

!   public void SetFromSomeWhereElse(FileDescriptor input)
!   {
!       test = input;
!   }
}

```

Accessing to set test field is restricted to its declaring type's constructor only.

- Only below types are allowed for readonly / constant static fields:

| Type |
|--------------------------|
| All Primitive Types |
| Marshaller<T> |
| Method<T, T> |
| MessageParser<T> |
| FieldCodec<T> |
| MapField<T, T> |
| ReadonlyCollection<T> |
| ReadonlyDictionary<T, T> |

* T can only be primitive type

Exception Case: If a type has a readonly field same type as itself, it is only allowed if the type has no instance field.

This is to support Linq related generated types.

Allowed:

```
public class TestType
{
    private static readonly TestType test;

    private static int i;
}
```

Not Allowed:

```
public class TestType
{
    private static readonly TestType test;

    ! private int i;
}
```

In Contract State

In contract state, only below types are allowed:

| Primitive Types |
|-----------------|
| BoolState |
| Int32State |
| UInt32State |
| Int64State |
| UInt64State |
| StringState |
| BytesState |

| Complex Types |
|----------------------------|
| SingletonState<T> |
| ReadonlyState<T> |
| MappedState<T, T> |
| MappedState<T, T, T> |
| MappedState<T, T, T, T> |
| MappedState<T, T, T, T, T> |
| MethodReference<T, T> |
| ProtobufState<T> |
| ContractReferenceState |

18.5.3 Type and Namespace Restrictions

Nodes checks new contract code against below whitelist and if there is a usage of any type that is not covered in the whitelist, or the method access or type name is denied in below whitelist, the deployment will fail.

Assembly Dependencies

| Assembly | Trust |
|-------------------------------|---------|
| netstandard.dll | Partial |
| System.Runtime.dll | Partial |
| System.Runtime.Extensions.dll | Partial |
| System.Private.CoreLib.dll | Partial |
| System.ObjectModel.dll | Partial |
| System.Linq.dll | Full |
| System.Collections | Full |
| Google.Protobuf.dll | Full |
| AElf.Sdk.CSharp.dll | Full |
| AElf.Types.dll | Full |
| AElf.CSharp.Core.dll | Full |
| AElf.Cryptography.dll | Full |

Types and Members Whitelist in System Namespace

| Type | Member (Field / Method) | Allowed |
|-----------------------------|-------------------------|---------|
| Array | AsReadOnly | Allowed |
| Func<T> | ALL | Allowed |
| Func<T, T> | ALL | Allowed |
| Func<T, T, T> | ALL | Allowed |
| Nullable<T> | ALL | Allowed |
| Environment | CurrentManagedThreadId | Allowed |
| BitConverter | GetBytes | Allowed |
| NotImplementedException | ALL | Allowed |
| NotSupportedException | ALL | Allowed |
| ArgumentOutOfRangeException | ALL | Allowed |
| DateTime | Partially | Allowed |
| DateTime | Now, UtcNow, Today | Denied |
| Uri | TryCreate | Allowed |
| Uri | Scheme | Allowed |
| Uri | UriSchemeHttp | Allowed |
| Uri | UriSchemeHttps | Allowed |
| void | ALL | Allowed |
| object | ALL | Allowed |
| Type | ALL | Allowed |
| IDisposable | ALL | Allowed |
| Convert | ALL | Allowed |
| Math | ALL | Allowed |
| bool | ALL | Allowed |
| byte | ALL | Allowed |

continues on next page

Table 1 – continued from previous page

| Type | Member (Field / Method) | Allowed |
|---------|-------------------------|---------|
| sbyte | ALL | Allowed |
| char | ALL | Allowed |
| int | ALL | Allowed |
| uint | ALL | Allowed |
| long | ALL | Allowed |
| ulong | ALL | Allowed |
| decimal | ALL | Allowed |
| string | ALL | Allowed |
| string | Constructor | Denied |
| Byte[] | ALL | Allowed |

Types and Members Whitelist in System.Reflection Namespace

| Type | Member (Field / Method) | Allowed |
|---------------------------------------|-------------------------|---------|
| AssemblyCompanyAttribute | ALL | Allowed |
| AssemblyConfigurationAttribute | ALL | Allowed |
| AssemblyFileVersionAttribute | ALL | Allowed |
| AssemblyInformationalVersionAttribute | ALL | Allowed |
| AssemblyProductAttribute | ALL | Allowed |
| AssemblyTitleAttribute | ALL | Allowed |

Other Whitelisted Namespaces

| Namespace | Type | Member | Allowed |
|---------------------------------|----------------|--------------------|---------|
| System.Linq | ALL | ALL | Allowed |
| System.Collections | ALL | ALL | Allowed |
| System.Collections.Generic | ALL | ALL | Allowed |
| System.Collections.ObjectModel | ALL | ALL | Allowed |
| System.Globalization | CultureInfo | InvariantCulture | Allowed |
| System.Runtime.CompilerServices | RuntimeHelpers | InitializeArray | Allowed |
| System.Text | Encoding | UTF8, GetByteCount | Allowed |

Allowed Types for Arrays

| Type | Array Size Limit |
|----------------------|------------------|
| byte | 40960 |
| short | 20480 |
| int | 10240 |
| long | 5120 |
| ushort | 20480 |
| uint | 10240 |
| ulong | 5120 |
| decimal | 2560 |
| char | 20480 |
| string | 320 |
| Type | 5 |
| Object | 5 |
| FileDescriptor | 10 |
| GeneratedClrTypeInfo | 100 |

18.5.4 Other Restrictions

GetHashCode Usage

- *GetHashCode* method is only allowed to be called within *GetHashCode* methods. Calling *GetHashCode* methods from other methods is not allowed. This allows developers to implement their custom *GetHashCode* methods for their self defined types if required, and also allows protobuf generated message types.
- It is not allowed to set any field within *GetHashCode* methods.

Execution observer

- AElf's contract patcher will patch method call count observer for your contract. This is used to prevent infinitely method call like recursion. The number of method called in your contract will be counted during transaction execution. The observer will pause transaction execution if the number exceeds 15,000. The limit adjustment is governed by Parliament.
- AElf's contract patcher will patch method branch count observer for your contract. This is used to prevent infinitely loop case. The number of code control transfer in your contract will be counted during transaction execution. The observer will pause transaction execution if the number exceeds 15,000. The limit adjustment is governed by Parliament. The control transfer opcodes in C# contract are shown as below.

| |
|-------------------|
| Opcode |
| OpCodes.Beq |
| OpCodes.Beq_S |
| OpCodes.Bge |
| OpCodes.Bge_S |
| OpCodes.Bge_Un |
| OpCodes.Bge_Un_S |
| OpCodes.Bgt |
| OpCodes.Bgt_S |
| OpCodes.Ble |
| OpCodes.Ble_S |
| OpCodes.Ble_Un |
| OpCodes.Blt |
| OpCodes.Bne_Un |
| OpCodes.Bne_Un_S |
| OpCodes.Br |
| OpCodes.Brfalse |
| OpCodes.Brfalse_S |
| OpCodes.Brtrue |
| OpCodes.Brtrue |
| OpCodes.Brtrue_S |
| OpCodes.Br_S |

State size limit

- The size of data written to `State` would be limited every time. AElf's contract patcher is going to patch the code to validate your contract. As a result, you cannot write too big thing to contract and the limit is 128k by default. The limit adjustment is governed by `Parliament`.

AELF API 1.0

19.1 Chain API

19.1.1 Get information about a given block by block hash. Optionally with the list of its transactions.

| |
|---------------------------|
| GET /api/blockChain/block |
|---------------------------|

Parameters

| Type | Name | Description | Schema | Default |
|-------|--|-----------------------------|---------|---------|
| Query | blockHash <i>optional</i> | block hash | string | |
| Query | include Transactions <i>optional</i> | include transactions or not | boolean | "false" |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|-----------------|
| 200 | Success | <i>BlockDto</i> |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.2 Get information about a given block by block height. Optionally with the list of its transactions.

| |
|-----------------------------------|
| GET /api/blockChain/blockByHeight |
|-----------------------------------|

Parameters

| Type | Name | Description | Schema | Default |
|-------|--|-----------------------------|-----------------|---------|
| Query | blockHeight <i>optional</i> | block height | integer (int64) | |
| Query | include Transactions <i>optional</i> | include transactions or not | boolean | "false" |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|--------------------------|
| 200 | Success | BlockDto |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.3 Get the height of the current chain.

GET /api/blockChain/blockHeight

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|-----------------|
| 200 | Success | integer (int64) |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.4 Get the current state about a given block

GET /api/blockChain/blockState

Parameters

| Type | Name | Description | Schema |
|-------|----------------------------------|-------------|--------|
| Query | blockHash <i>optional</i> | block hash | string |

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|----------------------|
| 200 | Success | <i>BlockStateDto</i> |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.5 Get the current status of the block chain.

GET /api/blockChain/chainStatus

Responses

| HTTP Code | Description | Schema |
|------------|-------------|-----------------------|
| 200 | Success | <i>ChainStatusDto</i> |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.6 Get the protobuf definitions related to a contract

GET /api/blockChain/contractFileDescriptorSet

Parameters

| Type | Name | Description | Schema |
|--------------|--------------------------------|------------------|--------|
| Query | address <i>optional</i> | contract address | string |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|---------------|
| 200 | Success | string (byte) |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Blockchain

19.1.7 POST /api/blockChain/executeRawTransaction

Parameters

| Type | Name | Schema |
|-------------|------------------------------|---------------------------------|
| Body | input <i>optional</i> | <i>ExecuteRawTransactionDto</i> |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|--------|
| 200 | Success | string |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Blockchain

19.1.8 Call a read-only method on a contract.

POST /api/blockChain/executeTransaction

Parameters

| Type | Name | Schema |
|------|----------------|------------------------------|
| Body | input optional | <i>ExecuteTransactionDto</i> |

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|--------|
| 200 | Success | string |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.9 Get the merkle path of a transaction.

```
GET /api/blockChain/merklePathByTransactionId
```

Parameters

| Type | Name | Schema |
|-------|--------------------------------------|--------|
| Query | transactionId <i>optional</i> | string |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|-------------------------------|
| 200 | Success | MerklePathDto |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.10 Creates an unsigned serialized transaction

```
POST /api/blockChain/rawTransaction
```

Parameters

| Type | Name | Schema |
|------|------------------------------|---|
| Body | input <i>optional</i> | CreateRawTransactionInput |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|-----------------------------------|
| 200 | Success | <i>CreateRawTransactionOutput</i> |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.11 send a transaction

POST /api/blockChain/sendRawTransaction

Parameters

| Type | Name | Schema |
|-------------|------------------------------|--------------------------------|
| Body | input <i>optional</i> | <i>SendRawTransactionInput</i> |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|---------------------------------|
| 200 | Success | <i>SendRawTransactionOutput</i> |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.12 Broadcast a transaction

POST /api/blockChain/sendTransaction

Parameters

| Type | Name | Schema |
|-------------|------------------------------|-----------------------------|
| Body | input <i>optional</i> | <i>SendTransactionInput</i> |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|------------------------------|
| 200 | Success | <i>SendTransactionOutput</i> |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.13 Broadcast multiple transactions

POST /api/blockChain/sendTransactions

Parameters

| Type | Name | Schema |
|-------------|------------------------------|------------------------------|
| Body | input <i>optional</i> | <i>SendTransactionsInput</i> |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|------------------|
| 200 | Success | < string > array |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.14 Estimate transaction fee

POST /api/blockChain/calculateTransactionFee

Parameters

| Type | Name | Schema | Default |
|------|----------------|-------------------------------------|---------|
| Body | Input optional | <i>CalculateTransactionFeeInput</i> | |

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|--------------------------------------|
| 200 | Success | <i>CalculateTransactionFeeOutput</i> |

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.15 GET /api/blockChain/taskQueueStatus

Responses

| HTTP Code | Description | Schema |
|------------|-------------|-----------------------------------|
| 200 | Success | < <i>TaskQueueInfoDto</i> > array |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.16 Get the transaction pool status.

GET /api/blockChain/transactionPoolStatus

Responses

| HTTP Code | Description | Schema |
|------------|-------------|---------------------------------------|
| 200 | Success | <i>GetTransactionPoolStatusOutput</i> |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.17 Get the current status of a transaction

```
GET /api/blockChain/transactionResult
```

Parameters

| Type | Name | Description | Schema |
|-------|--------------------------------------|----------------|--------|
| Query | transactionId <i>optional</i> | transaction id | string |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|--------------------------------------|
| 200 | Success | TransactionResultDto |

The transaction result DTO object returned contains the transaction that contains the parameter values used for the call. The node will return the byte array as a base64 encoded string if it can't decode it.

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.1.18 Get multiple transaction results.

```
GET /api/blockChain/transactionResults
```

Parameters

| Type | Name | Description | Schema | Default |
|-------|----------------------------------|-------------|-----------------|---------|
| Query | blockHash <i>optional</i> | block hash | string | |
| Query | limit <i>optional</i> | limit | integer (int32) | 10 |
| Query | offset <i>optional</i> | offset | integer (int32) | 0 |

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|---------------------------------------|
| 200 | Success | < <i>TransactionResultDto</i> > array |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Blockchain

19.2 Net API

19.2.1 Get information about the node's connection to the network.

GET /api/net/networkInfo

Responses

| HTTP Code | Description | Schema |
|-----------|-------------|-----------------------------|
| 200 | Success | <i>GetNetworkInfoOutput</i> |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Net

19.2.2 Attempts to add a node to the connected network nodes

POST /api/net/peer

Parameters

| Type | Name | Schema |
|------|------------------------------|------------------------------|
| Body | input <i>optional</i> | AddPeerInput |

Responses

| HTTP Code | Description | Schema |
|------------|--------------|---------|
| 200 | Success | boolean |
| 401 | Unauthorized | |

Security

- Basic Authentication

Consumes

- application/json-patch+json; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/*+json; v=1.0
- application/x-protobuf; v=1.0

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Net

19.2.3 Attempts to remove a node from the connected network nodes

DELETE /api/net/peer

Parameters

| Type | Name | Description | Schema |
|--------------|--------------------------------|-------------|--------|
| Query | address <i>optional</i> | ip address | string |

Responses

| HTTP Code | Description | Schema |
|------------|--------------|---------|
| 200 | Success | boolean |
| 401 | Unauthorized | |

Security

- Basic Authentication

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- Net

19.2.4 Get peer info about the connected network nodes

```
GET /api/net/peers
```

Parameters

| Type | Name | Schema | Default |
|-------|------------------------------------|---------|---------|
| Query | withMetrics <i>optional</i> | boolean | "false" |

Responses

| HTTP Code | Description | Schema |
|------------|-------------|--------------------------|
| 200 | Success | < <i>PeerDto</i> > array |

Produces

- text/plain; v=1.0
- application/json; v=1.0
- text/json; v=1.0
- application/x-protobuf; v=1.0

Tags

- BlockChain

19.2.5 Definitions

AddPeerInput

| Name | Description | Schema |
|--------------------------------|-------------|--------|
| Address <i>optional</i> | ip address | string |

BlockBodyDto

| Name | Schema |
|--|------------------|
| Transactions <i>optional</i> | < string > array |
| TransactionsCount <i>optional</i> | integer (int32) |

BlockDto

| Name | Schema |
|----------------------------------|--------------------------------|
| BlockHash <i>optional</i> | string |
| Body <i>optional</i> | BlockBodyDto |
| Header <i>optional</i> | BlockHeaderDto |
| BlockSize <i>optional</i> | integer (int32) |

BlockHeaderDto

| Name | Schema |
|---|--------------------|
| Bloom <i>optional</i> | string |
| ChainId <i>optional</i> | string |
| Extra <i>optional</i> | string |
| Height <i>optional</i> | integer (int64) |
| MerkleTreeRootOfTransactions <i>optional</i> | string |
| MerkleTreeRootOfWorldState <i>optional</i> | string |
| MerkleTreeRootOfTransactionState <i>optional</i> | string |
| PreviousBlockHash <i>optional</i> | string |
| SignerPubkey <i>optional</i> | string |
| Time <i>optional</i> | string (date-time) |

BlockStateDto

| Name | Schema |
|-------------------------------------|------------------------|
| BlockHash <i>optional</i> | string |
| BlockHeight <i>optional</i> | integer (int64) |
| Changes <i>optional</i> | < string, string > map |
| Deletes <i>optional</i> | < string > array |
| PreviousHash <i>optional</i> | string |

ChainStatusDto

| Name | Schema |
|--|---------------------------------|
| BestChainHash <i>optional</i> | string |
| BestChainHeight <i>optional</i> | integer (int64) |
| Branches <i>optional</i> | < string, integer (int64) > map |
| ChainId <i>optional</i> | string |
| GenesisBlockHash <i>optional</i> | string |
| GenesisContractAddress <i>optional</i> | string |
| LastIrreversibleBlockHash <i>optional</i> | string |
| LastIrreversibleBlockHeight <i>optional</i> | integer (int64) |
| LongestChainHash <i>optional</i> | string |
| LongestChainHeight <i>optional</i> | integer (int64) |
| NotLinkedBlocks <i>optional</i> | < string, string > map |

CreateRawTransactionInput

| Name | Description | Schema |
|---------------------------------------|----------------------------|-----------------|
| From <i>required</i> | from address | string |
| MethodName <i>required</i> | contract method name | string |
| Params <i>required</i> | contract method parameters | string |
| RefBlockHash <i>required</i> | refer block hash | string |
| RefBlockNumber <i>required</i> | refer block height | integer (int64) |
| To <i>required</i> | to address | string |

CreateRawTransactionOutput

| Name | Schema |
|---------------------------------------|--------|
| RawTransaction <i>optional</i> | string |

ExecuteRawTransactionDto

| Name | Description | Schema |
|---------------------------------------|-----------------|--------|
| RawTransaction <i>optional</i> | raw transaction | string |
| Signature <i>optional</i> | signature | string |

ExecuteTransactionDto

| Name | Description | Schema |
|---------------------------------------|-----------------|--------|
| RawTransaction <i>optional</i> | raw transaction | string |

GetNetworkInfoOutput

| Name | Description | Schema |
|--|--|-----------------|
| Connections <i>optional</i> | total number of open connections between this node and other nodes | integer (int32) |
| ProtocolVersion <i>optional</i> | network protocol version | integer (int32) |
| Version <i>optional</i> | node version | string |

GetTransactionPoolStatusOutput

| Name | Schema |
|----------------------------------|-----------------|
| Queued <i>optional</i> | integer (int32) |
| Validated <i>optional</i> | integer (int32) |

LogEventDto

| Name | Schema |
|-----------------------------------|------------------|
| Address <i>optional</i> | string |
| Indexed <i>optional</i> | < string > array |
| Name <i>optional</i> | string |
| NonIndexed <i>optional</i> | string |

MerklePathDto

| Name | Schema |
|--|---|
| MerklePathNodes <i>optional</i> | < MerklePathNodeDto > array |

MerklePathNodeDto

| Name | Schema |
|--|---------|
| Hash <i>optional</i> | string |
| IsLeftChildNode <i>optional</i> | boolean |

MinerInRoundDto

| Name | Schema |
|---|------------------------------|
| ActualMiningTimes <i>optional</i> | < string (date-time) > array |
| ExpectedMiningTime <i>optional</i> | string (date-time) |
| ImpliedIrreversibleBlockHeight <i>optional</i> | integer (int64) |
| InValue <i>optional</i> | string |
| MissedBlocks <i>optional</i> | integer (int64) |
| Order <i>optional</i> | integer (int32) |
| OutValue <i>optional</i> | string |
| PreviousInValue <i>optional</i> | string |
| ProducedBlocks <i>optional</i> | integer (int64) |
| ProducedTinyBlocks <i>optional</i> | integer (int32) |

PeerDto

| Name | Schema |
|---|---|
| BufferedAnnouncementsCount <i>optional</i> | integer (int32) |
| BufferedBlocksCount <i>optional</i> | integer (int32) |
| BufferedTransactionsCount <i>optional</i> | integer (int32) |
| ConnectionTime <i>optional</i> | integer (int64) |
| Inbound <i>optional</i> | boolean |
| IpAddress <i>optional</i> | string |
| ProtocolVersion <i>optional</i> | integer (int32) |
| RequestMetrics <i>optional</i> | < RequestMetric > array |
| ConnectionStatus <i>optional</i> | string |
| NodeVersion <i>optional</i> | string |

RequestMetric

| Name | Schema |
|--------------------------------------|---------------------------|
| Info <i>optional</i> | string |
| MethodName <i>optional</i> | string |
| RequestTime <i>optional</i> | Timestamp |
| RoundTripTime <i>optional</i> | integer (int64) |

RoundDto

| Name | Schema |
|--|---|
| ConfirmedIrreversibleBlockHeight <i>optional</i> | integer (int64) |
| ConfirmedIrreversibleBlockRoundNumber <i>optional</i> | integer (int64) |
| ExtraBlockProducerOfPreviousRound <i>optional</i> | string |
| IsMinerListJustChanged <i>optional</i> | boolean |
| RealTimeMinerInformation <i>optional</i> | < string, MinerInRoundDto > map |
| RoundId <i>optional</i> | integer (int64) |
| RoundNumber <i>optional</i> | integer (int64) |
| TermNumber <i>optional</i> | integer (int64) |

SendRawTransactionInput

| Name | Description | Schema |
|--|----------------------------------|---------|
| ReturnTransaction <i>optional</i> | return transaction detail or not | boolean |
| Signature <i>optional</i> | signature | string |
| Transaction <i>optional</i> | raw transaction | string |

SendRawTransactionOutput

| Name | Schema |
|--------------------------------------|---------------------------------------|
| Transaction <i>optional</i> | <i>TransactionDto</i> |
| TransactionId <i>optional</i> | string |

SendTransactionInput

| Name | Description | Schema |
|---------------------------------------|-----------------|--------|
| RawTransaction <i>optional</i> | raw transaction | string |

SendTransactionOutput

| Name | Schema |
|--------------------------------------|--------|
| TransactionId <i>optional</i> | string |

SendTransactionsInput

| Name | Description | Schema |
|--|------------------|--------|
| RawTransactions <i>optional</i> | raw transactions | string |

TaskQueueInfoDto

| Name | Schema |
|-----------------------------|-----------------|
| Name <i>optional</i> | string |
| Size <i>optional</i> | integer (int32) |

Timestamp

| Name | Schema |
|--------------------------------|-----------------|
| Nanos <i>optional</i> | integer (int32) |
| Seconds <i>optional</i> | integer (int64) |

TransactionDto

| Name | Schema |
|---------------------------------------|-----------------|
| From <i>optional</i> | string |
| MethodName <i>optional</i> | string |
| Params <i>optional</i> | string |
| RefBlockNumber <i>optional</i> | integer (int64) |
| RefBlockPrefix <i>optional</i> | string |
| Signature <i>optional</i> | string |
| To <i>optional</i> | string |

TransactionResultDto

| Name | Schema |
|--|---------------------------------------|
| BlockHash <i>optional</i> | string |
| BlockNumber <i>optional</i> | integer (int64) |
| Bloom <i>optional</i> | string |
| Error <i>optional</i> | string |
| Logs <i>optional</i> | < LogEventDto > array |
| ReturnValue <i>optional</i> | string |
| Status <i>optional</i> | string |
| Transaction <i>optional</i> | TransactionDto |
| TransactionId <i>optional</i> | string |
| TransactionSize <i>optional</i> | integer (int32) |

CalculateTransactionFeeInput

| Name | Schema |
|--------------------------------------|--------|
| RawTrasaction <i>optional</i> | string |

CalculateTransactionFeeOutput

| Name | Schema |
|---------------------------------------|--------------------------|
| Success <i>optional</i> | bool |
| TransactionFee <i>optional</i> | Dictionary<string, long> |
| ResourceFee <i>optional</i> | Dictionary<string, long> |

20.1 aelf-sdk.js - AELF JavaScript API

20.1.1 Introduction

aelf-sdk.js for aelf is like web.js for ethereum.

aelf-sdk.js is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.js, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.js](#)

20.1.2 Adding aelf-sdk.js

First you need to get aelf-sdk.js into your project. This can be done using the following methods:

npm: `npm install aelf-sdk`

pure js: `link dist/aelf.umd.js`

After that you need to create a aelf instance and set a provider.

```
// in brower use: <script src="https://unpkg.com/aelf-sdk@lastest/dist/aelf.umd.js"></  
↪script>  
// in node.js use: const AElf = require('aelf-sdk');  
const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:8000'));
```

20.1.3 Examples

You can also see full examples in `./examples`;

Create instance

Create a new instance of AElf, connect to an AELF chain node.

```
import AElf from 'aelf-sdk';

// create a new instance of AElf
const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:1235'));
```

Create or load a wallet

Create or load a wallet with AElf.wallet

```
// create a new wallet
const newWallet = AElf.wallet.createNewWallet();
// load a wallet by private key
const privateKeyWallet = AElf.wallet.getWalletByPrivateKey('xxxxxxx');
// load a wallet by mnemonic
const mnemonicWallet = AElf.wallet.getWalletByMnemonic('set kite ...');
```

Get a system contract address

Get a system contract address, take AElf.ContractNames.Token as an example

```
const tokenContractName = 'AElf.ContractNames.Token';
let tokenContractAddress;
(async () => {
  // get chain status
  const chainStatus = await aelf.chain.getChainStatus();
  // get genesis contract address
  const GenesisContractAddress = chainStatus.GenesisContractAddress;
  // get genesis contract instance
  const zeroContract = await aelf.chain.contractAt(GenesisContractAddress, newWallet);
  // Get contract address by the read only method `GetContractAddressByName` of genesis
  ↪ contract
  tokenContractAddress = await zeroContract.GetContractAddressByName.call(AElf.utils.
  ↪ sha256(tokenContractName));
})();
```

Get a contract instance

Get a contract instance by contract address

```
const wallet = AElf.wallet.createNewWallet();
let tokenContract;
// Use token contract for examples to demonstrate how to get a contract instance in
  ↪ different ways
// in async function
(async () => {
  tokenContract = await aelf.chain.contractAt(tokenContractAddress, wallet)
```

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```

})();

// promise way
aelf.chain.contractAt(tokenContractAddress, wallet)
  .then(result => {
    tokenContract = result;
  });

// callback way
aelf.chain.contractAt(tokenContractAddress, wallet, (error, result) => {if (error) throw
↪error; tokenContract = result;});

```

Use contract instance

How to use contract instance

A contract instance consists of several contract methods and methods can be called in ↪two ways: read-only and send transaction.

```

(async () => {
  // get the balance of an address, this would not send a transaction,
  // or store any data on the chain, or required any transaction fee, only get the ↪
  ↪balance
  // with `.call` method, `aelf-sdk` will only call read-only method
  const result = await tokenContract.GetBalance.call({
    symbol: "ELF",
    owner: "7s4XoUHfPuqoZAwnTV7pHWZAaivMil8aZrDSnY9brE1woa8vz"
  });
  console.log(result);
  /**
   {
     "symbol": "ELF",
     "owner": "2661mQaaPnzLCoqXPeys3Vzf2wtGM1kSrqVBgNY4JUaGBxEsX8",
     "balance": "10000000000000"
   }*/
  // with no `.call`, `aelf-sdk` will sign and send a transaction to the chain, and ↪
  ↪return a transaction id.
  // make sure you have enough transaction fee `ELF` in your wallet
  const transactionId = await tokenContract.Transfer({
    symbol: "ELF",
    to: "7s4XoUHfPuqoZAwnTV7pHWZAaivMil8aZrDSnY9brE1woa8vz",
    amount: "10000000000",
    memo: "transfer in demo"
  });
  console.log(transactionId);
  /**
   {
     "TransactionId": "123123"
   }
  */
})();

```

Change the node endpoint

Change the node endpoint by using `aelf.setProvider`

```
import AElf from 'aelf-sdk';

const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:1235'));
aelf.setProvider(new AElf.providers.HttpProvider('http://127.0.0.1:8000'));
```

20.1.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html``

tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

parameters and returns based on the URL: <https://aelf-public-node.aelf.io/swagger/index.html>

The usage of these methods is based on the AElf instance, so if you don't have one please create it:

```
import AElf from 'aelf-sdk';

// create a new instance of AElf, change the URL if needed
const aelf = new AElf(new AElf.providers.HttpProvider('http://127.0.0.1:1235'));
```

1.getChainStatus

Get the current status of the block chain.

Web API path

`/api/blockChain/chainStatus`

GET

Parameters

Empty

Returns

- Object
 - ChainId - String
 - Branches - Object
 - NotLinkedBlocks - Object
 - LongestChainHeight - Number
 - LongestChainHash - String
 - GenesisBlockHash - String
 - GenesisContractAddress - String
 - LastIrreversibleBlockHash - String
 - LastIrreversibleBlockHeight - Number
 - BestChainHash - String

– BestChainHeight – Number

Example

```
aelf.chain.getChainStatus()
.then(res => {
  console.log(res);
})
```

2.getContractFileDescriptorSet

Get the protobuf definitions related to a contract

Web API path

/api/blockChain/contractFileDescriptorSet

GET

Parameters

- contractAddress – String address of a contract

Returns

- String

Example

```
aelf.chain.getContractFileDescriptorSet(contractAddress)
.then(res => {
  console.log(res);
})
```

3.getBlockHeight

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

GET

Parameters

Empty

Returns

- Number

Example

```
aelf.chain.getBlockHeight()
.then(res => {
  console.log(res);
})
```

4.getBlock

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- blockHash - String
- includeTransactions - Boolean :
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- Object
 - BlockHash - String
 - Header - Object
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - Array
 - * Height - Number
 - * Time - google.protobuf.Timestamp
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String
 - Body - Object
 - * TransactionsCount - Number
 - * Transactions - Array
 - transactionId - String

Example

```
aelf.chain.getBlock(blockHash, false)
  .then(res => {
    console.log(res);
  })
```

5.getBlockByHeight

Web API path

/api/blockChain/blockByHeight

Get block information by block height.

Parameters

- blockHeight - Number
- includeTransactions - Boolean :
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- Object
 - BlockHash - String
 - Header - Object
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - Array
 - * Height - Number
 - * Time - google.protobuf.Timestamp
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String
 - Body - Object
 - * TransactionsCount - Number
 - * Transactions - Array
 - transactionId - String

Example

```
aelf.chain.getBlockByHeight(12, false)
  .then(res => {
    console.log(res);
  })
```

6.getTxResult

Get the result of a transaction

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - String

Returns

- Object
 - TransactionId - String
 - Status - String
 - Logs - Array
 - * Address - String
 - * Name - String
 - * Indexed - Array
 - * NonIndexed - String
 - Bloom - String
 - BlockNumber - Number
 - Transaction - Object
 - * From - String
 - * To - String
 - * RefBlockNumber - Number
 - * RefBlockPrefix - String
 - * MethodName - String
 - * Params - Object
 - * Signature - String
 - ReadableReturnValue - Object
 - Error - String

Example

```
aelf.chain.getTxResult(transactionId)
  .then(res => {
    console.log(res);
  })
```

7.getTxResults

Get multiple transaction results in a block

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - String
- offset - Number
- limit - Number

Returns

- Array - The array of method descriptions:
 - the transaction result object

Example

```
aelf.chain.getTxResults(blockHash, 0, 2)
  .then(res => {
    console.log(res);
  })
```

8.getTransactionPoolStatus

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Parameters

Empty

9.sendTransaction

Broadcast a transaction

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- Object - Serialization of data into protobuf data, The object with the following structure :
 - RawTransaction - String :

usually developers don't need to use this function directly, just get a contract method and send transaction by call contract method:

10.sendTransactions

Broadcast multiple transactions

POST

Parameters

- Object - The object with the following structure :
 - RawTransaction - String

11.callReadOnly

Call a read-only method on a contract.

POST

Parameters

- Object - The object with the following structure :
 - RawTransaction - String

12.getPeers

Get peer info about the connected network nodes

GET

Parameters

- withMetrics - Boolean :
 - true with metrics
 - false without metrics

13.addPeer

Attempts to add a node to the connected network nodes

POST

Parameters

- Object - The object with the following structure :
 - Address - String

14.removePeer

Attempts to remove a node from the connected network nodes

DELETE

Parameters

- address - String

15.calculateTransactionFee

Estimate transaction fee

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput - Object - The object with the following structure :
 - RawTransaction - String

Returns

- CalculateTransactionFeeOutput - Object - The object with the following structure :
 - Success - Bool
 - TransactionFee - Array
 - ResourceFee - Array

Example

```
aelf.chain.calculateTransactionFee(rawTransaction)
  .then(res => {
    console.log(res);
  })
```

16.networkInfo

Get information about the node's connection to the network

GET

Parameters

Empty

20.1.5 AElf.wallet

AElf.wallet is a static property of AElf.

Use the api to see detailed results

1.createNewWallet

Returns

- Object
 - mnemonic - String: mnemonic
 - BIP44Path - String: m/purpose'/coin_type'/account'/change/address_index
 - childWallet - Object: HD Wallet
 - keyPair - String: The EC key pair generated by elliptic
 - privateKey - String: private Key
 - address - String: address

Example

```
import AElf from 'aelf-sdk';  
const wallet = AElf.wallet.createNewWallet();
```

2.getWalletByMnemonic

Parameters

mnemonic - String: wallet's mnemonic

Returns

- Object: Complete wallet object.

Example

```
const wallet = AElf.wallet.getWalletByMnemonic(mnemonic);
```

3.getWalletByPrivateKey

Parameters

- privateKey: String: wallet's private key

Returns

- Object: Complete wallet object, with empty mnemonic

Example

```
const wallet = AElf.wallet.getWalletByPrivateKey(privateKey);
```

4.signTransaction

Use wallet keypair to sign a transaction

Parameters

- rawTxn - String
- keyPair - String

Returns

- Object: The object with the following structure :

Example

```
const result = aelf.wallet.signTransaction(rawTxn, keyPair);
```

5.AESEncrypt

Encrypt a string by aes algorithm

Parameters

- input - String
- password - String

Returns

- String

6.AESDecrypt

Decrypt by aes algorithm

Parameters

- input - String
- password - String

Returns

- String

20.1.6 AElf.pbjs

The reference to protobuf.js, read the [documentation](#) to see how to use.

20.1.7 AElf.pbUtils

Some basic format methods of aelf.

For more information, please see the code in `src/utls/proto.js`. It is simple and easy to understand.

AElf.utls

Some methods for aelf.

For more information, please see the code in `src/utls/utls.js`. It is simple and easy to understand.

Check address

```
const AElf = require('aelf-sdk');
const {base58} = AElf.utls;
base58.decode('$addresss'); // throw error if invalid
```

20.1.8 AElf.version

```
import AElf from 'aelf-sdk';
AElf.version // eg. 3.2.23
```

20.1.9 Requirements

- Node.js
- NPM

20.1.10 Support

20.1.11 About contributing

Read out [contributing guide]

20.1.12 About Version

<https://semver.org/>

20.2 aelf-sdk.cs - AElf C# API

This C# library helps in the communication with an AElf node. You can find out more [here](#).

20.2.1 Introduction

aelf-sdk.cs is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.cs, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.cs](#)

20.2.2 Adding aelf-sdk.cs package

First you need to get AElf.Client package into your project. This can be done using the following methods:

Package Manager:

```
PM> Install-Package AElf.Client
```

.NET CLI

```
> dotnet add package AElf.Client
```

PackageReference

```
<PackageReference Include="AElf.Client" Version="X.X.X" />
```

20.2.3 Examples

Create instance

Create a new instance of AElfClient, and set url of an AElf chain node.

```
using AElf.Client.Service;

// create a new instance of AElfClient
AElfClient client = new AElfClient("http://127.0.0.1:1235");
```

Test connection

Check that the AElf chain node is connectable.

```
var isConnected = await client.IsConnectedAsync();
```

Initiate a transfer transaction

```

// Get token contract address.
var tokenContractAddress = await client.GetContractAddressByNameAsync(HashHelper.
    ↪ComputeFrom("AElf.ContractNames.Token"));

var methodName = "Transfer";
var param = new TransferInput
{
    To = new Address {Value = Address.FromBase58(
    ↪"7s4XoUHfPuqoZAwnTV7pHWZAaivMiL8aZrDSnY9brElwoa8vz").Value},
    Symbol = "ELF",
    Amount = 10000000000,
    Memo = "transfer in demo"
};
var ownerAddress = client.GetAddressFromPrivateKey(PrivateKey);

// Generate a transfer transaction.
var transaction = await client.GenerateTransaction(ownerAddress, tokenContractAddress.
    ↪ToBase58(), methodName, param);
var txWithSign = client.SignTransaction(PrivateKey, transaction);

// Send the transfer transaction to AElf chain node.
var result = await client.SendTransactionAsync(new SendTransactionInput
{
    RawTransaction = txWithSign.ToByteArray().ToHex()
});

await Task.Delay(4000);
// After the transaction is mined, query the execution results.
var transactionResult = await client.GetTransactionResultAsync(result.TransactionId);
Console.WriteLine(transactionResult.Status);

// Query account balance.
var paramGetBalance = new GetBalanceInput
{
    Symbol = "ELF",
    Owner = new Address {Value = Address.FromBase58(ownerAddress).Value}
};
var transactionGetBalance = await client.GenerateTransaction(ownerAddress,
    ↪tokenContractAddress.ToBase58(), "GetBalance", paramGetBalance);
var txWithSignGetBalance = client.SignTransaction(PrivateKey, transactionGetBalance);

var transactionGetBalanceResult = await client.ExecuteTransactionAsync(new
    ↪ExecuteTransactionDto
{
    RawTransaction = txWithSignGetBalance.ToByteArray().ToHex()
});

var balance = GetBalanceOutput.Parser.ParseFrom(ByteArrayHelper.
    ↪HexstringToByteArray(transactionGetBalanceResult));
Console.WriteLine(balance.Balance);

```

20.2.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html`` tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

The usage of these methods is based on the AElfClient instance, so if you don't have one please create it:

```
using AElf.Client.Service;

// create a new instance of AElf, change the URL if needed
AElfClient client = new AElfClient("http://127.0.0.1:1235");
```

GetChainStatus

Get the current status of the block chain.

Web API path

/api/blockChain/chainStatus

Parameters

Empty

Returns

- ChainStatusDto
 - ChainId - string
 - Branches - Dictionary<string,long>
 - NotLinkedBlocks - Dictionary<string,string>
 - LongestChainHeight - long
 - LongestChainHash - string
 - GenesisBlockHash - string
 - GenesisContractAddress - string
 - LastIrreversibleBlockHash - string
 - LastIrreversibleBlockHeight - long
 - BestChainHash - string
 - BestChainHeight - long

Example

```
await client.GetChainStatusAsync();
```

GetContractFileDescriptorSet

Get the protobuf definitions related to a contract.

Web API path

/api/blockChain/contractFileDescriptorSet

Parameters

- contractAddress - string address of a contract

Returns

- byte[]

Example

```
await client.GetContractFileDescriptorSetAsync(address);
```

GetBlockHeight

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

Parameters

Empty

Returns

- long

Example

```
await client.GetBlockHeightAsync();
```

GetBlock

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- blockHash - string
- includeTransactions - bool:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - string

- Header - BlockHeaderDto
 - * PreviousBlockHash - string
 - * MerkleTreeRootOfTransactions - string
 - * MerkleTreeRootOfWorldState - string
 - * Extra - string
 - * Height - long
 - * Time - DateTime
 - * ChainId - string
 - * Bloom - string
 - * SignerPubkey - string
- Body - BlockBodyDto
 - * TransactionsCount - int
 - * Transactions - List<string>

Example

```
await client.GetBlockByHashAsync(blockHash);
```

GetBlockByHeight

Web API path

/api/blockChain/blockByHeight

Get block information by block height.

Parameters

- blockHeight - long
- includeTransactions - bool :
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - string
 - Header - BlockHeaderDto
 - * PreviousBlockHash - string
 - * MerkleTreeRootOfTransactions - string
 - * MerkleTreeRootOfWorldState - string
 - * Extra - string
 - * Height - long
 - * Time - DateTime

```
    * ChainId - string
    * Bloom - string
    * SignerPubkey - string
- Body - BlockBodyDto
    * TransactionsCount - int
    * Transactions - List<string>
```

Example

```
await client.GetBlockByHeightAsync(height);
```

GetTransactionResult

Get the result of a transaction

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - string

Returns

- TransactionResultDto
 - TransactionId - string
 - Status - string
 - Logs - LogEventDto[]
 - * Address - string
 - * Name - string
 - * Indexed - string[]
 - * NonIndexed - string
 - Bloom - string
 - BlockNumber - long
 - Transaction - TransactionDto
 - * From - string
 - * To - string
 - * RefBlockNumber - long
 - * RefBlockPrefix - string
 - * MethodName - string
 - * Params - string
 - * Signature - string
 - Error - string

Example

```
await client.GetTransactionResultAsync(transactionId);
```

GetTransactionResults

Get multiple transaction results in a block.

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - string
- offset - int
- limit - int

Returns

- List<TransactionResultDto> - The array of transaction result:
 - the transaction result object

Example

```
await client.GetTransactionResultsAsync(blockHash, 0, 10);
```

GetTransactionPoolStatus

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Parameters

Empty

Returns

- TransactionPoolStatusOutput
 - Queued - int
 - Validated - int

Example

```
await client.GetTransactionPoolStatusAsync();
```

SendTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendTransactionInput - Serialization of data into protobuf data:
 - RawTransaction - string

Returns

- SendTransactionOutput
 - TransactionId - string

Example

```
await client.SendTransactionAsync(input);
```

SendRawTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendRawTransactionInput - Serialization of data into protobuf data:
 - Transaction - string
 - Signature - string
 - ReturnTransaction - bool

Returns

- SendRawTransactionOutput
 - TransactionId - string
 - Transaction - TransactionDto

Example

```
await client.SendRawTransactionAsync(input);
```

SendTransactions

Broadcast multiple transactions.

Web API path

/api/blockChain/sendTransactions

POST

Parameters

- SendTransactionsInput - Serialization of data into protobuf data:
 - RawTransactions - string

Returns

string[]

Example

```
await client.SendTransactionsAsync(input);
```

CreateRawTransaction

Creates an unsigned serialized transaction.

Web API path

/api/blockChain/rawTransaction

POST

Parameters

- CreateRawTransactionInput
 - From - string
 - To - string
 - RefBlockNumber - long
 - RefBlockHash - string
 - MethodName - string
 - Params - string

Returns

- CreateRawTransactionOutput- Serialization of data into protobuf data:
 - RawTransactions - string

Example

```
await client.CreateRawTransactionAsync(input);
```

ExecuteTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeTransaction

POST

Parameters

- ExecuteTransactionDto - Serialization of data into protobuf data:
 - RawTransaction - string

Returns

- string

Example

```
await client.ExecuteTransactionAsync(input);
```

ExecuteRawTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeRawTransaction

POST

Parameters

- ExecuteRawTransactionDto - Serialization of data into protobuf data:
 - RawTransaction - string
 - Signature - string

Returns

- string

Example

```
await client.ExecuteRawTransactionAsync(input);
```

GetPeers

Get peer info about the connected network nodes.

Web API path

/api/net/peers

Parameters

- withMetrics - bool

Returns

- List<PeerDto>
 - IPAddress - string
 - ProtocolVersion - int
 - ConnectionTime - long
 - ConnectionStatus - string
 - Inbound - bool
 - BufferedTransactionsCount - int
 - BufferedBlocksCount - int
 - BufferedAnnouncementsCount - int
 - NodeVersion - string
 - RequestMetrics - List<RequestMetric>
 - * RoundTripTime - long
 - * MethodName - string
 - * Info - string
 - * RequestTime - string

Example

```
await client.GetPeersAsync(false);
```

AddPeer

Attempts to add a node to the connected network nodes.

Web API path

/api/net/peer

POST

Parameters

- ipAddress - string

Returns

- bool

Example

```
await client.AddPeerAsync("127.0.0.1:7001");
```

RemovePeer

Attempts to remove a node from the connected network nodes.

Web API path

/api/net/peer

DELETE

Parameters

- ipAddress - string

Returns

- bool

Example

```
await client.RemovePeerAsync("127.0.0.1:7001");
```

CalculateTransactionFeeAsync

Estimate transaction fee.

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput - The object with the following structure :
 - RawTrasaction - String

Returns

- TransactionFeeResultOutput - The object with the following structure :
 - Success - bool
 - TransactionFee - Dictionary<string, long>
 - ResourceFee - Dictionary<string, long>

Example

```
var input = new CalculateTransactionFeeInput{  
    RawTransaction = RawTransaction  
};  
await Client.CalculateTransactionFeeAsync(input);
```


GetNetworkInfo

Get the network information of the node.

Web API path

/api/net/networkInfo

Parameters

Empty

Returns

- NetworkInfoOutput
 - Version - string
 - ProtocolVersion - int
 - Connections - int

Example

```
await client.GetNetworkInfoAsync();
```

20.2.5 AElf Client

IsConnected

Verify whether this sdk successfully connects the chain.

Parameters

Empty

Returns

- bool

Example

```
await client.IsConnectedAsync();
```

GetGenesisContractAddress

Get the address of genesis contract.

Parameters

Empty

Returns

- string

Example

```
await client.GetGenesisContractAddressAsync();
```

GetContractAddressByName

Get address of a contract by given contractNameHash.

Parameters

contractNameHash - Hash

Returns

- Address

Example

```
await client.GetContractAddressByNameAsync(contractNameHash);
```

GenerateTransaction

Build a transaction from the input parameters.

Parameters

- from - string
- to - string
- methodName - string
- input - IMessage

Returns

- Transaction

Example

```
await client.GenerateTransactionAsync(from, to, methodName, input);
```

GetFormattedAddress

Convert the Address to the displayed stringsymbol_base58-string_base58-string-chain-id.

Parameters

- address - Address

Returns

- string

Example

```
await client.GetFormattedAddressAsync(address);
```

SignTransaction

Sign a transaction using private key.

Parameters

- `privateKeyHex` - string
- `transaction` - Transaction

Returns

- Transaction

Example

```
client.SignTransaction(privateKeyHex, transaction);
```

GetAddressFromPubKey

Get the account address through the public key.

Parameters

- `pubKey` - string

Returns

string

Example

```
client.GetAddressFromPubKey(pubKey);
```

GetAddressFromPrivateKey

Get the account address through the private key.

Parameters

- `privateKeyHex` - string

Returns

- string

Example

```
client.GetAddressFromPrivateKey(privateKeyHex);
```

GenerateKeyPairInfo

Generate a new account key pair.

Parameters

Empty

Returns

- KeyPairInfo
 - PrivateKey - string
 - PublicKey - string
 - Address - string

Example

```
client.GenerateKeyPairInfo();
```

20.2.6 Supports

.NET Standard 2.0

20.3 aelf-sdk.go - AELF Go API

This Go library helps in the communication with an AElf node. You can find out more [here](#).

20.3.1 Introduction

aelf-sdk.go is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.go, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.go](#)

20.3.2 Adding aelf-sdk.go package

First you need to get aelf-sdk.go:

```
> go get -u github.com/AElfProject/aelf-sdk.go
```

20.3.3 Examples

Create instance

Create a new instance of AElfClient, and set url of an AElf chain node.

```
import ("github.com/AElfProject/aelf-sdk/go/client")

var aelf = client.AElfClient{
    Host:      "http://127.0.0.1:8000",
    Version:   "1.0",
    PrivateKey: "cd86ab6347d8e52bbbe8532141fc59ce596268143a308d1d40fedf385528b458",
}
```

Initiate a transfer transaction

```
// Get token contract address.
tokenContractAddress, _ := aelf.GetContractAddressByName("AElf.ContractNames.Token")
fromAddress := aelf.GetAddressFromPrivateKey(aelf.PrivateKey)
methodName := "Transfer"
toAddress, _ := util.Base58StringToAddress(
    ↪ "7s4XoUHFpuqoZAwnTV7pHWZAaivMiL8aZrDSnY9brElwoa8vz")

params := &pb.TransferInput{
    To:      toAddress,
    Symbol:  "ELF",
    Amount:  10000000000,
    Memo:    "transfer in demo",
}
paramsByte, _ := proto.Marshal(params)

// Generate a transfer transaction.
transaction, _ := aelf.CreateTransaction(fromAddress, tokenContractAddress, methodName, ↪
    ↪ paramsByte)
signature, _ := aelf.SignTransaction(aelf.PrivateKey, transaction)
transaction.Signature = signature

// Send the transfer transaction to AElf chain node.
transactionByets, _ := proto.Marshal(transaction)
sendResult, _ := aelf.SendTransaction(hex.EncodeToString(transactionByets))

time.Sleep(time.Duration(4) * time.Second)
transactionResult, _ := aelf.GetTransactionResult(sendResult.TransactionID)
fmt.Println(transactionResult)

// Query account balance.
ownerAddress, _ := util.Base58StringToAddress(fromAddress)
getBalanceInput := &pb.GetBalanceInput{
    Symbol:  "ELF",
    Owner:   ownerAddress,
}
getBalanceInputByte, _ := proto.Marshal(getBalanceInput)
```

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```

getBalanceTransaction, _ := aelf.CreateTransaction(fromAddress, tokenContractAddress,
↳ "GetBalance", getBalanceInputByte)
getBalanceTransaction.Params = getBalanceInputByte
getBalanceSignature, _ := aelf.SignTransaction(aelf.PrivateKey, getBalanceTransaction)
getBalanceTransaction.Signature = getBalanceSignature

getBalanceTransactionByets, _ := proto.Marshal(getBalanceTransaction)
getBalanceResult, _ := aelf.ExecuteTransaction(hex.
↳ EncodeToString(getBalanceTransactionByets))
balance := &pb.GetBalanceOutput{}
getBalanceResultBytes, _ := hex.DecodeString(getBalanceResult)
proto.Unmarshal(getBalanceResultBytes, balance)
fmt.Println(balance)

```

20.3.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html`` tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

The usage of these methods is based on the AElfClient instance, so if you don't have one please create it:

```

import ("github.com/AElfProject/aelf-sdk.go/client")

var aelf = client.AElfClient{
    Host:      "http://127.0.0.1:8000",
    Version:   "1.0",
    PrivateKey: "680afd630d82ae5c97942c4141d60b8a9fedfa5b2864fca84072c17ee1f72d9d",
}

```

GetChainStatus

Get the current status of the block chain.

Web API path

/api/blockChain/chainStatus

Parameters

Empty

Returns

- ChainStatusDto
 - ChainId - string
 - Branches - map[string]interface{}
 - NotLinkedBlocks - map[string]interface{}
 - LongestChainHeight - int64
 - LongestChainHash - string
 - GenesisBlockHash - string

- GenesisContractAddress - string
- LastIrreversibleBlockHash - string
- LastIrreversibleBlockHeight - int64
- BestChainHash - string
- BestChainHeight - int64

Example

```
chainStatus, err := aelf.GetChainStatus()
```

GetContractFileDescriptorSet

Get the protobuf definitions related to a contract.

Web API path

/api/blockChain/contractFileDescriptorSet

Parameters

- contractAddress - string address of a contract

Returns

- byte[]

Example

```
contractFile, err := aelf.GetContractFileDescriptorSet(
↳ "pykr77ft9UUKJZLVq15wCH8PinBSjVRQ12sD1Ayq92mKFsJ1i")
```

GetBlockHeight

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

Parameters

Empty

Returns

- float64

Example

```
height, err := aelf.GetBlockHeight()
```

GetBlock

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- blockHash - string
- includeTransactions - bool:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - string
 - Header - BlockHeaderDto
 - * PreviousBlockHash - string
 - * MerkleTreeRootOfTransactions - string
 - * MerkleTreeRootOfWorldState - string
 - * Extra - string
 - * Height - int64
 - * Time - string
 - * ChainId - string
 - * Bloom - string
 - * SignerPubkey - string
 - Body - BlockBodyDto
 - * TransactionsCount - int
 - * Transactions - []string

Example

```
block, err := aelf.GetBlockByHash(blockHash, true)
```

GetBlockByHeight

Web API path

/api/blockChain/blockByHeight

Get block information by block height.

Parameters

- blockHeight - int64
- includeTransactions - bool:

- true require transaction ids list in the block
- false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - string
 - Header - BlockHeaderDto
 - * PreviousBlockHash - string
 - * MerkleTreeRootOfTransactions - string
 - * MerkleTreeRootOfWorldState - string
 - * Extra - string
 - * Height - int64
 - * Time - string
 - * ChainId - string
 - * Bloom - string
 - * SignerPubkey - string
 - Body - BlockBodyDto
 - * TransactionsCount - int
 - * Transactions - []string

Example

```
block, err := aelf.GetBlockByHeight(100, true)
```

GetTransactionResult

Get the result of a transaction.

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - string

Returns

- TransactionResultDto
 - TransactionId - string
 - Status - string
 - Logs - []LogEventDto
 - * Address - string
 - * Name - string
 - * Indexed - []string

```

        * NonIndexed - string
    - Bloom - string
    - BlockNumber - int64
    - BlockHash - string
    - Transaction - TransactionDto
        * From - string
        * To - string
        * RefBlockNumber - int64
        * RefBlockPrefix - string
        * MethodName - string
        * Params - string
        * Signature - string
    - ReturnValue - string
    - Error - string

```

Example

```
transactionResult, err := aelf.GetTransactionResult(transactionID)
```

GetTransactionResults

Get multiple transaction results in a block.

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - string
- offset - int
- limit - int

Returns

- []TransactionResultDto - The array of transaction result:
 - the transaction result object

Example

```
transactionResults, err := aelf.GetTransactionResults(blockHash, 0, 10)
```

GetTransactionPoolStatus

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Parameters

Empty

Returns

- TransactionPoolStatusOutput
 - Queued - int
 - Validated - int

Example

```
poolStatus, err := aelf.GetTransactionPoolStatus()
```

SendTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendTransactionInput - Serialization of data into protobuf data:
 - RawTransaction - string

Returns

- SendTransactionOutput
 - TransactionId - string

Example

```
sendResult, err := aelf.SendTransaction(input)
```

SendRawTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendRawTransactionInput - Serialization of data into protobuf data:

- Transaction - string
- Signature - string
- ReturnTransaction - bool

Returns

- SendRawTransactionOutput
 - TransactionId - string
 - Transaction - TransactionDto

Example

```
sendRawResult, err := aelf.SendRawTransaction(input)
```

SendTransactions

Broadcast multiple transactions.

Web API path

/api/blockChain/sendTransactions

*POST**Parameters*

- rawTransactions - string - Serialization of data into protobuf data:

Returns

- []interface{}

Example

```
results, err := aelf.SendTransactions(transactions)
```

CreateRawTransaction

Creates an unsigned serialized transaction.

Web API path

/api/blockChain/rawTransaction

*POST**Parameters*

- CreateRawTransactionInput
 - From - string
 - To - string
 - RefBlockNumber - int64
 - RefBlockHash - string
 - MethodName - string
 - Params - string

Returns

- CreateRawTransactionOutput- Serialization of data into protobuf data:
 - RawTransactions - string

Example

```
result, err := aelf.CreateRawTransaction(input)
```

ExecuteTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeTransaction

*POST**Parameters*

- rawTransaction - string

Returns

- string

Example

```
executerresult, err := aelf.ExecuteTransaction(rawTransaction)
```

ExecuteRawTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeRawTransaction

*POST**Parameters*

- ExecuteRawTransactionDto - Serialization of data into protobuf data:
 - RawTransaction - string
 - Signature - string

Returns

- string

Example

```
executeRawresult, err := aelf.ExecuteRawTransaction(executeRawinput)
```

GetPeers

Get peer info about the connected network nodes.

Web API path

/api/net/peers

Parameters

- withMetrics - bool

Returns

- []PeerDto
 - IPAddress - string
 - ProtocolVersion - int
 - ConnectionTime - int64
 - ConnectionStatus - string
 - Inbound - bool
 - BufferedTransactionsCount - int
 - BufferedBlocksCount - int
 - BufferedAnnouncementsCount - int
 - NodeVersion - string
 - RequestMetrics - []RequestMetric
 - * RoundTripTime - int64
 - * MethodName - string
 - * Info - string
 - * RequestTime - string

Example

```
peers, err := aelf.GetPeers(false);
```

AddPeer

Attempts to add a node to the connected network nodes.

Web API path

/api/net/peer

POST

Parameters

- ipAddress - string

Returns

- bool

Example

```
addResult, err := aelf.AddPeer("127.0.0.1:7001");
```

RemovePeer

Attempts to remove a node from the connected network nodes.

Web API path

/api/net/peer

DELETE

Parameters

- ipAddress - string

Returns

- bool

Example

```
removeResult, err := aelf.RemovePeer("127.0.0.1:7001");
```

CalculateTransactionFee

Estimate transaction fee.

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput - object - The object with the following structure :
 - RawTrasaction - string

Returns

- TransactionFeeResultOutput - object - The object with the following structure :
 - Success - bool
 - TransactionFee - map[string]interface{}
 - ResourceFee - map[string]interface{}

Example

```
calculateTransactionFee, err := aelf.CalculateTransactionFee(transactionFeeInput)
```

GetNetworkInfo

Get the network information of the node.

Web API path

/api/net/networkInfo

Parameters

Empty

Returns

- NetworkInfoOutput
 - Version - string
 - ProtocolVersion - int
 - Connections - int

Example

```
networkInfo, err := aelf.GetNetworkInfo()
```

20.3.5 AElf Client

IsConnected

Verify whether this sdk successfully connects the chain.

Parameters

Empty

Returns

- bool

Example

```
isConnected := aelf.IsConnected()
```

GetGenesisContractAddress

Get the address of genesis contract.

Parameters

Empty

Returns

- string

Example

```
contractAddress, err := aelf.GetGenesisContractAddress()
```


GetContractAddressByName

Get address of a contract by given contractNameHash.

Parameters

- contractNameHash - string

Returns

- Address

Example

```
contractAddress, err := aelf.GetContractAddressByName("AElf.ContractNames.Token")
```

CreateTransaction

Build a transaction from the input parameters.

Parameters

- from - string
- to - string
- methodName - string
- params - []byte

Returns

Transaction

Example

```
transaction, err := aelf.CreateTransaction(fromAddress, toAddress, methodName, param)
```

GetFormattedAddress

Convert the Address to the displayed stringsymbol_base58-string_base58-string-chain-id.

Parameters

- address - string

Returns

- string

Example

```
formattedAddress, err := aelf.GetFormattedAddress(address);
```

SignTransaction

Sign a transaction using private key.

Parameters

- `privateKey` - string
- `transaction` - Transaction

Returns

- `[]byte`

Example

```
signature, err := aelf.SignTransaction(privateKey, transaction)
```

GetAddressFromPubKey

Get the account address through the public key.

Parameters

- `pubKey` - string

Returns

- string

Example

```
address := aelf.GetAddressFromPubKey(pubKey);
```

GetAddressFromPrivateKey

Get the account address through the private key.

Parameters

- `privateKey` - string

Returns

- string

Example

```
address := aelf.GetAddressFromPrivateKey(privateKey)
```

GenerateKeyPairInfo

Generate a new account key pair.

Parameters

Empty

Returns

- KeyPairInfo
 - PrivateKey - string
 - PublicKey - string
 - Address - string

Example

```
keyPair := aelf.GenerateKeyPairInfo()
```

20.3.6 Supports

Go 1.13

20.4 aelf-sdk.java - AELF Java API

This Java library helps in the communication with an AElf node. You can find out more [here](#).

20.4.1 Introduction

aelf-sdk.java is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.java, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.java](#)

20.4.2 Adding aelf-sdk.java package

First you need to get elf-sdk.java package into your project: [MvnRepository](#)

Maven:

```
<!-- https://mvnrepository.com/artifact/io.aelf/aelf-sdk -->
<dependency>
  <groupId>io.aelf</groupId>
  <artifactId>aelf-sdk</artifactId>
  <version>0.X.X</version>
</dependency>
```

20.4.3 Examples

Create instance

Create a new instance of AElfClient, and set url of an AElf chain node.

```
using AElf.Client.Service;

// create a new instance of AElf, change the URL if needed
AElfClient client = new AElfClient("http://127.0.0.1:1235");
```

Test connection

Check that the AElf chain node is connectable.

```
boolean isConnected = client.isConnected();
```

Initiate a transfer transaction

```
// Get token contract address.
String tokenContractAddress = client.getContractAddressByName(privateKey, Sha256.
    ↳getBytesSha256("AElf.ContractNames.Token"));

Client.Address.Builder to = Client.Address.newBuilder();
to.setValue(ByteString.copyFrom(Base58.decodeChecked(
    ↳"7s4XoUHfPuqoZAwnTV7pHWZAaivMiL8aZrDSnY9brElwoa8vz")));
Client.Address toObj = to.build();

TokenContract.TransferInput.Builder paramTransfer = TokenContract.TransferInput.
    ↳newBuilder();
paramTransfer.setTo(toObj);
paramTransfer.setSymbol("ELF");
paramTransfer.setAmount(10000000000);
paramTransfer.setMemo("transfer in demo");
TokenContract.TransferInput paramTransferObj = paramTransfer.build();

String ownerAddress = client.getAddressFromPrivateKey(privateKey);

Transaction.Builder transactionTransfer = client.generateTransaction(ownerAddress,
    ↳tokenContractAddress, "Transfer", paramTransferObj.toByteArray());
Transaction transactionTransferObj = transactionTransfer.build();
transactionTransfer.setSignature(ByteString.copyFrom(ByteArrayHelper.
    ↳hexToByteArray(client.signTransaction(privateKey, transactionTransferObj))));
transactionTransferObj = transactionTransfer.build();

// Send the transfer transaction to AElf chain node.
SendTransactionInput sendTransactionInputObj = new SendTransactionInput();
sendTransactionInputObj.setRawTransaction(Hex.toHexString(transactionTransferObj.
    ↳toByteArray()));
SendTransactionOutput sendResult = client.sendTransaction(sendTransactionInputObj);
```

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```

Thread.sleep(4000);
// After the transaction is mined, query the execution results.
TransactionResultDto transactionResult = client.getTransactionResult(sendResult.
↳getTransactionId());
System.out.println(transactionResult.getStatus());

// Query account balance.
Client.Address.Builder owner = Client.Address.newBuilder();
owner.setValue(ByteString.copyFrom(Base58.decodeChecked(ownerAddress)));
Client.Address ownerObj = owner.build();

TokenContract.GetBalanceInput.Builder paramGetBalance = TokenContract.GetBalanceInput.
↳newBuilder();
paramGetBalance.setSymbol("ELF");
paramGetBalance.setOwner(ownerObj);
TokenContract.GetBalanceInput paramGetBalanceObj = paramGetBalance.build();

Transaction.Builder transactionGetBalance = client.generateTransaction(ownerAddress,
↳tokenContractAddress, "GetBalance", paramGetBalanceObj.toByteArray());
Transaction transactionGetBalanceObj = transactionGetBalance.build();
String signature = client.signTransaction(privateKey, transactionGetBalanceObj);
transactionGetBalance.setSignature(ByteString.copyFrom(ByteArrayHelper.
↳hexToByteArray(signature)));
transactionGetBalanceObj = transactionGetBalance.build();

ExecuteTransactionDto executeTransactionDto = new ExecuteTransactionDto();
executeTransactionDto.setRawTransaction(Hex.toHexString(transactionGetBalanceObj.
↳toByteArray()));
String transactionGetBalanceResult = client.executeTransaction(executeTransactionDto);

TokenContract.GetBalanceOutput balance = TokenContract.GetBalanceOutput.
↳getDefaultInstance().parseFrom(ByteArrayHelper.
↳hexToByteArray(transactionGetBalanceResult));
System.out.println(balance.getBalance());

```

20.4.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html`` tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

The usage of these methods is based on the AElfClient instance, so if you don't have one please create it:

```

using AElf.Client.Service;

// create a new instance of AElf, change the URL if needed
AElfClient client = new AElfClient("http://127.0.0.1:1235");

```

GetChainStatus

Get the current status of the block chain.

Web API path

/api/blockChain/chainStatus

Parameters

Empty

Returns

- ChainStatusDto
 - ChainId - String
 - Branches - HashMap<String, Long>
 - NotLinkedBlocks - ashMap<String, String>
 - LongestChainHeight - long
 - LongestChainHash - String
 - GenesisBlockHash - String
 - GenesisContractAddress - String
 - LastIrreversibleBlockHash - String
 - LastIrreversibleBlockHeight - long
 - BestChainHash - String
 - BestChainHeight - long

Example

```
client.getChainStatus();
```

GetContractFileDescriptorSet

Get the protobuf definitions related to a contract.

Web API path

/api/blockChain/contractFileDescriptorSet

Parameters

- contractAddress - String address of a contract

Returns

- byte[]

Example

```
client.getContractFileDescriptorSet(address);
```

GetBlockHeight

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

Parameters

Empty

Returns

- long

Example

```
client.getBlockHeight();
```

GetBlock

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- blockHash - String
- includeTransactions - boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - String
 - Header - BlockHeaderDto
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - String
 - * Height - long
 - * Time - Date
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String
 - Body - BlockBodyDto
 - * TransactionsCount - int

* Transactions - List<String>

Example

```
client.getBlockByHash(blockHash);
```

GetBlockByHeight

Get block information by block height.

Web API path

/api/blockChain/blockByHeight

Parameters

- blockHeight - long
- includeTransactions - boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- BlockDto
 - BlockHash - String
 - Header - BlockHeaderDto
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - String
 - * Height - long
 - * Time - Date
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String
 - Body - BlockBodyDto
 - * TransactionsCount - int
 - * Transactions - List<String>

Example

```
client.getBlockByHeight(height);
```


GetTransactionResult

Get the result of a transaction.

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - String

Returns

- TransactionResultDto
 - TransactionId - String
 - Status - String
 - Logs - ist<LogEventDto>
 - * Address - String
 - * Name - String
 - * Indexed - List<String>
 - * NonIndexed - String
 - Bloom - String
 - BlockNumber - long
 - Transaction - TransactionDto
 - * From - String
 - * To - String
 - * RefBlockNumber - long
 - * RefBlockPrefix - String
 - * MethodName - String
 - * Params - String
 - * Signature - String
 - Error - String

Example

```
client.getTransactionResult(transactionId);
```

GetTransactionResults

Get multiple transaction results in a block.

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - String
- offset - int
- limit - int

Returns

- List<TransactionResultDto> - The array of transaction result:
 - the transaction result object

Example

```
client.getTransactionResults(blockHash, 0, 10);
```

GetTransactionPoolStatus

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Parameters

Empty

Returns

- TransactionPoolStatusOutput
 - Queued - int
 - Validated - int

Example

```
client.getTransactionPoolStatus();
```

SendTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendTransactionInput - Serialization of data into protobuf data:

- RawTransaction - String

Returns

- SendTransactionOutput
 - TransactionId - String

Example

```
client.sendTransaction(input);
```

SendRawTransaction

Broadcast a transaction.

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- SendRawTransactionInput - Serialization of data into protobuf data:
 - Transaction - String
 - Signature - String
 - ReturnTransaction - boolean

Returns

- SendRawTransactionOutput
 - TransactionId - String
 - Transaction - TransactionDto

Example

```
client.sendRawTransaction(input);
```

SendTransactions

Broadcast multiple transactions.

Web API path

/api/blockChain/sendTransactions

POST

Parameters

- SendTransactionsInput - Serialization of data into protobuf data:
 - RawTransactions - String

Returns

- List<String>

Example

```
client.sendTransactions(input);
```

CreateRawTransaction

Creates an unsigned serialized transaction.

Web API path

/api/blockChain/rawTransaction

POST

Parameters

- CreateRawTransactionInput
 - From - String
 - To - String
 - RefBlockNumber - long
 - RefBlockHash - String
 - MethodName - String
 - Params - String

Returns

- CreateRawTransactionOutput- Serialization of data into protobuf data:
 - RawTransaction - String

Example

```
client.createRawTransaction(input);
```

ExecuteTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeTransaction

POST

Parameters

- ExecuteTransactionDto - Serialization of data into protobuf data:
 - RawTransaction - String

Returns

- String

Example

```
client.executeTransaction(input);
```

ExecuteRawTransaction

Call a read-only method on a contract.

Web API path

/api/blockChain/executeRawTransaction

POST

Parameters

- ExecuteRawTransactionDto - Serialization of data into protobuf data:
 - RawTransaction - String
 - Signature - String

Returns

- String

Example

```
client.executeRawTransaction(input);
```

GetPeers

Get peer info about the connected network nodes.

Web API path

/api/net/peers

Parameters

- withMetrics - boolean

Returns

- List<PeerDto>
 - IPAddress - String
 - ProtocolVersion - int
 - ConnectionTime - long
 - ConnectionStatus - String
 - Inbound - boolean
 - BufferedTransactionsCount - int
 - BufferedBlocksCount - int
 - BufferedAnnouncementsCount - int
 - NodeVersion - String
 - RequestMetrics - List<RequestMetric>
 - * RoundTripTime - long
 - * MethodName - String
 - * Info - String

* RequestTime - String

Example

```
client.getPeers(false);
```

AddPeer

Attempts to add a node to the connected network nodes.

Web API path

/api/net/peer

POST

Parameters

- AddPeerInput
 - Address - String

Returns

- boolean

Example

```
client.addPeer("127.0.0.1:7001");
```

RemovePeer

Attempts to remove a node from the connected network nodes.

Web API path

/api/net/peer

DELETE

Parameters

- address - string

Returns

- boolean

Example

```
client.removePeer("127.0.0.1:7001");
```

calculateTransactionFee

Estimate transaction fee.

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput
 - RawTrasaction - string

Returns

- CalculateTransactionFeeOutput - The object with the following structure :
 - Success - boolean
 - TransactionFee - HashMap<String, Long>
 - ResourceFee - HashMap<String, Long>

Example

```
CalculateTransactionFeeOutput output = client.calculateTransactionFee(input);
```

GetNetworkInfo

Get the network information of the node.

Web API path

/api/net/networkInfo

Parameters

Empty

Returns

- NetworkInfoOutput
 - Version - String
 - ProtocolVersion - int
 - Connections - int

Example

```
client.getNetworkInfo();
```

20.4.5 AEIf Client

IsConnected

Verify whether this sdk successfully connects the chain.

Parameters

Empty

Returns

- boolean

Example

```
client.isConnected();
```

GetGenesisContractAddress

Get the address of genesis contract.

Parameters

Empty

Returns

- String

Example

```
client.getGenesisContractAddress();
```

GetContractAddressByName

Get address of a contract by given contractNameHash.

Parameters

- privateKey - String
- contractNameHash - byte[]

Returns

- String

Example

```
client.getContractAddressByName(privateKey, contractNameHash);
```


GenerateTransaction

Build a transaction from the input parameters.

Parameters

- from - String
- to - String
- methodName - String
- input - byte[]

Returns

- Transaction

Example

```
client.generateTransaction(from, to, methodName, input);
```

GetFormattedAddress

Convert the Address to the displayed stringsymbol_base58-string_base58-String-chain-id.

Parameters

- privateKey - String
- address - String

Returns

- String

Example

```
client.getFormattedAddress(privateKey, address);
```

SignTransaction

Sign a transaction using private key.

Parameters

- privateKeyHex - String
- transaction - Transaction

Returns

- String

Example

```
client.signTransaction(privateKeyHex, transaction);
```

GetAddressFromPubKey

Get the account address through the public key.

Parameters

- pubKey - String

Returns

- String

Example

```
client.getAddressFromPubKey(pubKey);
```

GetAddressFromPrivateKey

Get the account address through the private key.

Parameters

- privateKey - String

Returns

- String

Example

```
client.getAddressFromPrivateKey(privateKey);
```

GenerateKeyPairInfo

Generate a new account key pair.

Parameters

Empty

Returns

- KeyPairInfo
 - PrivateKey - String
 - PublicKey - String
 - Address - String

Example

```
client.generateKeyPairInfo();
```

20.4.6 Supports

- JDK1.8+
- Log4j2.6.2

20.5 aelf-sdk.php - AELF PHP API

20.5.1 Introduction

aelf-sdk.php for aelf is like web.js for ethereum.

aelf-sdk.php is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.php, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.php](#))

20.5.2 Adding AElf php SDK

In order to install this library via composer run the following command in the console:

```
$ composer require aelf/aelf-sdk dev-dev
```

composer require curl/curl

If you directly clone the sdk You must install composer and execute it in the root directory

```
"aelf/aelf-sdk": "dev-dev"
```

20.5.3 Examples

You can also see full examples in ./test;

1. Create instance

Create a new instance of AElf, connect to an AELF chain node. Using this instance, you can call the APIs on AElf.

```
require_once 'vendor/autoload.php';
use AElf\AElf;
$url = '127.0.0.1:8000';
$aelf = new AElf($url);
```

2. Get a system contract address

Get a system contract address, take AElf.ContractNames.Token as an example

```
require_once 'vendor/autoload.php';
use AElf\AElf;
$url = '127.0.0.1:8000';
$aelf = new AElf($url);

$privateKey = 'cd86ab6347d8e52bbbe8532141fc59ce596268143a308d1d40fedf385528b458';
$bytes = new Hash();
$bytes->setValue(hex2bin(hash('sha256', 'AElf.ContractNames.Token')));
$contractAddress = $aelf->GetContractAddressByName($privateKey, $bytes);
```

3. Send a transaction

Get the contract address, and then send the transaction.

```
require_once 'vendor/autoload.php';
use AElf\AElf;
$url = '127.0.0.1:8000';
// create a new instance of AElf
$aelf = new AElf($url);

// private key
$privateKey = 'cd86ab6347d8e52bbbe8532141fc59ce596268143a308d1d40fedf385528b458';

$aelfEcdsa = new BitcoinECDSA();
$aelfEcdsa->setPrivateKey($privateKey);
$publicKey = $aelfEcdsa->getUncompressedPubKey();
$address = $aelfEcdsa->hash256(hex2bin($publicKey));
$address = $address . substr($aelfEcdsa->hash256(hex2bin($address)), 0, 8);
// sender address
$base58Address = $aelfEcdsa->base58_encode($address);

// transaction input
$params = new Hash();
$params->setValue(hex2bin(hash('sha256', 'AElf.ContractNames.Vote')));

// transaction method name
$methodName = "GetContractAddressByName";

// transaction contract address
$toAddress = $aelf->getGenesisContractAddress();

// generate a transaction
$transactionObj = $aelf->generateTransaction($base58Address, $toAddress, $methodName,
↪ $params);

//signature
$signature = $aelf->signTransaction($privateKey, $transactionObj);
$transactionObj->setSignature(hex2bin($signature));
```

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```
// obj Dto
$executeTransactionDtoObj = ['RawTransaction' => bin2hex($transaction->
    ↳serializeToString())];

$result = $aelf->sendTransaction($executeTransactionDtoObj);
print_r($result);
```

20.5.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html``

tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

The usage of these methods is based on the AElf instance, so if you don't have one please create it:

```
require_once 'vendor/autoload.php';
use AElf\AElf;
$url = '127.0.0.1:8000';
// create a new instance of AElf
$aelf = new AElf($url);
```

1. getChainStatus

Get the current status of the block chain.

Web API path

/api/blockChain/chainStatus

Parameters

Empty

Returns

- Array
 - ChainId - String
 - Branches - Array
 - NotLinkedBlocks - Array
 - LongestChainHeight - Integer
 - LongestChainHash - String
 - GenesisBlockHash - String
 - GenesisContractAddress - String
 - LastIrreversibleBlockHash - String
 - LastIrreversibleBlockHeight - Integer
 - BestChainHash - String
 - BestChainHeight - Integer

Example

```
// create a new instance of AElf
$aelf = new AElf($url);

$chainStatus = $aelf->getChainStatus();
print_r($chainStatus);
```

2. getBlockHeight

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

Parameters

Empty

Returns

- Integer

Example

```
$aelf = new AElf($url);

$height = $aelfClient->GetBlockHeight();
print($height);
```

3. getBlock

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- block_hash - String
- include_transactions - Boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- Array
 - BlockHash - String
 - Header - Array
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String

- * Extra - List
- * Height - Integer
- * Time - String
- * ChainId - String
- * Bloom - String
- * SignerPubkey - String
- Body - Array
 - * TransactionsCount - Integer
 - * Transactions - Array
 - transactionId - String

Example

```
$aelf = new AElf($url);

$block = $aelf->getBlockByHeight(1, true);
$block2 = $aelf->getBlockByHash($block['BlockHash'], false);
print_r($block2);
```

4. getBlockByHeight

Web API path

/api/blockChain/blockByHeight

Get block information by block height.

Parameters

- block_height - Number
- include_transactions - Boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- Array
 - BlockHash - String
 - Header - Array
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - List
 - * Height - Integer
 - * Time - String
 - * ChainId - String

- * Bloom - String
- * SignerPubkey - String
- Body - Array
 - * TransactionsCount - Integer
 - * Transactions - Array
 - transactionId - String

Example

```
$aelf = new AElf($url);  
  
$block = $aelf->getBlockByHeight(1, true);  
print_r($block);
```

5. getTransactionResult

Get the result of a transaction

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - String

Returns

- Object
 - TransactionId - String
 - Status - String
 - Logs - Array
 - * Address - String
 - * Name - String
 - * Indexed - Array
 - * NonIndexed - String
 - Bloom - String
 - BlockNumber - Integer
 - Transaction - Array
 - * From - String
 - * To - String
 - * RefBlockNumber - Integer
 - * RefBlockPrefix - String
 - * MethodName - String
 - * Params - json

- * Signature - String
- ReadableReturnValue - String
- Error - String

Example

```
$aelf = new AElf($url);

$block = $aelf->getBlockByHeight(1, true);
$transactionResult = $aelf->getTransactionResult($block['Body']['Transactions'][0]);
print_r('# get_transaction_result');
print_r($transactionResult);
```

6. getTransactionResults

Get multiple transaction results in a block

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - String
- offset - Number
- limit - Number

Returns

- List - The array of method descriptions:
 - the transaction result object

Example

```
$aelf = new AElf($url);

$block = $aelf->getBlockByHeight(1, true);
$transactionResults = $aelf->getTransactionResults($block['Body']);
print_r($transactionResults);
```

7. getTransactionPoolStatus

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Example

```
$aelf = new AElf($url);

$status = $aelf->getTransactionPoolStatus();
print_r($status);
```

8. sendTransaction

Broadcast a transaction

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- transaction - String - Serialization of data into String

Example

```
$aelf = new AElf($url);

$params = new Hash();
$params->setValue(hex2bin(hash('sha256', 'AElf.ContractNames.Vote')));
$transaction = buildTransaction($aelf->getGenesisContractAddress(),
    ↪ 'GetContractAddressByName', $params);
$executeTransactionDtoObj = ['RawTransaction' => bin2hex($transaction->
    ↪ serializeToString())];
$result = $aelf->sendTransaction($executeTransactionDtoObj);
print_r($result);
```

9. sendTransactions

Broadcast multiple transactions

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- transactions - String - Serialization of data into String

Example

```
$aelf = new AElf($url);

$paramsList = [$params1, $params2];
$rawTransactionsList = [];
foreach ($paramsList as $param) {
    $transactionObj = buildTransaction($toAddress, $methodName, $param);
    $rawTransactions = bin2hex($transactionObj->serializeToString());
    array_push($rawTransactionsList, $rawTransactions);
}
$sendTransactionsInputs = ['RawTransactions' => implode(',', $rawTransactionsList)];
$listString = $this->aelf->sendTransactions($sendTransactionsInputs);
print_r($listString);
```

10. getPeers

Get peer info about the connected network nodes

Web API path

/api/net/peers

Example

```
$aelf = new AElf($url);  
print_r($aelf->getPeers(true));
```

11. addPeer

Attempts to add a node to the connected network nodes

Web API path

/api/net/peer

POST

Parameters

- `peer_address` - String - peer's endpoint

Example

```
$aelf = new AElf($url);  
$aelf->addPeer($url);
```

12. removePeer

Attempts to remove a node from the connected network nodes

Web API path

/api/net/peer?address=

POST

Parameters

- `peer_address` - String - peer's endpoint

Example

```
$aelf = new AElf($url);  
$aelf->removePeer($url);
```

13. createRawTransaction

create a raw transaction

Web API path

/api/blockchain/rawTransaction

POST

Parameters

- transaction - Array

Returns

- Array
 - RawTransaction - hex string bytes generated by transaction information

Example

```
$aelf = new AElf($url);

$status = $aelf->getChainStatus();
$params = base64_encode(hex2bin(hash('sha256', 'AElf.ContractNames.Consensus')));
$params = array('value' => $params);
$transaction = [
    "from" => $aelf->getAddressFromPrivateKey($privateKey),
    "to" => $aelf->getGenesisContractAddress(),
    "refBlockNumber" => $status['BestChainHeight'],
    "refBlockHash" => $status['BestChainHash'],
    "methodName" => "GetContractAddressByName",
    "params" => json_encode($params)
];
$rawTransaction = $aelf->createRawTransaction($transaction);
print_r($rawTransaction);
```

14. sendRawTransaction

send raw transactions

Web API path

/api/blockchain/sendRawTransaction

Parameters

- Transaction - raw transaction
- Signature - signature
- ReturnTransaction - indicates whether to return transaction

Example

```
$aelf = new AElf($url);

$rawTransaction = $aelf->createRawTransaction($transaction);
$transactionId = hash('sha256', hex2bin($rawTransaction['RawTransaction']));
```

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```

$sign = $aelf->getSignatureWithPrivateKey($privateKey, $transactionId);
$transaction = array('Transaction' => $rawTransaction['RawTransaction'], 'signature' =>
    ↳$sign, 'returnTransaction' => true);
$execute = $aelf->sendRawTransaction($transaction);
print_r($execute);

```

15. executeRawTransaction

execute raw transactions

Web API path

/api/blockchain/executeRawTransaction

Post

Parameters

- RawTransaction - raw transaction
- Signature - signature

Example

```

$aelf = new AElf($url);

$rawTransaction = $aelf->createRawTransaction($transaction);
$transactionId = hash('sha256', hex2bin($rawTransaction['RawTransaction']));
$sign = $aelf->getSignatureWithPrivateKey($privateKey, $transactionId);
$transaction = array('RawTransaction' => $rawTransaction['RawTransaction'], 'signature' ↳
    ↳=> $sign);
$execute = $aelf->executeRawTransaction($transaction);
print_r($execute);

```

16. getMerklePathByTransactionId

get merkle path

Web API path

/api/blockchain/merklePathByTransactionId?transactionId=

Parameters

- transactionId - String

Example

```

$aelf = new AElf($url);

$block = $aelf->getBlockByHeight(1, true);
$merklePath = $aelf->getMerklePathByTransactionId($block['Body']['Transactions'][0]);

```

17. calculateTransactionFee

Estimate transaction fee

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput - Object - The object with the following structure :
 - RawTransaction - String

Returns

- CalculateTransactionFeeOutput - Object - The object with the following structure :
 - Success - Bool
 - TransactionFee - Array
 - ResourceFee - Array

Example

```
$aelf = new AElf($url);
$calculateTransactionFeeInputParam = [
    "rawTransaction" => $rawTransactionInput,
];
$result = $this->aelf->calculateTransactionFee($calculateTransactionFeeInputParam);
print_r($result);
```

18. getNetworkInfo

get network information

Web API path

/api/net/networkInfo

Example

```
$aelf = new AElf($url);

print_r($aelf->getNetworkInfo());
```

19. getContractFileDescriptorSet

get contract file descriptor set

Web API path

/api/blockChain/contractFileDescriptorSet

Example

```

$aelf = new AElf($url);

$blockDto = $aelf->getBlockByHeight($blockHeight, false);
$transactionResultDtoList = $aelf->getTransactionResults($blockDto['BlockHash'], 0, 10);
foreach ($transactionResultDtoList as $v) {
    $request = $aelf->getContractFileDescriptorSet($v['Transaction']['To']);
    print_r($request);
}

```

20. getTaskQueueStatus

get task queue status

Web API path

/api/blockChain/taskQueueStatus

Example

```

$aelf = new AElf($url);

$taskQueueStatus = $aelf->getTaskQueueStatus();
print_r($taskQueueStatus);

```

21. executeTransaction

execute transaction

Web API path

Post

/api/blockChain/executeTransaction

Example

```

$aelf = new AElf($url);

$methodName = "GetNativeTokenInfo";
$bytes = new Hash();
$bytes->setValue(hex2bin(hash('sha256', 'AElf.ContractNames.Token')));
$toAddress = $aelf->GetContractAddressByName($privateKey, $bytes);
$param = new Hash();
$param->setValue('');
$transaction = $aelf->generateTransaction($fromAddress, $toAddress, $methodName, $param);
$signature = $aelf->signTransaction($privateKey, $transaction);
$transaction->setSignature(hex2bin($signature));
$executeTransactionDtoObj = ['RawTransaction' => bin2hex($transaction->
    ↳serializeToString())];
$response = $aelf->executeTransaction($executeTransactionDtoObj);
$tokenInfo = new TokenInfo();
$tokenInfo->mergeFromString(hex2bin($response));

```

20.5.5 Other Tool Kit

AElf supply some APIs to simplify developing.

1. getChainId

get chain id

```
$aelf = new AElf($url);

$chainId = $aelf->getChainId();
print_r($chainId);
```

2. generateTransaction

generate a transaction object

```
$aelf = new AElf($url);

$params = new Hash();
$params->setValue('');
$transaction = $aelf->generateTransaction($fromAddress, $toAddress, $methodName, $params);
```

3. signTransaction

sign a transaction

```
$aelf = new AElf($url);

$transaction = $aelf->generateTransaction($fromAddress, $toAddress, $methodName, $params);
$signature = $aelf->signTransaction($privateKey, $transaction);
```

4. getGenesisContractAddress

get the genesis contract's address

```
$aelf = new AElf($url);

$genesisContractAddress = $aelf->getGenesisContractAddress();
print_r($genesisContractAddress);
```


5. getAddressFromPubKey

calculate the account address according to the public key

```
$aelf = new AElf($url);

$pubKeyAddress = $aelf->getAddressFromPubKey(
    ↪ '04166cf4be901dee1c21f3d97b9e4818f229bec72a5ecd56b5c4d6ce7abfc3c87e25c36fd279db721acf4258fb489b4a4406';
    ↪ ');
print_r($pubKeyAddress);
```

6. getFormattedAddress

convert the Address to the displayed stringsymbol_base58-string_base58-string-chain-id.

```
$aelf = new AElf($url);

$addressVal = $aelf->getFormattedAddress($privateKey, $base58Address);
print_r($addressVal);
```

7. generateKeyPairInfo

generate a new key pair using ECDSA

```
$aelf = new AElf($url);

$pairInfo = $aelf->generateKeyPairInfo();
print_r($pairInfo);
```

8. getContractAddressByName

get contract's address from its name

```
$aelf = new AElf($url);

$bytes = new Hash();
$bytes->setValue(hex2bin(hash('sha256', 'AElf.ContractNames.Token')));
$contractAddress = $aelf->GetContractAddressByName($privateKey, $bytes);
print_r($contractAddress);
```

9. getAddressFromPrivateKey

get address from a private key

```
$aelf = new AElf($url);

$address = $aelf->getAddressFromPrivateKey($privateKey);
print_r($address);
```

10. getSignatureWithPrivateKey

given a private key, get the signature

```
$aelf = new AElf($url);

$sign = $aelf->getSignatureWithPrivateKey($privateKey, $transactionId);
print_r($sign);
```

11. isConnected

check if it connects the chain

```
$aelf = new AElf($url);

$isConnected = $this->aelf->isConnected();
print_r($isConnected);
```

12. getTransactionFees

get the transaction fee from transaction result

```
$aelf = new AElf($url);

$block = $aelf->getBlockByHeight(1, true);
$transactionResult = $aelf->getTransactionResult($block['Body']['Transactions'][0]);
$transactionFees = $aelf->getTransactionFees($transactionResult);
print_r($transactionFees);
```

20.5.6 AElf.version

```
$aelf = new AElf($url);

$version = $aelf->version;
```

20.5.7 Requirements

- [php](#)

20.5.8 About contributing

Read out [contributing guide]

20.5.9 About Version

<https://semver.org/>

20.6 aelf-sdk.py - AElf Python API

20.6.1 Introduction

aelf-sdk.py for aelf is like web.js for ethereum.

aelf-sdk.py is a collection of libraries which allow you to interact with a local or remote aelf node, using a HTTP connection.

The following documentation will guide you through installing and running aelf-sdk.py, as well as providing a API reference documentation with examples.

If you need more information you can check out the repo : [aelf-sdk.py](#)

20.6.2 Adding aelf-sdk.js

First you need to get aelf-sdk package into your project. This can be done using the following methods:

```
pip: pip install aelf-sdk
```

After that you need to create a aelf instance by a node's URL.

```
chain = AElf('http://127.0.0.1:8000')
```

20.6.3 Examples

You can also see full examples in ./test;

1. Create instance

Create a new instance of AElf, connect to an AELF chain node. Using this instance, you can call the APIs on AElf.

```
from aelf import AElf

// create a new instance of AElf
aelf = AElf('http://127.0.0.1:8000')
```

2. Get a system contract address

Get a system contract address, take `AElf.ContractNames.Token` as an example

```
from aelf import AElf

aelf = AElf('http://127.0.0.1:8000')
// get genesis contract address
genesis_contract_address = aelf.get_genesis_contract_address_string()

// get contract address
// in fact, get_system_contract_address call the method 'GetContractAddressByName' in
↳ the genesis contract to get other contracts' address
multi_token_contract_address = aelf.get_system_contract_address('AElf.ContractNames.Token
↳')
```

3. Send a transaction

Get the contract address, and then send the transaction.

```
from aelf import AElf

url = 'http://127.0.0.1:8000'
// create a new instance of AElf
aelf = AElf(url)

// generate the private key
private_key_string = 'b344570eb80043d7c5ae9800c813b8842660898bf03cbd41e583b4e54af4e7fa'
private_key = PrivateKey(bytes(bytearray.fromhex(private_key_string)))

// create input, the type is generated by protoc
cross_chain_transfer_input = CrossChainTransferInput()

// generate the transaction
transaction = aelf.create_transaction(to_address, method_name, params.
↳ SerializeToString())

// sign the transaction by user's private key
aelf.sign_transaction(private_key, transaction)

// execute the transaction
aelf.execute_transaction(transaction)
```

20.6.4 Web API

You can see how the Web Api of the node works in ``{chainAddress}/swagger/index.html``

tip: for an example, my local address: 'http://127.0.0.1:1235/swagger/index.html'

The usage of these methods is based on the AElf instance, so if you don't have one please create it:

```
from aelf import AElf

// create a new instance of AElf, change the URL if needed
aelf = AElf('http://127.0.0.1:8000')
```

1. get_chain_status

Get the current status of the block chain.

Web API path

/api/blockChain/chainStatus

Parameters

Empty

Returns

- json
 - ChainId - String
 - Branches - json
 - NotLinkedBlocks - json
 - LongestChainHeight - Number
 - LongestChainHash - String
 - GenesisBlockHash - String
 - GenesisContractAddress - String
 - LastIrreversibleBlockHash - String
 - LastIrreversibleBlockHeight - Number
 - BestChainHash - String
 - BestChainHeight - Number

Example

```
aelf = AElf(url)

chain_status = aelf.get_chain_status()
print('# get_chain_status', chain_status)
```

2. get_block_height

Get current best height of the chain.

Web API path

/api/blockChain/blockHeight

Parameters

Empty

Returns

- Number

Example

```
aelf = AElf(url)

block_height = aelf.get_block_height()
print('# get_block_height', block_height)
```

3. get_block

Get block information by block hash.

Web API path

/api/blockChain/block

Parameters

- block_hash - String
- include_transactions - Boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- json
 - BlockHash - String
 - Header - json
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - List
 - * Height - Number
 - * Time - json
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String

- Body - json
 - * TransactionsCount - Number
 - * Transactions - List
 - transactionId - String

Example

```
aelf = AElf(url)

block = aelf.get_block(blockHash)
print('# get_block', block)
```

4. get_block_by_height

Web API path

/api/blockChain/blockByHeight

Get block information by block height.

Parameters

- block_height - Number
- include_transactions - Boolean:
 - true require transaction ids list in the block
 - false Doesn't require transaction ids list in the block

Returns

- json
 - BlockHash - String
 - Header - json
 - * PreviousBlockHash - String
 - * MerkleTreeRootOfTransactions - String
 - * MerkleTreeRootOfWorldState - String
 - * Extra - List
 - * Height - Number
 - * Time - json
 - * ChainId - String
 - * Bloom - String
 - * SignerPubkey - String
 - Body - json
 - * TransactionsCount - Number
 - * Transactions - List
 - transactionId - String

Example

```
aelf = AElf(url)

block_by_height = aelf.get_block_by_height(12, false)
print('# get_block_by_height', block_by_height)
```

5. get_transaction_result

Get the result of a transaction

Web API path

/api/blockChain/transactionResult

Parameters

- transactionId - String

Returns

- json
 - TransactionId - String
 - Status - String
 - Logs - List
 - * Address - String
 - * Name - String
 - * Indexed - List
 - * NonIndexed - String
 - Bloom - String
 - BlockNumber - Number
 - Transaction - List
 - * From - String
 - * To - String
 - * RefBlockNumber - Number
 - * RefBlockPrefix - String
 - * MethodName - String
 - * Params - json
 - * Signature - String
 - ReadableReturnValue - json
 - Error - String

Example


```
aelf = AElf(url)

transaction_result = aelf.get_transaction_result(transactionId)
print('# get_transaction_results', transaction_result)
```

6. get_transaction_results

Get multiple transaction results in a block

Web API path

/api/blockChain/transactionResults

Parameters

- blockHash - String
- offset - Number
- limit - Number

Returns

- List - The array of method descriptions:
 - the transaction result object

Example

```
aelf = AElf(url)

transaction_results = aelf.get_transaction_results(blockHash, 0, 2)
print('# get_transaction_results', transaction_results)
```

7. get_transaction_pool_status

Get the transaction pool status.

Web API path

/api/blockChain/transactionPoolStatus

Example

```
aelf = AElf(url)

tx_pool_status = aelf.get_transaction_pool_status()
print('# get_transaction_pool_status', tx_pool_status)
```

8. send_transaction

Broadcast a transaction

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- transaction - String - Serialization of data into String

Example

```
aelf = AElf(url)

current_height = aelf.get_block_height()
block = aelf.get_block_by_height(current_height, include_transactions=False)
transaction = Transaction()
transaction.to_address.CopyFrom(aelf.get_system_contract_address("AElf.ContractNames.
↳Consensus"))
transaction.ref_block_number = current_height
transaction.ref_block_prefix = bytes.fromhex(block['BlockHash'])[0:4]
transaction.method_name = 'GetCurrentMinerList'
transaction = aelf.sign_transaction(private_key, transaction)
result = aelf.send_transaction(transaction.SerializePartialToString().hex())
print('# send_transaction', result)
```

9. send_transactions

Broadcast multiple transactions

Web API path

/api/blockChain/sendTransaction

POST

Parameters

- transactions - String - Serialization of data into String

Example

```
aelf = AElf(url)

current_height = aelf.get_block_height()
block = aelf.get_block_by_height(current_height, include_transactions=False)
transaction1 = Transaction().SerializePartialToString().hex()
transaction2 = Transaction().SerializePartialToString().hex()
result = aelf.send_transaction(transaction1 + ',' + transaction2)
print('# send_transactions', result)
```

10. get_peers

Get peer info about the connected network nodes

Web API path

/api/net/peers

Example

```

aelf = AElf(url)

peers = aelf.get_peers()
print('# get_peers', peers)

```

11. add_peer

Attempts to add a node to the connected network nodes

Web API path

/api/net/peer

POST

Parameters

- `peer_address` - String - peer's endpoint

Example

```

aelf = AElf(url)

add_peer = aelf.add_peer(endpoint)
print('# add_peers', add_peer)

```

12. remove_peer

Attempts to remove a node from the connected network nodes

Web API path

/api/net/peer?address=

POST

Parameters

- `peer_address` - String - peer's endpoint

Example

```

aelf = AElf(url)

remove_peer = aelf.remove_peer(address)
print('# remove_peer', remove_peer)

```

13. create_raw_transaction

create a raw transaction

Web API path

/api/blockchain/rawTransaction

POST

Parameters

- transaction - the json format transaction

Returns

- json
 - RawTransaction - hex string bytes generated by transaction information

Example

```
aelf = AElf(url)

transaction = {
    "From": aelf.get_address_string_from_public_key(public_key),
    "To": aelf.get_system_contract_address_string("AElf.ContractNames.Consensus"),
    "RefBlockNumber": 0,
    "RefBlockHash": "b344570eb80043d7c5ae9800c813b8842660898bf03cbd41e583b4e54af4e7fa",
    "MethodName": "GetCurrentMinerList",
    "Params": '{}'}
}
raw_transaction = aelf.create_raw_transaction(transaction)
```

14. send_raw_transaction

send raw transactions

Web API path

/api/blockchain/sendRawTransaction

Parameters

- Transaction - raw transaction
- Signature - signature
- ReturnTransaction - indicates whether to return transaction

Example

```
aelf = AElf(url)

raw_transaction = aelf.create_raw_transaction(transaction)
signature = private_key.sign_recoverable(bytes.fromhex(raw_transaction['RawTransaction']
→ ']))
transaction_2 = {
    "Transaction": raw_transaction['RawTransaction'],
    'Signature': signature.hex(),
```

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```
'ReturnTransaction': True
}
print('# send_raw_transaction', aelf.send_raw_transaction(transaction_2))
```

15. execute_raw_transaction

execute raw transactions

Web API path

/api/blockchain/executeRawTransaction

Post

Parameters

- RawTransaction - raw transaction
- Signature - signature

Example

```
aelf = AElf(url)

raw_transaction = aelf.create_raw_transaction(transaction)
signature = private_key.sign_recoverable(bytes.fromhex(raw_transaction['RawTransaction']
→)))
transaction_1 = {
    "RawTransaction": raw_transaction['RawTransaction'],
    "Signature": signature.hex()
}
print('# execute_raw_transaction', aelf.execute_raw_transaction(transaction_1))
```

16. get_merkle_path

get merkle path

Web API path

/api/blockchain/merklePathByTransactionId?transactionId=

Parameters

- transactionId - String

Example

```
aelf = AElf(url)

transaction_results = aelf.get_transaction_results(transactionId)
print('# get_transaction_results', transaction_results)
```

17. calculate_transaction_fee

Estimate transaction fee

Web API path

/api/blockChain/calculateTransactionFee

POST

Parameters

- CalculateTransactionFeeInput - json - The json with the following structure :
 - RawTransaction - String

Returns

- CalculateTransactionFeeOutput - json - The json with the following structure :
 - Success - Boolean
 - TransactionFee - Array
 - ResourceFee - Array

Example

```
aelf = AElf(url)

calculate_transaction_fee_input = {
    "RawTransaction": RawTransaction
}
calculate_transaction_fee_output = self.chain.calculate_transaction_fee_result(calculate_
↪transaction_fee_input)
```

18. get_network_info

Get the network information of the node.

Web API path

/api/net/networkInfo

Example

```
aelf = AElf(url)

print('# get_network_info', aelf.get_network_info())
```

20.6.5 AElf.client

Use the api to see detailed results

1. get_genesis_contract_address_string

Returns

- String: zero contract address

Example

```
aelf = AElf(url)

genesis_contract_address = aelf.get_genesis_contract_address_string()
```

2. get_system_contract_address

Parameters

- contract_name - String : system Contract's name

Returns

- Address: system Contract's address

Example

```
aelf = AElf(url)

multi_token_contract_address = aelf.get_system_contract_address('AElf.ContractNames.Token
↪')
```

3. get_system_contract_address_string

Parameters

- contract_name - String : system Contract's name

Returns

- String: system Contract's address

Example

```
aelf = AElf(url)

multi_token_contract_address_string = aelf.get_system_contract_address_string('AElf.
↪ContractNames.Token')
```

4. create_transaction

create a transaction

Parameters

- `to_address` - `Address` or `String`: target contract's address
- `method_name` - `String`: method name
- `params` - `String`: serilize paramters into `String`

Example

```
aelf = AElf(url)

params = Hash()
params.value = hashlib.sha256(contract_name.encode('utf8')).digest()
transaction = self.create_transaction(genesisContractAddress, 'GetContractAddressByName',
↪ params.SerializeToString())
```

5. sign_transaction

sign transaction with user's private key

Parameters

- `private_key` - `String`: user's private key
- `transaction` - `Transaction`: transaction

Example_

```
aelf = AElf(url)

to_address_string = aelf.get_genesis_contract_address_string()
params = Hash()
params.value = hashlib.sha256(contract_name.encode('utf8')).digest()
transaction = aelf.create_transaction(to_address_string, 'GetContractAddressByName',
↪ params.SerializeToString())
transaction = aelf.sign_transaction(private_key, transaction)
```

6. get_address_from_public_key

generate address from public key

Parameters

- `public_key` - `bytes`: user's pubilc key

Returns

- `Address`

Example_

```
aelf = AElf(url)

address = aelf.get_address_from_public_key(public_key)
```


7. get_address_string_from_public_key

generate address string from public key

Parameters

- `public_key` - bytes : user's public key

Returns

- String

Example_

```
aelf = AElf(url)

address = aelf.get_address_string_from_public_key(public_key)
```

8. get_chain_id

get chain id

Returns

- Number

Example_

```
aelf = AElf(url)

chain_id = aelf.get_chain_id()
print('# get_chain_id', chain_id)
```

9. get_formatted_address

get formatted address

Parameters

- `address` Address : address

Returns

- String

Example_

```
aelf = AElf(url)

address = aelf.chain.get_system_contract_address("AElf.ContractNames.Consensus")
formatted_address = aelf.get_formatted_address(address)
print('formatted address', formatted_address)
```

10. is_connected

check whether to connect the node

Example_

```
aelf = AElf(url)

is_connected = aelf.is_connected()
```

20.6.6 Toolkits.py

AElfToolkit Encapsulate AElf and user's private key. It simplifies the procedures of sending some transactions. You can find it in src/aelf/toolkits.py.

Create a toolkit

Create a toolkit with AElfToolkit.

```
from aelf import AElfToolkit

// generate the private key
private_key_string = 'b344570eb80043d7c5ae9800c813b8842660898bf03cbd41e583b4e54af4e7fa'
private_key = PrivateKey(bytes(bytearray.fromhex(private_key_string)))
// create a toolkit
toolkit = AElfToolkit('http://127.0.0.1:8000', private_key)
```

Send a transaction

Send a CrossChainTransfer transaction

```
from aelf import AElfToolkit

// generate the private key
private_key_string = 'b344570eb80043d7c5ae9800c813b8842660898bf03cbd41e583b4e54af4e7fa'
private_key = PrivateKey(bytes(bytearray.fromhex(private_key_string)))

// create input, the type is generated by protoc
cross_chain_transfer_input = CrossChainTransferInput()

// AElfToolkit simplifies this transaction execution.
// create a toolkit
toolkit = AElfToolkit('http://127.0.0.1:8000', private_key)
toolkit.cross_chain_transfer(to_address_string, symbol, amount, memo, to_chain_id)
```

20.6.7 Requirements

- python
- docker

20.6.8 Support

node

20.6.9 About contributing

Read out [contributing guide]

20.6.10 About Version

<https://semver.org/>

C# REFERENCE

21.1 AElf.Sdk.CSharp

21.1.1 Contents

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- *BytesState*
- *CSharpSmartContractContext*
 - *ChainId*
 - *CurrentBlockTime*
 - *CurrentHeight*
 - *Origin*
 - *PreviousBlockHash*
 - *Self*
 - *Sender*
 - *StateProvider*
 - *TransactionId*
 - *Variables*
 - *Transaction*
 - *Call(fromAddress,toAddress,methodName,args)*
 - *ConvertHashToInt64(hash,start,end)*
 - *ConvertVirtualAddressToContractAddress(virtualAddress)*
 - *ConvertVirtualAddressToContractAddress(virtualAddress,contractAddress)*
 - *ConvertVirtualAddressToContractAddressWithContractHashName(virtualAddress)*
 - *ConvertVirtualAddressToContractAddressWithContractHashName(virtualAddress,contractAddress)*
 - *DeployContract(address,registration,name)*
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 - *GetContractAddressByName(hash)*

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- *Fire(context,eventData)*
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- *GenerateId(this,token)*
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- *GenerateId(this,address,token)*
- *SendInline(context,toAddress,methodName,message)*
- *SendInline(context,toAddress,methodName,message)*
- *SendVirtualInline(context,fromVirtualAddress,toAddress,methodName,message)*
- *SmartContractConstants*
- *StringState*
- *UInt32State*
- *UInt64State*

BoolState type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around boolean values for use in smart contract state.

BytesState type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around byte arrays for use in smart contract state.

CSharpSmartContractContext type

Namespace

AElf.Sdk.CSharp

Summary

Represents the transaction execution context in a smart contract. An instance of this class is present in the base class for smart contracts (Context property). It provides access to properties and methods useful for implementing the logic in smart contracts.

ChainId property

Summary

The chain id of the chain on which the contract is currently running.

CurrentBlockTime property

Summary

The time included in the current blocks header.

CurrentHeight property

Summary

The height of the block that contains the transaction currently executing.

Origin property

Summary

The address of the sender (signer) of the transaction being executed. It's type is an AElf address. It corresponds to the From field of the transaction. This value never changes, even for nested inline calls. This means that when you access this property in your contract, it's value will be the entity that created the transaction (user or smart contract through an inline call).

PreviousBlockHash property**Summary**

The hash of the block that precedes the current in the blockchain structure.

Self property**Summary**

The address of the contract currently being executed. This changes for every transaction and inline transaction.

Sender property**Summary**

The Sender of the transaction that is executing.

StateProvider property**Summary**

Provides access to the underlying state provider.

TransactionId property**Summary**

The ID of the transaction that's currently executing.

Variables property**Summary**

Provides access to variable of the bridge.

Transaction property**Summary**

Including some transaction info.

Call(fromAddress,toAddress,methodName,args) method**Summary**

Calls a method on another contract.

Returns

The result of the call.

Parameters

| Name | Type | Description |
|------------------------------|----------------------------|--|
| fromAddress | AElf.Types.Address | The address to use as sender. |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to call. |
| args | Google.Protobuf.ByteString | The input arguments for calling that method. This is usually generated from the protobuf |
| definition of the input type | | |

Generic Types

| Name | Description |
|------|---------------------------------|
| T | The type of the return message. |

ConvertHashToInt64(hash,start,end) method**Summary**

Converts the input hash to a 64-bit signed integer.

Returns

The 64-bit signed integer.

Parameters

| Name | Type | Description |
|-------|-----------------|---|
| hash | AElf.Types.Hash | The hash. |
| start | System.Int64 | The inclusive lower bound of the number returned. |
| end | System.Int64 | The exclusive upper bound of the number returned. endValue must be greater than or equal to startValue. |

Exceptions

| Name | Description |
|--------------------------|---|
| System.ArgumentException | startValue is less than 0 or greater than endValue. |

ConvertVirtualAddressToContractAddress(virtualAddress) method

Summary

Converts a virtual address to a contract address.

Returns

The converted address.

Parameters

| Name | Type | Description |
|----------------|-----------------|---|
| virtualAddress | AElf.Types.Hash | The virtual address that want to convert. |

ConvertVirtualAddressToContractAddress(virtualAddress,contractAddress) method

Summary

Converts a virtual address to a contract address with the contract address.

Returns

The converted address.

Parameters

| Name | Type | Description |
|-----------------|--------------------|---|
| virtualAddress | AElf.Types.Hash | The virtual address that want to convert. |
| contractAddress | AElf.Types.Address | The contract address. |

ConvertVirtualAddressToContractAddressWithContractHashName(virtualAddress) method

Summary

Converts a virtual address to a contract address with the current contract hash name.

Returns

The converted address.

Parameters

| Name | Type | Description |
|----------------|-----------------|---|
| virtualAddress | AElf.Types.Hash | The virtual address that want to convert. |

ConvertVirtualAddressToContractAddressWithContractHashName(virtualAddress,contractAddress) method

Summary

Converts a virtual address to a contract address with the contract hash name.

Returns

Parameters

| Name | Type | Description |
|-----------------|--------------------|---|
| virtualAddress | AElf.Types.Hash | The virtual address that want to convert. |
| contractAddress | AElf.Types.Address | The contract address. |

DeployContract(address,registration,name) method**Summary**

Deploy a new smart contract (only the genesis contract can call it).

Parameters

| Name | Type | Description |
|--------------|--------------------------------------|---|
| address | AElf.Types.Address | The address of new smart contract. |
| registration | AElf.Types.SmartContractRegistration | The registration of the new smart contract. |
| name | AElf.Types.Hash | The hash value of the smart contract name. |

FireLogEvent(logEvent) method**Summary**

This method is used to produce logs that can be found in the transaction result after execution.

Parameters

| Name | Type | Description |
|----------|---------------------|--------------------|
| logEvent | AElf.Types.LogEvent | The event to fire. |

GenerateId(contractAddress,bytes) method**Summary**

Generate a hash type id based on the contract address and the bytes.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|-----------------|---|---|
| contractAddress | AElf.Types.Address | The contract address on which the id generation is based. |
| bytes | System.Collections.Generic.IEnumerable<System.Byte> | The bytes on which the id generation is based. |

GetContractAddressByName(hash) method**Summary**

It's sometimes useful to get the address of a system contract. The input is a hash of the system contracts name. These hashes are easily accessible through the constants in the SmartContractConstants.cs file of the C# SDK.

Returns

The address of the system contract.

Parameters

| Name | Type | Description |
|------|-----------------|-----------------------|
| hash | AElf.Types.Hash | The hash of the name. |

GetPreviousBlockTransactions() method**Summary**

Returns the transaction included in the previous block (previous to the one currently executing).

Returns

A list of transaction.

Parameters

This method has no parameters.

GetRandomHash(fromHash) method**Summary**

Gets a random hash based on the input hash.

Returns

Random hash.

Parameters

| Name | Type | Description |
|----------|-----------------|-------------|
| fromHash | AElf.Types.Hash | Hash. |

GetSystemContractNameToAddressMapping() method

Summary

Get the mapping that associates the system contract addresses and their name's hash.

Returns

The addresses with their hashes.

Parameters

This method has no parameters.

GetZeroSmartContractAddress() method

Summary

This method returns the address of the Genesis contract (smart contract zero) of the current chain.

Returns

The address of the genesis contract.

Parameters

This method has no parameters.

GetZeroSmartContractAddress(chainId) method

Summary

This method returns the address of the Genesis contract (smart contract zero) of the specified chain.

Returns

The address of the genesis contract, for the given chain.

Parameters

| Name | Type | Description |
|---------|---------------------------|-----------------|
| chainId | <code>System.Int32</code> | The chain's ID. |

LogDebug(func) method

Summary

Application logging - when writing a contract it is useful to be able to log some elements in the applications log file to simplify development. Note that these logs are only visible when the node executing the transaction is build in debug mode.

Parameters

| Name | Type | Description |
|------|--|---|
| func | <code>System.Func {System.String}</code> | The logic that will be executed for logging purposes. |

RecoverPublicKey() method

Summary

Recovers the public key of the transaction Sender.

Returns

A byte array representing the public key.

Parameters

This method has no parameters.

SendInline(toAddress,methodName,args) method**Summary**

Sends an inline transaction to another contract.

Parameters

| Name | Type | Description |
|-------------------------------|--------------------------------|--|
| toAddress | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| args | Google.Protobuf .ByteString | The input arguments for calling that method. This is usually generated from the protobuf |
| definition of the input type. | | |

SendVirtualInline(fromVirtualAddress,toAddress,methodName,args) method**Summary**

Sends a virtual inline transaction to another contract.

Parameters

| Name | Type | Description |
|-------------------------------|--------------------------------|--|
| fromVirtualAddress | AElf.Types.Hash | The hash based on which virtual address is generated. |
| toAddress | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| args | Google.Protobuf .ByteString | The input arguments for calling that method. This is usually generated from the protobuf |
| definition of the input type. | | |

SendVirtualInline(fromVirtualAddress,toAddress,methodName,args,logTransaction) method**Summary**

Add an overloaded SDK method SendVirtualInline to support automatically firing a LogEvent to log the inline transactions from virtual addresses.

Parameters

| Name | Type | Description |
|-------------------------------|--------------------------------|---|
| fromVirtualAddress | AElf.Types.Hash | The hash based on which virtual address is generated. |
| toAddress | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| args | Google.Protobuf .ByteString | The input arguments for calling that method. This is usually generated from the protobuf. |
| logTransaction | System.Boolean | Whether to fire a logEvent to log inline transactions. |
| definition of the input type. | | |

SendVirtualInlineBySystemContract(fromVirtualAddress,toAddress,methodName,args) method

Summary

Like SendVirtualInline but the virtual address uses a system smart contract.

Parameters

| Name | Type | Description |
|-------------------------------|--------------------------------|---|
| fromVirtualAddress | AElf.Types.Hash | The hash based on which virtual address is generated. This method is only available to system smart contract. |
| toAddress | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| args | Google.Protobuf .ByteString | The input arguments for calling that method. This is usually generated from the protobuf. |
| definition of the input type. | | |

SendVirtualInlineBySystemContract(fromVirtualAddress,toAddress,methodName,args,logTransaction) method

Summary

Add an overloaded SDK method SendVirtualInlineBySystemContract, like SendVirtualInline, but the virtual address uses a system smart contract.

Parameters

| Name | Type | Description |
|-------------------------------|----------------------------|---|
| fromVirtualAddress | AElf.Types.Hash | The hash based on which virtual address is generated. This method is only available to system smart contract. |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| args | Google.Protobuf.ByteString | The input arguments for calling that method. This is usually generated from the protobuf. |
| logTransaction | System.Boolean | Whether to fire a logEvent to log inline transactions. |
| definition of the input type. | | |

UpdateContract(address,registration,name) method

Summary

Update a smart contract (only the genesis contract can call it).

Parameters

| Name | Type | Description |
|--------------|--------------------------------------|--|
| address | AElf.Types.Address | The address of smart contract to update. |
| registration | AElf.Types.SmartContractRegistration | The registration of the smart contract to update. |
| name | AElf.Types.Hash <#T-AElf-Types-Hash> | The hash value of the smart contract name to update. |

ValidateStateSize(obj) method

Summary

Verify that the state size is within the valid value.

Returns

The state.

Parameters

| Name | Type | Description |
|------|-------------------------------|-------------|
| obj | System.Object | The state. |

Exceptions

| Name | Description |
|--|-----------------------------------|
| AElf.Kernel.SmartContract.StateOverSizeException | The state size exceeds the limit. |

VerifySignature(tx) method**Summary**

Returns whether or not the given transaction is well formed and the signature is correct.

Returns

The verification results.

Parameters

| Name | Type | Description |
|------|--|----------------------------|
| tx | AElf.Types.Transaction | The transaction to verify. |

CheckContractVersion(previousContractVersion,registration) method**Summary**

Check the contract version when updating the contract. (only the genesis contract can call it).

Returns

| Name | Type | Description |
|---------------------|--------------------------------|---|
| IsSubsequentVersion | System.Boolean | Whether the contract version is a subsequent version. |

Parameters

| Name | Type | Description |
|-------------------------|--------------------------------------|---|
| previousContractVersion | System.String | The previous contract version. |
| registration | AElf.Types.SmartContractRegistration | The registration of the smart contract to update. |

DeploySmartContract(address,registration,name) method

Summary

Deploy a new smart contract with contract version(only the genesis contract can call it).

Returns

| Name | Type | Description |
|---------------------|----------------|--|
| ContractVersion | System.String | The verison of smart contract to update. |
| IsSubsequentVersion | System.boolean | Whether the contract version is a subsequent version |

Parameters

| Name | Type | Description |
|--------------|--------------------------------------|---|
| address | AElf.Types.Address | The address of new smart contract. |
| name | AElf.Types.Hash | The hash value of the smart contract name. |
| registration | AElf.Types.SmartContractRegistration | The registration of the smart contract to update. |

UpdateSmartContract(address,registration,name,previousContractVersion) method

Summary

Update a smart contract with contract version (only the genesis contract can call it).

Returns

| Name | Type | Description |
|---------------------|----------------|---|
| ContractVersion | System.String | The verison of smart contract to update. |
| IsSubsequentVersion | System.Boolean | Whether the contract version is a subsequent version. |

Parameters

| Name | Type | Description |
|-------------------------|--------------------------------------|--|
| address | AElf.Types.Address | The address of smart contract to update. |
| name | AElf.Types.Hash | The hash value of the smart contract name to update. |
| registration | AElf.Types.SmartContractRegistration | The registration of the smart contract to update. |
| previousContractVersion | System.String | The previous contract version. |

ECVrfVerify(pubKey,alpha,pi,beta) method

Summary

Verify the ECVrf proof.

Returns

The verified result and the VRF hash output.

Parameters

| Name | Type | Description |
|--------|--------|---------------------------|
| pubKey | byte[] | The public key. |
| alpha | byte[] | The VRF hash input. |
| pi | byte[] | The proof to be verified. |
| beta | byte[] | The VRF hash output. |

CSharpSmartContract type

Namespace

AElf.Sdk.CSharp

Summary

This class represents a base class for contracts written in the C# language. The generated code from the protobuf definitions will inherit from this class.

Generic Types

| Name | Description |
|----------------|-------------|
| TContractState | |

Context property

Summary

Represents the transaction execution context in a smart contract. It provides access inside the contract to properties and methods useful for implementing the smart contracts action logic.

State property

Summary

Provides access to the State class instance. TContractState is the type of the state class defined by the contract author.

ContractState type

Namespace

AElf.Sdk.CSharp.State

Summary

Base class for the state class in smart contracts.

Int32State type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around 32-bit integer values for use in smart contract state.

Int64State type**Namespace**

AElf.Sdk.CSharp.State

Summary

Wrapper around 64-bit integer values for use in smart contract state.

MappedState type**Namespace**

AElf.Sdk.CSharp.State

Summary

Key-value pair data structure used for representing state in contracts.

Generic Types

| Name | Description |
|---------|------------------------|
| TKey | The type of the key. |
| TEntity | The type of the value. |

SingletonState type**Namespace**

AElf.Sdk.CSharp.State

Summary

Represents single values of a given type, for use in smart contract state.

SmartContractBridgeContextExtensions type**Namespace**

AElf.Sdk.CSharp

Summary

Extension methods that help with the interactions with the smart contract execution context.

Call(context,address,methodName,message) method

Summary

Calls a method on another contract.

Returns

The return value of the call.

Parameters

| Name | Type | Description |
|-------------------------------|--|--|
| context | AElf.Kernel.SmartContract. SmartContractBridgeContext | The virtual address of the system. contract to use as sender. |
| address | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to call. |
| message | Google.Protobuf.ByteString | The input arguments for calling that method. This is usually generated from the protobuf |
| definition of the input type. | | |

Generic Types

| Name | Description |
|------|------------------------------|
| T | The return type of the call. |

Call(context,address,methodName,message) method

Summary

Calls a method on another contract.

Returns

The result of the call.

Parameters

| Name | Type | Description |
|-------------|---|--|
| context | <i>AElf.Sdk.CSharp.CSharpSmartContractContext</i> | An instance of ISmartContractBridgeContext |
| address | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| method-Name | System.String | The name of method you want to call. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

Generic Types

| Name | Description |
|------|---------------------------------|
| T | The type of the return message. |

Call(context,fromAddress,toAddress,methodName,message) method

Summary

Calls a method on another contract.

Returns

The result of the call.

Parameters

| Name | Type | Description |
|-------------|---|--|
| context | <i>AElf.Sdk.CSharp.CSharpSmartContractContext</i> | An instance of ISmartContractBridgeContext |
| fromAddress | AElf.Types. Address | The address to use as sender. |
| toAddressvv | AElf.Types. Address | The address of the contract you're seeking to interact with. |
| method-Name | System.String | The name of method you want to call. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

Generic Types

| Name | Description |
|------|---------------------------------|
| T | The type of the return message. |

Call(context,address,methodName,message) method

Summary

Calls a method on another contract.

Returns

The result of the call.

Parameters

| Name | Type | Description |
|-------------|---|--|
| context | <i>AElf.Sdk.CSharp.CSharpSmartContractContext</i> | An instance of ISmartContractBridgeContext |
| address | AElf.Types. Address | The address to use as sender. |
| method-Name | <i>System.String</i> | The name of method you want to call. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

Generic Types

| Name | Description |
|------|---------------------------------|
| T | The type of the return message. |

ConvertToByteString(message) method

Summary

Serializes a protobuf message to a protobuf ByteString.

Returns

ByteString.Empty if the message is null

Parameters

| Name | Type | Description |
|---------|--------------------------|---------------------------|
| message | Google.Protobuf.IMessage | The message to serialize. |

ConvertVirtualAddressToContractAddress(this,virtualAddress) method

Summary

Converts a virtual address to a contract address.

Returns

Parameters

| Name | Type | Description |
|---------------------|---|---|
| this | AElf.Kernel.SmartContract. ISmartContractBridge-Context | An instance of ISmartContractBridge-Context |
| virtualAd- dress | AElf.Types.Hash Address | The virtual address that want to convert. |

ConvertVirtualAddressToContractAddressWithContractHashName(this, virtualAddress) method

Summary

Converts a virtual address to a contract address with the currently running contract address.

Returns

Parameters

| Name | Type | Description |
|---------------------|---|---|
| this | AElf.Kernel.SmartContract. ISmartContractBridge-Context | An instance of ISmartContractBridge-Context |
| virtualAd- dress | AElf.Types.Hash Address | The virtual address that want to convert. |

Fire(context,eventData) method**Summary**

Logs an event during the execution of a transaction. The event type is defined in the AElf.CSharp.core project.

Parameters

| Name | Type | Description |
|-----------|---|--|
| context | <i>AElf.Sdk.CSharp.CSharpSmartContractContext</i> | An instance of ISmartContractBridgeContext |
| eventData | | The event to log. |

Generic Types

| Name | Description |
|------|------------------------|
| T | The type of the event. |

GenerateId(this,bytes) method**Summary**

Generate a hash type id based on the currently running contract address and the bytes.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|-------|--|--|
| this | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |
| bytes | <i>System.Collections.Generic.IEnumerable{System.Byte}</i> | The bytes on which the id generation is based. |

GenerateId(this,token) method**Summary**

Generate a hash type id based on the currently running contract address and the token.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|-------|--|--|
| this | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |
| token | System.String | The token on which the id generation is based. |

GenerateId(this,token) method**Summary**

Generate a hash type id based on the currently running contract address and the hash type token.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|-------|--|--|
| this | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |
| token | AElf.Types.Hash | The hash type token on which the id generation is based. |

GenerateId(this) method**Summary**

Generate a hash type id based on the currently running contract address.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|------|--|--|
| this | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |

GenerateId(this,address,token) method

Summary

Generate a hash type id based on the address and the bytes.

Returns

The generated hash type id.

Parameters

| Name | Type | Description |
|---------|--|--|
| this | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |
| address | AElf.Types.Address | The address on which the id generation is based. |
| token | AElf.Types.Hash | The hash type token on which the id generation is based. |

SendInline(context,toAddress,methodName,message) method

Summary

Sends an inline transaction to another contract.

Parameters

| Name | Type | Description |
|------------|--|--|
| context | AElf.Kernel.SmartContract. ISmartContractBridgeContext | An instance of ISmartContractBridgeContext |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

SendInline(context,toAddress,methodName,message) method**Summary**

Sends a virtual inline transaction to another contract.

Parameters

| Name | Type | Description |
|-------------|---|--|
| context | AElf.Kernel.SmartContract. ISmartContract-BridgeContext | An instance of ISmartContractBridgeContext |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| method-Name | System.String | The name of method you want to invoke. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

SendVirtualInline(context,fromVirtualAddress,toAddress,methodName,message) method**Summary**

Sends a virtual inline transaction to another contract.

Parameters

| Name | Type | Description |
|--------------------|---|--|
| context | AElf.Kernel.SmartContract. ISmartContract-BridgeContext | An instance of ISmartContractBridgeContext |
| fromVirtualAddress | AElf.Types.Hash | The virtual address to use as sender. |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

**SendVirtualInline(context,fromVirtualAddress,toAddress,methodName,
message) method**

Summary

Sends a virtual inline transaction to another contract.

Parameters

| Name | Type | Description |
|-------------------------|---|--|
| context | AElf.Kernel.SmartContract. ISmartContract-BridgeContext | An instance of ISmartContractBridgeContext |
| fromVirtualAd- dress | AElf.Types.Hash | The virtual address to use as sender. |
| toAddress | AElf.Types.Address | The address of the contract you're seeking to interact with. |
| methodName | System.String | The name of method you want to invoke. |
| message | Google.Protobuf.ByteString | The protobuf message that will be the input to the call. |

SmartContractConstants type

Namespace

AElf.Sdk.CSharp

Summary

Static class containing the hashes built from the names of the contracts.

StringState type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around string values for use in smart contract state.

UInt32State type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around unsigned 32-bit integer values for use in smart contract state.

UInt64State type

Namespace

AElf.Sdk.CSharp.State

Summary

Wrapper around unsigned 64-bit integer values for use in smart contract state.

21.2 AElf.CSharp.Core

21.2.1 Contents

- *Builder*
 - *ctor()*
 - *AddMethod(method,handler)*
 - *Build()*
- *EncodingHelper*
 - *EncodeUtf8(str)*
- *IMethod*
 - *FullName*
 - *Name*
 - *ServiceName*
 - *Type*
- *Marshaller*
 - *ctor(serializer,deserializer)*
 - *Deserializer*
 - *Serializer*
- *Marshallers*
 - *StringMarshaller*

- *Create()*
- *MethodType*
 - *Action*
 - *View*
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 - *ctor(type,serviceName,name,requestMarshaller,responseMarshaller)*
 - *FullName*
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 - *ServiceName*
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 - *GetFullName()*
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 - *CheckNotNull(reference)*
 - *CheckNotNullreference,paramName)*
- *SafeMath*
- *ServerServiceDefinition*
 - *BindService()*
 - *CreateBuilder()*
- *ServiceBinderBase*
 - *AddMethod(method,handler)*
- *TimestampExtensions*
 - *AddDays(timestamp,days)*
 - *AddHours(timestamp,hours)*
 - *AddMilliseconds(timestamp,milliseconds)*
 - *AddMinutes(timestamp,minutes)*
 - *AddSeconds(timestamp,seconds)*
 - *Max(timestamp1,timestamp2)*
 - *Milliseconds(duration)*
- *UnaryServerMethod*

Builder type**Namespace**

AElf.CSharp.Core.ServerServiceDefinition

Summary

Builder class for *ServerServiceDefinition*.

ctor() constructor**Summary**

Creates a new instance of builder.

Parameters

This constructor has no parameters.

AddMethod`2(method,handler) method**Summary**

Adds a definition for a single request - single response method.

Returns

This builder instance.

Parameters

| Name | Type | Description |
|---------|---|---------------------|
| method | <i>AElf.CSharp.Core.Method</i> | The method. |
| handler | <i>AElf.CSharp.Core.UnaryServerMethod</i> | The method handler. |

Generic Types

| Name | Description |
|-----------|-----------------------------|
| TRequest | The request message class. |
| TResponse | The response message class. |

Build() method**Summary**

Creates an immutable `ServerServiceDefinition` from this builder.

Returns

The `ServerServiceDefinition` object.

Parameters

This method has no parameters.

EncodingHelper type**Namespace**

AElf.CSharp.Core.Utils

Summary

Helper class for serializing strings.

EncodeUtf8(str) method**Summary**

Serializes a UTF-8 string to a byte array.

Returns

the serialized string.

Parameters

| Name | Type | Description |
|------|-------------------------------|-------------|
| str | System.String | |

IMethod type

Namespace

AElf.CSharp.Core

Summary

A non-generic representation of a remote method.

FullName property

Summary

Gets the fully qualified name of the method. On the server side, methods are dispatched based on this name.

Name property

Summary

Gets the unqualified name of the method.

ServiceName property

Summary

Gets the name of the service to which this method belongs.

Type property

Summary

Gets the type of the method.

Marshaller type

Namespace

AElf.CSharp.Core

Summary

Encapsulates the logic for serializing and deserializing messages.

ctor(serializer,deserializer) constructor

Summary

Initializes a new marshaller from simple serialize/deserialize functions.

Parameters

| Name | Type | Description |
|------------|-----------------------------|---|
| serializer | System.Func | Function that will be used to deserialize messages. |

Deserializer property

Summary

Gets the deserializer function.

Serializer property

Summary

Gets the serializer function.

Marshallers type

Namespace

AElf.CSharp.Core

Summary

Utilities for creating marshallers.

StringMarshaller property

Summary

Returns a marshaller for `string` type. This is useful for testing.

Create() method

Summary

Creates a marshaller from specified serializer and deserializer.

Parameters

This method has no parameters.

MethodType type

Namespace

AElf.CSharp.Core

Action constants

Summary

The method modifies the contrac state.

View constants

Summary

The method doesn't modify the contract state.

Method type

Namespace

AElf.CSharp.Core

Summary

A description of a remote method.

Generic Types

| Name | Description |
|-----------|--|
| TRequest | Request message type for this method. |
| TResponse | Response message type for this method. |

ctor(type,serviceName,name,requestMarshaller,responseMarshaller) constructor

Summary

Initializes a new instance of the `Method` class.

Parameters

| Name | Type | Description |
|---------------------|------------------------------------|---|
| type | <i>AElf.CSharp.Core.Method</i> | Type of method. |
| serviceName | <i>System.String</i> | Name of service this method belongs to. |
| name | <i>System.String</i> | Unqualified name of the method. |
| request Marshaller | <i>AElf.CSharp.Core.Marshaller</i> | Marshaller used for request messages. |
| response Marshaller | <i>AElf.CSharp.Core.Marshaller</i> | Marshaller used for response messages. |

FullName property

Summary

Gets the fully qualified name of the method. On the server side, methods are dispatched based on this name.

Name property

Summary

Gets the unqualified name of the method.

RequestMarshaller property

Summary

Gets the marshaller used for request messages.

ResponseMarshaller property

Summary

Gets the marshaller used for response messages.

ServiceName property

Summary

Gets the name of the service to which this method belongs.

Type property

Summary

Gets the type of the method.

GetFullName() method

Summary

Gets full name of the method including the service name.

Parameters

This method has no parameters.

Preconditions type

Namespace

AElf.CSharp.Core.Utils

CheckNotNull(reference) method

Summary

Throws [ArgumentNullException](#) if reference is null.

Parameters

| Name | Type | Description |
|-----------|------|----------------|
| reference | | The reference. |

CheckNotNull(reference,paramName) method

Summary

Throws [ArgumentNullException](#) if reference is null.

Parameters

| Name | Type | Description |
|-----------|-------------------------------|---------------------|
| reference | | The reference. |
| paramName | System.String | The parameter name. |

SafeMath type

Namespace

AElf.CSharp.Core

Summary

Helper methods for safe math operations that explicitly check for overflow.

ServerServiceDefinition type

Namespace

AElf.CSharp.Core

Summary

Stores mapping of methods to server call handlers. Normally, the `ServerServiceDefinition` objects will be created by the `BindService` factory method that is part of the autogenerated code for a protocol buffers service definition.

BindService() method

Summary

Forwards all the previously stored `AddMethod` calls to the service binder.

Parameters

This method has no parameters.

CreateBuilder() method

Summary

Creates a new builder object for `ServerServiceDefinition`.

Returns

The builder object.

Parameters

This method has no parameters.

ServiceBinderBase type

Namespace

AElf.CSharp.Core

Summary

Allows binding server-side method implementations in alternative serving stacks. Instances of this class are usually populated by the `BindService` method that is part of the autogenerated code for a protocol buffers service definition.

AddMethod(method,handler) method

Summary

Adds a definition for a single request - single response method.

Parameters

| Name | Type | Description |
|---------|---|---------------------|
| method | <i>AElf.CSharp.Core.Method</i> | The method. |
| handler | <i>AElf.CSharp.Core.UnaryServerMethod</i> | The method handler. |

Generic Types

| Name | Description |
|-----------|-----------------------------|
| TRequest | The request message class. |
| TResponse | The response message class. |

TimestampExtensions type

Namespace

AElf.CSharp.Core.Extension

Summary

Helper methods for dealing with protobuf timestamps.

AddDays(timestamp,days) method

Summary

Adds a given amount of days to a timestamp. Returns a new instance.

Returns

a new timestamp instance.

Parameters

| Name | Type | Description |
|-----------|--|---------------------|
| timestamp | Google.Protobuf.WellKnownTypes.Timestamp | the timestamp. |
| days | System.Int64 | the amount of days. |

AddHours(timestamp, hours) method

Summary

Adds a given amount of hours to a timestamp. Returns a new instance.

Returns

a new timestamp instance.

Parameters

| Name | Type | Description |
|-----------|--|----------------------|
| timestamp | Google.Protobuf.WellKnownTypes.Timestamp | the timestamp. |
| hours | System.Int64 | the amount of hours. |

AddMilliseconds(timestamp, milliseconds) method

Summary

Adds a given amount of milliseconds to a timestamp. Returns a new instance.

Returns

a new timestamp instance.

Parameters

| Name | Type | Description |
|--------------|--|------------------------------------|
| timestamp | Google.Protobuf.WellKnownTypes.Timestamp | the timestamp. |
| milliseconds | System.Int64 | the amount of milliseconds to add. |

AddMinutes(timestamp,minutes) method**Summary**

Adds a given amount of minutes to a timestamp. Returns a new instance.

Returns

a new timestamp instance.

Parameters

| Name | Type | Description |
|-----------|---|------------------------|
| timestamp | Google.Protobuf .WellKnownTypes.Timestamp | the timestamp. |
| minutes | System.Int64 | the amount of minutes. |

AddSeconds(timestamp,seconds) method**Summary**

Adds a given amount of seconds to a timestamp. Returns a new instance.

Returns

a new timestamp instance.

Parameters

| Name | Type | Description |
|-----------|--|------------------------|
| timestamp | Google.Protobuf .WellKnownTypes.Timestam | the timestamp. |
| seconds | System.Int64 | the amount of seconds. |

Max(timestamp1,timestamp2) method**Summary**

Compares two timestamps and returns the greater one.

Returns

the greater timestamp.

Parameters

| Name | Type | Description |
|------------|---|----------------------|
| timestamp1 | Google.Protobuf .WellKnownTypes.Timestamp | the first timestamp |
| timestamp2 | Google.Protobuf .WellKnownTypes.Timestamp | the second timestamp |

Milliseconds(duration) method

Summary

Converts a protobuf duration to long.

Returns

the duration represented with a long.

Parameters

| Name | Type | Description |
|----------|--|--------------------------|
| duration | Google.Protobuf .WellKnownTypes.Duration | the duration to convert. |

UnaryServerMethod type

Namespace

AElf.CSharp.Core

Summary

Handler for a contract method.

Generic Types

| Name | Description |
|-----------|--|
| TRequest | Request message type for this method. |
| TResponse | Response message type for this method. |

SMART CONTRACT APIS

This section gives an overview of some important contracts and contract methods. It's not meant to be exhaustive. With every method description we give the parameter message in JSON format, this can be useful when using client (like **aelf-command**).

22.1 AElf.Contracts.Association

Association contract.

Organizations established to achieve specific goals can use this contract to cooperatively handle transactions within the organization

Implement AElf Standards ACS1 and ACS3.

22.1.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|--|---------------------------------|--|
| CreateOrganization | <i>Association.CreateOrganizationInput</i> | <i>aelf.Address</i> | Create an organization and return its address. |
| CreateOrganization-BySystemContract | <i>Association.CreateOrganizationBySystemContractInput</i> | <i>aelf.Address</i> | Creates an organization by system contract and return its address. |
| AddMember | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Add organization members. |
| RemoveMember | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Remove organization members. |
| ChangeMember | <i>Association.ChangeMemberInput</i> | <i>google.protobuf.Empty</i> | Replace organization member with a new member. |
| GetOrganization | <i>aelf.Address</i> | <i>Association.Organization</i> | Get the organization according to the organization address. |
| CalculateOrganizationAddress | <i>Association.CreateOrganizationInput</i> | <i>aelf.Address</i> | Calculate the input and return the organization address. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|-------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.String</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.String</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS3

| Method Name | Request Type | Response Type | Description |
|---------------------------------------|--|------------------------------|---|
| CreateProposal | <i>acs3.CreateProposal</i> | <i>google.protobuf.Int64</i> | Create a proposal for which organization members can vote. When the proposal is released, a transaction will be sent to the specified contract. Return id of the newly created proposal. |
| Approve | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Approve a proposal according to the proposal ID. |
| Reject | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Reject a proposal according to the proposal ID. |
| Abstain | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Abstain a proposal according to the proposal ID. |
| Release | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Release a proposal according to the proposal ID and send a transaction to the specified contract. |
| ChangeOrganization-Threshold | <i>acs3.ProposalReleaseThreshold</i> | <i>google.protobuf.Empty</i> | Change the thresholds associated with proposals. All fields will be overwritten by the input value and this will affect all current proposals of the organization. Note: only the organization can execute this through a proposal. |
| ChangeOrganization-Proposer-WhiteList | <i>acs3.ProposerWhiteList</i> | <i>google.protobuf.Empty</i> | Change the white list of organization proposer. This method overrides the list of whitelisted proposers. |
| CreateProposal-BySystem-Contract | <i>acs3.CreateProposalBySystemContract</i> | <i>google.protobuf.Int64</i> | Create a proposal by system contracts, and return id of the newly created proposal. |
| ClearProposal | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Remove the specified proposal. If the proposal is in effect, the cleanup fails. |
| GetProposal | <i>aelf.Hash</i> | <i>acs3.Proposal</i> | Get a proposal according to the proposal ID. |
| Validate-OrganizationExist | <i>aelf.Address</i> | <i>google.protobuf.Bool</i> | Check the existence of an organization. |
| ValidateProposerIn-WhiteList | <i>acs3.ValidateProposerInWhiteList</i> | <i>google.protobuf.Bool</i> | Check if a proposer is whitelisted. |

22.1.2 Contract Types

AElf.Contracts.Association

Association.ChangeMemberInput

| Field | Type | Description | Label |
|------------|---------------------|-------------------------|-------|
| old_member | <i>aelf.Address</i> | The old member address. | |
| new_member | <i>aelf.Address</i> | The new member address. | |

Association.CreateOrganizationBySystemContractInput

| Field | Type | Description | Label |
|--------------------------------------|--------------------------------|---|-------|
| organization_creation_input | <i>CreateOrganizationInput</i> | The parameters of creating organization. | |
| organization_address_feedback_method | <i>string</i> | The organization address callback method which replies the organization address to caller contract. | |

Association.CreateOrganizationInput

| Field | Type | Description | Label |
|----------------------------|--------------------------------------|--|-------|
| organization_member_list | <i>OrganizationMemberList</i> | Initial organization members. | |
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| proposer_white_list | <i>acs3.ProposerWhiteList</i> | The proposer whitelist. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Association.MemberAdded

| Field | Type | Description | Label |
|----------------------|---------------------|---------------------------|-------|
| member | <i>aelf.Address</i> | The added member address. | |
| organization_address | <i>aelf.Address</i> | The organization address. | |

Association.MemberChanged

| Field | Type | Description | Label |
|----------------------|---------------------|---------------------------|-------|
| old_member | <i>aelf.Address</i> | The old member address. | |
| new_member | <i>aelf.Address</i> | The new member address. | |
| organization_address | <i>aelf.Address</i> | The organization address. | |

Association.MemberRemoved

| Field | Type | Description | Label |
|----------------------|---------------------|-----------------------------|-------|
| member | <i>aelf.Address</i> | The removed member address. | |
| organization_address | <i>aelf.Address</i> | The organization address. | |

Association.Organization

| Field | Type | Description | Label |
|----------------------------|--------------------------------------|--|-------|
| organization_member_list | <i>OrganizationMemberList</i> | The organization members. | |
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| proposer_white_list | <i>acs3.ProposerWhiteList</i> | The proposer whitelist. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |
| organization_hash | <i>aelf.Hash</i> | The organizations id. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Association.OrganizationMemberList

| Field | Type | Description | Label |
|----------------------|---------------------|--------------------------------------|----------|
| organization_members | <i>aelf.Address</i> | The address of organization members. | repeated |

Association.ProposalInfo

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-----------|
| proposal_id | <i>aelf.Hash</i> | The proposal ID. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| approvals | <i>aelf.Address</i> | Address list of approved. | re-peated |
| rejections | <i>aelf.Address</i> | Address list of rejected. | re-peated |
| abstentions | <i>aelf.Address</i> | Address list of abstained. | re-peated |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS3**acs3.CreateProposalBySystemContractInput**

| Field | Type | Description | Label |
|-----------------|----------------------------|--------------------------------------|-------|
| proposal_input | <i>CreateProposalInput</i> | The parameters of creating proposal. | |
| origin_proposer | <i>aelf.Address</i> | The actor that trigger the call. | |

acs3.CreateProposalInput

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-------|
| contract_method_name | <i>string</i> | The name of the method to call after release. | |
| to_address | <i>aelf.Address</i> | The address of the contract to call after release. | |
| params | <i>bytes</i> | The parameter of the method to be called after the release. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The timestamp at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |
| token | <i>aelf.Hash</i> | The token is for proposal id generation and with this token, proposal id can be calculated before proposing. | |

acs3.OrganizationCreated

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| organization_address | <i>aelf.Address</i> | The address of the created organization. | |

acs3.OrganizationHashAddressPair

| Field | Type | Description | Label |
|----------------------|---------------------|------------------------------|-------|
| organization_hash | <i>aelf.Hash</i> | The id of organization. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |

acs3.OrganizationThresholdChanged

| Field | Type | Description | Label |
|----------------------------|---------------------------------|----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address | |
| proposer_release_threshold | <i>ProposalReleaseThreshold</i> | The new release threshold. | |

acs3.OrganizationWhiteListChanged

| Field | Type | Description | Label |
|----------------------|--------------------------|-----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address. | |
| proposer_white_list | <i>ProposerWhiteList</i> | The new proposer whitelist. | |

acs3.ProposalCreated

| Field | Type | Description | Label |
|----------------------|---------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the created proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the created proposal. | |

acs3.ProposalOutput

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| to_be_released | <i>bool</i> | Indicates if this proposal is releasable. | |
| approval_count | <i>int64</i> | Approval count for this proposal. | |
| rejection_count | <i>int64</i> | Rejection count for this proposal. | |
| abstention_count | <i>int64</i> | Abstention count for this proposal. | |

acs3.ProposalReleaseThreshold

| Field | Type | Description | Label |
|------------------------------|--------------|---|-------|
| minimal_approval_threshold | <i>int64</i> | The value for the minimum approval threshold. | |
| maximal_rejection_threshold | <i>int64</i> | The value for the maximal rejection threshold. | |
| maximal_abstention_threshold | <i>int64</i> | The value for the maximal abstention threshold. | |
| minimal_vote_threshold | <i>int64</i> | The value for the minimal vote threshold. | |

acs3.ProposalReleased

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the released proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the released proposal. | |

acs3.ProposerWhiteList

| Field | Type | Description | Label |
|-----------|---------------------|------------------------------|----------|
| proposers | <i>aelf.Address</i> | The address of the proposers | repeated |

acs3.ReceiptCreated

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| address | <i>aelf.Address</i> | The sender address. | |
| receipt_type | <i>string</i> | The type of receipt(Approve, Reject or Abstain). | |
| time | <i>google.protobuf.Timestamp</i> | The timestamp of this method call. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

acs3.ValidateProposerInWhiteListInput

| Field | Type | Description | Label |
|----------------------|---------------------|----------------------------------|-------|
| proposer | <i>aelf.Address</i> | The address to search/check. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

AElf.Types

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.2 AElf.Contracts.Referendum

Referendum contract.

Production nodes or associations cannot determine all decisions. Some extremely important decisions, especially those involving user rights and interests, should involve all users and give full control to the user's voting for governance. The Referendum contract is built for this.

Implement AElf Standards ACS1 and ACS3.

22.2.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|---|--------------------------------|--|
| ReclaimVoteToken | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Unlock the token used for voting according to proposal id. |
| CreateOrganization | <i>Referendum.CreateOrganizationInput</i> | <i>aelf.Address</i> | Create an organization and return its address. |
| CreateOrganization-BySystemContract | <i>Referendum.CreateOrganizationBySystemContractInput</i> | <i>aelf.Address</i> | Creates an organization by system contract and return its address. |
| GetOrganization | <i>aelf.Address</i> | <i>Referendum.Organization</i> | Get the organization according to the organization address. |
| CalculateOrganizationAddress | <i>Referendum.CreateOrganizationInput</i> | <i>aelf.Address</i> | Calculate the input and return the organization address. |
| GetProposalVirtual-Address | <i>aelf.Hash</i> | <i>aelf.Address</i> | Get the virtual address of a proposal based on the proposal id. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>acs1.MethodFee</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS3

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|---|----------------------------------|---|
| CreateProposal | <i>acs3.CreateProposalInput</i> | <i>acs3.Proposal</i> | Create a proposal for which organization members can vote. When the proposal is released, a transaction will be sent to the specified contract. Return id of the newly created proposal. |
| Approve | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Approve a proposal according to the proposal ID. |
| Reject | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Reject a proposal according to the proposal ID. |
| Abstain | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Abstain a proposal according to the proposal ID. |
| Release | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Release a proposal according to the proposal ID and send a transaction to the specified contract. |
| ChangeOrganizationThreshold | <i>acs3.ProposalReleaseThresholdInput</i> | <i>google.protobuf.Empty</i> | Change the thresholds associated with proposals. All fields will be overwritten by the input value and this will affect all current proposals of the organization. Note: only the organization can execute this through a proposal. |
| ChangeOrganizationProposerWhiteList | <i>acs3.ProposerWhiteListInput</i> | <i>google.protobuf.Empty</i> | Change the white list of organization proposer. This method overrides the list of whitelisted proposers. |
| CreateProposal-BySystem-Contract | <i>acs3.CreateProposalBySystemContractInput</i> | <i>acs3.Proposal</i> | Create a proposal by system contracts, and return id of the newly created proposal. |
| ClearProposal | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Remove the specified proposal. If the proposal is in effect, the cleanup fails. |
| GetProposal | <i>aelf.Hash</i> | <i>acs3.Proposal</i> | Get one proposal according to the proposal ID. |
| Validate-OrganizationExist | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> | Check the existence of an organization. |
| ValidateProposerIn-WhiteList | <i>acs3.ValidateProposerInWhiteListInput</i> | <i>google.protobuf.BoolValue</i> | Check if the proposer is whitelisted. |

22.2.2 Contract Types

AElf.Contracts.Referendum

Referendum.CreateOrganizationBySystemContractInput

| Field | Type | Description | Label |
|--------------------------------------|--------------------------------|---|-------|
| organization_creation_input | <i>CreateOrganizationInput</i> | The parameters of creating organization. | |
| organization_address_feedback_method | <i>string</i> | The organization address callback method which replies the organization address to caller contract. | |

Referendum.CreateOrganizationInput

| Field | Type | Description | Label |
|----------------------------|--------------------------------------|--|-------|
| token_symbol | <i>string</i> | The token used during proposal operations. | |
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| proposer_white_list | <i>acs3.ProposerWhiteList</i> | The proposer whitelist. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Referendum.Organization

| Field | Type | Description | Label |
|----------------------------|--------------------------------------|--|-------|
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| token_symbol | <i>string</i> | The token used during proposal operations. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |
| organization_hash | <i>aelf.Hash</i> | The organizations id. | |
| proposer_white_list | <i>acs3.ProposerWhiteList</i> | The proposer whitelist. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Referendum.ProposalInfo

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The proposal ID. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| approval_count | <i>int64</i> | The count of approved. | |
| rejection_count | <i>int64</i> | The count of rejected. | |
| abstention_count | <i>int64</i> | The count of abstained. | |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |

Referendum.Receipt

| Field | Type | Description | Label |
|--------------|------------------|-----------------------------|-------|
| amount | <i>int64</i> | The amount of token locked. | |
| token_symbol | <i>string</i> | The symbol of token locked. | |
| lock_id | <i>aelf.Hash</i> | The lock id. | |

Referendum.ReferendumReceiptCreated

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| address | <i>aelf.Address</i> | The sender address. | |
| symbol | <i>string</i> | The symbol of token locked. | |
| amount | <i>int64</i> | The amount of token locked. | |
| receipt_type | <i>string</i> | The type of receipt(Approve, Reject or Abstain). | |
| time | <i>google.protobuf.Timestamp</i> | The timestamp of this method call. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS3**acs3.CreateProposalBySystemContractInput**

| Field | Type | Description | Label |
|-----------------|----------------------------|--------------------------------------|-------|
| proposal_input | <i>CreateProposalInput</i> | The parameters of creating proposal. | |
| origin_proposer | <i>aelf.Address</i> | The actor that trigger the call. | |

acs3.CreateProposalInput

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-------|
| contract_method_name | <i>string</i> | The name of the method to call after release. | |
| to_address | <i>aelf.Address</i> | The address of the contract to call after release. | |
| params | <i>bytes</i> | The parameter of the method to be called after the release. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The timestamp at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |
| token | <i>aelf.Hash</i> | The token is for proposal id generation and with this token, proposal id can be calculated before proposing. | |

acs3.OrganizationCreated

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| organization_address | <i>aelf.Address</i> | The address of the created organization. | |

acs3.OrganizationHashAddressPair

| Field | Type | Description | Label |
|----------------------|---------------------|------------------------------|-------|
| organization_hash | <i>aelf.Hash</i> | The id of organization. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |

acs3.OrganizationThresholdChanged

| Field | Type | Description | Label |
|----------------------------|---------------------------------|----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address | |
| proposer_release_threshold | <i>ProposalReleaseThreshold</i> | The new release threshold. | |

acs3.OrganizationWhiteListChanged

| Field | Type | Description | Label |
|----------------------|--------------------------|-----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address. | |
| proposer_white_list | <i>ProposerWhiteList</i> | The new proposer whitelist. | |

acs3.ProposalCreated

| Field | Type | Description | Label |
|----------------------|---------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the created proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the created proposal. | |

acs3.ProposalOutput

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| to_be_released | <i>bool</i> | Indicates if this proposal is releasable. | |
| approval_count | <i>int64</i> | Approval count for this proposal. | |
| rejection_count | <i>int64</i> | Rejection count for this proposal. | |
| abstention_count | <i>int64</i> | Abstention count for this proposal. | |

acs3.ProposalReleaseThreshold

| Field | Type | Description | Label |
|------------------------------|--------------|---|-------|
| minimal_approval_threshold | <i>int64</i> | The value for the minimum approval threshold. | |
| maximal_rejection_threshold | <i>int64</i> | The value for the maximal rejection threshold. | |
| maximal_abstention_threshold | <i>int64</i> | The value for the maximal abstention threshold. | |
| minimal_vote_threshold | <i>int64</i> | The value for the minimal vote threshold. | |

acs3.ProposalReleased

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the released proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the released proposal. | |

acs3.ProposerWhiteList

| Field | Type | Description | Label |
|-----------|---------------------|------------------------------|----------|
| proposers | <i>aelf.Address</i> | The address of the proposers | repeated |

acs3.ReceiptCreated

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| address | <i>aelf.Address</i> | The sender address. | |
| receipt_type | <i>string</i> | The type of receipt(Approve, Reject or Abstain). | |
| time | <i>google.protobuf.Timestamp</i> | The timestamp of this method call. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

acs3.ValidateProposerInWhiteListInput

| Field | Type | Description | Label |
|----------------------|---------------------|----------------------------------|-------|
| proposer | <i>aelf.Address</i> | The address to search/check. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.3 AElf.Contracts.Parliament

Parliament contract.

The production nodes use the Parliament contract to govern important matters. In the initial state, the production nodes are members of the parliament, and only when two-thirds of the production nodes vote in favor of a given decision, will it be executed.

Implement AElf Standards ACS1 and ACS3.

22.3.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|---|------------------------------------|--|
| Initialize | <i>Parliament.InitializeInput</i> | <i>google.protobuf.Empty</i> | Initialize parliament proposer whitelist and create the first parliament organization with specific proposer_authority_required. |
| CreateOrganization | <i>Parliament.CreateOrganizationInput</i> | <i>aelf.Address</i> | Create an organization and return its address. |
| ApproveMulti-Proposals | <i>Parliament.ProposalIdList</i> | <i>google.protobuf.Empty</i> | Approve proposal. |
| CreateOrganizationBySystemContract | <i>Parliament.CreateOrganizationBySystemContractInput</i> | <i>aelf.Address</i> | Creates an organization by system contract and return its address. |
| GetOrganization | <i>aelf.Address</i> | <i>Parliament.OrganizationInfo</i> | Get the organization according to the organization address. |
| GetDefaultOrganizationAddress | <i>google.protobuf.Empty</i> | <i>aelf.Address</i> | Get the default organization address. |
| ValidateAddressIsParliament-Member | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Validate if the provided address is a parliament member. |
| GetProposer-WhiteList | <i>google.protobuf.Empty</i> | <i>acs3.ProposerWhitelist</i> | Return the list of whitelisted proposers. |
| GetNotVoted-PendingProposals | <i>Parliament.ProposalIdList</i> | <i>Parliament.ProposalIdList</i> | Filter still pending ones not yet voted by the sender from provided proposals. |
| GetNotVoted-Proposals | <i>Parliament.ProposalIdList</i> | <i>Parliament.ProposalIdList</i> | Filter not yet voted ones by the sender from provided proposals. |
| CalculateOrganizationAddress | <i>Parliament.CreateOrganizationInput</i> | <i>aelf.Address</i> | Calculates with input and return the organization address. |
| GetReleaseThresholdReachedProposals | <i>Parliament.ProposalIdList</i> | <i>Parliament.ProposalIdList</i> | Filter reached release threshold proposals. |
| GetAvailableProposals | <i>Parliament.ProposalIdList</i> | <i>Parliament.ProposalIdList</i> | Filter available proposals. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|------------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringValue</i> | <i>acs1.MethodFee</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS3

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|---|----------------------------------|---|
| CreateProposal | <i>acs3.CreateProposalInput</i> | <i>acs3.Proposal</i> | Create a proposal for which organization members can vote. When the proposal is released, a transaction will be sent to the specified contract. Return id of the newly created proposal. |
| Approve | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Approve a proposal according to the proposal ID. |
| Reject | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Reject a proposal according to the proposal ID. |
| Abstain | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Abstain a proposal according to the proposal ID. |
| Release | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Release a proposal according to the proposal ID and send a transaction to the specified contract. |
| ChangeOrganizationThreshold | <i>acs3.ProposalReleaseThresholdInput</i> | <i>google.protobuf.Empty</i> | Change the thresholds associated with proposals. All fields will be overwritten by the input value and this will affect all current proposals of the organization. Note: only the organization can execute this through a proposal. |
| ChangeOrganizationProposerWhiteList | <i>acs3.ProposerWhiteListInput</i> | <i>google.protobuf.Empty</i> | Change the white list of organization proposer. This method overrides the list of whitelisted proposers. |
| CreateProposalBySystemContract | <i>acs3.CreateProposalBySystemContractInput</i> | <i>acs3.Proposal</i> | Create a proposal by system contracts, and return id of the newly created proposal. |
| ClearProposal | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Remove the specified proposal. If the proposal is in effect, the cleanup fails. |
| GetProposal | <i>aelf.Hash</i> | <i>acs3.Proposal</i> | Get one proposal according to the proposal ID. |
| ValidateOrganizationExist | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> | Check the existence of an organization. |
| ValidateProposerInWhiteList | <i>acs3.ValidateProposerInWhiteListInput</i> | <i>google.protobuf.BoolValue</i> | Check if the proposer is whitelisted. |

22.3.2 Contract Types

AElf.Contracts.Parliament

Parliament.CreateOrganizationBySystemContractInput

| Field | Type | Description | Label |
|--------------------------------------|--------------------------------|---|-------|
| organization_creation_input | <i>CreateOrganizationInput</i> | The parameters of creating organization. | |
| organization_address_feedback_method | <i>string</i> | The organization address callback method which replies the organization address to caller contract. | |

Parliament.CreateOrganizationInput

| Field | Type | Description | Label |
|-------------------------------------|--------------------------------------|---|-------|
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| proposer_authority_required | <i>bool</i> | Setting this to true can allow anyone to create proposals. | |
| parliament_member_proposing_allowed | <i>bool</i> | Setting this to true can allow parliament member to create proposals. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Parliament.InitializeInput

| Field | Type | Description | Label |
|-----------------------------|---------------------|--|-------|
| privileged_proposer | <i>aelf.Address</i> | Privileged proposer would be the first address in parliament proposer whitelist. | |
| proposer_authority_required | <i>bool</i> | The setting indicates if proposals need authority to be created for first/default parliament organization. | |

Parliament.Organization

| Field | Type | Description | Label |
|-------------------------------------|--------------------------------------|--|-------|
| proposer_authority_required | <i>bool</i> | Indicates if proposals need authority to be created. | |
| organization_address | <i>aelf.Address</i> | The organization address. | |
| organization_hash | <i>aelf.Hash</i> | The organization id. | |
| proposal_release_threshold | <i>acs3.ProposalReleaseThreshold</i> | The threshold for releasing the proposal. | |
| parliament_member_proposing_allowed | <i>bool</i> | Indicates if parliament member can propose to this organization. | |
| creation_token | <i>aelf.Hash</i> | The creation token is for organization address generation. | |

Parliament.ProposalIdList

| Field | Type | Description | Label |
|--------------|------------------|---------------------------|----------|
| proposal_ids | <i>aelf.Hash</i> | The list of proposal ids. | repeated |

Parliament.ProposalInfo

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-----------|
| proposal_id | <i>aelf.Hash</i> | The proposal ID. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| approvals | <i>aelf.Address</i> | Address list of approved. | re-peated |
| rejections | <i>aelf.Address</i> | Address list of rejected. | re-peated |
| abstentions | <i>aelf.Address</i> | Address list of abstained. | re-peated |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS3**acs3.CreateProposalBySystemContractInput**

| Field | Type | Description | Label |
|-----------------|----------------------------|--------------------------------------|-------|
| proposal_input | <i>CreateProposalInput</i> | The parameters of creating proposal. | |
| origin_proposer | <i>aelf.Address</i> | The actor that trigger the call. | |

acs3.CreateProposalInput

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-------|
| contract_method_name | <i>string</i> | The name of the method to call after release. | |
| to_address | <i>aelf.Address</i> | The address of the contract to call after release. | |
| params | <i>bytes</i> | The parameter of the method to be called after the release. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The timestamp at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |
| token | <i>aelf.Hash</i> | The token is for proposal id generation and with this token, proposal id can be calculated before proposing. | |

acs3.OrganizationCreated

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| organization_address | <i>aelf.Address</i> | The address of the created organization. | |

acs3.OrganizationHashAddressPair

| Field | Type | Description | Label |
|----------------------|---------------------|------------------------------|-------|
| organization_hash | <i>aelf.Hash</i> | The id of organization. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |

acs3.OrganizationThresholdChanged

| Field | Type | Description | Label |
|----------------------------|---------------------------------|----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address | |
| proposer_release_threshold | <i>ProposalReleaseThreshold</i> | The new release threshold. | |

acs3.OrganizationWhiteListChanged

| Field | Type | Description | Label |
|----------------------|--------------------------|-----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address. | |
| proposer_white_list | <i>ProposerWhiteList</i> | The new proposer whitelist. | |

acs3.ProposalCreated

| Field | Type | Description | Label |
|----------------------|---------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the created proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the created proposal. | |

acs3.ProposalOutput

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| to_be_released | <i>bool</i> | Indicates if this proposal is releasable. | |
| approval_count | <i>int64</i> | Approval count for this proposal. | |
| rejection_count | <i>int64</i> | Rejection count for this proposal. | |
| abstention_count | <i>int64</i> | Abstention count for this proposal. | |

acs3.ProposalReleaseThreshold

| Field | Type | Description | Label |
|------------------------------|--------------|---|-------|
| minimal_approval_threshold | <i>int64</i> | The value for the minimum approval threshold. | |
| maximal_rejection_threshold | <i>int64</i> | The value for the maximal rejection threshold. | |
| maximal_abstention_threshold | <i>int64</i> | The value for the maximal abstention threshold. | |
| minimal_vote_threshold | <i>int64</i> | The value for the minimal vote threshold. | |

acs3.ProposalReleased

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the released proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the released proposal. | |

acs3.ProposerWhiteList

| Field | Type | Description | Label |
|-----------|---------------------|------------------------------|----------|
| proposers | <i>aelf.Address</i> | The address of the proposers | repeated |

acs3.ReceiptCreated

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| address | <i>aelf.Address</i> | The sender address. | |
| receipt_type | <i>string</i> | The type of receipt(Approve, Reject or Abstain). | |
| time | <i>google.protobuf.Timestamp</i> | The timestamp of this method call. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

acs3.ValidateProposerInWhiteListInput

| Field | Type | Description | Label |
|----------------------|---------------------|----------------------------------|-------|
| proposer | <i>aelf.Address</i> | The address to search/check. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|---|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_bytes | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction its actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|---------------------------|--|----------|
| transaction_id | Hash | The transaction id. | |
| status | Transaction-Result-Status | The transaction result status. | |
| logs | LogEvent | The log events. | repeated |
| bloom | bytes | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | bytes | The return value of the transaction execution. | |
| block_number | number | The height of the block that packages the transaction. | |
| block_hash | hash | The hash of the block that packages the transaction. | |
| error | string | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.4 AElf.Contracts.Consensus.AEDPoS

AEDPoS contract.

Used to managing block producers and synchronizing data.

Implement AElf Standards ACS1, ACS4, ACS6, ACS10 and ACS11.

22.4.1 Contract Methods

| Method Name | Request Type | Response Type |
|------------------------------------|---|--|
| InitialAElfConsensusContract | <i>AEDPoS.InitialAElfConsensusContractInput</i> | <i>google.protobuf.Empty</i> |
| FirstRound | <i>AEDPoS.Round</i> | <i>google.protobuf.Empty</i> |
| UpdateValue | <i>AEDPoS.UpdateValueInput</i> | <i>google.protobuf.Empty</i> |
| NextRound | <i>AEDPoS.NextRoundInput</i> | <i>google.protobuf.Empty</i> |
| NextTerm | <i>AEDPoS.NextTermInput</i> | <i>google.protobuf.Empty</i> |
| UpdateTinyBlockInformation | <i>AEDPoS.TinyBlockInput</i> | <i>google.protobuf.Empty</i> |
| SetMaximumMinersCount | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Empty</i> |
| ChangeMaximumMinersCountController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| RecordCandidateReplacement | <i>AEDPoS.RecordCandidateReplacementInput</i> | <i>google.protobuf.Empty</i> |
| GetCurrentMinerList | <i>google.protobuf.Empty</i> | <i>AEDPoS.MinerList</i> |
| GetCurrentMinerPubkeyList | <i>google.protobuf.Empty</i> | <i>AEDPoS.PubkeyList</i> |
| GetCurrentMinerListWithRoundNumber | <i>google.protobuf.Empty</i> | <i>AEDPoS.MinerListWithRoundNumber</i> |
| GetRoundInformation | <i>google.protobuf.Int64Value</i> | <i>AEDPoS.Round</i> |
| GetCurrentRoundNumber | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetCurrentRoundInformation | <i>google.protobuf.Empty</i> | <i>AEDPoS.Round</i> |
| GetPreviousRoundInformation | <i>google.protobuf.Empty</i> | <i>AEDPoS.Round</i> |
| GetCurrentTermNumber | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetCurrentTermMiningReward | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetMinerList | <i>AEDPoS.GetMinerListInput</i> | <i>AEDPoS.MinerList</i> |
| GetPreviousMinerList | <i>google.protobuf.Empty</i> | <i>AEDPoS.MinerList</i> |
| GetMinedBlocksOfPreviousTerm | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetNextMinerPubkey | <i>google.protobuf.Empty</i> | <i>google.protobuf.StringValue</i> |
| IsCurrentMiner | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> |
| GetNextElectCountDown | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetPreviousTermInformation | <i>google.protobuf.Int64Value</i> | <i>AEDPoS.Round</i> |
| GetRandomHash | <i>google.protobuf.Int64Value</i> | <i>aelf.Hash</i> |
| GetMaximumBlocksCount | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int32Value</i> |
| GetMaximumMinersCount | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int32Value</i> |
| GetMaximumMinersCountController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> |
| GetMainChainCurrentMinerList | <i>google.protobuf.Empty</i> | <i>AEDPoS.MinerList</i> |
| GetPreviousTermMinerPubkeyList | <i>google.protobuf.Empty</i> | <i>AEDPoS.PubkeyList</i> |

Table 1 – continu

| Method Name | Request Type | Response Type |
|--------------------------------|-----------------------------------|-----------------------------------|
| GetCurrentMiningRewardPerBlock | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| SetMinerIncreaseInterval | <i>google.protobuf.Int64Value</i> | <i>google.protobuf.Empty</i> |
| GetMinerIncreaseInterval | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|---------------------------------------|---------------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.StringMapValue</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringMapValue</i> | <i>google.protobuf.StringMapValue</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS4

| Method Name | Request Type | Response Type | Description |
|------------------------------------|-----------------------------------|-----------------------------------|--|
| GetConsensusCommand | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get consensus command based on the consensus contract state and the input public key. |
| GetConsensusExtra-Data | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get consensus extra data when a block is generated. |
| Generate-Consensus-Transactions | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Generate consensus system transactions when a block is generated. Each block will contain only one consensus transaction, which is used to write the latest consensus information to the State database. |
| Validate-Consensus-BeforeExecution | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Before executing the block, verify that the consensus information in the block header is correct. |
| Validate-Consensus-AfterExecution | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | After executing the block, verify that the state information written to the consensus is correct. |

AElf.Standards.ACS6

| Method Name | Request Type | Response Type | Description |
|-----------------|-----------------------------------|-----------------------------------|--|
| GetRandom-Bytes | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get random number according to block height. |

AElf.Standards.ACS10

| Method Name | Request Type | Response Type | Description |
|---------------------------|-----------------------------------|------------------------------|--|
| Donate | <i>acs10.DonateInput</i> | <i>google.protobuf.Empty</i> | Donate tokens from the caller to the treasury. If the tokens are not native tokens in the current chain, they will be first converted to the native token. |
| Release | <i>acs10.ReleaseInput</i> | <i>google.protobuf.Empty</i> | Release dividend pool according to the period number. |
| SetSymbol-List | <i>acs10.SymbolList</i> | <i>google.protobuf.Empty</i> | Set token symbols dividend pool supports. |
| GetSymbol-List | <i>google.protobuf.Empty</i> | <i>acs10.SymbolList</i> | Query the token symbols dividend pool supports. |
| GetUndistributedDividends | <i>google.protobuf.Empty</i> | <i>acs10.DividendQuery</i> | Query the balance of undistributed tokens whose symbols are included in the symbol list. |
| GetDividends | <i>google.protobuf.BytesValue</i> | <i>acs10.DividendQuery</i> | Query the dividend information according to the height. |

AElf.Standards.ACS11

| Method Name | Request Type | Response Type | Description |
|-----------------------------------|-----------------------------------|-----------------------------------|---|
| UpdateInformationFrom-CrossChain | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.Empty</i> | Update the consensus information of the side chain. |
| GetChainInitializationInformation | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get the current miner list and consensus round information. |
| CheckCrossChainIndexingPermission | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> | Verify that the input address is the current miner. |

22.4.2 Contract Types

AElf.Contracts.Consensus.AEDPoS

AEDPoS.AElfConsensusHeaderInformation

| Field | Type | Description | Label |
|---------------|-------------------------------|-----------------------------|-------|
| sender_pubkey | <i>bytes</i> | The sender public key. | |
| round | <i>Round</i> | The round information. | |
| behaviour | <i>AElfConsensusBehaviour</i> | The behaviour of consensus. | |

AEDPoS.AElfConsensusHint

| Field | Type | Description | Label |
|-------------------|-------------------------------|-----------------------------|-------|
| behaviour | <i>AElfConsensusBehaviour</i> | The behaviour of consensus. | |
| round_id | <i>int64</i> | The round id. | |
| previous_round_id | <i>int64</i> | The previous round id. | |

AEDPoS.AElfConsensusTriggerInformation

| Field | Type | Description | Label |
|--------------------|--|----------------------------------|----------|
| pubkey | <i>bytes</i> | The miner public key. | |
| in_value | <i>aelf.Hash</i> | The InValue for current round. | |
| previous_in_value | <i>aelf.Hash</i> | The InValue for previous round. | |
| behaviour | <i>AElfConsensusBehaviour</i> | The behaviour of consensus. | |
| encrypted_pieces | <i>AElfConsensusTriggerInformation.EncryptedPiecesEntry</i> | The encrypted pieces of InValue. | repeated |
| decrypted_pieces | <i>AElfConsensusTriggerInformation.DecryptedPiecesEntry</i> | The decrypted pieces of InValue. | repeated |
| revealed_in_values | <i>AElfConsensusTriggerInformation.RevealedInValuesEntry</i> | The revealed InValues. | repeated |

AEDPoS.AElfConsensusTriggerInformation.DecryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.AElfConsensusTriggerInformation.EncryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.AElfConsensusTriggerInformation.RevealedInValuesEntry

| Field | Type | Description | Label |
|-------|------------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>aelf.Hash</i> | | |

AEDPoS.Candidates

| Field | Type | Description | Label |
|---------|--------------|----------------------------|----------|
| pubkeys | <i>bytes</i> | The candidate public keys. | repeated |

AEDPoS.ConsensusInformation

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

AEDPoS.GetMinerListInput

| Field | Type | Description | Label |
|-------------|--------------|------------------|-------|
| term_number | <i>int64</i> | The term number. | |

AEDPoS.HashList

| Field | Type | Description | Label |
|--------|------------------|-------------|----------|
| values | <i>aelf.Hash</i> | | repeated |

AEDPoS.InitialAElfConsensusContractInput

| Field | Type | Description | Label |
|-------------------------|--------------|--|-------|
| is_term_stay_one | <i>bool</i> | Whether not to change the term. | |
| is_side_chain | <i>bool</i> | Is a side chain. | |
| period_seconds | <i>int64</i> | The number of seconds per term. | |
| miner_increase_interval | <i>int64</i> | The interval second that increases the number of miners. | |

AEDPoS.IrreversibleBlockFound

| Field | Type | Description | Label |
|---------------------------|--------------|--------------------------------------|-------|
| irreversible_block_height | <i>int64</i> | The irreversible block height found. | |

AEDPoS.IrreversibleBlockHeightUnacceptable

| Field | Type | Description | Label |
|---------------------------------------|--------------|--|-------|
| distance_to_irreversible_block_height | <i>int64</i> | Distance to the height of the last irreversible block. | |

AEDPoS.LatestPubkeyToTinyBlocksCount

| Field | Type | Description | Label |
|--------------|---------------|---|-------|
| pubkey | <i>string</i> | The miner public key. | |
| blocks_count | <i>int64</i> | The count of blocks the miner produced. | |

AEDPoS.MinerInRound

| Field | Type | Description | Label |
|-----------------------------------|--|--|----------|
| order | <i>int32</i> | The order of the miner producing block. | |
| is_extra_block_producer | <i>bool</i> | Is extra block producer in the current round. | |
| in_value | <i>aelf.Hash</i> | Generated by secret sharing and used for validation between miner. | |
| out_value | <i>aelf.Hash</i> | Calculated from current in value. | |
| signature | <i>aelf.Hash</i> | Calculated from current in value and signatures of previous round. | |
| expected_mining_time | <i>google.protobuf.Timestamp</i> | The expected mining time. | |
| produced_blocks | <i>int64</i> | The amount of produced blocks. | |
| missed_time_slots | <i>int64</i> | The amount of missed time slots. | |
| pubkey | <i>string</i> | The public key of this miner. | |
| previous_in_value | <i>aelf.Hash</i> | The InValue of the previous round. | |
| supposed_order_of_next_round | <i>int32</i> | The supposed order of mining for the next round. | |
| final_order_of_next_round | <i>int32</i> | The final order of mining for the next round. | |
| actual_mining_time | <i>google.protobuf.Timestamp</i> | The actual mining time, miners must fill actual mining time when they do the mining. | repeated |
| encrypted_pieces | <i>MinerInRound.EncryptedPiecesEntry</i> | The encrypted pieces of InValue. | repeated |
| decrypted_pieces | <i>MinerInRound.DecryptedPiecesEntry</i> | The decrypted pieces of InValue. | repeated |
| produced_tiny_blocks | <i>int64</i> | The amount of produced tiny blocks. | |
| implied_irreversible_block_height | <i>int64</i> | The irreversible block height that current miner recorded. | |

AEDPoS.MinerInRound.DecryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.MinerInRound.EncryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.MinerList

| Field | Type | Description | Label |
|---------|--------------|-----------------------------|----------|
| pubkeys | <i>bytes</i> | The miners public key list. | repeated |

AEDPoS.MinerListWithRoundNumber

| Field | Type | Description | Label |
|--------------|------------------|---------------------|-------|
| miner_list | <i>MinerList</i> | The list of miners. | |
| round_number | <i>int64</i> | The round number. | |

AEDPoS.MinerReplaced

| Field | Type | Description | Label |
|------------------|---------------|---------------------------|-------|
| new_miner_pubkey | <i>string</i> | The new miner public key. | |

AEDPoS.MiningInformationUpdated

| Field | Type | Description | Label |
|---------------------|----------------------------------|-----------------------------|-------|
| pubkey | <i>string</i> | The miner public key. | |
| mining_time | <i>google.protobuf.Timestamp</i> | The current block time. | |
| behaviour | <i>string</i> | The behaviour of consensus. | |
| block_height | <i>int64</i> | The current block height. | |
| previous_block_hash | <i>aelf.Hash</i> | The previous block hash. | |

AEDPoS.MiningRewardGenerated

| Field | Type | Description | Label |
|-------------|--------------|--|-------|
| term_number | <i>int64</i> | The number of term the mining reward is generated. | |
| amount | <i>int64</i> | The amount of mining reward. | |

AEDPoS.PubkeyList

| Field | Type | Description | Label |
|---------|---------------|-----------------------------|----------|
| pubkeys | <i>string</i> | The miners public key list. | repeated |

AEDPoS.RandomNumberRequestInformation

| Field | Type | Description | Label |
|-----------------------|--------------|--|-------|
| target_round_number | <i>int64</i> | The random hash is likely generated during this round. | |
| order | <i>int64</i> | | |
| expected_block_height | <i>int64</i> | | |

AEDPoS.RecordCandidateReplacementInput

| Field | Type | Description | Label |
|------------|---------------|-------------|-------|
| old_pubkey | <i>string</i> | | |
| new_pubkey | <i>string</i> | | |

AEDPoS.NextRoundInput

| Field | Type | Description | Label |
|---|--|---|----------|
| round_number | <i>int64</i> | The round number. | |
| real_time_miners_information | <i>Round.RealTimeMinersInformation</i> | Current miner information, miner public key -> miner information. | repeated |
| main_chain_miners_round_number | <i>int64</i> | The round number on the main chain | |
| blockchain_age | <i>int64</i> | The time from chain start to current round (seconds). | |
| extra_block_producer_of_previous_round | <i>string</i> | The miner public key that produced the extra block in the previous round. | |
| term_number | <i>int64</i> | The current term number. | |
| confirmed_irreversible_block_height | <i>int64</i> | The height of the confirmed irreversible block. | |
| confirmed_irreversible_block_round_number | <i>int64</i> | The round number of the confirmed irreversible block. | |
| is_miner_list_just_changed | <i>bool</i> | Is miner list different from the the miner list in the previous round. | |
| round_id_for_validation | <i>int64</i> | The round id, calculated by summing block producers' expecting time (second). | |
| random_number | <i>bytes</i> | The random number. | |

AEDPoS.NextTermInput

| Field | Type | Description | Label |
|---|--|---|----------|
| round_number | <i>int64</i> | The round number. | |
| real_time_miners_information | <i>Round.RealTimeMinersInformation</i> | Current miner information, miner public key -> miner information. | repeated |
| main_chain_miners_round_number | <i>int64</i> | The round number on the main chain | |
| blockchain_age | <i>int64</i> | The time from chain start to current round (seconds). | |
| extra_block_producer_of_previous_round | <i>string</i> | The miner public key that produced the extra block in the previous round. | |
| term_number | <i>int64</i> | The current term number. | |
| confirmed_irreversible_block_height | <i>int64</i> | The height of the confirmed irreversible block. | |
| confirmed_irreversible_block_round_number | <i>int64</i> | The round number of the confirmed irreversible block. | |
| is_miner_list_just_changed | <i>bool</i> | Is miner list different from the the miner list in the previous round. | |
| round_id_for_validation | <i>int64</i> | The round id, calculated by summing block producers' expecting time (second). | |
| random_number | <i>bytes</i> | The random number. | |

AEDPoS.Round.RealTimeMinersInformationEntry

| Field | Type | Description | Label |
|-------|---------------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>MinerInRound</i> | | |

AEDPoS.SecretSharingInformation

| Field | Type | Description | Label |
|-------------------|--------------|---------------------------------|-------|
| previous_round | <i>Round</i> | The previous round information. | |
| current_round_id | <i>int64</i> | The current round id. | |
| previous_round_id | <i>int64</i> | The previous round id. | |

AEDPoS.TermInfo

| Field | Type | Description | Label |
|--------------|--------------|-------------|-------|
| term_number | <i>int64</i> | | |
| round_number | <i>int64</i> | | |

AEDPoS.TermNumberLookUp

| Field | Type | Description | Label |
|-------|----------------------------------|------------------------------|----------|
| map | <i>TermNumberLookUp.MapEntry</i> | Term number -> Round number. | repeated |

AEDPoS.TermNumberLookUp.MapEntry

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| key | <i>int64</i> | | |
| value | <i>int64</i> | | |

AEDPoS.TinyBlockInput

| Field | Type | Description | Label |
|--------------------|----------------------------------|------------------------------------|-------|
| round_id | <i>int64</i> | The round id. | |
| actual_mining_time | <i>google.protobuf.Timestamp</i> | The actual mining time. | |
| produced_blocks | <i>int64</i> | Count of blocks currently produced | |

AEDPoS.UpdateValueInput

| Field | Type | Description | Label |
|-----------------------------------|---|--|----------|
| out_value | <i>aelf.Hash</i> | Calculated from current in value. | |
| signature | <i>aelf.Hash</i> | Calculated from current in value and signatures of previous round. | |
| round_id | <i>int64</i> | To ensure the values to update will be apply to correct round by comparing round id. | |
| previous_in_value | <i>aelf.Hash</i> | Publish previous in value for validation previous signature and previous out value. | |
| actual_mining_time | <i>google.protobuf.Timestamp</i> | The actual mining time, miners must fill actual mining time when they do the mining. | |
| supposed_order_of_next_round | <i>int32</i> | The supposed order of mining for the next round. | |
| tune_order_information | <i>UpdateValueInput.TuneOrderInformationEntry</i> | The tuning order of mining for the next round, miner public key -> order. | repeated |
| encrypted_pieces | <i>UpdateValueInput.EncryptedPiecesEntry</i> | The encrypted pieces of InValue. | repeated |
| decrypted_pieces | <i>UpdateValueInput.DecryptedPiecesEntry</i> | The decrypted pieces of InValue. | repeated |
| produced_blocks | <i>int64</i> | The amount of produced blocks. | |
| miners_previous_in_values | <i>UpdateValueInput.MinersPreviousInValuesEntry</i> | The InValue in the previous round, miner public key -> InValue. | repeated |
| implied_irreversible_block_height | <i>int64</i> | The irreversible block height that miner recorded. | |

AEDPoS.UpdateValueInput.DecryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.UpdateValueInput.EncryptedPiecesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

AEDPoS.UpdateValueInput.MinersPreviousInValuesEntry

| Field | Type | Description | Label |
|-------|------------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>aelf.Hash</i> | | |

AEDPoS.UpdateValueInput.TuneOrderInformationEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

AEDPoS.VoteMinersCountInput

| Field | Type | Description | Label |
|--------------|--------------|-------------|-------|
| miners_count | <i>int32</i> | | |
| amount | <i>int64</i> | | |

AEDPoS.AElfConsensusBehaviour

| Name | Number | Description |
|--------------|--------|-------------|
| UPDATE_VALUE | 0 | |
| NEXT_ROUND | 1 | |
| NEXT_TERM | 2 | |
| NOTHING | 3 | |
| TINY_BLOCK | 4 | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS4**acs4.ConsensusCommand**

| Field | Type | Description | Label |
|------------------------------------|----------------------------------|--|-------|
| limit_milliseconds_of_mining_block | <i>int32</i> | Time limit of mining next block. | |
| hint | <i>bytes</i> | Context of Hint is diverse according to the consensus protocol we choose, so we use bytes. | |
| arranged_mining_time | <i>google.protobuf.Timestamp</i> | The time of arrange mining. | |
| mining_due_time | <i>google.protobuf.Timestamp</i> | The expiration time of mining. | |

acs4.TransactionList

| Field | Type | Description | Label |
|--------------|-------------------------|--------------------------------|----------|
| transactions | <i>aelf.Transaction</i> | Consensus system transactions. | repeated |

acs4.ValidationResult

| Field | Type | Description | Label |
|---------------|---------------|----------------------------------|-------|
| success | <i>bool</i> | Is successful. | |
| message | <i>string</i> | The error message. | |
| is_re_trigger | <i>bool</i> | Whether to trigger mining again. | |

AElf.Standards.ACS6**AElf.Standards.ACS10****acs10.Dividends**

| Field | Type | Description | Label |
|-------|-----------------------------|----------------------------------|----------|
| value | <i>Dividends.ValueEntry</i> | The dividends, symbol -> amount. | repeated |

acs10.Dividends.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs10.DonateInput

| Field | Type | Description | Label |
|--------|---------------|-----------------------------|-------|
| symbol | <i>string</i> | The token symbol to donate. | |
| amount | <i>int64</i> | The amount to donate. | |

acs10.DonationReceived

| Field | Type | Description | Label |
|---------------|---------------------|-------------------------------|-------|
| from | <i>aelf.Address</i> | The address of donors. | |
| pool_contract | <i>aelf.Address</i> | The address of dividend pool. | |
| symbol | <i>string</i> | The token symbol Donated. | |
| amount | <i>int64</i> | The amount Donated. | |

acs10.ReleaseInput

| Field | Type | Description | Label |
|---------------|--------------|-------------------------------|-------|
| period_number | <i>int64</i> | The period number to release. | |

acs10.SymbolList

| Field | Type | Description | Label |
|-------|---------------|------------------------|----------|
| value | <i>string</i> | The token symbol list. | repeated |

AElf.Standards.ACS11**AElf.Types****aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.5 AElf.Contracts.Election

Election contract.

Used for voting for Block Producers.

Implement AElf Standards ACS1.

22.5.1 Contract Methods

| Method Name | Request Type | Response Type |
|------------------------------------|---|--------------------------------------|
| InitialElectionContract | <i>Election.InitialElectionContractInput</i> | <i>google.protobuf.Empty</i> |
| RegisterElectionVotingEvent | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> |
| TakeSnapshot | <i>Election.TakeElectionSnapshotInput</i> | <i>google.protobuf.Empty</i> |
| AnnounceElection | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> |
| QuitElection | <i>google.protobuf.StringValue</i> | <i>google.protobuf.Empty</i> |
| Vote | <i>Election.VoteMinerInput</i> | <i>aelf.Hash</i> |
| ChangeVotingOption | <i>Election.ChangeVotingOptionInput</i> | <i>google.protobuf.Empty</i> |
| Withdraw | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> |
| UpdateCandidateInformation | <i>Election.UpdateCandidateInformationInput</i> | <i>google.protobuf.Empty</i> |
| UpdateMultipleCandidateInformation | <i>Election.UpdateMultipleCandidateInformationInput</i> | <i>google.protobuf.Empty</i> |
| UpdateMinersCount | <i>Election.UpdateMinersCountInput</i> | <i>google.protobuf.Empty</i> |
| SetProfitsReceiver | <i>Election.SetProfitsReceiverInput</i> | <i>google.protobuf.Empty</i> |
| SetTreasurySchemeIds | <i>Election.SetTreasurySchemeIdsInput</i> | <i>google.protobuf.Empty</i> |
| SetVoteWeightInterest | <i>Election.VoteWeightInterestList</i> | <i>google.protobuf.Empty</i> |
| SetVoteWeightProportion | <i>Election.VoteWeightProportion</i> | <i>google.protobuf.Empty</i> |
| ChangeVoteWeightInterestController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ReplaceCandidatePubkey | <i>Election.ReplaceCandidatePubkeyInput</i> | <i>google.protobuf.Empty</i> |
| SetCandidateAdmin | <i>Election.SetCandidateAdminInput</i> | <i>google.protobuf.Empty</i> |
| GetCandidates | <i>google.protobuf.Empty</i> | <i>Election.PubkeyList</i> |
| GetVotedCandidates | <i>google.protobuf.Empty</i> | <i>Election.PubkeyList</i> |
| GetCandidateInformation | <i>google.protobuf.StringValue</i> | <i>Election.CandidateInformation</i> |
| GetVictories | <i>google.protobuf.Empty</i> | <i>Election.PubkeyList</i> |
| GetTermSnapshot | <i>Election.GetTermSnapshotInput</i> | <i>Election.TermSnapshot</i> |
| GetMinersCount | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int32Value</i> |
| GetElectionResult | <i>Election.GetElectionResultInput</i> | <i>Election.ElectionResult</i> |
| GetElectorVote | <i>google.protobuf.StringValue</i> | <i>Election.ElectorVote</i> |
| GetElectorVoteWithRecords | <i>google.protobuf.StringValue</i> | <i>Election.ElectorVote</i> |
| GetElectorVoteWithAllRecords | <i>google.protobuf.StringValue</i> | <i>Election.ElectorVote</i> |
| GetCandidateVote | <i>google.protobuf.StringValue</i> | <i>Election.CandidateVote</i> |
| GetCandidateVoteWithRecords | <i>google.protobuf.StringValue</i> | <i>Election.CandidateVote</i> |
| GetCandidateVoteWithAllRecords | <i>google.protobuf.StringValue</i> | <i>Election.CandidateVote</i> |

| Method Name | Request Type | Response Type |
|---------------------------------|---|--|
| GetVotersCount | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetVotesAmount | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> |
| GetPageableCandidateInformation | <i>Election.PageInformation</i> | <i>Election.GetPageableCandidateInform</i> |
| GetMinerElectionVotingItemId | <i>google.protobuf.Empty</i> | <i>aelf.Hash</i> |
| GetDataCenterRankingList | <i>google.protobuf.Empty</i> | <i>Election.DataCenterRankingList</i> |
| GetVoteWeightSetting | <i>google.protobuf.Empty</i> | <i>Election.VoteWeightInterestList</i> |
| GetVoteWeightProportion | <i>google.protobuf.Empty</i> | <i>Election.VoteWeightProportion</i> |
| GetCalculateVoteWeight | <i>Election.VoteInformation</i> | <i>google.protobuf.Int64Value</i> |
| GetVoteWeightInterestController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> |
| GetMinerReplacementInformation | <i>Election.GetMinerReplacementInformationInput</i> | <i>Election.MinerReplacementInformati</i> |
| GetCandidateAdmin | <i>google.protobuf.StringValue</i> | <i>aelf.Address</i> |
| GetNewestPubkey | <i>google.protobuf.StringValue</i> | <i>google.protobuf.StringValue</i> |
| GetReplacedPubkey | <i>google.protobuf.StringValue</i> | <i>google.protobuf.StringValue</i> |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|------------------------------------|------------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringValue</i> | <i>google.protobuf.StringValue</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.5.2 Contract Types

AElf.Contracts.Election

Election.CandidateDetail

| Field | Type | Description | Label |
|-----------------------|-----------------------------|---|-------|
| candidate_information | <i>CandidateInformation</i> | The candidate information. | |
| obtained_votes_amount | <i>int64</i> | The number of votes a candidate has obtained. | |

Election.CandidateInformation

| Field | Type | Description | Label |
|-----------------------------|------------------|--|-----------|
| pubkey | <i>string</i> | Candidate's public key. | |
| terms | <i>int64</i> | The number of terms that the candidate is elected. | re-peated |
| produced_blocks | <i>int64</i> | The number of blocks the candidate has produced. | |
| missed_time_slots | <i>int64</i> | The time slot for which the candidate failed to produce blocks. | |
| continual_appointment_count | <i>int64</i> | The count of continual appointment. | |
| announcement_transaction_id | <i>aelf.Hash</i> | The transaction id when the candidate announced. | |
| is_current_candidate | <i>bool</i> | Indicate whether the candidate can be elected in the current term. | |

Election.CandidatePubkeyReplaced

| Field | Type | Description | Label |
|------------|---------------|-------------|-------|
| old_pubkey | <i>string</i> | | |
| new_pubkey | <i>string</i> | | |

Election.CandidateVote

| Field | Type | Description | Label |
|--------------------------------------|-----------------------------|---|-----------|
| obtained_active_voting_record_ids | <i>aelf.Hash</i> | The active voting record ids obtained. | re-peated |
| obtained_withdrawn_voting_record_ids | <i>aelf.Hash</i> | The active voting record ids that were withdrawn. | re-peated |
| obtained_active_voted_votes_amount | <i>int64</i> | The total number of active votes obtained. | |
| all_obtained_voted_votes_amount | <i>int64</i> | The total number of votes obtained. | |
| obtained_active_voting_records | <i>ElectionVotingRecord</i> | The active voting records. | re-peated |
| obtained_withdrawn_votes_records | <i>ElectionVotingRecord</i> | The voting records that were withdrawn. | re-peated |
| pubkey | <i>bytes</i> | Public key for candidate. | |

Election.ChangeVotingOptionInput

| Field | Type | Description | Label |
|------------------|------------------|-------------------------------|-------|
| vote_id | <i>aelf.Hash</i> | The vote id to change. | |
| candidate_pubkey | <i>string</i> | The new candidate public key. | |

Election.DataCenterRankingList

| Field | Type | Description | Label |
|--------------|---|---|----------|
| data_centers | <i>DataCenterRankingList.DataCentersEntry</i> | The top n * 5 candidates with vote amount, candidate public key -> vote amount. | repeated |

Election.DataCenterRankingList.DataCentersEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Election.ElectionResult

| Field | Type | Description | Label |
|-------------|------------------------------------|---|----------|
| term_number | <i>int64</i> | The term number | |
| results | <i>ElectionResult.ResultsEntry</i> | The election result, candidates' public key -> number of votes. | repeated |
| is_active | <i>bool</i> | Whether an election is currently being held. | |

Election.ElectionResult.ResultsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Election.ElectionVotingRecord

| Field | Type | Description | Label |
|--------------------|----------------------------------|---|-------|
| voter | <i>aelf.Address</i> | The address of voter. | |
| candidate | <i>string</i> | The public key of candidate. | |
| amount | <i>int64</i> | Amount of voting. | |
| term_number | <i>int64</i> | The term number of voting. | |
| vote_id | <i>aelf.Hash</i> | The vote id. | |
| lock_time | <i>int64</i> | Vote lock time. | |
| unlock_timestamp | <i>google.protobuf.Timestamp</i> | The unlock timestamp. | |
| withdraw_timestamp | <i>google.protobuf.Timestamp</i> | The withdraw timestamp. | |
| vote_timestamp | <i>google.protobuf.Timestamp</i> | The vote timestamp. | |
| is_withdrawn | <i>bool</i> | Indicates if the vote has been withdrawn. | |
| weight | <i>int64</i> | Vote weight for sharing bonus. | |
| is_change_target | <i>bool</i> | Whether vote others. | |

Election.ElectorVote

| Field | Type | Description | Label |
|-----------------------------|-----------------------------|--|----------|
| active_voting_record_ids | <i>aelf.Hash</i> | The active voting record ids. | repeated |
| withdrawn_voting_record_ids | <i>aelf.Hash</i> | The voting record ids that were withdrawn. | repeated |
| active_voted_votes_amount | <i>int64</i> | The total number of active votes. | |
| all_voted_votes_amount | <i>int64</i> | The total number of votes (including the number of votes withdrawn). | |
| active_voting_records | <i>ElectionVotingRecord</i> | The active voting records. | repeated |
| withdrawn_votes_records | <i>ElectionVotingRecord</i> | The voting records that were withdrawn. | repeated |
| pubkey | <i>bytes</i> | Public key for voter. | |
| address | <i>aelf.Address</i> | Address for voter. | |

Election.EvilMinerDetected

| Field | Type | Description | Label |
|--------|---------------|-------------------------------|-------|
| pubkey | <i>string</i> | The public key of evil miner. | |

Election.GetElectionResultInput

| Field | Type | Description | Label |
|-------------|--------------|------------------|-------|
| term_number | <i>int64</i> | The term number. | |

Election.GetMinerReplacementInformationInput

| Field | Type | Description | Label |
|--------------------|---------------|------------------------------------|----------|
| current_miner_list | <i>string</i> | The current miner list to inspect. | repeated |

Election.GetPageableCandidateInformationOutput

| Field | Type | Description | Label |
|-------|------------------------|--------------------------------|----------|
| value | <i>CandidateDetail</i> | The details of the candidates. | repeated |

Election.GetTermSnapshotInput

| Field | Type | Description | Label |
|-------------|--------------|------------------|-------|
| term_number | <i>int64</i> | The term number. | |

Election.InitialElectionContractInput

| Field | Type | Description | Label |
|-------------------------|---------------|--|----------|
| minimum_lock_time | <i>int64</i> | Minimum number of seconds for locking. | |
| maximum_lock_time | <i>int64</i> | Maximum number of seconds for locking. | |
| miner_list | <i>string</i> | The current miner list. | repeated |
| time_each_term | <i>int64</i> | The number of seconds per term. | |
| miner_increase_interval | <i>int64</i> | The interval second that increases the number of miners. | |

Election.MinerReplacementInformation

| Field | Type | Description | Label |
|-------------------------------|---------------|--|----------|
| alternative_candidate_pubkeys | <i>string</i> | The alternative candidate public keys. | repeated |
| evil_miner_pubkeys | <i>string</i> | The evil miner public keys. | repeated |

Election.PagelInformation

| Field | Type | Description | Label |
|--------|--------------|------------------------|-------|
| start | <i>int32</i> | The start index. | |
| length | <i>int32</i> | The number of records. | |

Election.PubkeyList

| Field | Type | Description | Label |
|-------|--------------|-------------------------|----------|
| value | <i>bytes</i> | Candidates' public keys | repeated |

Election.ReplaceCandidatePubkeyInput

| Field | Type | Description | Label |
|------------|---------------|-------------|-------|
| old_pubkey | <i>string</i> | | |
| new_pubkey | <i>string</i> | | |

Election.SetCandidateAdminInput

| Field | Type | Description | Label |
|--------|---------------------|-------------|-------|
| pubkey | <i>string</i> | | |
| admin | <i>aelf.Address</i> | | |

Election.SetProfitsReceiverInput

| Field | Type | Description | Label |
|---------------------------|---------------------|---|-------|
| candidate_pubkey | <i>string</i> | The candidate's public key. | |
| profits_receiver_address | <i>aelf.Address</i> | The address of profits receiver. | |
| previous_receiver_address | <i>aelf.Address</i> | The previous address of profits receiver. | |

Election.SetTreasurySchemeldsInput

| Field | Type | Description | Label |
|-------------------------|------------------|--------------------------------------|-------|
| treasury_hash | <i>aelf.Hash</i> | The scheme id of treasury reward. | |
| welfare_hash | <i>aelf.Hash</i> | The scheme id of welfare reward. | |
| subsidy_hash | <i>aelf.Hash</i> | The scheme id of subsidy reward. | |
| votes_reward_hash | <i>aelf.Hash</i> | The scheme id of votes reward. | |
| re_election_reward_hash | <i>aelf.Hash</i> | The scheme id of re-election reward. | |

Election.TakeElectionSnapshotInput

| Field | Type | Description | Label |
|--------------|--------------|--|-------|
| term_number | <i>int64</i> | The term number to take snapshot. | |
| mined_blocks | <i>int64</i> | The number of mined blocks of this term. | |
| round_number | <i>int64</i> | The end round number of this term. | |

Election.TermSnapshot

| Field | Type | Description | Label |
|------------------|---|---|----------|
| end_round_number | <i>int64</i> | The end round number of this term. | |
| mined_blocks | <i>int64</i> | The number of blocks mined in this term. | |
| election_result | <i>TermSnapshot.ElectionResultEntry</i> | The election result, candidates' public key -> number of votes. | repeated |

Election.TermSnapshot.ElectionResultEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Election.UpdateCandidateInformationInput

| Field | Type | Description | Label |
|----------------------------|---------------|---|-------|
| pubkey | <i>string</i> | The candidate public key. | |
| recently_produced_blocks | <i>int64</i> | The number of blocks recently produced. | |
| recently_missed_time_slots | <i>int64</i> | The number of time slots recently missed. | |
| is_evil_node | <i>bool</i> | Is it a evil node. If true will remove the candidate. | |

Election.UpdateMinersCountInput

| Field | Type | Description | Label |
|--------------|--------------|---------------------|-------|
| miners_count | <i>int32</i> | The count of miner. | |

Election.UpdateMultipleCandidateInformationInput

| Field | Type | Description | Label |
|-------|--|--------------------------------------|----------|
| value | <i>UpdateCandidateInformationInput</i> | The candidate information to update. | repeated |

Election.UpdateTermNumberInput

| Field | Type | Description | Label |
|-------------|--------------|------------------|-------|
| term_number | <i>int64</i> | The term number. | |

Election.VoteInformation

| Field | Type | Description | Label |
|-----------|--------------|-------------------|-------|
| amount | <i>int64</i> | Amount of voting. | |
| lock_time | <i>int64</i> | Vote lock time. | |

Election.VoteMinerInput

| Field | Type | Description | Label |
|------------------|----------------------------------|---------------------------------|-------|
| candidate_pubkey | <i>string</i> | The candidate public key. | |
| amount | <i>int64</i> | The amount token to vote. | |
| end_timestamp | <i>google.protobuf.Timestamp</i> | The end timestamp of this vote. | |
| token | <i>aelf.Hash</i> | Used to generate vote id. | |

Election.VoteWeightInterest

| Field | Type | Description | Label |
|----------|--------------|------------------------|-------|
| day | <i>int32</i> | Number of days locked. | |
| interest | <i>int32</i> | Locked interest. | |
| capital | <i>int32</i> | | |

Election.VoteWeightInterestList

| Field | Type | Description | Label |
|----------------------------|---------------------------|------------------------------|----------|
| vote_weight_interest_infos | <i>VoteWeightInterest</i> | The weight of vote interest. | repeated |

Election.VoteWeightProportion

| Field | Type | Description | Label |
|-------------------|--------------|-------------------------------|-------|
| time_proportion | <i>int32</i> | The weight of lock time. | |
| amount_proportion | <i>int32</i> | The weight of the votes cast. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.6 AElf.Contracts.Genesis

Genesis contract.

Used to manage the deployment and update of contracts.

Implement AElf Standards ACS0 and ACS1.

22.6.1 Contract Methods

| Method Name | Request Type | Re- sponse Type | Description |
|--|---|------------------------------|---|
| Initialize | <i>Zero.InitializeInput</i> | <i>google.protobuf.Empty</i> | Initialize the genesis contract. |
| SetInitialController- Address | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Set initial controller address for CodeCheck- Controller and ContractDeploymentController. |
| ChangeContractDe- ploymentController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Modify the contract deployment controller au- thority. Note: Only old controller has permis- sion to do this. |
| ChangeCodeCheck- Controller | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Modify the contract code check controller au- thority. Note: Only old controller has permis- sion to do this. |
| GetContractDeploy- mentController | <i>google.protobuf.Empty</i> | <i>Authority- Info</i> | Query the ContractDeploymentController au- thority info. |
| GetCodeCheckCon- troller | <i>google.protobuf.Empty</i> | <i>Authority- Info</i> | Query the CodeCheckController authority info. |
| SetContractProposal- ExpirationTimePeriod | <i>Zero.SetContractProposalExpirationTimePeriod</i> | <i>google.protobuf.Empty</i> | Set expiration time for contract proposals, 72 hours by default |
| GetCurrentCon- tractProposalExpira- tionTimePeriod | <i>google.protobuf.Empty</i> | <i>int32</i> | get the expiration time for the current contract proposal |

AElf.Standards.ACS0

| Method Name | Request Type | Response Type | Description |
|--|--|---------------------------------------|--|
| DeploySystemSmartContract | <i>acs0.SystemContractDeployInput</i> | <i>aelf.Address</i> | Deploy a system smart contract on chain and return the address of the system contract deployed. |
| DeploySmartContract | <i>acs0.ContractDeployInput</i> | <i>aelf.Address</i> | Deploy a smart contract on chain and return the address of the contract deployed. |
| UpdateSmartContract | <i>acs0.ContractUpdateInput</i> | <i>aelf.Address</i> | Update a smart contract on chain. |
| ProposeNewContract | <i>acs0.ContractDeployInput</i> | <i>aelf.Hash</i> | Create a proposal to deploy a new contract and returns the id of the proposed contract. |
| ProposeContractCodeCheck | <i>acs0.ContractCodeCheckInput</i> | <i>aelf.Hash</i> | Create a proposal to check the code of a contract and return the id of the proposed contract. |
| ProposeUpdateContract | <i>acs0.ContractUpdateInput</i> | <i>aelf.Hash</i> | Create a proposal to update the specified contract and return the id of the proposed contract. |
| ReleaseApprovedContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the contract proposal which has been approved. |
| ReleaseCodeCheckedContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the proposal which has passed the code check. |
| ValidateSystemContractAddress | <i>acs0.ValidateSystemContractAddressInput</i> | <i>google.protobuf.Empty</i> | Validate whether the input system contract exists. |
| SetContractProposerRequiredState | <i>google.protobuf.BoolValue</i> | <i>google.protobuf.Empty</i> | Set authority of contract deployment. |
| CurrentContractSerialNumber | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> | Get the current serial number of genesis contract (corresponds to the serial number that will be given to the next deployed contract). |
| GetContractInfo | <i>aelf.Address</i> | <i>acs0.ContractInfo</i> | Get detailed information about the specified contract. |
| GetContractAuthor | <i>aelf.Address</i> | <i>aelf.Address</i> | Get author of the specified contract. |
| GetContractHash | <i>aelf.Address</i> | <i>aelf.Hash</i> | Get the code hash of the contract about the specified address. |
| GetContractAddressByName | <i>aelf.Hash</i> | <i>aelf.Address</i> | Get the address of a system contract by its name. |
| GetSmartContractRegistrationByAddress | <i>aelf.Address</i> | <i>aelf.SmartContractRegistration</i> | Get the registration of a smart contract by its address. |
| GetSmartContractRegistrationByCodeHash | <i>aelf.Hash</i> | <i>aelf.SmartContractRegistration</i> | Get the registration of a smart contract by code hash. |
| DeployUserSmartContract | <i>acs0.UserContractDeployInput</i> | <i>acs0.UserContractDeployOutput</i> | Deploy a user smart contract on chain and return the hash of the contract code. |
| UpdateUserSmartContract | <i>acs0.UserContractUpdateInput</i> | <i>google.protobuf.Empty</i> | Update a user smart contract on chain. |
| ReleaseApprovedUserSmartContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the proposal which has passed the code check. |
| PerformDeployUserSmartContract | <i>acs0.UserContractDeployInput</i> | <i>google.protobuf.Empty</i> | Perform user contract deployment. |
| PerformUpdateUserSmartContract | <i>acs0.UserContractUpdateInput</i> | <i>google.protobuf.Empty</i> | Perform user contract update. |
| SetContractAuthor | <i>acs0.SetContractAuthorInput</i> | <i>google.protobuf.Empty</i> | Set authority of the specified contract. |
| SetSigner | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Set proxy signer that provides signature for contract deployment/update. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Bytes</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Bytes</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.Bytes</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.6.2 Contract Types**AElf.Contracts.Genesis****Zero.ContractProposingInput**

| Field | Type | Description | Label |
|---------------|-------------------------------------|---|-------|
| proposer | <i>aelf.Address</i> | The address of proposer for contract deployment/update. | |
| status | <i>ContractProposingInputStatus</i> | The status of proposal. | |
| ex-pired_time | <i>google.protobuf.Timestamp</i> | The expiration time of proposal. | |

Zero.InitializeInput

| Field | Type | Description | Label |
|--|-------------|--|-------|
| contract_deployment_authority_required | <i>bool</i> | Whether contract deployment/update requires authority. | |

Zero.ContractProposingInputStatus

| Name | Number | Description |
|---------------------|--------|-------------------------------------|
| PROPOSED | 0 | Proposal is proposed. |
| APPROVED | 1 | Proposal is approved by parliament. |
| CODE_CHECK_PROPOSED | 2 | Code check is proposed. |
| CODE_CHECKED | 3 | Passed code checks. |

Zero.SetContractProposalExpirationTimePeriodInput

| Field | Type | Description | Label |
|------------------------|--------------|-------------------------------|-------|
| expiration_time_period | <i>int32</i> | the period of expiration time | |

AElf.Standards.ACS0**acs0.AuthorUpdated**

| Field | Type | Description | Label |
|-----------------------|---------------------|---|-------|
| address | <i>aelf.address</i> | The byte array of the contract code. | |
| old_author | <i>aelf.address</i> | The category of contract code(0: C#). | |
| CrossChainCreateToken | <i>aelf.address</i> | Indicates if the contract is the system contract. | |

acs0.CodeCheckRequired

| Field | Type | Description | Label |
|------------------------------|------------------|---|-------|
| code | <i>bytes</i> | The byte array of the contract code. | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| is_system_contract | <i>bool</i> | Indicates if the contract is the system contract. | |
| is_user_contract | <i>bool</i> | Indicates if the contract is the user contract. | |

acs0.CodeUpdated

| Field | Type | Description | Label |
|---------------|---------------------|--|-------|
| address | <i>aelf.Address</i> | The address of the updated contract. | |
| old_code_hash | <i>aelf.Hash</i> | The byte array of the old contract code. | |
| new_code_hash | <i>aelf.Hash</i> | The byte array of the new contract code. | |
| version | <i>int32</i> | The version of the current contract. | |

acs0.ContractCodeCheckInput

| Field | Type | Description | Label |
|------------------------------|------------------|---|-------|
| contract_input | <i>bytes</i> | The byte array of the contract code to be checked. | |
| is_contract_deployment | <i>bool</i> | Whether the input contract is to be deployed or updated. | |
| code_check_release_method | <i>string</i> | Method to call after code check complete(DeploySmartContract or UpdateSmartContract). | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| is_system_contract | <i>bool</i> | Indicates if the contract is the system contract. | |

acs0.ContractDeployed

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| author | <i>aelf.Address</i> | The author of the contract, this is the person who deployed the contract. | |
| code_hash | <i>aelf.Hash</i> | The hash of the contract code. | |
| address | <i>aelf.Address</i> | The address of the contract. | |
| version | <i>int32</i> | The version of the current contract. | |
| name | <i>aelf.Hash</i> | The name of the contract. It has to be unique. | |
| contract_version | <i>string</i> | The version of the current contract. | |
| deployer | <i>aelf.Address</i> | The actual address that initiate the contract deployment. | |

acs0.ContractDeploymentInput

| Field | Type | Description | Label |
|--------------------|-------------------------------|---|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| contract_operation | <i>acs0.ContractOperation</i> | The information needed for contract deployment. | |

acs0.ContractInfo

| Field | Type | Description | Label |
|--------------------|---------------------|---|-------|
| serial_number | <i>int64</i> | The serial number of the contract. | |
| author | <i>aelf.Address</i> | The author of the contract, this is the person who deployed the contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code_hash | <i>aelf.Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |
| contract_version | <i>string</i> | The version of the current contract. | |
| is_user_contract | <i>bool</i> | Indicates if the contract is the user contract. | |
| deployer | <i>aelf.Address</i> | The actual address that initiate the contract deployment. | |

acs0.ContractProposed

| Field | Type | Description | Label |
|------------------------------|------------------|----------------------------------|-------|
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |

acs0.ContractUpdateInput

| Field | Type | Description | Label |
|--------------------|-------------------------------|--|-------|
| address | <i>aelf.Address</i> | The contract address that needs to be updated. | |
| code | <i>bytes</i> | The byte array of the new contract code. | |
| contract_operation | <i>acs0.ContractOperation</i> | The information needed for contract update. | |

acs0.UserContractUpdateInput

| Field | Type | Description | Label |
|---------|---------------------|---|-------|
| address | <i>aelf.Address</i> | The user contract address that needs to be updated. | |
| code | <i>bytes</i> | The byte array of the new user contract code. | |

acs0.ReleaseContractInput

| Field | Type | Description | Label |
|------------------------------|------------------|----------------------------------|-------|
| proposal_id | <i>aelf.Hash</i> | The hash of the proposal. | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |

acs0.SystemContractDeploymentInput

| Field | Type | Description | Label |
|--------------------------|--|---|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| name | <i>aelf.Hash</i> | The name of the contract. It has to be unique. | |
| transaction_method_calls | <i>SystemContractDeploymentInput.SystemTransactionMethodCallList</i> | An initial list of transactions for the system contract, which is executed in sequence when the contract is deployed. | |

acs0.SystemContractDeploymentInput.SystemTransactionMethodCall

| Field | Type | Description | Label |
|-------------|---------------|--|-------|
| method_name | <i>string</i> | The method name of system transaction. | |
| params | <i>bytes</i> | The params of system transaction method. | |

acs0.SystemContractDeploymentInput.SystemTransactionMethodCallList

| Field | Type | Description | Label |
|-------|--|----------------------------------|----------|
| value | <i>SystemContractDeploymentInput.SystemTransactionMethodCall</i> | The list of system transactions. | repeated |

acs0.ValidateSystemContractAddressInput

| Field | Type | Description | Label |
|---------------------------|---------------------|--------------------------------|-------|
| system_contract_hash_name | <i>aelf.Hash</i> | The name hash of the contract. | |
| address | <i>aelf.Address</i> | The address of the contract. | |

acs0.DeployUserSmartContractOutput

| Field | Type | Description | Label |
|-----------|------------------|---|-------|
| code_hash | <i>aelf.Hash</i> | The deployed or updated contract code hash. | |

acs0.SetContractAuthorInput

| Field | Type | Description | Label |
|------------------|---------------------|--|-------|
| contract_address | <i>aelf.Address</i> | The author's contract address needs to be updated. | |
| new_author | <i>aelf.Address</i> | The new contract author. | |

acs0.ContractOperation

| Field | Type | Description | Label |
|-----------|---------------------|---|-------|
| chain_id | <i>int32</i> | The ID of the chain where the contract is deployed/updated. | |
| code_hash | <i>aelf.Hash</i> | The hash of the contract code. | |
| deployer | <i>aelf.Address</i> | The actual address that initiate the contract deployment. | |
| salt | <i>aelf.Hash</i> | The hash based on which user contract address is generated. | |
| version | <i>int32</i> | The version of the deployed/updated contract. | |
| signature | <i>bytes</i> | The signature for deployer verification. | |

acs0.UserContractDeploymentInput

| Field | Type | Description | Label |
|----------|------------------|---|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| salt | <i>aelf.Hash</i> | The hash based on which user contract address is generated. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|--------------|---------------------------------------|-------|
| category | <i>int32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|---|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction its actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.7 AElf.Contracts.MultiToken

MultiToken contract.

The MultiToken contract is mainly used to manage the user's account and transaction fees related Settings.

Implement AElf Standards ACS1 and ACS2.

22.7.1 Contract Methods

| Method Name | Request Type | Response Type |
|---|--|--|
| AdvanceResourceToken | <i>tokenimpl.AdvanceResourceTokenInput</i> | <i>google.protobuf.Empty</i> |
| TakeResourceTokenBack | <i>tokenimpl.TakeResourceTokenBackInput</i> | <i>google.protobuf.Empty</i> |
| RegisterCrossChainTokenContractAddress | <i>tokenimpl.RegisterCrossChainTokenContractAddressInput</i> | <i>google.protobuf.Empty</i> |
| SetFeeReceiver | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> |
| ValidateTokenInfoExists | <i>tokenimpl.ValidateTokenInfoExistsInput</i> | <i>google.protobuf.Empty</i> |
| UpdateRental | <i>tokenimpl.UpdateRentalInput</i> | <i>google.protobuf.Empty</i> |
| UpdateRentedResources | <i>tokenimpl.UpdateRentedResourcesInput</i> | <i>google.protobuf.Empty</i> |
| TransferToContract | <i>tokenimpl.TransferToContractInput</i> | <i>google.protobuf.Empty</i> |
| ChangeSideChainRentalController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ChangeSymbolsToPayTXSizeFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ChangeCrossChainTokenContractRegistrationController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ChangeUserFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ChangeDeveloperController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> |
| ConfigTransactionFeeFreeAllowances | <i>token.ConfigTransactionFeeFreeAllowancesInput</i> | <i>google.protobuf.Empty</i> |
| GetFeeReceiver | <i>google.protobuf.Empty</i> | <i>aelf.Address</i> |
| GetResourceUsage | <i>google.protobuf.Empty</i> | <i>tokenimpl.ResourceUsage</i> |
| GetSymbolsToPayTXSizeFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> |
| GetCrossChainTokenContractRegistrationController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> |
| GetUserFeeController | <i>google.protobuf.Empty</i> | <i>tokenimpl.UserFeeController</i> |
| GetDeveloperFeeController | <i>google.protobuf.Empty</i> | <i>tokenimpl.DeveloperFeeController</i> |
| GetSideChainRentalControllerCreateInfo | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> |
| GetTransactionFeeFreeAllowances | <i>aelf.Address</i> | <i>token.TransactionFeeFreeAllowances</i> |
| GetTransactionFeeFreeAllowancesConfig | <i>google.protobuf.Empty</i> | <i>token.GetTransactionFeeFreeAllowancesConfig</i> |
| GetTransactionFeeDelegates | <i>token.GetTransactionFeeDelegatesInput</i> | <i>token.GetTransactionFeeDelegates</i> |
| GetVirtualAddressForLocking | <i>tokenimpl.GetVirtualAddressForLockingInput</i> | <i>aelf.Address</i> |
| GetOwningRental | <i>google.protobuf.Empty</i> | <i>tokenimpl.OwningRental</i> |
| GetOwningRentalUnitValue | <i>google.protobuf.Empty</i> | <i>tokenimpl.OwningRentalUnitValue</i> |
| Create | <i>token.CreateInput</i> | <i>google.protobuf.Empty</i> |
| Issue | <i>token.IssueInput</i> | <i>google.protobuf.Empty</i> |
| Transfer | <i>token.TransferInput</i> | <i>google.protobuf.Empty</i> |
| TransferFrom | <i>token.TransferFromInput</i> | <i>google.protobuf.Empty</i> |

| Method Name | Request Type | Response Type |
|---|---|--|
| Approve | <i>token.ApproveInput</i> | <i>google.protobuf.Empty</i> |
| UnApprove | <i>token.UnApproveInput</i> | <i>google.protobuf.Empty</i> |
| Lock | <i>token.LockInput</i> | <i>google.protobuf.Empty</i> |
| Unlock | <i>token.UnlockInput</i> | <i>google.protobuf.Empty</i> |
| Burn | <i>token.BurnInput</i> | <i>google.protobuf.Empty</i> |
| SetPrimaryTokenSymbol | <i>token.SetPrimaryTokenSymbolInput</i> | <i>google.protobuf.Empty</i> |
| CrossChainTransfer | <i>token.CrossChainTransferInput</i> | <i>google.protobuf.Empty</i> |
| CrossChainReceiveToken | <i>token.CrossChainReceiveTokenInput</i> | <i>google.protobuf.Empty</i> |
| CrossChainCreateToken | <i>token.CrossChainCreateTokenInput</i> | <i>google.protobuf.Empty</i> |
| InitializeFromParentChain | <i>token.InitializeFromParentChainInput</i> | <i>google.protobuf.Empty</i> |
| ClaimTransactionFees | <i>token.TotalTransactionFeesMap</i> | <i>google.protobuf.Empty</i> |
| ChargeTransactionFees | <i>token.ChargeTransactionFeesInput</i> | <i>token.ChargeTransactionFeesResponse</i> |
| ChargeUserContractTransactionFees | <i>token.ChargeTransactionFeesInput</i> | <i>token.ChargeTransactionFeesResponse</i> |
| CheckThreshold | <i>token.CheckThresholdInput</i> | <i>google.protobuf.Empty</i> |
| InitialCoefficients | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> |
| DonateResourceToken | <i>token.TotalResourceTokensMaps</i> | <i>google.protobuf.Empty</i> |
| ChargeResourceToken | <i>token.ChargeResourceTokenInput</i> | <i>google.protobuf.Empty</i> |
| CheckResourceToken | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> |
| SetSymbolsToPayTxSizeFee | <i>token.SymbolListToPayTxSizeFee</i> | <i>google.protobuf.Empty</i> |
| UpdateCoefficientsForSender | <i>token.UpdateCoefficientsInput</i> | <i>google.protobuf.Empty</i> |
| UpdateCoefficientsForContract | <i>token.UpdateCoefficientsInput</i> | <i>google.protobuf.Empty</i> |
| InitializeAuthorizedController | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> |
| GetTokenInfo | <i>token.GetTokenInfoInput</i> | <i>token.TokenInfo</i> |
| GetNativeTokenInfo | <i>google.protobuf.Empty</i> | <i>token.TokenInfo</i> |
| GetResourceTokenInfo | <i>google.protobuf.Empty</i> | <i>token.TokenInfo</i> |
| GetBalance | <i>token.GetBalanceInput</i> | <i>token.GetBalanceResponse</i> |
| GetAllowance | <i>token.GetAllowanceInput</i> | <i>token.GetAllowanceResponse</i> |
| IsInWhiteList | <i>token.IsInWhiteListInput</i> | <i>google.protobuf.Empty</i> |
| GetLockedAmount | <i>token.GetLockedAmountInput</i> | <i>token.GetLockedAmountResponse</i> |
| GetCrossChainTransferTokenContractAddress | <i>token.GetCrossChainTransferTokenContractAddressInput</i> | <i>aelf.Address</i> |
| GetPrimaryTokenSymbol | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> |
| GetCalculateFeeCoefficientsForContract | <i>google.protobuf.Int32Value</i> | <i>token.CalculateFeeCoefficientsResponse</i> |
| GetCalculateFeeCoefficientsForSender | <i>google.protobuf.Empty</i> | <i>token.CalculateFeeCoefficientsResponse</i> |
| GetSymbolsToPayTxSizeFee | <i>google.protobuf.Empty</i> | <i>token.SymbolListToPayTxSizeFee</i> |
| GetLatestTotalTransactionFeesMapHash | <i>google.protobuf.Empty</i> | <i>aelf.Hash</i> |
| GetLatestTotalResourceTokensMapsHash | <i>google.protobuf.Empty</i> | <i>aelf.Hash</i> |
| IsTokenAvailableForMethodFee | <i>google.protobuf.StringValue</i> | <i>google.protobuf.Empty</i> |
| SetTransactionFeeDelegations | <i>token.SetTransactionFeeDelegationsInput</i> | <i>token.SetTransactionFeeDelegationsResponse</i> |
| SetTransactionFeeDelegateInfos | <i>token.SetTransactionFeeDelegateInfosInput</i> | <i>google.protobuf.Empty</i> |
| RemoveTransactionFeeFreeAllowancesConfig | <i>token.RemoveTransactionFeeFreeAllowancesConfigInput</i> | <i>google.protobuf.Empty</i> |
| RemoveTransactionFeeDelegator | <i>token.RemoveTransactionFeeDelegatorInput</i> | <i>google.protobuf.Empty</i> |
| RemoveTransactionFeeDelegatorInfos | <i>token.RemoveTransactionFeeDelegatorInfosInput</i> | <i>google.protobuf.Empty</i> |
| RemoveTransactionFeeDelegatee | <i>token.RemoveTransactionFeeDelegateeInput</i> | <i>google.protobuf.Empty</i> |
| RemoveTransactionFeeDelegateeInfos | <i>token.RemoveTransactionFeeDelegateeInfosInput</i> | <i>google.protobuf.Empty</i> |
| GetTransactionFeeDelegationsOfADelegatee | <i>token.GetTransactionFeeDelegationsOfADelegateeInput</i> | <i>token.TransactionFeeDelegationsOfADelegateeResponse</i> |
| GetTransactionFeeDelegateeList | <i>token.GetTransactionFeeDelegateeListInput</i> | <i>token.TransactionFeeDelegateeListResponse</i> |
| GetTransactionFeeDelegateInfo | <i>token.GetTransactionFeeDelegateInfoInput</i> | <i>token.TransactionFeeDelegateInfoResponse</i> |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Bytes</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.Bytes</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS2

| Method Name | Request Type | Response Type | Description |
|------------------|-------------------------|--------------------------|--|
| GetResource-Info | <i>aelf.Transaction</i> | <i>acs2.ResourceInfo</i> | Gets the resource information that the transaction execution depends on. |

22.7.2 Contract Types**AElf.Contracts.MultiToken****tokenimpl.AdvanceResourceTokenInput**

| Field | Type | Description | Label |
|-----------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address to transfer. | |
| resource_token_symbol | <i>string</i> | The resource token symbol to transfer. | |
| amount | <i>int64</i> | The amount of resource token to transfer. | |

tokenimpl.DeveloperFeeController

| Field | Type | Description | Label |
|-----------------------|----------------------|--|-------|
| root_controller | <i>AuthorityInfo</i> | The association that governs the organization. | |
| parliament_controller | <i>AuthorityInfo</i> | The parliament organization of members. | |
| developer_controller | <i>AuthorityInfo</i> | The developer organization of members. | |

tokenimpl.GetVirtualAddressForLockingInput

| Field | Type | Description | Label |
|---------|---------------------|--------------------------|-------|
| address | <i>aelf.Address</i> | The address of the lock. | |
| lock_id | <i>aelf.Hash</i> | The id of the lock. | |

tokenimpl.OwningRental

| Field | Type | Description | Label |
|------------------|---|---|-----------|
| re-source_amount | <i>OwningRental.ResourceAmountEntry</i> | The amount of resource tokens owed, symbol -> amount. | re-peated |

tokenimpl.OwningRental.ResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

tokenimpl.OwningRentalUnitValue

| Field | Type | Description | Label |
|----------------------|---|--|-----------|
| re-source_unit_value | <i>OwningRentalUnitValue.ResourceUnitValueEntry</i> | Resource unit price, symbol -> unit price. | re-peated |

tokenimpl.OwningRentalUnitValue.ResourceUnitValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

tokenimpl.RegisterCrossChainTokenContractAddressInput

| Field | Type | Description | Label |
|------------------------|------------------------|---|-------|
| from_chain_id | <i>int32</i> | The source chain id. | |
| parent_chain_height | <i>int64</i> | The parent chain height of the transaction. | |
| transaction_bytes | <i>bytes</i> | The raw bytes of the transfer transaction. | |
| merkle_path | <i>aelf.MerklePath</i> | The merkle path created from the transaction. | |
| token_contract_address | <i>aelf.Address</i> | The token contract address. | |

tokenimpl.ResourceUsage

| Field | Type | Description | Label |
|-------|---------------------------------|--|----------|
| value | <i>ResourceUsage.ValueEntry</i> | The amount of resource tokens usage, symbol -> amount. | repeated |

tokenimpl.ResourceUsage.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

tokenimpl.TakeResourceTokenBackInput

| Field | Type | Description | Label |
|-----------------------|---------------------|--|-------|
| contract_address | <i>aelf.Address</i> | The contract address to take back. | |
| resource_token_symbol | <i>string</i> | The resource token symbol to take back. | |
| amount | <i>int64</i> | The amount of resource token to take back. | |

tokenimpl.TransferToContractInput

| Field | Type | Description | Label |
|--------|---------------|----------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| amount | <i>int64</i> | The amount of token. | |
| memo | <i>string</i> | The memo. | |

tokenimpl.UpdateRentalInput

| Field | Type | Description | Label |
|--------|--------------------------------------|--|----------|
| rental | <i>UpdateRentalInput.RentalEntry</i> | The unit price of resource tokens, symbol -> unit price. | repeated |

tokenimpl.UpdateRentalInput.RentalEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

tokenimpl.UpdateRentedResourcesInput

| Field | Type | Description | Label |
|------------------|---|--|----------|
| re-source_amount | <i>UpdateRentedResourcesInput.ResourceAmountEntry</i> | Amount of resource tokens consumed per minute, symbol -> resource consumption. | repeated |

tokenimpl.UpdateRentedResourcesInput.ResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

tokenimpl.UserFeeController

| Field | Type | Description | Label |
|-----------------------|----------------------|--|-------|
| root_controller | <i>AuthorityInfo</i> | The association that governs the organization. | |
| parliament_controller | <i>AuthorityInfo</i> | The parliament organization of members. | |
| referendum_controller | <i>AuthorityInfo</i> | The referendum organization of members. | |

tokenimpl.ValidateTokenInfoExistsInput

| Field | Type | Description | Label |
|----------------|----------------------------------|---|-------|
| symbol | <i>string</i> | The symbol of the token. | |
| token_name | <i>string</i> | The full name of the token. | |
| total_supply | <i>int64</i> | The total supply of the token. | |
| decimals | <i>int32</i> | The precision of the token. | |
| issuer | <i>aelf.Address</i> | The address that has permission to issue the token/collection/nft. | |
| is_burnable | <i>bool</i> | A flag indicating if this token is burnable. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |
| external_info | <i>map<string, string></i> | Attributes or description of the token/collection/nft. There is no mandatory constraint on the naming of the key. But it is recommended to use __nft as the prefix key to set the nft attribute, such as __nft_image_url. | |
| owner | <i>aelf.Address</i> | The address that has permission to create nft. | |

token.AllCalculateFeeCoefficients

| Field | Type | Description | Label |
|-------|---------------------------------|--------------------------------------|----------|
| value | <i>CalculateFeeCoefficients</i> | The coefficients of fee Calculation. | repeated |

token.ApproveInput

| Field | Type | Description | Label |
|---------|---------------------|---|-------|
| spender | <i>aelf.Address</i> | The address that allowance will be increased. | |
| symbol | <i>string</i> | The symbol of token to approve. | |
| amount | <i>int64</i> | The amount of token to approve. | |

token.Approved

| Field | Type | Description | Label |
|---------|---------------------|--|-------|
| owner | <i>aelf.Address</i> | The address of the token owner. | |
| spender | <i>aelf.Address</i> | The address that allowance be increased. | |
| symbol | <i>string</i> | The symbol of approved token. | |
| amount | <i>int64</i> | The amount of approved token. | |

token.BurnInput

| Field | Type | Description | Label |
|--------|---------------|------------------------------|-------|
| symbol | <i>string</i> | The symbol of token to burn. | |
| amount | <i>int64</i> | The amount of token to burn. | |

token.Burned

| Field | Type | Description | Label |
|--------|---------------------|--------------------------------------|-------|
| burner | <i>aelf.Address</i> | The address who wants to burn token. | |
| symbol | <i>string</i> | The symbol of burned token. | |
| amount | <i>int64</i> | The amount of burned token. | |

token.CalculateFeeAlgorithmUpdated

| Field | Type | Description | Label |
|---------------------------|------------------------------------|--|-------|
| all_type_fee_coefficients | <i>AllCalculateFeeCoefficients</i> | All calculate fee coefficients after modification. | |

token.CalculateFeeCoefficients

| Field | Type | Description | Label |
|-------------------------|--------------------------------------|---|-----------|
| fee_token_type | <i>int32</i> | The resource fee type, like READ, WRITE, etc. | |
| piece_coefficients_list | <i>CalculateFeePieceCoefficients</i> | Coefficients of one single piece. | re-peated |

token.CalculateFeePieceCoefficients

| Field | Type | Description | Label |
|-------|--------------|--|-----------|
| value | <i>int32</i> | Coefficients of one single piece. The first char is its type: liner / power. The second char is its piece upper bound. | re-peated |

token.ChainPrimaryTokenSymbolSet

| Field | Type | Description | Label |
|--------------|---------------|----------------------|-------|
| token_symbol | <i>string</i> | The symbol of token. | |

token.ChargeResourceTokenInput

| Field | Type | Description | Label |
|----------|--|--|-----------|
| cost_dic | <i>ChargeResourceTokenInput.CostDicEntry</i> | Collection of charge resource token, Symbol->Amount. | re-peated |
| caller | <i>aelf.Address</i> | The sender of the transaction. | |

token.ChargeResourceTokenInput.CostDicEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

token.ChargeTransactionFeesInput

| Field | Type | Description | Label |
|----------------------------|-----------------------------|--------------------------------------|----------|
| method_name | <i>string</i> | The method name of transaction. | |
| contract_address | <i>aelf.Address</i> | The contract address of transaction. | |
| transaction_size_fee | <i>int64</i> | The amount of transaction size fee. | |
| symbols_to_pay_tx_size_fee | <i>SymbolToPayTxSizeFee</i> | Transaction fee token information. | repeated |

token.ChargeTransactionFeesOutput

| Field | Type | Description | Label |
|----------------------|---------------|------------------------------------|-------|
| success | <i>bool</i> | Whether the charge was successful. | |
| charging_information | <i>string</i> | The charging information. | |

token.CheckThresholdInput

| Field | Type | Description | Label |
|---------------------|---|--|----------|
| sender | <i>aelf.Address</i> | The sender of the transaction. | |
| symbol_to_threshold | <i>CheckThresholdInput.SymbolToThresholdEntry</i> | The threshold to set, Symbol->Threshold. | repeated |
| is_check_allowance | <i>bool</i> | Whether to check the allowance. | |

token.CheckThresholdInput.SymbolToThresholdEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

token.ConfigTransactionFeeFreeAllowancesInput

| Field | Type | Description | Label |
|-------|--|--|----------|
| value | <i>token.ConfigTransactionFeeFreeAllowance</i> | The configuration of transaction fee free allowance. | repeated |

token.ConfigTransactionFeeFreeAllowance

| Field | Type | Description | Label |
|--------------------------------|--|---|-------|
| symbol | <i>string</i> | The symbol of threshold token. | |
| transaction_fee_free_allowance | <i>token.TransactionFeeFreeAllowance</i> | The allowance of each token when a user gets his allowance at the full amount. | |
| refresh_seconds | <i>int64</i> | The time needed for a user's allowance to be refreshed back to the full amount. Unit: second | |
| threshold | <i>int64</i> | The required amount of Token in possession for a user to be eligible for transaction fee exemption. | |

token.TransactionFeeFreeAllowances

| Field | Type | Description | Label |
|-------|--|-----------------------------|----------|
| value | <i>token.TransactionFeeFreeAllowance</i> | The allowance of the token. | repeated |

token.TransactionFeeFreeAllowance

| Field | Type | Description | Label |
|--------|---------------|-----------------------------------|-------|
| symbol | <i>string</i> | Token symbol. | |
| amount | <i>int64</i> | The amount of fee free allowance. | |

token.TransactionFeeFreeAllowanceConfig

| Field | Type | Description | Label |
|------------------|--|---|-------|
| symbol | <i>string</i> | The symbol of threshold token. | |
| free_allowance | <i>token.TransactionFeeFreeAllowance</i> | The allowance of each token when a user gets his allowance of the full amount. | |
| re-fresh_seconds | <i>int64</i> | The time needed for a user's allowance to be refreshed back to the full amount. Unit: second | |
| threshold | <i>int64</i> | The required amount of Token in possession for a user to be eligible for transaction fee exemption. | |

token.TransactionFeeFreeAllowanceMap

| Field | Type | Description | Label |
|-------|---|---|-------|
| map | <i>map<string, token.TransactionFeeFreeAllowance></i> | <free allowance symbol, free allowance> | |

token.ContractTotalResourceTokens

| Field | Type | Description | Label |
|------------------|-------------------------------|----------------------------|-------|
| contract_address | <i>aelf.Address</i> | The contract address. | |
| tokens_map | <i>TotalResourceTokensMap</i> | Resource tokens to charge. | |

token.CreateInput

| Field | Type | Description | Label |
|----------------|----------------------------------|---|----------|
| symbol | <i>string</i> | The symbol of the token/collection/nft. | |
| token_name | <i>string</i> | The full name of the token/collection/nft. | |
| total_supply | <i>int64</i> | The total supply of the token/collection/nft. | |
| decimals | <i>int32</i> | The precision of the token/collection/nft. | |
| issuer | <i>aelf.Address</i> | The address that has permission to issue the token/collection/nft. | |
| is_burnable | <i>bool</i> | A flag indicating if this token/collection/nft is burnable. | |
| lock_whitelist | <i>aelf.Address</i> | A whitelist address list used to lock tokens/collection/nft. | repeated |
| issue_chain_id | <i>int32</i> | The chain id of the token/collection/nft. | |
| external_info | <i>map<string, string></i> | Attributes or description of the token/collection/nft. There is no mandatory constraint on the naming of the key. But it is recommended to use __nft as the prefix key to set the nft attribute, such as __nft_image_url. | |
| owner | <i>aelf.Address</i> | The address that has permission to create nft. | |

token.CrossChainCreateTokenInput

| Field | Type | Description | Label |
|---------------------|------------------------|--|-------|
| from_chain_id | <i>int32</i> | The chain id of the chain on which the token was created. | |
| parent_chain_height | <i>int64</i> | The height of the transaction that created the token/collection/nft. | |
| transaction_bytes | <i>bytes</i> | The transaction that created the token/collection/nft. | |
| merkle_path | <i>aelf.MerklePath</i> | The merkle path created from the transaction that created the transaction. | |

token.CrossChainReceiveTokenInput

| Field | Type | Description | Label |
|----------------------------|------------------------|--|-------|
| from_chain_id | <i>int32</i> | The source chain id. | |
| parent_chain_height | <i>int64</i> | The height of the transfer transaction. | |
| transfer_transaction_bytes | <i>bytes</i> | The raw bytes of the transfer transaction. | |
| merkle_path | <i>aelf.MerklePath</i> | The merkle path created from the transfer transaction. | |

token.CrossChainReceived

| Field | Type | Description | Label |
|-------------------------|---------------------|--|-------|
| from | <i>aelf.Address</i> | The source address of the transferred token. | |
| to | <i>aelf.Address</i> | The destination address of the transferred token. | |
| symbol | <i>string</i> | The symbol of the received token. | |
| amount | <i>int64</i> | The amount of the received token. | |
| memo | <i>string</i> | The memo. | |
| from_chain_id | <i>int32</i> | The destination chain id. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |
| parent_chain_height | <i>int64</i> | The parent chain height of the transfer transaction. | |
| transfer_transaction_id | <i>aelf.Hash</i> | The id of transfer transaction. | |

token.CrossChainTransferInput

| Field | Type | Description | Label |
|----------------|---------------------|----------------------------------|-------|
| to | <i>aelf.Address</i> | The receiver of transfer. | |
| symbol | <i>string</i> | The symbol of token. | |
| amount | <i>int64</i> | The amount of token to transfer. | |
| memo | <i>string</i> | The memo. | |
| to_chain_id | <i>int32</i> | The destination chain id. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |

token.CrossChainTransferred

| Field | Type | Description | Label |
|----------------|---------------------|---|-------|
| from | <i>aelf.Address</i> | The source address of the transferred token. | |
| to | <i>aelf.Address</i> | The destination address of the transferred token. | |
| symbol | <i>string</i> | The symbol of the transferred token. | |
| amount | <i>int64</i> | The amount of the transferred token. | |
| memo | <i>string</i> | The memo. | |
| to_chain_id | <i>int32</i> | The destination chain id. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |

token.ExtraTokenListModified

| Field | Type | Description | Label |
|--------------------------------|---------------------------------|------------------------------------|-------|
| symbol_list_to_pay_tx_size_fee | <i>SymbolListToPayTxSizeFee</i> | Transaction fee token information. | |

token.GetAllowanceInput

| Field | Type | Description | Label |
|---------|---------------------|---------------------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| owner | <i>aelf.Address</i> | The address of the token owner. | |
| spender | <i>aelf.Address</i> | The address of the spender. | |

token.GetAllowanceOutput

| Field | Type | Description | Label |
|-----------|---------------------|---------------------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| owner | <i>aelf.Address</i> | The address of the token owner. | |
| spender | <i>aelf.Address</i> | The address of the spender. | |
| allowance | <i>int64</i> | The amount of allowance. | |

token.GetBalanceInput

| Field | Type | Description | Label |
|--------|---------------------|----------------------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| owner | <i>aelf.Address</i> | The target address of the query. | |

token.GetBalanceOutput

| Field | Type | Description | Label |
|---------|---------------------|----------------------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| owner | <i>aelf.Address</i> | The target address of the query. | |
| balance | <i>int64</i> | The balance of the owner. | |

token.GetCrossChainTransferTokenContractAddressInput

| Field | Type | Description | Label |
|---------|--------------|---------------|-------|
| chainId | <i>int32</i> | The chain id. | |

token.GetLockedAmountInput

| Field | Type | Description | Label |
|---------|---------------------|--------------------------|-------|
| address | <i>aelf.Address</i> | The address of the lock. | |
| symbol | <i>string</i> | The token symbol. | |
| lock_id | <i>aelf.Hash</i> | The id of the lock. | |

token.GetLockedAmountOutput

| Field | Type | Description | Label |
|---------|---------------------|--------------------------|-------|
| address | <i>aelf.Address</i> | The address of the lock. | |
| symbol | <i>string</i> | The token symbol. | |
| lock_id | <i>aelf.Hash</i> | The id of the lock. | |
| amount | <i>int64</i> | The locked amount. | |

token.GetTokenInfoInput

| Field | Type | Description | Label |
|--------|---------------|----------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |

token.GetTransactionFeeDelegatesInput

| Field | Type | Description | Label |
|-------------------|---------------------|---------------------------|-------|
| delegator_address | <i>aelf.Address</i> | The address of delegator. | |

token.GetTransactionFeeDelegateeListInput

| Field | Type | Description | Label |
|-------------------|---------------------|---------------------------|-------|
| delegator_address | <i>aelf.Address</i> | The address of delegator. | |
| contract_address | <i>aelf.Address</i> | The contract address. | |
| method_name | <i>string</i> | The method name. | |

token.GetTransactionFeeDelegateeListOutput

| Field | Type | Description | Label |
|---------------------|---------------------|--------------------------------|----------|
| delegatee_addresses | <i>aelf.Address</i> | The address list of delegatee. | repeated |

token.GetTransactionFeeDelegateInfoInput

| Field | Type | Description | Label |
|-------------------|---------------------|---------------------------|-------|
| delegator_address | <i>aelf.Address</i> | The address of delegator. | |
| delegatee_address | <i>aelf.Address</i> | The address of delegatee. | |
| contract_address | <i>aelf.Address</i> | The contract address. | |
| method_name | <i>string</i> | The method name. | |

token.GetTransactionFeeFreeAllowancesConfigOutput

| Field | Type | Description | Label |
|-------|---|--|----------|
| value | <i>token.TransactionFeeFreeAllowanceConfigs</i> | The configuration of transaction fee free allowance. | repeated |

token.InitializeFromParentChainInput

| Field | Type | Description | Label |
|---|--|-------------------------------|----------|
| resource_amount | <i>InitializeFromParentChainInput.ResourceAmountEntry</i> | The amount of resource. | repeated |
| registered_other_token_contract_addresses | <i>InitializeFromParentChainInput.RegisteredOtherTokenContractAddressesEntry</i> | The token contract addresses. | repeated |
| creator | <i>aelf.Address</i> | The creator the side chain. | |

token.InitializeFromParentChainInput.RegisteredOtherTokenContractAddressesEntry

| Field | Type | Description | Label |
|-------|---------------------|-------------|-------|
| key | <i>int32</i> | | |
| value | <i>aelf.Address</i> | | |

token.InitializeFromParentChainInput.ResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

token.IsInWhiteListInput

| Field | Type | Description | Label |
|---------|---------------------|-----------------------|-------|
| symbol | <i>string</i> | The symbol of token. | |
| address | <i>aelf.Address</i> | The address to check. | |

token.IssueInput

| Field | Type | Description | Label |
|--------|---------------------|---|-------|
| symbol | <i>string</i> | The token/collection/nft symbol to issue. | |
| amount | <i>int64</i> | The token/collection/nft amount to issue. | |
| memo | <i>string</i> | The memo. | |
| to | <i>aelf.Address</i> | The target address to issue. | |

token.Issued

| Field | Type | Description | Label |
|--------|---------------------|-----------------------------|-------|
| symbol | <i>string</i> | The symbol of issued token. | |
| amount | <i>int64</i> | The amount of issued token. | |
| memo | <i>string</i> | The memo. | |
| to | <i>aelf.Address</i> | The issued target address. | |

token.LockInput

| Field | Type | Description | Label |
|---------|---------------------|----------------------------------|-------|
| address | <i>aelf.Address</i> | The one want to lock his token. | |
| lock_id | <i>aelf.Hash</i> | Id of the lock. | |
| symbol | <i>string</i> | The symbol of the token to lock. | |
| usage | <i>string</i> | a memo. | |
| amount | <i>int64</i> | The amount of tokens to lock. | |

token.RemoveTransactionFeeDelegatorInfosInput

| Field | Type | Description | Label |
|---------------------------|----------------------------------|-----------------------------------|----------|
| delegator_address | <i>aelf.Address</i> | The address of delegator. | |
| delegate_transaction_list | <i>token.DelegateTransaction</i> | The transaction list of delegate. | repeated |

token.RemoveTransactionFeeDelegateeInfosInput

| Field | Type | Description | Label |
|---------------------------|----------------------------------|-----------------------------------|----------|
| delegator_address | <i>aelf.Address</i> | The address of delegatee. | |
| delegate_transaction_list | <i>token.DelegateTransaction</i> | The transaction list of delegate. | repeated |

token.DelegateTransaction

| Field | Type | Description | Label |
|------------------|---------------------|-----------------------|-------|
| contract_address | <i>aelf.Address</i> | The contract address. | |
| method_name | <i>string</i> | The method name. | |

token.RentalAccountBalanceInsufficient

| Field | Type | Description | Label |
|--------|---------------|--|-------|
| symbol | <i>string</i> | The symbol of insufficient rental account balance. | |
| amount | <i>int64</i> | The balance of the account. | |

token.RentalCharged

| Field | Type | Description | Label |
|----------|---------------------|-----------------------------------|-------|
| symbol | <i>string</i> | The symbol of rental fee charged. | |
| amount | <i>int64</i> | The amount of rental fee charged. | |
| payer | <i>aelf.Address</i> | The payer of rental fee. | |
| receiver | <i>aelf.Address</i> | The receiver of rental fee. | |

token.RemoveTransactionFeeFreeAllowancesConfigInput

| Field | Type | Description | Label |
|---------|---------------|---|----------|
| symbols | <i>string</i> | List of symbols to remove from configuration of transaction fee free allowance. | repeated |

token.ResourceTokenClaimed

| Field | Type | Description | Label |
|----------|---------------------|----------------------------|-------|
| symbol | <i>string</i> | The symbol of fee claimed. | |
| amount | <i>int64</i> | The amount of fee claimed. | |
| payer | <i>aelf.Address</i> | The payer of fee. | |
| receiver | <i>aelf.Address</i> | The receiver of fee. | |

token.SetTransactionFeeDelegateInfos

| Field | Type | Description | Label |
|--------------------|---------------------------|---|----------|
| delegator_address | <i>aelf.Address</i> | The address of delegator. | |
| delegate_info_list | <i>token.DelegateInfo</i> | The delegate information for the transaction. | repeated |

token.DelegateInfo

| Field | Type | Description | Label |
|---------------------|---------------------------------|---|-------|
| delegations | <i>map<string, int64></i> | <token symbol,amount> | |
| contract_address | <i>aelf.Address</i> | The contract address. | |
| method_name | <i>string</i> | The method name. | |
| isUnlimitedDelegate | <i>bool</i> | Whether to pay transaction fee continuously without limitation. | |

token.SetPrimaryTokenSymbolInput

| Field | Type | Description | Label |
|--------|---------------|--------------------------|-------|
| symbol | <i>string</i> | The symbol of the token. | |

token.SymbolListToPayTxSizeFee

| Field | Type | Description | Label |
|----------------------------|-----------------------------|------------------------------------|----------|
| symbols_to_pay_tx_size_fee | <i>SymbolToPayTxSizeFee</i> | Transaction fee token information. | repeated |

token.SymbolToPayTxSizeFee

| Field | Type | Description | Label |
|--------------------|---------------|---|-------|
| token_symbol | <i>string</i> | The symbol of token. | |
| base_token_weight | <i>int32</i> | The charge weight of primary token. | |
| added_token_weight | <i>int32</i> | The new added token charge weight. For example, the charge weight of primary Token is set to 1. The newly added token charge weight is set to 10. If the transaction requires 1 unit of primary token, the user can also pay for 10 newly added tokens. | |

token.TransactionFeeClaimed

| Field | Type | Description | Label |
|----------|---------------------|----------------------------|-------|
| symbol | <i>string</i> | The symbol of fee claimed. | |
| amount | <i>int64</i> | The amount of fee claimed. | |
| receiver | <i>aelf.Address</i> | The receiver of fee. | |

token.TransactionFeeFreeAllowancesMap

| Field | Type | Description | Label |
|-------|--|-------------------------------------|-------|
| map | <i>map<string, TransactionFeeFreeAllowanceMap></i> | <threshold symbol, free allowances> | |

token.TokenCreated

| Field | Type | Description | Label |
|----------------|---------------------|--|-------|
| symbol | <i>string</i> | The symbol of the token. | |
| token_name | <i>string</i> | The full name of the token. | |
| total_supply | <i>int64</i> | The total supply of the token. | |
| decimals | <i>int32</i> | The precision of the token. | |
| issuer | <i>aelf.Address</i> | The address that created the token. | |
| is_burnable | <i>bool</i> | A flag indicating if this token is burnable. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |

token.TokenInfo

| Field | Type | Description | Label |
|----------------|---------------------|--|-------|
| symbol | <i>string</i> | The symbol of the token.f | |
| token_name | <i>string</i> | The full name of the token. | |
| supply | <i>int64</i> | The current supply of the token. | |
| total_supply | <i>int64</i> | The total supply of the token. | |
| decimals | <i>int32</i> | The precision of the token. | |
| issuer | <i>aelf.Address</i> | The address that created the token. | |
| is_burnable | <i>bool</i> | A flag indicating if this token is burnable. | |
| issue_chain_id | <i>int32</i> | The chain id of the token. | |
| issued | <i>int64</i> | The amount of issued tokens. | |

token.TokenInfoList

| Field | Type | Description | Label |
|-------|------------------|----------------------------|----------|
| value | <i>TokenInfo</i> | List of token information. | repeated |

token.TotalResourceTokensMap

| Field | Type | Description | Label |
|-------|--|--|----------|
| value | <i>TotalResourceTokensMap.ValueEntry</i> | Resource token dictionary, Symbol->Amount. | repeated |

token.TotalResourceTokensMap.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

token.TotalResourceTokensMaps

| Field | Type | Description | Label |
|--------------|------------------------------------|---|----------|
| value | <i>ContractTotalResourceTokens</i> | Resource tokens to charge. | repeated |
| block_hash | <i>aelf.Hash</i> | The hash of the block processing the transaction. | |
| block_height | <i>int64</i> | The height of the block processing the transaction. | |

token.TotalTransactionFeesMap

| Field | Type | Description | Label |
|--------------|---|---|----------|
| value | <i>TotalTransactionFeesMap.ValueEntry</i> | Token dictionary that charge transaction fee, Symbol->Amount. | repeated |
| block_hash | <i>aelf.Hash</i> | The hash of the block processing the transaction. | |
| block_height | <i>int64</i> | The height of the block processing the transaction. | |

token.TransactionFeeCharged

| Field | Type | Description | Label |
|-----------------|------------------|---|----------|
| symbol | <i>string</i> | Resource tokens to charge. | repeated |
| amount | <i>int64</i> | The hash of the block processing the transaction. | |
| chargingAddress | <i>aelf.Hash</i> | The height of the block processing the transaction. | |

token.TotalTransactionFeesMap.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

token.TransactionFeeBill

| Field | Type | Description | Label |
|----------|--|--|----------|
| fees_map | <i>TransactionFeeBill.FeesMapEntry</i> | The transaction fee dictionary, Symbol->fee. | repeated |

token.TransactionFeeBill.FeesMapEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

token.TransferFromInput

| Field | Type | Description | Label |
|--------|---------------------|---------------------------------------|-------|
| from | <i>aelf.Address</i> | The source address of the token. | |
| to | <i>aelf.Address</i> | The destination address of the token. | |
| symbol | <i>string</i> | The symbol of the token to transfer. | |
| amount | <i>int64</i> | The amount to transfer. | |
| memo | <i>string</i> | The memo. | |

token.TransferInput

| Field | Type | Description | Label |
|--------|---------------------|-------------------------------|-------|
| to | <i>aelf.Address</i> | The receiver of the token. | |
| symbol | <i>string</i> | The token symbol to transfer. | |
| amount | <i>int64</i> | The amount to to transfer. | |
| memo | <i>string</i> | The memo. | |

token.Transferred

| Field | Type | Description | Label |
|--------|---------------------|---|-------|
| from | <i>aelf.Address</i> | The source address of the transferred token. | |
| to | <i>aelf.Address</i> | The destination address of the transferred token. | |
| symbol | <i>string</i> | The symbol of the transferred token. | |
| amount | <i>int64</i> | The amount of the transferred token. | |
| memo | <i>string</i> | The memo. | |

token.UnApproveInput

| Field | Type | Description | Label |
|---------|---------------------|---|-------|
| spender | <i>aelf.Address</i> | The address that allowance will be decreased. | |
| symbol | <i>string</i> | The symbol of token to un-approve. | |
| amount | <i>int64</i> | The amount of token to un-approve. | |

token.UnApproved

| Field | Type | Description | Label |
|---------|---------------------|--|-------|
| owner | <i>aelf.Address</i> | The address of the token owner. | |
| spender | <i>aelf.Address</i> | The address that allowance be decreased. | |
| symbol | <i>string</i> | The symbol of un-approved token. | |
| amount | <i>int64</i> | The amount of un-approved token. | |

token.UnlockInput

| Field | Type | Description | Label |
|---------|---------------------|-------------------------------------|-------|
| address | <i>aelf.Address</i> | The one want to un-lock his token. | |
| lock_id | <i>aelf.Hash</i> | Id of the lock. | |
| symbol | <i>string</i> | The symbol of the token to un-lock. | |
| usage | <i>string</i> | a memo. | |
| amount | <i>int64</i> | The amount of tokens to un-lock. | |

token.UpdateCoefficientsInput

| Field | Type | Description | Label |
|---------------|---------------------------------|----------------------------------|----------|
| piece_numbers | <i>int32</i> | The specify pieces gonna update. | repeated |
| coefficients | <i>CalculateFeeCoefficients</i> | Coefficients of one single type. | |

token.FeeTypeEnum

| Name | Number | Description |
|---------|--------|-------------|
| READ | 0 | |
| STORAGE | 1 | |
| WRITE | 2 | |
| TRAFFIC | 3 | |
| TX | 4 | |

token.SetTransactionFeeDelegationsInput

| Field | Type | Description | Label |
|-------------------|---------------------------------|----------------------------|-------|
| delegator_address | <i>aelf.Addressss</i> | The address of delegator. | |
| delegations | <i>map<string, int64></i> | <token symbol, delegation> | |

token.SetTransactionFeeDelegationsOutput

| Field | Type | Description | Label |
|---------|-------------|---------------------------------|-------|
| success | <i>bool</i> | Whether set delegation success. | |

token.RemoveTransactionFeeDelegatorInput

| Field | Type | Description | Label |
|-------------------|-----------------------|--------------------------|-------|
| delegator_address | <i>aelf.Addressss</i> | The address of delegator | |

token.RemoveTransactionFeeDelegateeInput

| Field | Type | Description | Label |
|-------------------|-----------------------|--------------------------|-------|
| delegatee_address | <i>aelf.Addressss</i> | The address of delegatee | |

token.MethodFeeFreeAllowance

| Field | Type | Description | Label |
|--------|---------------|----------------------------------|-------|
| symbol | <i>string</i> | Token symbol | |
| amount | <i>int64</i> | The amount of fee free allowance | |

token.GetTransactionFeeDelegationsOfADelegateeInput

| Field | Type | Description | Label |
|-------------------|-----------------------|--------------------------|-------|
| delegatee_address | <i>aelf.Addressss</i> | The address of delegatee | |
| delegator_address | <i>aelf.Addressss</i> | The address of delegator | |

token.TransactionFeeDelegations

| Field | Type | Description | Label |
|--------------|---------------------------------|--|-------|
| delegations | <i>map<string, int64></i> | The number of tokens allowed to be delegated | |
| block_height | <i>int64</i> | The block height when the information of delegation is added | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS2**acs2.ResourceInfo**

| Field | Type | Description | Label |
|--------------------|-----------------------------|--|----------|
| write_paths | <i>aelf.ScopedStatePath</i> | The state path that depends on when writing. | repeated |
| read_paths | <i>aelf.ScopedStatePath</i> | The state path that depends on when reading. | repeated |
| non_parallelizable | <i>bool</i> | Whether the transaction is not executed in parallel. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.8 AElf.Contracts.Profit

Profit contract.

The Profit contract is an abstract layer for creating scheme to share bonus. Developers can build a system to distribute bonus by call this contract.

Implement AElf Standards ACS1.

22.8.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|---------------------------|------------------------------------|--------------------------------------|--|
| CreateScheme | <i>Profit.CreateScheme</i> | <i>aelf.Hash</i> | Create a scheme for profit distribution, and return the created scheme id. |
| AddBeneficiary | <i>Profit.AddBeneficiary</i> | <i>google.protobuf.Empty</i> | Add beneficiary to scheme. |
| RemoveBeneficiary | <i>Profit.RemoveBeneficiary</i> | <i>google.protobuf.Empty</i> | Remove beneficiary from scheme. |
| AddBeneficiaries | <i>Profit.AddBeneficiaries</i> | <i>google.protobuf.Empty</i> | Batch add beneficiary to scheme. |
| RemoveBeneficiaries | <i>Profit.RemoveBeneficiaries</i> | <i>google.protobuf.Empty</i> | Batch remove beneficiary from scheme. |
| ContributeProfits | <i>Profit.ContributeProfits</i> | <i>google.protobuf.Empty</i> | Contribute profit to a scheme. |
| ClaimProfits | <i>Profit.ClaimProfits</i> | <i>google.protobuf.Empty</i> | The beneficiary draws tokens from the scheme. |
| DistributeProfits | <i>Profit.DistributeProfits</i> | <i>google.protobuf.Empty</i> | Distribute profits to schemes, including its sub scheme according to period and token symbol, should be called by the manager. |
| AddSubScheme | <i>Profit.AddSubScheme</i> | <i>google.protobuf.Empty</i> | Add sub scheme to a scheme. This will effectively add the specified sub-scheme as a beneficiary of the parent scheme. |
| RemoveSubScheme | <i>Profit.RemoveSubScheme</i> | <i>google.protobuf.Empty</i> | Remove sub scheme from a scheme. |
| ResetManager | <i>Profit.ResetManager</i> | <i>google.protobuf.Empty</i> | Reset the manager of a scheme. |
| GetManagingSchemeIds | <i>Profit.GetManagingSchemeIds</i> | <i>Profit.SchemeIds</i> | Get all schemes managed by the specified manager. |
| GetScheme | <i>aelf.Hash</i> | <i>Profit.Scheme</i> | Get scheme according to scheme id. |
| GetSchemeAddress | <i>Profit.SchemePeriod</i> | <i>aelf.Address</i> | Get the virtual address of the number of period of the scheme. |
| GetDistributedProfitsInfo | <i>Profit.SchemePeriod</i> | <i>Profit.DistributedProfitsInfo</i> | Query the distributed profit information for the specified period. |
| GetProfitDetails | <i>Profit.GetProfitDetails</i> | <i>Profit.ProfitDetails</i> | Query the beneficiary's profit information on the scheme. |
| GetProfitAmount | <i>Profit.GetProfitAmount</i> | <i>google.protobuf.Int64Value</i> | Query the amount of profit according to token symbol. (up to 10 periods). |
| GetProfitsMap | <i>Profit.ClaimProfits</i> | <i>Profit.ReceivedProfitsMap</i> | Query profit (up to 10 periods). |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Bytes</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Bytes</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.Bytes</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.8.2 Contract Types

AElf.Contracts.Profit

Profit.AddBeneficiariesInput

| Field | Type | Description | Label |
|--------------------|-------------------------|---|----------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| beneficiary_shares | <i>BeneficiaryShare</i> | The beneficiary information. | repeated |
| end_period | <i>int64</i> | The end period which the beneficiary receives the profit. | |

Profit.AddBeneficiaryInput

| Field | Type | Description | Label |
|-------------------|-------------------------|---|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| beneficiary_share | <i>BeneficiaryShare</i> | The beneficiary information. | |
| end_period | <i>int64</i> | The end period which the beneficiary receives the profit. | |

Profit.AddSubSchemeInput

| Field | Type | Description | Label |
|-------------------|------------------|----------------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The parent scheme id. | |
| sub_scheme_id | <i>aelf.Hash</i> | The sub scheme id. | |
| sub_scheme_shares | <i>int64</i> | The profit weight of sub scheme. | |

Profit.BeneficiaryShare

| Field | Type | Description | Label |
|-------------|---------------------|---|-------|
| beneficiary | <i>aelf.Address</i> | The address of beneficiary. | |
| shares | <i>int64</i> | The profit weight of the beneficiary in the scheme. | |

Profit.ClaimProfitsInput

| Field | Type | Description | Label |
|-------------|---------------------|-----------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| beneficiary | <i>aelf.Address</i> | The address of beneficiary. | |

Profit.ContributeProfitsInput

| Field | Type | Description | Label |
|-----------|------------------|--|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id to contribute. | |
| amount | <i>int64</i> | The amount to contribute. | |
| period | <i>int64</i> | The number of periods in which the income is used for dividends. | |
| symbol | <i>string</i> | The token symbol to contribute. | |

Profit.CreateSchemeInput

| Field | Type | Description | Label |
|-----------------------------------|---------------------|--|-------|
| profit_receiving_due_period_count | <i>int64</i> | Period of profit distribution. | |
| is_release_all_balance_every_time | <i>bool</i> default | Whether all the schemes balance will be distributed during distribution each period. | |
| delay_distribute_period_count | <i>int32</i> | Delay distribute period. | |
| manager | <i>aelf.Address</i> | The manager of this scheme, the default is the creator. | |
| can_remove_beneficiary_directly | <i>bool</i> | Whether you can directly remove the beneficiary. | |
| token | <i>aelf.Hash</i> | Use to generate scheme id. | |

Profit.CreatedSchemelds

| Field | Type | Description | Label |
|------------|------------------|-----------------|----------|
| scheme_ids | <i>aelf.Hash</i> | The scheme ids. | repeated |

Profit.DistributeProfitsInput

| Field | Type | Description | Label |
|-------------|---|--|----------|
| scheme_id | <i>aelf.Hash</i> | The scheme id to distribute. | |
| period | <i>int64</i> | The period number to distribute, should be the current period. | |
| amounts_map | <i>DistributeProfitsInput.AmountsMapEntry</i> | The amount to distribute, symbol -> amount. | repeated |

Profit.DistributeProfitsInput.AmountsMapEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Profit.DistributedProfitsInfo

| Field | Type | Description | Label |
|--------------|---|--|----------|
| total_shares | <i>int64</i> | The total amount of shares in this scheme at the current period. | |
| amounts_map | <i>DistributedProfitsInfo.AmountsMapEntry</i> | The contributed amount in this scheme at the current period. | repeated |
| is_released | <i>bool</i> | Whether released. | |

Profit.DistributedProfitsInfo.AmountsMapEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>sint64</i> | | |

Profit.GetManagingSchemeldsInput

| Field | Type | Description | Label |
|---------|---------------------|----------------------|-------|
| manager | <i>aelf.Address</i> | The manager address. | |

Profit.GetProfitAmountInput

| Field | Type | Description | Label |
|-------------|---------------------|----------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| symbol | <i>string</i> | The token symbol. | |
| beneficiary | <i>aelf.Address</i> | The beneficiary's address. | |

Profit.GetProfitDetailsInput

| Field | Type | Description | Label |
|-------------|---------------------|-----------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| beneficiary | <i>aelf.Address</i> | The address of beneficiary. | |

Profit.ProfitDetail

| Field | Type | Description | Label |
|--------------------|--------------|--|-------|
| start_period | <i>int64</i> | The start period number. | |
| end_period | <i>int64</i> | The end period number. | |
| shares | <i>int64</i> | The weight of the proceeds on the current period of the scheme. | |
| last_profit_period | <i>int64</i> | The last period number that the beneficiary received the profit. | |
| is_weight_removed | <i>bool</i> | Whether the weight has been removed. | |

Profit.ProfitDetails

| Field | Type | Description | Label |
|---------|---------------------|-------------------------|----------|
| details | <i>ProfitDetail</i> | The profit information. | repeated |

Profit.ProfitsClaimed

| Field | Type | Description | Label |
|----------------|---------------------|---|-------|
| beneficiary | <i>aelf.Address</i> | The beneficiary's address claimed. | |
| symbol | <i>string</i> | The token symbol claimed. | |
| amount | <i>int64</i> | The amount claimed. | |
| period | <i>int64</i> | The period number claimed. | |
| claimer_shares | <i>int64</i> | The shares of the claimer. | |
| total_shares | <i>int64</i> | The total shares at the current period. | |

Profit.ReceivedProfitsMap

| Field | Type | Description | Label |
|-------|--------------------------------------|---|----------|
| value | <i>ReceivedProfitsMap.ValueEntry</i> | The collection of profits received, token symbol -> amount. | repeated |

Profit.ReceivedProfitsMap.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Profit.RemoveBeneficiariesInput

| Field | Type | Description | Label |
|---------------|---------------------|-------------------------------|----------|
| beneficiaries | <i>aelf.Address</i> | The addresses of beneficiary. | repeated |
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |

Profit.RemoveBeneficiaryInput

| Field | Type | Description | Label |
|-------------|---------------------|-----------------------------|-------|
| beneficiary | <i>aelf.Address</i> | The address of beneficiary. | |
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |

Profit.RemoveSubSchemeInput

| Field | Type | Description | Label |
|---------------|------------------|-----------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The parent scheme id. | |
| sub_scheme_id | <i>aelf.Hash</i> | The sub scheme id. | |

Profit.ResetManagerInput

| Field | Type | Description | Label |
|-------------|---------------------|-----------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| new_manager | <i>aelf.Address</i> | The address of new manager. | |

Profit.Scheme

| Field | Type | Description | Label |
|--|--------------------------------------|---|----------|
| virtual_address | <i>aelf.Address</i> | The virtual address of the scheme. | |
| total_shares | <i>int64</i> | The total weight of the scheme. | |
| manager | <i>aelf.Address</i> | The manager of the scheme. | |
| current_period | <i>int64</i> | The current period. | |
| sub_schemes | <i>SchemeBeneficiaryShare</i> | Sub schemes information. | repeated |
| can_remove_beneficiary_directly | <i>bool</i> | Whether you can directly remove the beneficiary. | |
| profit_receiving_due_period_count | <i>int64</i> | Period of profit distribution. | |
| is_release_all_balance_every_time_by_default | <i>bool</i> | Whether all the schemes balance will be distributed during distribution each period. | |
| scheme_id | <i>aelf.Hash</i> | The is of the scheme. | |
| delay_distribute_period_count | <i>int32</i> | Delay distribute period. | |
| cached_delay_total_shares | <i>Scheme.CachedDelayTotalShares</i> | The scheme's current total share for deferred distribution of benefits, period -> total shares. | repeated |
| received_token_symbols | <i>string</i> | The received token symbols. | repeated |

Profit.Scheme.CachedDelayTotalSharesEntry

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| key | <i>int64</i> | | |
| value | <i>int64</i> | | |

Profit.SchemeBeneficiaryShare

| Field | Type | Description | Label |
|-----------|------------------|-------------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The id of the sub scheme. | |
| shares | <i>int64</i> | The weight of the sub scheme. | |

Profit.SchemeCreated

| Field | Type | Description | Label |
|--|---------------------|--|-------|
| virtual_address | <i>aelf.Address</i> | The virtual address of the created scheme. | |
| manager | <i>aelf.Address</i> | The manager of the created scheme. | |
| profit_receiving_due_period_count | <i>int64</i> | Period of profit distribution. | |
| is_release_all_balance_every_time_by_default | <i>bool</i> | Whether all the schemes balance will be distributed during distribution each period. | |
| scheme_id | <i>aelf.Hash</i> | The id of the created scheme. | |

Profit.SchemePeriod

| Field | Type | Description | Label |
|-----------|------------------|--------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| period | <i>int64</i> | The period number. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.9 AElf.Contracts.CrossChain

Cross-Chain contract.

Implement AElf Standards ACS1 and ACS7.

22.9.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|---|--|--|--|
| Initialize | <i>Cross-Chain.InitializeInput</i> | <i>google.protobuf.Empty</i> | Propose once cross chain indexing. |
| SetInitial-SideChainLife-timeControllerAd-dress | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Set the initial SideChainLifetimeController address which should be parliament organization by default. |
| SetInitialIndexing-ControllerAddress | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | Set the initial CrossChainIndexingController address which should be parliament organization by default. |
| ChangeCross-ChainIndexing-Controller | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the cross chain indexing controller. |
| ChangeSideChain-LifetimeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the lifetime controller of the side chain. |
| ChangeSideChain-IndexingFeeCon-troller | <i>Cross-Chain.ChangeSideChainIndexingFeeControllerInput</i> | <i>google.protobuf.Empty</i> | Change indexing fee adjustment controller for specific side chain. |
| AcceptCross-ChainIndexing-Proposal | <i>Cross-Chain.AcceptCrossChainIndexingProposalInput</i> | <i>google.protobuf.Empty</i> | When the indexing proposal is released, clean up the pending proposal. |
| GetSideChainCre-ator | <i>google.protobuf.Int32Value</i> | <i>aelf.Address</i> | Get the side chain creator address according to side chain id. |
| GetChainStatus | <i>google.protobuf.Int32Value</i> | <i>Cross-Chain.GetChainStatusOutput</i> | Get the current status of side chain according to side chain id. |
| GetSideChain-Height | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int64Value</i> | Get the side chain height according to side chain id. |
| GetParentChain-Height | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> | Get the height of parent chain. |
| GetParentChainId | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int32Value</i> | Get the chain id of parent chain. |
| GetSideChainBal-ance | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int64Value</i> | Get the balance of side chain indexing according to side chain id. |
| GetSideChainIn-dexingFeeDebt | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int64Value</i> | Get the fee debt of side chain indexing according to side chain id. |
| GetIndexingPro-posalStatus | <i>google.protobuf.Empty</i> | <i>Cross-Chain.GetIndexingProposalStatusOutput</i> | Get the status of the current indexing proposal. |
| GetSideChainIn-dexingFeePrice | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int64Value</i> | Get the side chain indexing fee price according to side chain id. |
| GetSideChainLife-timeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Get the lifetime controller of the side chain. |
| GetCrossChainIn-dexingController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Get the cross chain indexing controller. |
| GetSideChainIn-dexingFeeCon-troller | <i>google.protobuf.Int32Value</i> | <i>AuthorityInfo</i> | Get the indexing fee controller of side chain according to side chain id. |

AEIf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>acs1.MethodFee</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS7

| Method Name | Request Type | Response Type | Description |
|--|--|--|--|
| ProposeCrossChainIndexing | <i>acs7.CrossChainBlockIndexingProposal</i> | <i>google.protobuf.Empty</i> | Propose once cross chain indexing. |
| ReleaseCrossChainIndexingProposal | <i>acs7.ReleaseCrossChainBlockIndexingProposal</i> | <i>google.protobuf.Empty</i> | Release the proposed indexing if already approved. |
| RequestSideChainCreation | <i>acs7.SideChainCreationRequest</i> | <i>google.protobuf.Empty</i> | Request side chain creation. |
| ReleaseSideChainCreation | <i>acs7.ReleaseSideChainCreationRequest</i> | <i>google.protobuf.Empty</i> | Release the side chain creation request if already approved and it will call the method <code>CreateSideChain</code> . |
| CreateSideChain | <i>acs7.CreateSideChainRequest</i> | <i>google.protobuf.Int32Value</i> | Create the side chain and returns the newly created side chain ID. Only <code>SideChainLifetimeController</code> is permitted to invoke this method. |
| Recharge | <i>acs7.RechargeInput</i> | <i>google.protobuf.Empty</i> | Recharge for the specified side chain. |
| DisposeSideChain | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int32Value</i> | Dispose a side chain according to side chain id. Only <code>SideChainLifetimeController</code> is permitted to invoke this method. |
| AdjustIndexingFeePrice | <i>acs7.AdjustIndexingFeeRequest</i> | <i>google.protobuf.Empty</i> | Adjust side chain indexing fee. Only <code>IndexingFeeController</code> is permitted to invoke this method. |
| VerifyTransaction | <i>acs7.VerifyTransactionRequest</i> | <i>google.protobuf.BoolValue</i> | Verify cross chain transaction. |
| GetSideChainIdAndHeight | <i>google.protobuf.Empty</i> | <i>acs7.ChainIdAndHeight</i> | Get the side chain id and height of the current chain. |
| GetSideChainIndexingInformationList | <i>google.protobuf.Empty</i> | <i>acs7.SideChainIndexingInformationList</i> | Get the indexing information of side chains. |
| GetAllChainsIdAndHeight | <i>google.protobuf.Empty</i> | <i>acs7.ChainIdAndHeightList</i> | Get the id and recorded height of all chains. |
| GetIndexedSideChainBlockDataByHeight | <i>google.protobuf.Int64Value</i> | <i>acs7.IndexedSideChainBlockData</i> | Get the block data of indexed side chain according to height. |
| GetBoundParentChainHeightAndMerklePathByHeight | <i>google.protobuf.Int64Value</i> | <i>acs7.CrossChainMerklePathAndHeight</i> | Get the merkle path bound up with side chain according to height. |
| GetChainInitializationData | <i>google.protobuf.Int32Value</i> | <i>acs7.ChainInitializationData</i> | Get the initialization data for specified side chain. |

22.9.2 Contract Types

AElf.Contracts.CrossChain

CrossChain.AcceptCrossChainIndexingProposalInput

| Field | Type | Description | Label |
|----------|--------------|------------------------------------|-------|
| chain_id | <i>int32</i> | The chain id of accepted indexing. | |

CrossChain.ChainIndexingProposal

| Field | Type | Description | Label |
|---------------------------------|--|---|-------|
| proposal_id | <i>aelf.Hash</i> | The id of cross chain indexing proposal. | |
| proposer | <i>aelf.Address</i> | The proposer of cross chain indexing. | |
| proposed_cross_chain_block_data | <i>acs7.CrossChainBlockData</i> | The cross chain data proposed. | |
| status | <i>CrossChainIndexingProposal-Status</i> | The status of of cross chain indexing proposal. | |
| chain_id | <i>int32</i> | The chain id of the indexing. | |

CrossChain.ChangeSideChainIndexingFeeControllerInput

| Field | Type | Description | Label |
|----------------|----------------------|---|-------|
| chain_id | <i>int32</i> | The side chain id. | |
| authority_info | <i>AuthorityInfo</i> | The changed controller of indexing fee. | |

CrossChain.CrossChainIndexingControllerChanged

| Field | Type | Description | Label |
|----------------|----------------------|-------------------------------------|-------|
| authority_info | <i>AuthorityInfo</i> | The changed controller of indexing. | |

CrossChain.Disposed

| Field | Type | Description | Label |
|----------|--------------|-----------------------------|-------|
| chain_id | <i>int32</i> | The disposed side chain id. | |

CrossChain.GetChainStatusOutput

| Field | Type | Description | Label |
|--------|------------------------|---------------------------|-------|
| status | <i>SideChainStatus</i> | The status of side chain. | |

CrossChain.GetIndexingProposalStatusOutput

| Field | Type | Description | Label |
|----------------------------------|--|---|----------|
| chain_indexing_proposal_statuses | <i>CrossChainIndexingProposalStatusOutput.ChainIndexingProposalStatusEntry</i> | The collection of pending indexing proposal, the key is chain id. | repeated |

CrossChain.GetIndexingProposalStatusOutput.ChainIndexingProposalStatusEntry

| Field | Type | Description | Label |
|-------|---|-------------|-------|
| key | <i>int32</i> | | |
| value | <i>PendingChainIndexingProposalStatus</i> | | |

CrossChain.GetPendingCrossChainIndexingProposalOutput

| Field | Type | Description | Label |
|---------------------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The proposal id of cross chain indexing. | |
| proposer | <i>aelf.Address</i> | The proposer of cross chain indexing proposal. | |
| to_be_released | <i>bool</i> | True if the proposal can be released, otherwise false. | |
| proposed_cross_chain_block_data | <i>acs7.CrossChainBlockData</i> | The cross chain data proposed. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The proposal expiration time. | |

CrossChain.InitializeInput

| Field | Type | Description | Label |
|---------------------------------|--------------|---|-------|
| parent_chain_id | <i>int32</i> | The id of parent chain. | |
| creation_height_on_parent_chain | <i>int64</i> | The height of side chain created on parent chain. | |
| is_privilege_preserved | <i>bool</i> | True if chain privilege needed, otherwise false. | |

CrossChain.ParentChainIndexed

| Field | Type | Description | Label |
|----------------|--------------|--------------------------|-------|
| chain_id | <i>bytes</i> | Indexed parent chain id. | |
| indexed_height | <i>int64</i> | Indexed block height. | |

CrossChain.PendingChainIndexingProposalStatus

| Field | Type | Description | Label |
|---------------------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of cross chain indexing proposal. | |
| proposer | <i>aelf.Address</i> | The proposer of cross chain indexing. | |
| to_be_released | <i>bool</i> | True if the proposal can be released, otherwise false. | |
| proposed_cross_chain_block_data | <i>acs7.CrossChainBlockData</i> | The cross chain data proposed. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The proposal expiration time. | |

CrossChain.ProposedCrossChainIndexing

| Field | Type | Description | Label |
|-------------------------------------|---|---|----------|
| chain_indexing_proposal_collections | <i>ProposedCrossChainIndexing.ChainIndexingProposalCollectionsEntry</i> | The collection of chain indexing proposal, the key is chain id. | repeated |

CrossChain.ProposedCrossChainIndexing.ChainIndexingProposalCollectionsEntry

| Field | Type | Description | Label |
|-------|------------------------------|-------------|-------|
| key | <i>int32</i> | | |
| value | <i>ChainIndexingProposal</i> | | |

CrossChain.SideChainCreatedEvent

| Field | Type | Description | Label |
|---------|---------------------|--|-------|
| creator | <i>aelf.Address</i> | The proposer who propose to create the side chain. | |
| chainId | <i>int32</i> | The created side chain id. | |

CrossChain.SideChainCreationRequestState

| Field | Type | Description | Label |
|-----------------------------|--|---|-------|
| side_chain_creation_request | <i>stacs7.SideChainCreationRequest</i> | The parameters of creating side chain. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The expiration date of the proposal. | |
| proposer | <i>aelf.Address</i> | The proposer who proposed to create the side chain. | |

CrossChain.SideChainIndexed

| Field | Type | Description | Label |
|----------------|--------------|------------------------|-------|
| chain_id | <i>bytes</i> | Indexed side chain id. | |
| indexed_height | <i>int64</i> | Indexed block height. | |

CrossChain.SideChainIndexingFeeControllerChanged

| Field | Type | Description | Label |
|----------------|----------------------|--|-------|
| chain_id | <i>int32</i> | The side chain id. | |
| authority_info | <i>AuthorityInfo</i> | The changed controller of side chain indexing fee. | |

CrossChain.SideChainInfo

| Field | Type | Description | Label |
|---------------------------------|--|--|-----------|
| proposer | <i>aelf.Address</i> | The proposer who propose to create the side chain. | |
| side_chain_status | <i>SideChainStatus</i> | The status of side chain. | |
| side_chain_id | <i>int32</i> | The side chain id. | |
| creation_timestamp | <i>google.protobuf.Timestamp</i> | The time of side chain created. | |
| creation_height_on_parent_chain | <i>int64</i> | The height of side chain created on parent chain. | |
| indexing_price | <i>int64</i> | The price of indexing fee. | |
| is_privilege_preserved | <i>bool</i> | True if chain privilege needed, otherwise false. | |
| arrears_info | <i>SideChain-Info.ArrearsInfoEntry</i> | creditor and amounts for the chain indexing fee debt | re-peated |
| indexing_fee_controller | <i>AuthorityInfo</i> | The controller of indexing fee. | |

CrossChain.SideChainInfo.ArrearsInfoEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

CrossChain.SideChainLifetimeControllerChanged

| Field | Type | Description | Label |
|----------------|----------------------|--|-------|
| authority_info | <i>AuthorityInfo</i> | The changed controller of side chain lifetime. | |

CrossChain.CrossChainIndexingProposalStatus

| Name | Number | Description |
|--------------|--------|---------------------------------|
| NON_PROPOSED | 0 | |
| PENDING | 1 | The proposal is pending. |
| ACCEPTED | 2 | The proposal has been released. |

CrossChain.SideChainStatus

| Name | Number | Description |
|-------------------|--------|---|
| FATAL | 0 | Currently no meaning. |
| ACTIVE | 1 | The side chain is being indexed. |
| INDEXING_FEE_DEBT | 2 | The side chain is in debt for indexing fee. |
| TERMINATED | 3 | The side chain is disposed. |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS7**acs7.AdjustIndexingFeeInput**

| Field | Type | Description | Label |
|---------------|--------------|--------------------------------|-------|
| side_chain_id | <i>int32</i> | The side chain id to adjust. | |
| indexing_fee | <i>int64</i> | The new price of indexing fee. | |

acs7.ChainIdAndHeightDict

| Field | Type | Description | Label |
|----------------|---|---|----------|
| id_height_dict | <i>ChainIdAndHeightDict.IdHeightDictEntry</i> | A collection of chain ids and heights, where the key is the chain id and the value is the height. | repeated |

acs7.ChainIdAndHeightDict.IdHeightDictEntry

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| key | <i>int32</i> | | |
| value | <i>int64</i> | | |

acs7.ChainInitializationConsensusInfo

| Field | Type | Description | Label |
|------------------------|--------------|-------------------------|-------|
| initial_consensus_data | <i>bytes</i> | Initial consensus data. | |

acs7.ChainInitializationData

| Field | Type | Description | Label |
|-------------------------------------|---|---|-------|
| chain_id | <i>int32</i> | The id of side chain. | |
| creator | <i>aelf.Address</i> | The side chain creator. | |
| creation_timestamp | <i>google.protobuf.Timestamp</i> | The timestamp for side chain creation. | |
| creation_height_on_parent_chain | <i>int64</i> | The height of side chain creation on parent chain. | |
| chain_creator_privilege_preserved | <i>bool</i> | Creator privilege boolean flag: True if chain creator privilege preserved, otherwise false. | |
| parent_chain_token_contract_address | <i>aelf.Address</i> | Parent chain token contract address. | |
| chain_initialization_consensus_info | <i>ChainInitializationConsensusInfo</i> | Initial consensus information. | |
| native_token_info_data | <i>bytes</i> | The native token info. | |
| resource_token_info | <i>ResourceTokenInfo</i> | The resource token information. | |
| chain_primary_token_info | <i>ChainPrimaryTokenInfo</i> | The chain primary token information. | |

acs7.ChainPrimaryTokenInfo

| Field | Type | Description | Label |
|-------------------------------------|-----------------------------------|--|----------|
| chain_primary_token_data | <i>bytes</i> | The side chain primary token data. | |
| side_chain_token_initial_issue_list | <i>SideChainTokenInitialIssue</i> | The side chain primary token initial issue list. | repeated |

acs7.CreateSideChainInput

| Field | Type | Description | Label |
|-----------------------------|---------------------------------|---|-------|
| side_chain_creation_request | <i>SideChainCreationRequest</i> | The request information of the side chain creation. | |
| proposer | <i>aelf.Address</i> | The proposer of the side chain creation. | |

acs7.CrossChainBlockData

| Field | Type | Description | Label |
|------------------------------|-----------------------------|--|----------|
| side_chain_block_data_list | <i>SideChainBlockData</i> | The side chain block data list to index. | repeated |
| parent_chain_block_data_list | <i>ParentChainBlockData</i> | The parent chain block data list to index. | repeated |

acs7.CrossChainExtraData

| Field | Type | Description | Label |
|-------------------------------------|------------------|---|-------|
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | Merkle tree root of side chain block transaction status root. | |

acs7.CrossChainIndexingDataProposedEvent

| Field | Type | Description | Label |
|---------------------------|----------------------------|--|-------|
| proposed_cross_chain_data | <i>CrossChainBlockData</i> | Proposed cross chain data to be indexed. | |
| proposal_id | <i>aelf.Hash</i> | The proposal id. | |

acs7.CrossChainMerkleProofContext

| Field | Type | Description | Label |
|-------------------------------|------------------------|--|-------|
| bound_parent_chain_height | <i>int64</i> | The height of parent chain bound up with side chain. | |
| merkle_path_from_parent_chain | <i>aelf.MerklePath</i> | The merkle path generated from parent chain. | |

acs7.IndexedParentChainBlockData

| Field | Type | Description | Label |
|------------------------------|-----------------------------|---|----------|
| local_chain_height | <i>int64</i> | The height of the local chain when indexing the parent chain. | |
| parent_chain_block_data_list | <i>ParentChainBlockData</i> | Parent chain block data. | repeated |

acs7.IndexedSideChainBlockData

| Field | Type | Description | Label |
|----------------------------|---------------------------|------------------------|----------|
| side_chain_block_data_list | <i>SideChainBlockData</i> | Side chain block data. | repeated |

acs7.ParentChainBlockData

| Field | Type | Description | Label |
|-------------------------------------|--|--|----------|
| height | <i>int64</i> | The height of parent chain. | |
| cross_chain_extra_data | <i>CrossChainExtraData</i> | The merkle tree root computing from side chain roots. | |
| chain_id | <i>int32</i> | The parent chain id. | |
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | The merkle tree root computing from transactions status in parent chain block. | |
| indexed_merkle_path | <i>ParentChainBlockData.IndexedMerklePathEntry</i> | Indexed block height from side chain and merkle path for this side chain block | repeated |
| extra_data | <i>ParentChainBlockData.ExtraDataEntry</i> | Extra data map. | repeated |

acs7.ParentChainBlockData.ExtraDataEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

acs7.ParentChainBlockData.IndexedMerklePathEntry

| Field | Type | Description | Label |
|-------|------------------------|-------------|-------|
| key | <i>int64</i> | | |
| value | <i>aelf.MerklePath</i> | | |

acs7.RechargeInput

| Field | Type | Description | Label |
|----------|--------------|---------------------------|-------|
| chain_id | <i>int32</i> | The chain id to recharge. | |
| amount | <i>int64</i> | The amount to recharge. | |

acs7.ReleaseCrossChainIndexingProposalInput

| Field | Type | Description | Label |
|---------------|--------------|-------------------------------|----------|
| chain_id_list | <i>int32</i> | List of chain ids to release. | repeated |

acs7.ReleaseSideChainCreationInput

| Field | Type | Description | Label |
|-------------|------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The proposal id of side chain creation. | |

acs7.ResourceTokenInfo

| Field | Type | Description | Label |
|---------------------------|---|------------------------------------|----------|
| re-source_token_list_data | <i>bytes</i> | The resource token information. | |
| initial_resource_amount | <i>ResourceTokenInfo.InitialResourceAmountEntry</i> | The initial resource token amount. | repeated |

acs7.ResourceTokenInfo.InitialResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

acs7.SideChainBlockData

| Field | Type | Description | Label |
|-------------------------------------|------------------|--|-------|
| height | <i>int64</i> | The height of side chain block. | |
| block_header_hash | <i>aelf.Hash</i> | The hash of side chain block. | |
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | The merkle tree root computing from transactions status in side chain block. | |
| chain_id | <i>int32</i> | The id of side chain. | |

acs7.SideChainBlockDataIndexed**acs7.SideChainCreationRequest**

| Field | Type | Description | Label |
|-----------------------------------|--|---|----------|
| indexing_price | <i>int64</i> | The cross chain indexing price. | |
| locked_token_amount | <i>int64</i> | Initial locked balance for a new side chain. | |
| is_privilege_preserved | <i>bool</i> | Creator privilege boolean flag: True if chain creator privilege preserved, otherwise false. | |
| side_chain_token_creation_request | <i>SideChainTokenCreationRequest</i> | Side chain token information. | |
| side_chain_token_initial_issue | <i>SideChainTokenInitialIssue</i> | A list of accounts and amounts that will be issued when the chain starts. | repeated |
| initial_resource_amount | <i>SideChainCreationRequest.InitialResourceAmountEntry</i> | The initial rent resources. | repeated |

acs7.SideChainCreationRequest.InitialResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

acs7.SideChainIndexingInformation

| Field | Type | Description | Label |
|----------------|--------------|---------------------|-------|
| chain_id | <i>int32</i> | The side chain id. | |
| indexed_height | <i>int64</i> | The indexed height. | |

acs7.SideChainIndexingInformationList

| Field | Type | Description | Label |
|---------------------------|-------------------------------------|--|----------|
| indexing_information_list | <i>SideChainIndexingInformation</i> | A list contains indexing information of side chains. | repeated |

acs7.SideChainTokenCreationRequest

| Field | Type | Description | Label |
|-------------------------------|---------------|--|-------|
| side_chain_token_symbol | <i>string</i> | Token symbol of the side chain to be created | |
| side_chain_token_name | <i>string</i> | Token name of the side chain to be created | |
| side_chain_token_total_supply | <i>int64</i> | Token total supply of the side chain to be created | |
| side_chain_token_decimals | <i>int32</i> | Token decimals of the side chain to be created | |

acs7.SideChainTokenInitialIssue

| Field | Type | Description | Label |
|---------|---------------------|----------------------------------|-------|
| address | <i>aelf.Address</i> | The account that will be issued. | |
| amount | <i>int64</i> | The amount that will be issued. | |

acs7.VerifyTransactionInput

| Field | Type | Description | Label |
|---------------------|------------------------|--|-------|
| transaction_id | <i>aelf.Hash</i> | The cross chain transaction id to verify. | |
| path | <i>aelf.MerklePath</i> | The merkle path of the transaction. | |
| parent_chain_height | <i>int64</i> | The height of parent chain that indexing this transaction. | |
| verified_chain_id | <i>int32</i> | The chain id to verify. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.10 AElf.Contracts.Treasury

Treasury contract.

Used for distributing bonus' to voters and candidates during the election process.

Implement AElf Standards ACS1 and ACS10.

22.10.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|---------------------------------|--|--|---|
| InitialTreasuryContract | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> | Initialize treasury contract. |
| InitialMiningRewardProfitItem | <i>google.protobuf.Empty</i> | <i>google.protobuf.Empty</i> | Initialize the sub-item of the bonus scheme. |
| DonateAll | <i>Treasury.DonateAllInput</i> | <i>google.protobuf.Empty</i> | Donate all tokens owned by the sender. |
| SetDividendPoolWeightSetting | <i>Treasury.DividendPoolWeightSetting</i> | <i>google.protobuf.Empty</i> | Set the dividend weight of the sub-item of the dividend item. |
| SetMinerRewardWeightSetting | <i>Treasury.MinerRewardWeightSetting</i> | <i>google.protobuf.Empty</i> | Set the miner reward weight. |
| SetProfitsReceiver | <i>Treasury.SetProfitsReceiverInput</i> | <i>google.protobuf.Empty</i> | Set collect profits receiver address. |
| UpdateMiningReward | <i>google.protobuf.Int64Value</i> | <i>google.protobuf.Empty</i> | Set the reward for mining. |
| ChangeTreasuryController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the governance authority information for treasury contract. |
| RecordMinerReplacement | <i>Treasury.RecordMinerReplacementInput</i> | <i>google.protobuf.Empty</i> | AEDPoS Contract can notify Treasury Contract to aware miner replacement happened. |
| GetWelfareRewardAmountSample | <i>Treasury.GetWelfareRewardAmountSampleInput</i> | <i>Treasury.GetWelfareRewardAmountSampleOutput</i> | Used to estimate the revenue weight of 10000 tokens owned by users. |
| GetTreasurySchemeId | <i>google.protobuf.Empty</i> | <i>aelf.Hash</i> | Get the scheme id of treasury. |
| GetDividendPoolWeightProportion | <i>google.protobuf.Empty</i> | <i>Treasury.DividendPoolWeightProportion</i> | Query the weight percentage of dividend pool items. |
| GetMinerRewardWeightProportion | <i>google.protobuf.Empty</i> | <i>Treasury.MinerRewardWeightProportion</i> | Query the weight percentage of the dividend item for miner. |
| GetTreasuryController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the governance authority information. |
| GetProfitsReceiver | <i>google.protobuf.StringValue</i> | <i>aelf.Address</i> | Get profits receiver, If not set, return the candidate's address. |
| GetProfitsReceiverOrDefault | <i>google.protobuf.StringValue</i> | <i>aelf.Address</i> | Get profits receiver, If not set, return null. |
| ReplaceCandidateProfitsReceiver | <i>Treasury.ReplaceCandidateProfitsReceiverInput</i> | <i>google.protobuf.Empty</i> | Query the governance authority information. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|---|---|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.StringMapMethodFee</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringMapMethodFee</i> | <i>google.protobuf.StringMapMethodFee</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

AElf.Standards.ACS10

| Method Name | Request Type | Response Type | Description |
|---------------------------|------------------------------|-------------------------------|--|
| Donate | <i>acs10.DonateInput</i> | <i>google.protobuf.Empty</i> | Donate tokens from the caller to the treasury. If the tokens are not native tokens in the current chain, they will be first converted to the native token. |
| Release | <i>acs10.ReleaseInput</i> | <i>google.protobuf.Empty</i> | Release dividend pool according the period number. |
| SetSymbolList | <i>acs10.SymbolList</i> | <i>google.protobuf.Empty</i> | Set the token symbols dividend pool supports. |
| GetSymbolList | <i>google.protobuf.Empty</i> | <i>SymbolList</i> | Query the token symbols dividend pool supports. |
| GetUndistributedDividends | <i>google.protobuf.Empty</i> | <i>UndistributedDividends</i> | Query the balance of undistributed tokens whose symbols are included in the symbol list. |
| GetDividends | <i>google.protobuf.Empty</i> | <i>DividendInfo</i> | Query the dividend information according to the height. |

22.10.2 Contract Types

AElf.Contracts.Treasury

Treasury.DividendPoolWeightProportion

| Field | Type | Description | Label |
|--|-----------------------------|------------------------------------|-------|
| <code>citizen_welfare_proportion_info</code> | <i>SchemeProportionInfo</i> | The proportion of citizen welfare. | |
| <code>backup_subsidy_proportion_info</code> | <i>SchemeProportionInfo</i> | The proportion of candidate nodes. | |
| <code>miner_reward_proportion_info</code> | <i>SchemeProportionInfo</i> | The proportion of miner | |

Treasury.DividendPoolWeightSetting

| Field | Type | Description | Label |
|------------------------|--------------|---|-------|
| citizen_welfare_weight | <i>int32</i> | The dividend weight of citizen welfare. | |
| backup_subsidy_weight | <i>int32</i> | The dividend weight of candidate nodes. | |
| miner_reward_weight | <i>int32</i> | The dividend weight of miner. | |

Treasury.DonateAllInput

| Field | Type | Description | Label |
|--------|---------------|-----------------------------|-------|
| symbol | <i>string</i> | The token symbol to donate. | |

Treasury.GetWelfareRewardAmountSampleInput

| Field | Type | Description | Label |
|-------|--------------|------------------|----------|
| value | <i>int64</i> | Token lock time. | repeated |

Treasury.GetWelfareRewardAmountSampleOutput

| Field | Type | Description | Label |
|-------|--------------|------------------------|----------|
| value | <i>int64</i> | The weight calculated. | repeated |

Treasury.MinerReElectionInformation

| Field | Type | Description | Label |
|----------------------------------|--|--|---------------|
| contin- ual_appointment_times | <i>MinerReElectionInformation.ContinualAppointmentTimesEntry</i> | The reappointment information for miner. | re- peated |

Treasury.MinerReElectionInformation.ContinualAppointmentTimesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Treasury.MinerRewardWeightProportion

| Field | Type | Description | Label |
|-------------------------------------|------------------------------|---|-------|
| basic_miner_reward_proportion_info | <i>SchemeProportion-Info</i> | The proportion of the basic income of the miner. | |
| votes_weight_reward_proportion_info | <i>SchemeProportion-Info</i> | The proportion of the vote of the miner. | |
| re_election_reward_proportion_info | <i>SchemeProportion-Info</i> | The proportion of the reappointment of the miner. | |

Treasury.MinerRewardWeightSetting

| Field | Type | Description | Label |
|----------------------------|--------------|--|-------|
| basic_miner_reward_weight | <i>int32</i> | The dividend weight of the basic income of the miner. | |
| votes_weight_reward_weight | <i>int32</i> | The dividend weight of the vote of the miner. | |
| re_election_reward_weight | <i>int32</i> | The dividend weight of the reappointment of the miner. | |

Treasury.RecordMinerReplacementInput

| Field | Type | Description | Label |
|---------------------|---------------|-------------|-------|
| old_pubkey | <i>string</i> | | |
| new_pubkey | <i>string</i> | | |
| current_term_number | <i>int64</i> | | |

Treasury.SchemeProportionInfo

| Field | Type | Description | Label |
|------------|------------------|-----------------------------|-------|
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| proportion | <i>int32</i> | Dividend weight percentage. | |

Treasury.SetProfitsReceiverInput

| Field | Type | Description | Label |
|--------------------------|------------------|----------------------------------|-------|
| pubkey | <i>string</i> | The candidate's public key. | |
| profits_receiver_address | <i>aelf.Hash</i> | The address of profits receiver. | |

Treasury.ReplaceCandidateProfitsReceiverInput

| Field | Type | Description | Label |
|------------|---------------|---------------------------------|-------|
| old_pubkey | <i>string</i> | The old candidate's public key. | |
| new_pubkey | <i>string</i> | The new candidate's public key. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Standards.ACS10**acs10.Dividends**

| Field | Type | Description | Label |
|-------|-----------------------------|----------------------------------|----------|
| value | <i>Dividends.ValueEntry</i> | The dividends, symbol -> amount. | repeated |

acs10.Dividends.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs10.DonateInput

| Field | Type | Description | Label |
|--------|---------------|-----------------------------|-------|
| symbol | <i>string</i> | The token symbol to donate. | |
| amount | <i>int64</i> | The amount to donate. | |

acs10.DonationReceived

| Field | Type | Description | Label |
|---------------|---------------------|-------------------------------|-------|
| from | <i>aelf.Address</i> | The address of donors. | |
| pool_contract | <i>aelf.Address</i> | The address of dividend pool. | |
| symbol | <i>string</i> | The token symbol Donated. | |
| amount | <i>int64</i> | The amount Donated. | |

acs10.ReleaseInput

| Field | Type | Description | Label |
|---------------|--------------|-------------------------------|-------|
| period_number | <i>int64</i> | The period number to release. | |

acs10.SymbolList

| Field | Type | Description | Label |
|-------|---------------|------------------------|----------|
| value | <i>string</i> | The token symbol list. | repeated |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.11 AElf.Contracts.Vote

Vote contract.

The Vote contract is an abstract layer for voting. Developers implement concrete voting activities by calling this contract.

Implement AElf Standards ACS1.

22.11.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|-----------------------|-----------------------------------|------------------------------|---|
| Register | <i>Vote.VotingRegisterInput</i> | <i>google.protobuf.Empty</i> | Create a voting activity. |
| Vote | <i>Vote.VoteInput</i> | <i>google.protobuf.Empty</i> | After successfully creating a voting activity, others are able to vote. |
| Withdraw | <i>Vote.WithdrawInput</i> | <i>google.protobuf.Empty</i> | Any voter can withdraw the token after the lock time. |
| TakeSnapshot | <i>Vote.TakeSnapshotInput</i> | <i>google.protobuf.Empty</i> | Save the result of the specified number of votes and generates a new round votes. |
| AddOption | <i>Vote.AddOptionInput</i> | <i>google.protobuf.Empty</i> | Add an option to a voting activity. |
| RemoveOption | <i>Vote.RemoveOptionInput</i> | <i>google.protobuf.Empty</i> | Remove an option from a voting activity. |
| AddOptions | <i>Vote.AddOptionsInput</i> | <i>google.protobuf.Empty</i> | Add multiple options to a voting activity. |
| RemoveOptions | <i>Vote.RemoveOptionsInput</i> | <i>google.protobuf.Empty</i> | Remove multiple options from a voting activity. |
| GetVotingItem | <i>Vote.GetVotingItemInput</i> | <i>Vote.VotingItem</i> | Get a voting activity information. |
| GetVotingResult | <i>Vote.GetVotingResultInput</i> | <i>Vote.VotingResult</i> | Get a voting result according to the provided voting activity id and snapshot number. |
| GetLatestVotingResult | <i>aelf.Hash</i> | <i>Vote.VotingResult</i> | Gets the latest result according to the voting activity id. |
| GetVotingRecord | <i>aelf.Hash</i> | <i>Vote.VotingRecord</i> | Get the voting record according to vote id. |
| GetVotingRecords | <i>Vote.GetVotingRecordsInput</i> | <i>Vote.VotingRecords</i> | Get the voting record according to vote ids. |
| GetVotedItems | <i>aelf.Address</i> | <i>Vote.VotedItems</i> | Get all voted information according to voter address. |
| GetVotingIds | <i>Vote.GetVotingIdsInput</i> | <i>Vote.VotedIds</i> | Get the vote ids according to voting activity id. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|-------------------------------|------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Bytes</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.Bytes</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.11.2 Contract Types

AElf.Contracts.Vote

Vote.AddOptionInput

| Field | Type | Description | Label |
|----------------|------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| option | <i>string</i> | The new option to add. | |

Vote.AddOptionsInput

| Field | Type | Description | Label |
|----------------|------------------|-------------------------|----------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| options | <i>string</i> | The new options to add. | repeated |

Vote.GetVotingIdsInput

| Field | Type | Description | Label |
|----------------|---------------------|-------------------------|-------|
| voter | <i>aelf.Address</i> | The address of voter. | |
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |

Vote.GetVotingItemInput

| Field | Type | Description | Label |
|----------------|------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |

Vote.GetVotingRecordsInput

| Field | Type | Description | Label |
|-------|------------------|---------------|----------|
| ids | <i>aelf.Hash</i> | The vote ids. | repeated |

Vote.GetVotingResultInput

| Field | Type | Description | Label |
|-----------------|------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| snapshot_number | <i>int64</i> | The snapshot number. | |

Vote.RemoveOptionInput

| Field | Type | Description | Label |
|----------------|------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| option | <i>string</i> | The option to remove. | |

Vote.RemoveOptionsInput

| Field | Type | Description | Label |
|----------------|------------------|-------------------------|----------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| options | <i>string</i> | The options to remove. | repeated |

Vote.TakeSnapshotInput

| Field | Type | Description | Label |
|-----------------|------------------|------------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| snapshot_number | <i>int64</i> | The snapshot number to take. | |

Vote.VoteInput

| Field | Type | Description | Label |
|------------------|---------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| voter | <i>aelf.Address</i> | The address of voter. | |
| amount | <i>int64</i> | The amount of vote. | |
| option | <i>string</i> | The option to vote. | |
| vote_id | <i>aelf.Hash</i> | The vote id. | |
| is_change_target | <i>bool</i> | Whether vote others. | |

Vote.Voted

| Field | Type | Description | Label |
|-----------------|----------------------------------|-------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| voter | <i>aelf.Address</i> | The address of voter. | |
| snapshot_number | <i>int64</i> | The snapshot number. | |
| amount | <i>int64</i> | The amount of vote. | |
| vote_timestamp | <i>google.protobuf.Timestamp</i> | The time of vote. | |
| option | <i>string</i> | The option voted. | |
| vote_id | <i>aelf.Hash</i> | The vote id. | |

Vote.VotedIds

| Field | Type | Description | Label |
|-----------------|------------------|-------------------------|----------|
| active_votes | <i>aelf.Hash</i> | The active vote ids. | repeated |
| withdrawn_votes | <i>aelf.Hash</i> | The withdrawn vote ids. | repeated |

Vote.VotedItems

| Field | Type | Description | Label |
|---------------------|---|----------------|----------|
| voted_item_vote_ids | <i>VotedItems.VotedItemVoteIdsEntry</i> | The voted ids. | repeated |

Vote.VotedItems.VotedItemVoteIdsEntry

| Field | Type | Description | Label |
|-------|-----------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>VotedIds</i> | | |

Vote.VotingItem

| Field | Type | Description | Label |
|----------------------------------|----------------------------------|--|----------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| accepted_currency | <i>string</i> | The token symbol which will be accepted. | |
| is_lock_token | <i>bool</i> | Whether the vote will lock token. | |
| current_snapshot_number | <i>int64</i> | The current snapshot number. | |
| total_snapshot_number | <i>int64</i> | The total snapshot number. | |
| options | <i>string</i> | The list of options. | repeated |
| register_timestamp | <i>google.protobuf.Timestamp</i> | The register time of the voting activity. | |
| start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of the voting. | |
| end_timestamp | <i>google.protobuf.Timestamp</i> | The end time of the voting. | |
| current_snapshot_start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of current round of the voting. | |
| sponsor | <i>aelf.Address</i> | The sponsor address of the voting activity. | |

Vote.VotingItemRegistered

| Field | Type | Description | Label |
|----------------------------------|----------------------------------|--|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| accepted_currency | <i>string</i> | The token symbol which will be accepted. | |
| is_lock_token | <i>bool</i> | Whether the vote will lock token. | |
| current_snapshot_number | <i>int64</i> | The current snapshot number. | |
| total_snapshot_number | <i>int64</i> | The total number of snapshots of the vote. | |
| register_timestamp | <i>google.protobuf.Timestamp</i> | The register time of the voting activity. | |
| start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of the voting. | |
| end_timestamp | <i>google.protobuf.Timestamp</i> | The end time of the voting. | |
| current_snapshot_start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of current round of the voting. | |
| sponsor | <i>aelf.Address</i> | The sponsor address of the voting activity. | |

Vote.VotingRecord

| Field | Type | Description | Label |
|--------------------|----------------------------------|--------------------------------------|-------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| voter | <i>aelf.Address</i> | The address of voter. | |
| snapshot_number | <i>int64</i> | The snapshot number. | |
| amount | <i>int64</i> | The amount of vote. | |
| withdraw_timestamp | <i>google.protobuf.Timestamp</i> | The time of withdraw. | |
| vote_timestamp | <i>google.protobuf.Timestamp</i> | The time of vote. | |
| is_withdrawn | <i>bool</i> | Whether the vote had been withdrawn. | |
| option | <i>string</i> | The option voted. | |
| is_change_target | <i>bool</i> | Whether vote others. | |

Vote.VotingRecords

| Field | Type | Description | Label |
|---------|---------------------|---------------------|----------|
| records | <i>VotingRecord</i> | The voting records. | repeated |

Vote.VotingRegisterInput

| Field | Type | Description | Label |
|-----------------------|----------------------------------|--|----------|
| start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of the voting. | |
| end_timestamp | <i>google.protobuf.Timestamp</i> | The end time of the voting. | |
| accepted_currency | <i>string</i> | The token symbol which will be accepted. | |
| is_lock_token | <i>bool</i> | Whether the vote will lock token. | |
| total_snapshot_number | <i>int64</i> | The total number of snapshots of the vote. | |
| options | <i>string</i> | The list of options. | repeated |

Vote.VotingResult

| Field | Type | Description | Label |
|--------------------------|----------------------------------|---|----------|
| voting_item_id | <i>aelf.Hash</i> | The voting activity id. | |
| results | <i>VotingResult.ResultsEntry</i> | The voting result, option -> amount of votes, | repeated |
| snapshot_number | <i>int64</i> | The snapshot number. | |
| voters_count | <i>int64</i> | The total number of voters. | |
| snapshot_start_timestamp | <i>google.protobuf.Timestamp</i> | The start time of this snapshot. | |
| snapshot_end_timestamp | <i>google.protobuf.Timestamp</i> | The end time of this snapshot. | |
| votes_amount | <i>int64</i> | Total votes received during the process of this snapshot. | |

Vote.VotingResult.ResultsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

Vote.WithdrawInput

| Field | Type | Description | Label |
|---------|------------------|--------------|-------|
| vote_id | <i>aelf.Hash</i> | The vote id. | |

Vote.Withdrawn

| Field | Type | Description | Label |
|---------|------------------|--------------|-------|
| vote_id | <i>aelf.Hash</i> | The vote id. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.12 AElf.Contracts.TokenHolder

TokenHolder contract.

Used to build a a bonus model for distributing bonus' to whom hold the token.

Implement AElf Standards ACS1.

22.12.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|--------------------|---|--|--|
| CreateScheme | <i>TokenHolder.CreateTokenHolderProfitSchemeInput</i> | <i>google.protobuf.Empty</i> | Create a scheme for distributing bonus. |
| AddBeneficiary | <i>TokenHolder.AddTokenHolderBeneficiaryInput</i> | <i>google.protobuf.Empty</i> | Add a beneficiary to a scheme. |
| RemoveBeneficiary | <i>TokenHolder.RemoveTokenHolderBeneficiaryInput</i> | <i>google.protobuf.Empty</i> | Removes a beneficiary from a scheme. Note: amount > 0: update the weight of the beneficiary, amount = 0: remove the beneficiary. |
| ContributeProfits | <i>TokenHolder.ContributeProfitsInput</i> | <i>google.protobuf.Empty</i> | Contribute profit to a scheme. |
| DistributeProfits | <i>TokenHolder.DistributeProfitsInput</i> | <i>google.protobuf.Empty</i> | To distribute the profits of the scheme, the stakeholders of the project may go to receive dividends. |
| RegisterForProfits | <i>TokenHolder.RegisterForProfitsInput</i> | <i>google.protobuf.Empty</i> | The user registers a bonus project. |
| Withdraw | <i>aelf.Address</i> | <i>google.protobuf.Empty</i> | After the lockup time expires, the user can withdraw token. |
| ClaimProfits | <i>TokenHolder.ClaimProfitsInput</i> | <i>google.protobuf.Empty</i> | After DistributeProfits the holder can get his dividend. |
| GetScheme | <i>aelf.Address</i> | <i>TokenHolder.TokenHolderProfitScheme</i> | Query the details of the specified scheme. |
| GetProfitsMap | <i>TokenHolder.ClaimProfitsInput</i> | <i>TokenHolder.ReceivedProfitsMap</i> | Query the dividends available to the holder. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|-------------------------------|-------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Bytes</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.String</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.12.2 Contract Types

AElf.Contracts.TokenHolder

TokenHolder.AddTokenHolderBeneficiaryInput

| Field | Type | Description | Label |
|-------------|---------------------|--|-------|
| beneficiary | <i>aelf.Address</i> | Beneficiary's address. | |
| shares | <i>int64</i> | The weight of the beneficiary's dividends in the scheme. | |

TokenHolder.ClaimProfitsInput

| Field | Type | Description | Label |
|----------------|---------------------|----------------------------|-------|
| scheme_manager | <i>aelf.Address</i> | The manager of the scheme. | |
| beneficiary | <i>aelf.Address</i> | Beneficiary's address. | |

TokenHolder.ContributeProfitsInput

| Field | Type | Description | Label |
|----------------|---------------------|------------------------------------|-------|
| scheme_manager | <i>aelf.Address</i> | The manager of the scheme. | |
| amount | <i>int64</i> | The amount of token to contribute. | |
| symbol | <i>string</i> | The symbol of token to contribute. | |

TokenHolder.CreateTokenHolderProfitSchemeInput

| Field | Type | Description | Label |
|---------------------------|--|--|----------|
| symbol | <i>string</i> | The token symbol. | |
| minimum_lock_minutes | <i>int64</i> | Minimum lock time for holding token. | |
| auto_distribute_threshold | <i>TokenHolderProfitSchemeInput.AutoDistributeThresholdEntry</i> | Threshold setting for releasing dividends. | repeated |

TokenHolder.CreateTokenHolderProfitSchemeInput.AutoDistributeThresholdEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

TokenHolder.DistributeProfitsInput

| Field | Type | Description | Label |
|----------------|---|--|-----------|
| scheme_manager | <i>aelf.Address</i> | The manager of the scheme. | |
| amounts_map | <i>DistributeProfitsInput.AmountsMapEntry</i> | The token to distribute, symbol -> amount. | re-peated |

TokenHolder.DistributeProfitsInput.AmountsMapEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

TokenHolder.ReceivedProfitsMap

| Field | Type | Description | Label |
|-------|--------------------------------------|--|-----------|
| value | <i>ReceivedProfitsMap.ValueEntry</i> | The amount of token the beneficiary can get, symbol -> amount. | re-peated |

TokenHolder.ReceivedProfitsMap.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

TokenHolder.RegisterForProfitsInput

| Field | Type | Description | Label |
|----------------|---------------------|------------------------------|-------|
| scheme_manager | <i>aelf.Address</i> | The manager of the scheme. | |
| amount | <i>int64</i> | The amount of token holding. | |

TokenHolder.RemoveTokenHolderBeneficiaryInput

| Field | Type | Description | Label |
|-------------|---------------------|----------------------------------|-------|
| beneficiary | <i>aelf.Address</i> | Beneficiary's address. | |
| amount | <i>int64</i> | The amount of weights to remove. | |

TokenHolder.TokenHolderProfitScheme

| Field | Type | Description | Label |
|---------------------------|---|--|----------|
| symbol | <i>string</i> | The token symbol. | |
| scheme_id | <i>aelf.Hash</i> | The scheme id. | |
| period | <i>int64</i> | The current dividend period. | |
| minimum_lock_minutes | <i>int64</i> | Minimum lock time for holding token. | |
| auto_distribute_threshold | <i>TokenHolderProfitScheme.AutoDistributeThresholdEntry</i> | Threshold setting for releasing dividends. | repeated |

TokenHolder.TokenHolderProfitScheme.AutoDistributeThresholdEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.13 AElf.Contracts.Economic

Economic contract.

The Economic contract establishes the economic system of the AElf. When the block chain starts to work, this contract will initialize other contracts related to economic activities.

Implement AElf Standards ACS1.

22.13.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|------------------------|--|------------------------------|--|
| Issue-Native-Token | <i>Economic.IssueNativeTokenInput</i> | <i>google.protobuf.Empty</i> | Only Zero Contract is able to issue the native token. |
| InitialEconomic-System | <i>Economic.InitialEconomicSystemInput</i> | <i>google.protobuf.Empty</i> | Initialize other contracts related to economic activities (For instance, create the native token). This transaction only can be send once because after the first sending, its state will be set to initialized. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|----------------------------|------------------------------------|------------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringValue</i> | <i>google.protobuf.StringValue</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.13.2 Contract Types

AElf.Contracts.Economic

Economic.InitialEconomicSystemInput

| Field | Type | Description | Label |
|---------------------------------|---------------|---|-------|
| native_token_symbol | <i>string</i> | The native token symbol. | |
| native_token_name | <i>string</i> | The native token name. | |
| native_token_total_supply | <i>int64</i> | The native token total supply. | |
| native_token_decimals | <i>int32</i> | The accuracy of the native token. | |
| is_native_token_burnable | <i>bool</i> | It indicates if the token is burnable. | |
| mining_reward_total_amount | <i>int64</i> | It determines how much native token is used to reward the miners. | |
| transaction_size_fee_unit_price | <i>int64</i> | todo : remove unused fields | |

Economic.IssueNativeTokenInput

| Field | Type | Description | Label |
|--------|---------------------|-----------------------------|-------|
| amount | <i>int64</i> | The amount of token. | |
| memo | <i>string</i> | The memo. | |
| to | <i>aelf.Address</i> | The recipient of the token. | |

Economic.IssueResourceTokenInput

| Field | Type | Description | Label |
|--------|---------------------|-------------------------------|-------|
| symbol | <i>string</i> | The symbol of resource token. | |
| amount | <i>int64</i> | The amount of resource token. | |
| memo | <i>string</i> | The memo. | |
| to | <i>aelf.Address</i> | The recipient of the token. | |

AElf.Standards.ACS1

acs1.MethodFee

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.14 AElf.Contracts.TokenConverter

TokenConvert contract.

Using this contract can build a connection between the base token and other tokens created on the chain. After building the connection, users can trade tokens with the Bancor model. You can find the detail information about Bancor in AElf Economic System White Paper.

Implement AElf Standards ACS1.

22.14.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|---------------------------------|--|-------------------------------------|---|
| Initialize | <i>TokenConverter.InitializeInput</i> | <i>google.protobuf.Empty</i> | Initialize TokenConvert contract. |
| SetConnector | <i>TokenConverter.Connector</i> | <i>google.protobuf.Empty</i> | |
| Buy | <i>TokenConverter.BuyInput</i> | <i>google.protobuf.Empty</i> | After establishing bancor model of token and base token, you can buy token through this method. |
| Sell | <i>TokenConverter.SellInput</i> | <i>google.protobuf.Empty</i> | After establishing bancor model of token and base token, you can sell token through this method. |
| SetFeeRate | <i>google.protobuf.StringValue</i> | <i>google.protobuf.Empty</i> | Set the fee rate for buy/sell (fee amount = cost * feeRate). |
| UpdateConnector | <i>TokenConverter.Connector</i> | <i>google.protobuf.Empty</i> | Before calling the EnableConnector, the connector controller can update the pair connector through this method. |
| AddPairConnector | <i>TokenConverter.PairConnectorParam</i> | <i>google.protobuf.Empty</i> | Add a pair connector for new token and the base token. |
| EnableConnector | <i>TokenConverter.ToBeConnectedTokenInfo</i> | <i>google.protobuf.Empty</i> | After adding a pair, you need to call this method to enable it before buy and sell token. |
| ChangeConnectorController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Set the governance authority information for TokenConvert contract. |
| GetPairConnector | <i>TokenConverter.TokenSymbol</i> | <i>TokenConverter.PairConnector</i> | Query the pair connector according to token symbol. |
| GetFeeRate | <i>google.protobuf.Empty</i> | <i>google.protobuf.StringValue</i> | Query the fee rate for buy/sell. |
| GetBaseTokenSymbol | <i>google.protobuf.Empty</i> | <i>TokenConverter.TokenSymbol</i> | Query the symbol of base token. |
| GetNeededDeposit | <i>TokenConverter.ToBeConnectedTokenInfo</i> | <i>TokenConverter.TokenSymbol</i> | Query how much the base token need be deposited before enabling the connector. |
| GetDepositConnectorBalance | <i>google.protobuf.StringValue</i> | <i>google.protobuf.Int64Value</i> | Query how much the base token have been deposited. |
| GetControllerForManageConnector | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the governance authority information for TokenConvert contract. |
| IsSymbolAbleToSell | <i>google.protobuf.StringValue</i> | <i>google.protobuf.BoolValue</i> | Query whether the token can be sold. |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|------------------------------------|-----------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringValue</i> | <i>google.protobuf.Int64Value</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.14.2 Contract Types

AElf.Contracts.TokenConverter

TokenConverter.BuyInput

| Field | Type | Description | Label |
|-----------|---------------|--|-------|
| symbol | <i>string</i> | The token symbol you want to buy. | |
| amount | <i>int64</i> | The amount you want to buy. | |
| pay_limit | <i>int64</i> | Limit of cost. If the token required for buy exceeds this value, the buy will be abandoned. And 0 is no limit. | |

TokenConverter.Connector

| Field | Type | Description | Label |
|----------------------------|---------------|--|-------|
| symbol | <i>string</i> | The token symbol. | |
| virtual_balance | <i>int64</i> | The virtual balance for base token. | |
| weight | <i>string</i> | The calculated weight value for this Connector. | |
| is_virtual_balance_enabled | <i>bool</i> | Whether to use Virtual Balance. | |
| is_purchase_enabled | <i>bool</i> | Whether the connector is enabled. | |
| related_symbol | <i>string</i> | Indicates its related connector, the pair connector includes a new created token connector and the base token connector. | |
| is_deposit_account | <i>bool</i> | Indicates if the connector is base token connector. | |

TokenConverter.DepositInfo

| Field | Type | Description | Label |
|-----------------------------|--------------|--|-------|
| need_amount | <i>int64</i> | How much more base Token is needed as the deposit. | |
| amount_out_of_token_convert | <i>int64</i> | How many tokens are not on the TokenConvert address. | |

TokenConverter.InitializeInput

| Field | Type | Description | Label |
|-------------------|------------------|--|----------|
| base_token_symbol | <i>string</i> | Base token symbol, default is the native token symbol. | |
| fee_rate | <i>string</i> | The fee rate for buy/sell. | |
| connectors | <i>Connector</i> | The default added connectors. | repeated |

TokenConverter.PairConnector

| Field | Type | Description | Label |
|--------------------|------------------|---------------------------------------|-------|
| resource_connector | <i>Connector</i> | The connector of the specified token. | |
| deposit_connector | <i>Connector</i> | The related connector. | |

TokenConverter.PairConnectorParam

| Field | Type | Description | Label |
|---------------------------|---------------|---|-------|
| resource_connector_symbol | <i>string</i> | The token symbol. | |
| resource_weight | <i>string</i> | The weight value of this token in the Bancor model. | |
| native_virtual_balance | <i>int64</i> | This token corresponds to the value of base token. | |
| native_weight | <i>string</i> | The weight value of base token in Bancor model. | |

TokenConverter.SellInput

| Field | Type | Description | Label |
|---------------|---------------|---|-------|
| symbol | <i>string</i> | The token symbol you want to sell. | |
| amount | <i>int64</i> | The amount you want to sell. | |
| receive_limit | <i>int64</i> | Limits on tokens obtained by selling. If the token obtained is less than this value, the sale will be abandoned. And 0 is no limit. | |

TokenConverter.ToBeConnectedTokenInfo

| Field | Type | Description | Label |
|-------------------------|---------------|---|-------|
| token_symbol | <i>string</i> | The token symbol. | |
| amount_to_token_convert | <i>int64</i> | Specifies the number of tokens to convert to the TokenConvert contract. | |

TokenConverter.TokenBought

| Field | Type | Description | Label |
|---------------|---------------|-----------------------------------|-------|
| symbol | <i>string</i> | The token symbol bought. | |
| bought_amount | <i>int64</i> | The amount bought. | |
| base_amount | <i>int64</i> | The total cost of the base token. | |
| fee_amount | <i>int64</i> | The fee amount. | |

TokenConverter.TokenSold

| Field | Type | Description | Label |
|-------------|---------------|---------------------------------------|-------|
| symbol | <i>string</i> | The token symbol sold. | |
| sold_amount | <i>int64</i> | The amount sold. | |
| base_amount | <i>int64</i> | The total received of the base token. | |
| fee_amount | <i>int64</i> | The fee amount. | |

TokenConverter.TokenSymbol

| Field | Type | Description | Label |
|--------|---------------|-------------------|-------|
| symbol | <i>string</i> | The token symbol. | |

AElf.Standards.ACS1**acs1.MethodFee**

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types**aelf.Address**

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

22.15 AElf.Contracts.Configuration

Configuration contract.

Used to manage the configuration on the block chain.

Implement AElf Standards ACS1.

22.15.1 Contract Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------|--|-----------------------------------|--|
| SetConfiguration | <i>Configuration.SetConfigurationInput</i> | <i>google.protobuf.Empty</i> | Add or update configuration. |
| ChangeConfigurationController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is Parliament. |
| GetConfiguration | <i>google.protobuf.StringValue</i> | <i>google.protobuf.BytesValue</i> | Query the configuration by configuration's key. |
| GetConfigurationController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the controller information |

AElf.Standards.ACS1

| Method Name | Request Type | Response Type | Description |
|---------------------------|------------------------------------|-----------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethodFeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.StringValue</i> | <i>google.protobuf.BytesValue</i> | Query method fee information by method name. |
| GetMethodFeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

22.15.2 Contract Types

AElf.Contracts.Configuration

Configuration.ConfigurationSet

| Field | Type | Description | Label |
|-------|---------------|---|-------|
| key | <i>string</i> | The configuration's key. | |
| value | <i>bytes</i> | The configuration's value(binary data). | |

Configuration.SetConfigurationInput

| Field | Type | Description | Label |
|-------|---------------|---|-------|
| key | <i>string</i> | The configuration's key. | |
| value | <i>bytes</i> | The configuration's value(binary data). | |

AElf.Standards.ACS1

acs1.MethodFee

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AElf.Types

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

ACS INTRODUCTION

23.1 ACS0 - Contract Deployment Standard

ACS0 is used to manage the deployment and update of contracts.

23.1.1 Interface

The contract inherited from ACS0 need implement the following interfaces:

Methods

| Method Name | Request Type | Response Type | Description |
|--|--|---|--|
| DeploySystemSmartContract | <i>acs0.SystemContractDeployInput</i> | <i>aelf.Address</i> | Deploy a system smart contract on chain and return the address of the system contract deployed. |
| DeploySmartContract | <i>acs0.ContractDeployInput</i> | <i>aelf.Address</i> | Deploy a smart contract on chain and return the address of the contract deployed. |
| UpdateSmartContract | <i>acs0.ContractUpdateInput</i> | <i>aelf.Address</i> | Update a smart contract on chain. |
| ProposeNewContract | <i>acs0.ContractDeployInput</i> | <i>aelf.Hash</i> | Create a proposal to deploy a new contract and returns the id of the proposed contract. |
| ProposeContractCodeCheck | <i>acs0.ContractCodeCheckInput</i> | <i>aelf.Hash</i> | Create a proposal to check the code of a contract and return the id of the proposed contract. |
| ProposeUpdateContract | <i>acs0.ContractUpdateInput</i> | <i>aelf.Hash</i> | Create a proposal to update the specified contract and return the id of the proposed contract. |
| ReleaseApprovedContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the contract proposal which has been approved. |
| ReleaseCodeCheckedContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the proposal which has passed the code check. |
| ValidateSystemContractAddress | <i>acs0.ValidateSystemContractAddressInput</i> | <i>google.protobuf.Empty</i> | Validate whether the input system contract exists. |
| SetContractProposerRequiredState | <i>google.protobuf.BoolValue</i> | <i>google.protobuf.Empty</i> | Set authority of contract deployment. |
| CurrentContractSerialNumber | <i>google.protobuf.Empty</i> | <i>google.protobuf.Int64Value</i> | Get the current serial number of genesis contract (corresponds to the serial number that will be given to the next deployed contract). |
| GetContractInfo | <i>aelf.Address</i> | <i>acs0.ContractInfo</i> | Get detailed information about the specified contract. |
| GetContractAuthor | <i>aelf.Address</i> | <i>aelf.Address</i> | Get author of the specified contract. |
| GetContractHash | <i>aelf.Address</i> | <i>aelf.Hash</i> | Get the code hash of the contract about the specified address. |
| GetContractAddressByName | <i>aelf.Hash</i> | <i>aelf.Address</i> | Get the address of a system contract by its name. |
| GetSmartContractRegistrationByAddress | <i>aelf.Address</i> | <i>aelf.SmartContractRegistration</i> | Get the registration of a smart contract by its address. |
| GetSmartContractRegistrationByCodeHash | <i>aelf.Hash</i> | <i>aelf.SmartContractRegistration</i> | Get the registration of a smart contract by code hash. |
| DeployUserSmartContract | <i>acs0.ContractDeployUserSmartContractInput</i> | <i>acs0.DeployUserSmartContractOutput</i> | Deploy a user smart contract on chain and return the hash of the contract code. |
| UpdateUserSmartContract | <i>acs0.ContractUpdateUserSmartContractInput</i> | <i>google.protobuf.Empty</i> | Update a user smart contract on chain. |
| ReleaseApprovedUserSmartContract | <i>acs0.ReleaseContractProposal</i> | <i>google.protobuf.Empty</i> | Release the proposal which has passed the code check. |
| PerformDeployUserSmartContract | <i>acs0.ContractDeployUserSmartContractInput</i> | <i>aelf.Address</i> | Perform user contract deployment. |
| PerformUpdateUserSmartContract | <i>acs0.ContractUpdateUserSmartContractInput</i> | <i>google.protobuf.Empty</i> | Perform user contract update. |
| SetContractAuthor | <i>acs0.SetContractAuthorInput</i> | <i>google.protobuf.Empty</i> | Set authority of the specified contract. |

Types

acs0.AuthorUpdated

| Field | Type | Description | Label |
|-----------------------|---------------------|---|-------|
| address | <i>aelf.address</i> | The byte array of the contract code. | |
| old_author | <i>aelf.address</i> | The category of contract code(0: C#). | |
| CrossChainCreateToken | <i>aelf.address</i> | Indicates if the contract is the system contract. | |

acs0.CodeCheckRequired

| Field | Type | Description | Label |
|------------------------------|------------------|---|-------|
| code | <i>bytes</i> | The byte array of the contract code. | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| is_system_contract | <i>bool</i> | Indicates if the contract is the system contract. | |
| is_user_contract | <i>bool</i> | Indicates if the contract is the user contract. | |

acs0.CodeUpdated

| Field | Type | Description | Label |
|---------------|---------------------|--|-------|
| address | <i>aelf.Address</i> | The address of the updated contract. | |
| old_code_hash | <i>aelf.Hash</i> | The byte array of the old contract code. | |
| new_code_hash | <i>aelf.Hash</i> | The byte array of the new contract code. | |
| version | <i>int32</i> | The version of the current contract. | |

acs0.ContractCodeCheckInput

| Field | Type | Description | Label |
|------------------------------|------------------|---|-------|
| contract_input | <i>bytes</i> | The byte array of the contract code to be checked. | |
| is_contract_deployment | <i>bool</i> | Whether the input contract is to be deployed or updated. | |
| code_check_release_method | <i>string</i> | Method to call after code check complete(DeploySmartContract or UpdateSmartContract). | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| is_system_contract | <i>bool</i> | Indicates if the contract is the system contract. | |

acs0.ContractDeployed

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| author | <i>aelf.Address</i> | The author of the contract, this is the person who deployed the contract. | |
| code_hash | <i>aelf.Hash</i> | The hash of the contract code. | |
| address | <i>aelf.Address</i> | The address of the contract. | |
| version | <i>int32</i> | The version of the current contract. | |
| Name | <i>aelf.Hash</i> | The name of the contract. It has to be unique. | |
| contract_version | <i>string</i> | The version of the current contract. | |

acs0.ContractDeploymentInput

| Field | Type | Description | Label |
|----------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |

acs0.DeployUserSmartContractOutput

| Field | Type | Description | Label |
|-----------|------------------|---|-------|
| code_hash | <i>aelf.Hash</i> | The deployed or updated contract code hash. | |

acs0.ContractInfo

| Field | Type | Description | Label |
|--------------------|---------------------|---|-------|
| serial_number | <i>int64</i> | The serial number of the contract. | |
| author | <i>aelf.Address</i> | The author of the contract, this is the person who deployed the contract. | |
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code_hash | <i>aelf.Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |
| contract_version | <i>string</i> | The version of the current contract. | |
| is_user_contract | <i>bool</i> | Indicates if the contract is the user contract. | |

acs0.ContractProposed

| Field | Type | Description | Label |
|------------------------------|------------------|----------------------------------|-------|
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |

acs0.ContractUpdateInput

| Field | Type | Description | Label |
|---------|---------------------|--|-------|
| address | <i>aelf.Address</i> | The contract address that needs to be updated. | |
| code | <i>bytes</i> | The byte array of the new contract code. | |

acs0.SetContractAuthorInput

| Field | Type | Description | Label |
|------------------|---------------------|--|-------|
| contract_address | <i>aelf.Address</i> | The author's contract address needs to be updated. | |
| new_author | <i>aelf.Address</i> | The new contract author. | |

acs0.ReleaseContractInput

| Field | Type | Description | Label |
|------------------------------|------------------|----------------------------------|-------|
| proposal_id | <i>aelf.Hash</i> | The hash of the proposal. | |
| proposed_contract_input_hash | <i>aelf.Hash</i> | The id of the proposed contract. | |

acs0.SystemContractDeploymentInput

| Field | Type | Description | Label |
|--------------------------|--|---|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| name | <i>aelf.Hash</i> | The name of the contract. It has to be unique. | |
| transaction_method_calls | <i>SystemContractDeploymentInput</i> <i>SystemTransactionMethodCall</i> | An initial list of transactions for the system contract, which is executed in sequence when the contract is deployed. | |

acs0.SystemContractDeploymentInput.SystemTransactionMethodCall

| Field | Type | Description | Label |
|-------------|---------------|--|-------|
| method_name | <i>string</i> | The method name of system transaction. | |
| params | <i>bytes</i> | The params of system transaction method. | |

acs0.SystemContractDeploymentInput.SystemTransactionMethodCallList

| Field | Type | Description | Label |
|-------|--|----------------------------------|----------|
| value | <i>SystemContractDeploymentInput.SystemTransactionMethodCall</i> | The list of system transactions. | repeated |

acs0.ValidateSystemContractAddressInput

| Field | Type | Description | Label |
|---------------------------|---------------------|--------------------------------|-------|
| system_contract_hash_name | <i>aelf.Hash</i> | The name hash of the contract. | |
| address | <i>aelf.Address</i> | The address of the contract. | |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|--------------|---------------------------------------|-------|
| category | <i>int32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|---|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction its actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.1.2 Example

ACS0 declares methods for the scenes about contract deployment and update. AElf provides the implementation for ACS0, Genesis Contract. You can refer to the implementation of the [Genesis contract api](#).

23.2 ACS1 - Transaction Fee Standard

ACS1 is used to manage the transfer fee.

23.2.1 Interface

The contract inherited from ACS1 need implement the APIs below:

Methods

| Method Name | Request Type | Response Type | Description |
|----------------------------|-------------------------------|-------------------------------|--|
| SetMethodFee | <i>acs1.MethodFees</i> | <i>google.protobuf.Empty</i> | Set the method fees for the specified method. Note that this will override all fees of the method. |
| ChangeMethod-FeeController | <i>AuthorityInfo</i> | <i>google.protobuf.Empty</i> | Change the method fee controller, the default is parliament and default organization. |
| GetMethodFee | <i>google.protobuf.String</i> | <i>google.protobuf.String</i> | Query method fee information by method name. |
| GetMethod-FeeController | <i>google.protobuf.Empty</i> | <i>AuthorityInfo</i> | Query the method fee controller. |

Types

acs1.MethodFee

| Field | Type | Description | Label |
|-----------|---------------|-------------------------------------|-------|
| symbol | <i>string</i> | The token symbol of the method fee. | |
| basic_fee | <i>int64</i> | The amount of fees to be charged. | |

acs1.MethodFees

| Field | Type | Description | Label |
|------------------|------------------|--|----------|
| method_name | <i>string</i> | The name of the method to be charged. | |
| fees | <i>MethodFee</i> | List of fees to be charged. | repeated |
| is_size_fee_free | <i>bool</i> | Optional based on the implementation of SetMethodFee method. | |

AuthorityInfo

| Field | Type | Description | Label |
|------------------|---------------------|---|-------|
| contract_address | <i>aelf.Address</i> | The contract address of the controller. | |
| owner_address | <i>aelf.Address</i> | The address of the owner of the contract. | |

Attention: just the system contract on main chain is able to implement acs1.

23.2.2 Usage

On AElf, a pre-transaction is generated by pre-plugin `FeeChargePreExecutionPlugin` before the transaction main processing. It is used to charge the transaction fee.

The generated transaction's method is `ChargeTransactionFees`. The implementation is roughly like that (part of the code is omitted):

```

/// <summary>
/// Related transactions will be generated by acs1 pre-plugin service,
/// and will be executed before the origin transaction.
/// </summary>
/// <param name="input"></param>
/// <returns></returns>
public override BoolValue ChargeTransactionFees(ChargeTransactionFeesInput input)
{
    // ...
    // Record tx fee bill during current charging process.
    var bill = new TransactionFeeBill();
    var fromAddress = Context.Sender;
    var methodFees = Context.Call<MethodFees>(input.ContractAddress,
↳nameof(GetMethodFee),
        new StringValue {Value = input.MethodName});
    var successToChargeBaseFee = true;
    if (methodFees != null && methodFees.Fees.Any())
    {
        successToChargeBaseFee = ChargeBaseFee(GetBaseFeeDictionary(methodFees), ref
↳bill);
    }
    var successToChargeSizeFee = true;
    if (!IsMethodFeeSetToZero(methodFees))
    {
        // Then also do not charge size fee.
        successToChargeSizeFee = ChargeSizeFee(input, ref bill);
    }
    // Update balances.
    foreach (var tokenToAmount in bill.FeesMap)
    {
        ModifyBalance(fromAddress, tokenToAmount.Key, -tokenToAmount.Value);
        Context.Fire(new TransactionFeeCharged
        {
            Symbol = tokenToAmount.Key,
            Amount = tokenToAmount.Value
        });
    }
}

```

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```

        if (tokenToAmount.Value == 0)
        {
            //Context.LogDebug(() => $"Maybe incorrect charged tx fee of {tokenToAmount.
↪Key}: it's 0.");
        }
    }
    return new BoolValue {Value = successToChargeBaseFee && successToChargeSizeFee};
}

```

In this method, the transaction fee consists of two parts:

1. The system calls `GetMethodFee`(line 15) to get the transaction fee you should pay. Then, it will check whether your balance is enough. If your balance is sufficient, the fee will be signed in the bill (variant bill). If not, your transaction will be rejected.
2. If the method fee is not set to 0 by the contract developer, the system will charge size fee. (the size if calculate by the parameter's size)

After charging successfully, an `TransactionFeeCharged` event is thrown, and the balance of the sender is modified.

The `TransactionFeeCharged` event will be captured and processed on the chain to calculate the total amount of transaction fees charged in the block. In the next block, the 10% of the transaction fee charged in this block is destroyed, the remaining 90% flows to dividend pool on the main chain, and is transferred to the `FeeReceiver` on the side chain. The code is:

```

/// <summary>
/// Burn 10% of tx fees.
/// If Side Chain didn't set FeeReceiver, burn all.
/// </summary>
/// <param name="symbol"></param>
/// <param name="totalAmount"></param>
private void TransferTransactionFeesToFeeReceiver(string symbol, long totalAmount)
{
    Context.LogDebug(() => "Transfer transaction fee to receiver.");
    if (totalAmount <= 0) return;
    var burnAmount = totalAmount.Div(10);
    if (burnAmount > 0)
        Context.SendInline(Context.Self, nameof(Burn), new BurnInput
        {
            Symbol = symbol,
            Amount = burnAmount
        });
    var transferAmount = totalAmount.Sub(burnAmount);
    if (transferAmount == 0)
        return;
    var treasuryContractAddress =
        Context.GetContractAddressByName(SmartContractConstants.
↪TreasuryContractSystemName);
    if (treasuryContractAddress != null)
    {
        // Main chain would donate tx fees to dividend pool.
        if (State.DividendPoolContract.Value == null)
            State.DividendPoolContract.Value = treasuryContractAddress;
        State.DividendPoolContract.Donate.Send(new DonateInput

```

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```

        {
            Symbol = symbol,
            Amount = transferAmount
        });
    }
    else
    {
        if (State.FeeReceiver.Value != null)
        {
            Context.SendInline(Context.Self, nameof(Transfer), new TransferInput
            {
                To = State.FeeReceiver.Value,
                Symbol = symbol,
                Amount = transferAmount,
            });
        }
        else
        {
            // Burn all!
            Context.SendInline(Context.Self, nameof(Burn), new BurnInput
            {
                Symbol = symbol,
                Amount = transferAmount
            });
        }
    }
}

```

In this way, AElf charges the transaction fee via the `GetMethodFee` provided by ACS1, and the other three methods are used to help with the implementations of `GetMethodFee`.

23.2.3 Implementation

The easiest way to do this is to just implement the method `GetMethodFee`.

If there are `Foo1`, `Foo2`, `Bar1` and `Bar2` methods related to business logic in a contract, they are priced as 1, 1, 2, 2 ELF respectively, and the transaction fees of these four methods will not be easily modified later, they can be implemented as follows:

```

public override MethodFees GetMethodFee(StringValue input)
{
    if (input.Value == nameof(Foo1) || input.Value == nameof(Foo2))
    {
        return new MethodFees
        {
            MethodName = input.Value,
            Fees =
            {
                new MethodFee
                {
                    BasicFee = 1_000000000,
                    Symbol = Context.Variables.NativeSymbol
                }
            }
        }
    }
}

```

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```

        }
    }
};

}
if (input.Value == nameof(Bar1) || input.Value == nameof(Bar2))
{
    return new MethodFees
    {
        MethodName = input.Value,
        Fees =
        {
            new MethodFee
            {
                BasicFee = 2_000000000,
                Symbol = Context.Variables.NativeSymbol
            }
        }
    };
}
return new MethodFees();
}

```

This implementation can modify the transaction fee only by upgrading the contract, without implementing the other three interfaces.

A more recommended implementation needs to define an `MappedState` in the State file for the contract:

```
public MappedState<string, MethodFees> TransactionFees { get; set; }
```

Modify the `TransactionFees` data structure in the `SetMethodFee` method, and return the value in the `GetMethodFee` method.

In this solution, the implementation of `GetMethodFee` is very easy:

```
public override MethodFees GetMethodFee(StringValue input)
{
    return State.TransactionFees[input.Value];
}

```

The implementation of `SetMethodFee` requires the addition of permission management, since contract developers don't want the transaction fees of their contract methods to be arbitrarily modified by others.

Referring to the `MultiToken` contract, it can be implemented as follows:

Firstly, define a `SingletonState` with type `AuthorityInfo`(in `authority_info.proto`)

```
public SingletonState<AuthorityInfo> MethodFeeController { get; set; }
```

Then, check the sender's right by comparing its address with owner.

```
public override Empty SetMethodFee(MethodFees input)
{
    foreach (var symbolToAmount in input.Fees)
    {
        AssertValidToken(symbolToAmount.Symbol, symbolToAmount.BasicFee);
    }
}

```

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```

RequiredMethodFeeControllerSet();
Assert(Context.Sender ==                State.MethodFeeController.Value.OwnerAddress,
↪ "Unauthorized to set method fee.");
    State.TransactionFees[input.MethodName] = input;
    return new Empty();
}

```

AssertValidToken checks if the token symbol exists, and the BasicFee is reasonable.

The permission check code is in the lines 8 and 9, and RequiredMethodFeeControllerSet prevents the permission is not set before.

If permissions are not set, the SetMethodFee method can only be called by the default address of the Parliament organization. If a method is sent through this organization, it means that two-thirds of the block producers have agreed to the proposal.

```

private void RequiredMethodFeeControllerSet()
{
    if (State.MethodFeeController.Value != null) return;
    if (State.ParliamentContract.Value == null)
    {
        State.ParliamentContract.Value = Context.
↪ GetContractAddressByName(SmartContractConstants.ParliamentContractSystemName);
    }
    var defaultAuthority = new AuthorityInfo();
    // Parliament Auth Contract maybe not deployed.
    if (State.ParliamentContract.Value != null)
    {
        defaultAuthority.OwnerAddress = State.ParliamentContract.
↪ GetDefaultOrganizationAddress.Call(new Empty());
        defaultAuthority.ContractAddress = State.ParliamentContract.Value;
    }
    State.MethodFeeController.Value = defaultAuthority;
}

```

Of course, the authority of SetMethodFee can also be changed, provided that the transaction to modify the authority is sent from the default address of the Parliament contract:

```

public override Empty ChangeMethodFeeController(AuthorityInfo input)
{
    RequiredMethodFeeControllerSet();
    AssertSenderAddressWith(State.MethodFeeController.Value.OwnerAddress);
    var organizationExist = CheckOrganizationExist(input);
    Assert(organizationExist, "Invalid authority input.");
    State.MethodFeeController.Value = input;
    return new Empty();
}

```

The implementation of GetMethodFeeController is also very easy

```

public override AuthorityInfo GetMethodFeeController(Empty input)
{
    RequiredMethodFeeControllerSet();
}

```

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```

    return State.MethodFeeController.Value;
}

```

Above all, these are the two ways to implement `acs1`. Mostly, implementations will use a mixture of the two: part of methods' fee is set with a fixed value, the other part of method is not to set method fee.

23.2.4 Test

Create `ACS1`'s Stub, and call `GetMethodFee` and `GetMethodFeeController` to check if the return value is expected.

23.2.5 Example

All AElf system contracts implement `ACS1`, which can be used as a reference.

23.3 ACS2 - Parallel Execution Standard

`ACS2` is used to provide information for parallel execution of transactions.

23.3.1 Interface

A contract that inherits `ACS2` only needs to implement one method:

Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------|-------------------------|--------------------------|--|
| <code>GetResource-Info</code> | <i>aelf.Transaction</i> | <i>acs2.ResourceInfo</i> | Gets the resource information that the transaction execution depends on. |

Types

`acs2.ResourceInfo`

| Field | Type | Description | Label |
|---------------------------------|-----------------------------|--|----------|
| <code>write_paths</code> | <i>aelf.ScopedStatePath</i> | The state path that depends on when writing. | repeated |
| <code>read_paths</code> | <i>aelf.ScopedStatePath</i> | The state path that depends on when reading. | repeated |
| <code>non_parallelizable</code> | <i>bool</i> | Whether the transaction is not executed in parallel. | |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.3.2 Usage

AElf uses the key-value database to store data. For the data generated during the contract execution, a mechanism called **State Path** is used to determine the key of the data.

For example Token contract defines a property,

```
public MappedState<Address, string, long> Balances { get; set; }
```

it can be used to access, modify balance.

Assuming that the address of the Token contract is Nmjj7noTpMqZ522j76SDsFLhiKkThv1u3d4TxqJMD8v89tWmE. If you want to know the balance of the address 2EM5uV6bSJh6xJfZTUa1pZpYsYcCUAdPvZvFUJzMDJEx3rbioz, you can directly use this key to access redis / ssdb to get its value.

```
Nmj7noTpMqZ522j76SDsFLhiKkThv1u3d4TxqJMD8v89tWmE/Balances/  
↪2EM5uV6bSJh6xJfZTUa1pZpYsYcCUAdPvZvFUJzMDJEx3rbioz/ELF
```

On AElf, the implementation of parallel transaction execution is also based on the key, developers need to provide a method may access to the `StatePath`, then the corresponding transactions will be properly grouped before executing: if the two methods do not access the same `StatePath`, then you can safely place them in different groups.

Attention: The transaction will be canceled and labeled to “can not be grouped” when the `StatePath` mismatches the method.

If you are interested in the logic, you can view the code `ITransactionGrouper`, as well as `IParallelTransactionExecutingService`.

23.3.3 Implementation

Token contract, as an example, the core logic of method `Transfer` is to modify the balance of address. It accesses the balances property mentioned above twice.

At this point, we need to notify `ITransactionGrouper` via the `GetResourceInfo` method of the key of the ELF balance of address A and address B:

```
var args = TransferInput.Parser.ParseFrom(txn.Params);  
var resourceInfo = new ResourceInfo  
{  
    Paths =  
    {  
        GetPath(nameof(TokenContractState.Balances), txn.From.ToString(), args.Symbol),  
        GetPath(nameof(TokenContractState.Balances), args.To.ToString(), args.Symbol),  
    }  
};  
return resourceInfo;
```

The `GetPath` forms a `ScopedStatePath` from several pieces of data that make up the key:

```
private ScopedStatePath GetPath(params string[] parts)  
{  
    return new ScopedStatePath  
    {  
        Address = Context.Self,  
        Path = new StatePath  
        {  
            Parts =  
            {  
                parts  
            }  
        }  
    }  
}
```

23.3.4 Test

You can construct two transactions, and the transactions are passed directly to an implementation instance of `ITransactionGrouper`, and the `GroupAsync` method is used to see whether the two transactions are parallel.

We prepare two stubs that implement the ACS2 contract with different addresses to simulate the Transfer:

```
var keyPair1 = SampleECKeypairs.KeyPairs[0];
var acs2DemoContractStub1 = GetACS2DemoContractStub(keyPair1);
var keyPair2 = SampleECKeypairs.KeyPairs[1];
var acs2DemoContractStub2 = GetACS2DemoContractStub(keyPair2);
```

Then take out some services and data needed for testing from Application:

```
var transactionGrouper = Application.ServiceProvider.GetRequiredService
    <ITransactionGrouper>();
var blockchainService = Application.ServiceProvider.GetRequiredService
    <IBlockchainService>();
var chain = await blockchainService.GetChainAsync();
```

Finally, check it via transactionGrouper:

```
// Situation can be parallel executed.
{
    var groupedTransactions = await transactionGrouper.GroupAsync(new ChainContext
    {
        BlockHash = chain.BestChainHash,
        BlockHeight = chain.BestChainHeight
    }, new List<Transaction>
    {
        acs2DemoContractStub1.TransferCredits.GetTransaction(new TransferCreditsInput
        {
            To = Address.FromPublicKey(SampleECKeypairs.KeyPairs[2].PublicKey),
            Symbol = "ELF",
            Amount = 1
        }),
        acs2DemoContractStub2.TransferCredits.GetTransaction(new TransferCreditsInput
        {
            To = Address.FromPublicKey(SampleECKeypairs.KeyPairs[3].PublicKey),
            Symbol = "ELF",
            Amount = 1
        }),
    });
    groupedTransactions.Parallelizables.Count.ShouldBe(2);
}

// Situation cannot.
{
    var groupedTransactions = await transactionGrouper.GroupAsync(new ChainContext
    {
        BlockHash = chain.BestChainHash,
        BlockHeight = chain.BestChainHeight
    }, new List<Transaction>
    {
        acs2DemoContractStub1.TransferCredits.GetTransaction(new TransferCreditsInput
```

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```
{
    To = Address.FromPublicKey(SampleECKeypairs.KeyPairs[2].PublicKey),
    Symbol = "ELF",
    Amount = 1
}),
acs2DemoContractStub2.TransferCredits.GetTransaction(new TransferCreditsInput
{
    To = Address.FromPublicKey(SampleECKeypairs.KeyPairs[2].PublicKey),
    Symbol = "ELF",
    Amount = 1
}),
});
groupedTransactions.Parallelizables.Count.ShouldBe(1);
}
```

23.3.5 Example

You can refer to the implementation of the `MultiToken` contract for `GetResourceInfo`. Noting that for the `ResourceInfo` provided by the method `Transfer`, you need to consider charging a transaction fee in addition to the two keys mentioned in this article.

23.4 ACS3 - Contract Proposal Standard

ACS3 is suitable for the case that a method needs to be approved by multiple parties. At this time, you can consider using some of the interfaces provided by ACS3.

23.4.1 Interface

If you want multiple addresses vote to get agreement to do something, you can implement the following methods defined in ACS3:

Methods

| Method Name | Request Type | Response Type | Description |
|-------------------------------------|---|----------------------------------|---|
| CreateProposal | <i>acs3.CreateProposalInput</i> | <i>acs3.Proposal</i> | Create a proposal for which organization members can vote. When the proposal is released, a transaction will be sent to the specified contract. Return id of the newly created proposal. |
| Approve | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Approve a proposal according to the proposal ID. |
| Reject | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Reject a proposal according to the proposal ID. |
| Abstain | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Abstain a proposal according to the proposal ID. |
| Release | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Release a proposal according to the proposal ID and send a transaction to the specified contract. |
| ChangeOrganizationThreshold | <i>acs3.ProposalReleaseThresholdInput</i> | <i>google.protobuf.Empty</i> | Change the thresholds associated with proposals. All fields will be overwritten by the input value and this will affect all current proposals of the organization. Note: only the organization can execute this through a proposal. |
| ChangeOrganizationProposerWhiteList | <i>acs3.ProposerWhiteListInput</i> | <i>google.protobuf.Empty</i> | Change the white list of organization proposer. This method overrides the list of whitelisted proposers. |
| CreateProposalBySystemContract | <i>acs3.CreateProposalBySystemContractInput</i> | <i>acs3.Proposal</i> | Create a proposal by system contracts, and return id of the newly created proposal. |
| ClearProposal | <i>aelf.Hash</i> | <i>google.protobuf.Empty</i> | Remove the specified proposal. If the proposal is in effect, the cleanup fails. |
| GetProposal | <i>aelf.Hash</i> | <i>acs3.Proposal</i> | Get one proposal according to the proposal ID. |
| ValidateOrganizationExist | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> | Check the existence of an organization. |
| ValidateProposerInWhiteList | <i>acs3.ValidateProposerInWhiteListInput</i> | <i>google.protobuf.BoolValue</i> | Check if the proposer is whitelisted. |

Types

acs3.CreateProposalBySystemContractInput

| Field | Type | Description | Label |
|-----------------|----------------------------|--------------------------------------|-------|
| proposal_input | <i>CreateProposalInput</i> | The parameters of creating proposal. | |
| origin_proposer | <i>aelf.Address</i> | The actor that trigger the call. | |

acs3.CreateProposalInput

| Field | Type | Description | Label |
|--------------------------|----------------------------------|--|-------|
| contract_method_name | <i>string</i> | The name of the method to call after release. | |
| to_address | <i>aelf.Address</i> | The address of the contract to call after release. | |
| params | <i>bytes</i> | The parameter of the method to be called after the release. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The timestamp at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |
| proposal_description_url | <i>string</i> | Url is used for proposal describing. | |
| token | <i>aelf.Hash</i> | The token is for proposal id generation and with this token, proposal id can be calculated before proposing. | |

acs3.OrganizationCreated

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| organization_address | <i>aelf.Address</i> | The address of the created organization. | |

acs3.OrganizationHashAddressPair

| Field | Type | Description | Label |
|----------------------|---------------------|------------------------------|-------|
| organization_hash | <i>aelf.Hash</i> | The id of organization. | |
| organization_address | <i>aelf.Address</i> | The address of organization. | |

acs3.OrganizationThresholdChanged

| Field | Type | Description | Label |
|----------------------------|---------------------------------|----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address | |
| proposer_release_threshold | <i>ProposalReleaseThreshold</i> | The new release threshold. | |

acs3.OrganizationWhiteListChanged

| Field | Type | Description | Label |
|----------------------|--------------------------|-----------------------------|-------|
| organization_address | <i>aelf.Address</i> | The organization address. | |
| proposer_white_list | <i>ProposerWhiteList</i> | The new proposer whitelist. | |

acs3.ProposalCreated

| Field | Type | Description | Label |
|----------------------|---------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the created proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the created proposal. | |

acs3.ProposalOutput

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| contract_method_name | <i>string</i> | The method that this proposal will call when being released. | |
| to_address | <i>aelf.Address</i> | The address of the target contract. | |
| params | <i>bytes</i> | The parameters of the release transaction. | |
| expired_time | <i>google.protobuf.Timestamp</i> | The date at which this proposal will expire. | |
| organization_address | <i>aelf.Address</i> | The address of this proposals organization. | |
| proposer | <i>aelf.Address</i> | The address of the proposer of this proposal. | |
| to_be_released | <i>bool</i> | Indicates if this proposal is releasable. | |
| approval_count | <i>int64</i> | Approval count for this proposal. | |
| rejection_count | <i>int64</i> | Rejection count for this proposal. | |
| abstention_count | <i>int64</i> | Abstention count for this proposal. | |

acs3.ProposalReleaseThreshold

| Field | Type | Description | Label |
|------------------------------|--------------|---|-------|
| minimal_approval_threshold | <i>int64</i> | The value for the minimum approval threshold. | |
| maximal_rejection_threshold | <i>int64</i> | The value for the maximal rejection threshold. | |
| maximal_abstention_threshold | <i>int64</i> | The value for the maximal abstention threshold. | |
| minimal_vote_threshold | <i>int64</i> | The value for the minimal vote threshold. | |

acs3.ProposalReleased

| Field | Type | Description | Label |
|----------------------|---------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the released proposal. | |
| organization_address | <i>aelf.Address</i> | The organization address of the released proposal. | |

acs3.ProposerWhiteList

| Field | Type | Description | Label |
|-----------|---------------------|------------------------------|----------|
| proposers | <i>aelf.Address</i> | The address of the proposers | repeated |

acs3.ReceiptCreated

| Field | Type | Description | Label |
|----------------------|----------------------------------|--|-------|
| proposal_id | <i>aelf.Hash</i> | The id of the proposal. | |
| address | <i>aelf.Address</i> | The sender address. | |
| receipt_type | <i>string</i> | The type of receipt(Approve, Reject or Abstain). | |
| time | <i>google.protobuf.Timestamp</i> | The timestamp of this method call. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

acs3.ValidateProposerInWhiteListInput

| Field | Type | Description | Label |
|----------------------|---------------------|----------------------------------|-------|
| proposer | <i>aelf.Address</i> | The address to search/check. | |
| organization_address | <i>aelf.Address</i> | The address of the organization. | |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>number</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.4.2 Implementation

It is assumed here that there is only one organization in a contract, that is, there is no need to specifically define the Organization type. Since the organization is not explicitly declared and created, the organization's proposal whitelist does not exist. The process here is that the voter must use a certain token to vote.

For simplicity, only the core methods CreateProposal, Approve, Reject, Abstain, and Release are implemented here.

There are only two necessary State attributes:

```
public MappedState<Hash, ProposalInfo> Proposals { get; set; }
public SingletonState<ProposalReleaseThreshold> ProposalReleaseThreshold { get; set; }
```

The Proposals stores all proposal's information, and the ProposalReleaseThreshold is used to save the requirements that the contract needs to meet to release the proposal.

When the contract is initialized, the proposal release requirements should be set:

```
public override Empty Initialize(Empty input)
{
    State.TokenContract.Value =
        Context.GetContractAddressByName(SmartContractConstants.TokenContractSystemName);
    State.ProposalReleaseThreshold.Value = new ProposalReleaseThreshold
    {
        MinimalApprovalThreshold = 1,
        MinimalVoteThreshold = 1
    };
    return new Empty();
}
```

The requirement is at least one member who vote and at least one approval. Create proposal:

```
public override Hash CreateProposal(CreateProposalInput input)
{
    var proposalId = Context.GenerateId(Context.Self, input.Token);
    Assert(State.Proposals[proposalId] == null, "Proposal with same token already exists.
    →");
    State.Proposals[proposalId] = new ProposalInfo
    {
        ProposalId = proposalId,
        Proposer = Context.Sender,
        ContractMethodName = input.ContractMethodName,
        Params = input.Params,
        ExpiredTime = input.ExpiredTime,
        ToAddress = input.ToAddress,
        ProposalDescriptionUrl = input.ProposalDescriptionUrl
    };
    return proposalId;
}
```

Vote:

```
public override Empty Abstain(Hash input)
{
    Charge();
    var proposal = State.Proposals[input];
    if (proposal == null)
    {
        throw new AssertionException("Proposal not found.");
    }
    proposal.Abstentions.Add(Context.Sender);
    State.Proposals[input] = proposal;
    return new Empty();
}

public override Empty Approve(Hash input)
{
    Charge();
    var proposal = State.Proposals[input];
    if (proposal == null)
    {
```

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```

        throw new AssertionError("Proposal not found.");
    }
    proposal.Approvals.Add(Context.Sender);
    State.Proposals[input] = proposal;
    return new Empty();
}
public override Empty Reject(Hash input)
{
    Charge();
    var proposal = State.Proposals[input];
    if (proposal == null)
    {
        throw new AssertionError("Proposal not found.");
    }
    proposal.Rejections.Add(Context.Sender);
    State.Proposals[input] = proposal;
    return new Empty();
}
private void Charge()
{
    State.TokenContract.TransferFrom.Send(new TransferFromInput
    {
        From = Context.Sender,
        To = Context.Self,
        Symbol = Context.Variables.NativeSymbol,
        Amount = 1_000000000
    });
}

```

Release is just count the vote, here is a recommended implementation:

```

public override Empty Release(Hash input)
{
    var proposal = State.Proposals[input];
    if (proposal == null)
    {
        throw new AssertionError("Proposal not found.");
    }
    Assert(IsReleaseThresholdReached(proposal), "Didn't reach release threshold.");
    Context.SendInline(proposal.ToAddress, proposal.ContractMethodName, proposal.Params);
    return new Empty();
}
private bool IsReleaseThresholdReached(ProposalInfo proposal)
{
    var isRejected = IsProposalRejected(proposal);
    if (isRejected)
        return false;
    var isAbstained = IsProposalAbstained(proposal);
    return !isAbstained && CheckEnoughVoteAndApprovals(proposal);
}
private bool IsProposalRejected(ProposalInfo proposal)
{

```

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```

    var rejectionMemberCount = proposal.Rejections.Count;
    return rejectionMemberCount > State.ProposalReleaseThreshold.Value.
↳MaximalRejectionThreshold;
}
private bool IsProposalAbstained(ProposalInfo proposal)
{
    var abstentionMemberCount = proposal.Abstentions.Count;
    return abstentionMemberCount > State.ProposalReleaseThreshold.Value.
↳MaximalAbstentionThreshold;
}
private bool CheckEnoughVoteAndApprovals(ProposalInfo proposal)
{
    var approvedMemberCount = proposal.Approvals.Count;
    var isApprovalEnough =
        approvedMemberCount >= State.ProposalReleaseThreshold.Value.
↳MinimalApprovalThreshold;
    if (!isApprovalEnough)
        return false;
    var isVoteThresholdReached =
        proposal.Abstentions.Concat(proposal.Approvals).Concat(proposal.Rejections).
↳Count() >=
        State.ProposalReleaseThreshold.Value.MinimalVoteThreshold;
    return isVoteThresholdReached;
}

```

23.4.3 Test

Before testing, two methods were added to a Dapp contract. We will test the proposal with these methods.

Define a singleton string and an organization address state in the State class:

```

public StringState Slogan { get; set; }
public SingletonState<Address> Organization { get; set; }

```

A pair of Set/Get methods:

```

public override StringValue GetSlogan(Empty input)
{
    return State.Slogan.Value == null ? new StringValue() : new StringValue {Value =
↳State.Slogan.Value};
}

public override Empty SetSlogan(StringValue input)
{
    Assert(Context.Sender == State.Organization.Value, "No permission.");
    State.Slogan.Value = input.Value;
    return new Empty();
}

```

In this way, during the test, create a proposal for the SetSlogan. After passing and releasing, use the GetSlogan method to check whether the Slogan has been modified.

Prepare a Stub that implements the ACS3 contract:

```
var keyPair = SampleECKeypairs.KeyPairs[0];
var acs3DemoContractStub =
    GetTester<ACS3DemoContractContainer.ACS3DemoContractStub>(DAppContractAddress,
    ↪keyPair);
```

Since approval requires the contract to charge users, the user should send Approve transaction of the Token contract.

```
var tokenContractStub =
    GetTester<TokenContractContainer.TokenContractStub>(
        GetAddress(TokenSmartContractAddressNameProvider.StringName), keyPair);
await tokenContractStub.Approve.SendAsync(new ApproveInput
{
    Spender = DAppContractAddress,
    Symbol = "ELF",
    Amount = long.MaxValue
});
```

Create a proposal, the target method is SetSlogan, here we want to change the Slogan to “AElf” :

```
var proposalId = (await acs3DemoContractStub.CreateProposal.SendAsync(new
    ↪CreateProposalInput
{
    OrganizationAddress = OrganizationAddress
    ContractMethodName = nameof(acs3DemoContractStub.SetSlogan),
    ToAddress = DAppContractAddress,
    ExpiredTime = TimestampHelper.GetUtcNow().AddHours(1),
    Params = new StringValue {Value = "AElf"}.ToByteString(),
    Token = HashHelper.ComputeFrom("AElf")
})).Output;
```

Make sure that the Slogan is still an empty string at this time and then vote:

```
// Check slogan
{
    var slogan = await acs3DemoContractStub.GetSlogan.CallAsync(new Empty());
    slogan.Value.ShouldBeEmpty();
}
await acs3DemoContractStub.Approve.SendAsync(proposalId);
```

Release proposal, and the Slogan becomes “AElf”.

```
await acs3DemoContractStub.Release.SendAsync(proposalId);
// Check slogan
{
    var slogan = await acs3DemoContractStub.GetSlogan.CallAsync(new Empty());
    slogan.Value.ShouldBe("AElf");
}
```

23.5 ACS4 - Consensus Standard

ACS4 is used to customize consensus mechanisms.

23.5.1 Interface

If you want to customize the consensus mechanism, you need to implement the following five interfaces:

Methods

| Method Name | Request Type | Response Type | Description |
|----------------------------------|-----------------------------------|-----------------------------------|--|
| GetConsensusCommand | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get consensus command based on the consensus contract state and the input public key. |
| GetConsensusExtraData | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get consensus extra data when a block is generated. |
| GenerateConsensusTransactions | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Generate consensus system transactions when a block is generated. Each block will contain only one consensus transaction, which is used to write the latest consensus information to the State database. |
| ValidateConsensusBeforeExecution | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Before executing the block, verify that the consensus information in the block header is correct. |
| ValidateConsensusAfterExecution | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | After executing the block, verify that the state information written to the consensus is correct. |

Types

acs4.ConsensusCommand

| Field | Type | Description | Label |
|------------------------------------|----------------------------------|--|-------|
| limit_milliseconds_of_mining_block | <i>int32</i> | Time limit of mining next block. | |
| hint | <i>bytes</i> | Context of Hint is diverse according to the consensus protocol we choose, so we use bytes. | |
| arranged_mining_time | <i>google.protobuf.Timestamp</i> | The time of arrange mining. | |
| mining_due_time | <i>google.protobuf.Timestamp</i> | The expiration time of mining. | |

acs4.TransactionList

| Field | Type | Description | Label |
|--------------|-------------------------|--------------------------------|----------|
| transactions | <i>aelf.Transaction</i> | Consensus system transactions. | repeated |

acs4.ValidationResult

| Field | Type | Description | Label |
|---------------|---------------|----------------------------------|-------|
| success | <i>bool</i> | Is successful. | |
| message | <i>string</i> | The error message. | |
| is_re_trigger | <i>bool</i> | Whether to trigger mining again. | |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block hat packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block hat packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.5.2 Usage

The five interfaces defined in ACS4 basically correspond to the five methods of the `IConsensusService` interface in the `AElf.Kernel.Consensus` project:

| ACS4 | IConsensusService | Methodology | The Timing To Call |
|--------------------------------|--|---|--|
| GetConsensusCommand | Task TriggerConsensusAsync (ChainContext chainContext); | When TriggerConsensusAsync is called, it will use the account configured by the node to call the GetConsensusCommand method of the consensus contract to obtain block information ConsensusCommand), and use it to (see IConsensusScheduler implementation) | <ol style="list-style-type: none"> 1. When the node is started; 2. When the BestChainFoundEventData event is thrown; 3. When the validation of consensus data fails and the consensus needs to be triggered again (The IsReTrigger field of the ValidationResult type is true); |
| GetConsensus-ExtraData | Task<byte[]> GetConsensusExtraDataAsync(ChainContext chainContext); | When a node produces a block, it will generate block header information for the new block by IBlockExtraDataService. This service is implemented to traverse all IBlockExtraDataProvider implementations, and they generate binary array information into the ExtraData field of Block-Header. The consensus block header information is provided by ConsensusExtraDataProvider, in which the GetConsensusExtraDataAsync of the IConsensusService in the consensus contract is called, and the GetConsensusExtraDataAsync method is implemented by calling the GetConsensusExtraData in the consensus contract. | At the time that the node produces a new block. |
| GenerateConsensus-Transactions | Task<List<Transaction>> GenerateConsensusTransactionsAsync(ChainContext chainContext); | In the process of generating new blocks, a consensus transaction needs to be generated as one of the system | At the time that the node produces a new block. |
| 23.5. ACS4 - Consensus | Standard | transactions. The basic principle is the same as GetConsensusExtraData. | 563 |
| ValidateConsensus | Task<bool> ValidateConsensus | Task<bool> ValidateConsensus | Task<bool> ValidateConsensus |

23.5.3 Example

You can refer to the implementation of the [AEDPoS contract](#).

23.6 ACS5 - Contract Threshold Standard

If you want to raise the threshold for using contract, consider implementing ACS5.

23.6.1 Interface

To limit to call a method in a contract, you only need to implement the following five interfaces:

Methods

| Method Name | Request Type | Response Type | Description |
|---------------------------|--|--|---------------------------------------|
| SetMethodCallingThreshold | <i>acs5.SetMethodCallingThresholdRequest</i> | <i>google.protobuf.Empty</i> | Set the threshold for method calling. |
| GetMethodCallingThreshold | <i>google.protobuf.StringValue</i> | <i>acs5.MethodCallingThresholdResponse</i> | Get the threshold for method calling. |

Types

acs5.MethodCallingThreshold

| Field | Type | Description | Label |
|----------------------|---|---|----------|
| symbol_to_amount | <i>MethodCallingThreshold.SymbolToAmountEntry</i> | The threshold for method calling, token symbol -> amount. | repeated |
| threshold_check_type | <i>ThresholdCheckType</i> | The type of threshold check. | |

acs5.MethodCallingThreshold.SymbolToAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs5.SetMethodCallingThresholdInput

| Field | Type | Description | Label |
|----------------------|---|---|----------|
| method | <i>string</i> | The method name to check. | |
| symbol_to_amount | <i>SetMethodCallingThresholdInput.SymbolToAmountEntry</i> | The threshold for method calling, token symbol -> amount. | repeated |
| threshold_check_type | <i>ThresholdCheckType</i> | The type of threshold check. | |

acs5.SetMethodCallingThresholdInput.SymbolToAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs5.ThresholdCheckType

| Name | Number | Description |
|-----------|--------|---|
| BALANCE | 0 | Check balance only. |
| ALLOWANCE | 1 | Check balance and allowance at the same time. |

23.6.2 Usage

Similar to ACS1, which uses an automatically generated pre-plugin transaction called `ChargeTransactionFees` to charge a transaction fee, ACS5 automatically generates a pre-plugin transaction called `CheckThreshold` to test whether the account that sent the transaction can invoke the corresponding method.

The implementation of `CheckThreshold`:

```
public override Empty CheckThreshold(CheckThresholdInput input)
{
    var meetThreshold = false;
    var meetBalanceSymbolList = new List<string>();
    foreach (var symbolToThreshold in input.SymbolToThreshold)
    {
        if (GetBalance(input.Sender, symbolToThreshold.Key) < symbolToThreshold.Value)
            continue;
        meetBalanceSymbolList.Add(symbolToThreshold.Key);
    }
    if (meetBalanceSymbolList.Count > 0)
    {
        if (input.IsCheckAllowance)
        {
            foreach (var symbol in meetBalanceSymbolList)
            {
                if (State.Allowances[input.Sender][Context.Sender][symbol] <
```

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```

        input.SymbolToThreshold[symbol]) continue;
        meetThreshold = true;
        break;
    }
}
else
{
    meetThreshold = true;
}
}
if (input.SymbolToThreshold.Count == 0)
{
    meetThreshold = true;
}
Assert(meetThreshold, "Cannot meet the calling threshold.");
return new Empty();
}

```

In other words, if the token balance of the sender of the transaction or the amount authorized for the target contract does not reach the set limit, the pre-plugin transaction will throw an exception, thereby it prevents the original transaction from executing.

23.6.3 Implementation

Just like the `GetMethodFee` of ACS1, you can implement only one `GetMethodCallingThreshold` method.

It can also be achieved by using `MappedState<string, MethodCallingThreshold>` in the `State` class:

```
public MappedState<string, MethodCallingThreshold> MethodCallingThresholds { get; set; }
```

But at the same time, do not forget to configure the call permission of `SetMethodCallingThreshold`, which requires the definition of an `Admin` in the `State` (of course, you can also use ACS3):

```
public SingletonState<Address> Admin { get; set; }
```

The easiest implementation

```

public override Empty SetMethodCallingThreshold(SetMethodCallingThresholdInput input)
{
    Assert(State.Admin.Value == Context.Sender, "No permission.");
    State.MethodCallingThresholds[input.Method] = new MethodCallingThreshold
    {
        SymbolToAmount = {input.SymbolToAmount}
    };
    return new Empty();
}

public override MethodCallingThreshold GetMethodCallingThreshold(StringValue input)
{
    return State.MethodCallingThresholds[input.Value];
}

```

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```

public override Empty Foo(Empty input)
{
    return new Empty();
}

message SetMethodCallingThresholdInput {
    string method = 1;
    map<string, int64> symbol_to_amount = 2; // The order matters.
    ThresholdCheckType threshold_check_type = 3;
}

```

23.6.4 Test

You can test the Foo method defined above.

Make a Stub:

```

var keyPair = SampleECKeypairs.KeyPairs[0];
var acs5DemoContractStub =
    GetTester<ACS5DemoContractContainer.ACS5DemoContractStub>(DAppContractAddress,
    keyPair);

```

Before setting the threshold, check the current threshold, which should be 0:

```

var methodResult = await acs5DemoContractStub.GetMethodCallingThreshold.CallAsync(
    new StringValue
    {
        Value = nameof(acs5DemoContractStub.Foo)
    });
methodResult.SymbolToAmount.Count.ShouldBe(0);

```

The ELF balance of the caller of Foo should be greater than 1 ELF:

```

await acs5DemoContractStub.SetMethodCallingThreshold.SendAsync(
    new SetMethodCallingThresholdInput
    {
        Method = nameof(acs5DemoContractStub.Foo),
        SymbolToAmount =
        {
            {"ELF", 1_0000_0000}
        },
        ThresholdCheckType = ThresholdCheckType.Balance
    });

```

Check the threshold again:

```

methodResult = await acs5DemoContractStub.GetMethodCallingThreshold.CallAsync(
    new StringValue
    {
        Value = nameof(acs5DemoContractStub.Foo)
    });

```

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```
methodResult.SymbolToAmount.Count.ShouldBe(1);
methodResult.ThresholdCheckType.ShouldBe(ThresholdCheckType.Balance);
```

Send the Foo transaction via an account who has sufficient balance can succeed:

```
// Call with enough balance.
{
    var executionResult = await acs5DemoContractStub.Foo.SendAsync(new Empty());
    executionResult.TransactionResult.Status.ShouldBe(TransactionResultStatus.Mined);
}
```

Send the Foo transaction via another account without ELF fails:

```
// Call without enough balance.
{
    var poorStub =
        GetTester<ACS5DemoContractContainer.ACS5DemoContractStub>(DAppContractAddress,
            SampleECKeypairs.KeyPairs[1]);
    var executionResult = await poorStub.Foo.SendWithExceptionAsync(new Empty());
    executionResult.TransactionResult.Error.ShouldContain("Cannot meet the calling_
↪threshold.");
}
```

23.7 ACS6 - Random Number Provider Standard

If your contract is about to generate a random number, you can consider using acs6.

23.7.1 Interface

To provider a random number according to certain input, you only need to implement one interface:

Methods

| Method Name | Request Type | Response Type | Description |
|-----------------|-----------------------------------|-----------------------------------|--|
| GetRandom-Bytes | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get the random number provided by this contract. |

23.7.2 Usage

All you need is to override this method to return a random number according to the given input. You can decide the certain logic of generating random number yourself, just remember to return a BytesValue type, thus the caller can deserialize the output himself.

23.7.3 Implementation

The easiest implementation

```
public override BytesValue GetRandomBytes(BytesValue input)
{
    var serializedInput = new GetRandomBytesInput();
    serializedInput.MergeFrom(input.Value);
    var value = new Hash();
    value.MergeFrom(serializedInput.Value);
    var randomHashFromContext = Context.GetRandomHash(value);

    return new BytesValue
    {
        Value = serializedInput.Kind == 1
            ? new BytesValue {Value = randomHashFromContext.Value}.ToByteString()
            : new Int64Value {Value = Context.ConvertHashToInt64(randomHashFromContext, 1, 10000)}.ToByteString()
    };
}
```

23.8 ACS7 - Contract CrossChain Standard

ACS7 is for cross chain related contract implementation.

23.8.1 Interface

This involves methods for chain creation and indexing:

Methods

| Method Name | Request Type | Response Type | Description |
|---|--|--|--|
| ProposeCrossChainIndexing | <i>acs7.CrossChainBlockIndexingProposal</i> | <i>google.protobuf.Empty</i> | Propose once cross chain indexing. |
| ReleaseCrossChainIndexingProposal | <i>acs7.ReleaseCrossChainBlockIndexingProposal</i> | <i>google.protobuf.Empty</i> | Release the proposed indexing if already approved. |
| RequestSideChainCreation | <i>acs7.SideChainCreationRequest</i> | <i>google.protobuf.Empty</i> | Request side chain creation. |
| ReleaseSideChainCreation | <i>acs7.ReleaseSideChainCreationRequest</i> | <i>google.protobuf.Empty</i> | Release the side chain creation request if already approved and it will call the method <code>CreateSideChain</code> . |
| CreateSideChain | <i>acs7.CreateSideChainRequest</i> | <i>google.protobuf.Int32Value</i> | Create the side chain and returns the newly created side chain ID. Only <code>SideChainLifetimeController</code> is permitted to invoke this method. |
| Recharge | <i>acs7.RechargeInput</i> | <i>google.protobuf.Empty</i> | Recharge for the specified side chain. |
| DisposeSideChain | <i>google.protobuf.Int32Value</i> | <i>google.protobuf.Int32Value</i> | Dispose a side chain according to side chain id. Only <code>SideChainLifetimeController</code> is permitted to invoke this method. |
| AdjustIndexingFeePrice | <i>acs7.AdjustIndexingFeeInput</i> | <i>google.protobuf.Empty</i> | Adjust side chain indexing fee. Only <code>IndexingFeeController</code> is permitted to invoke this method. |
| VerifyTransaction | <i>acs7.VerifyTransactionRequest</i> | <i>google.protobuf.BoolValue</i> | Verify cross chain transaction. |
| Get-SideChainIdAnd-Height | <i>google.protobuf.Empty</i> | <i>acs7.ChainIdAndHeight</i> | Get the side chain id and height of the current chain. |
| GetSideChainIndexingInformation-List | <i>google.protobuf.Empty</i> | <i>acs7.SideChainIndexingInformationList</i> | Get the indexing information of side chains. |
| GetAllChainsIdAndHeight | <i>google.protobuf.Empty</i> | <i>acs7.ChainIdAndHeightList</i> | Get the id and recorded height of all chains. |
| GetIndexed-SideChainBlock-DataByHeight | <i>google.protobuf.Int64Value</i> | <i>acs7.IndexedSideChainBlockData</i> | Get the block data of indexed side chain according to height. |
| GetBoundParentChainHeightAndMerklePathBy-Height | <i>google.protobuf.Int64Value</i> | <i>acs7.CrossChainMerklePath</i> | Get the merkle path bound up with side chain according to height. |
| GetChainInitializationData | <i>google.protobuf.Int32Value</i> | <i>acs7.ChainInitializationData</i> | Get the initialization data for specified side chain. |

Types

acs7.AdjustIndexingFeeInput

| Field | Type | Description | Label |
|---------------|--------------|--------------------------------|-------|
| side_chain_id | <i>int32</i> | The side chain id to adjust. | |
| indexing_fee | <i>int64</i> | The new price of indexing fee. | |

acs7.ChainIdAndHeightDict

| Field | Type | Description | Label |
|----------------|---|---|----------|
| id_height_dict | <i>ChainIdAndHeightDict.IdHeightDictEntry</i> | A collection of chain ids and heights, where the key is the chain id and the value is the height. | repeated |

acs7.ChainIdAndHeightDict.IdHeightDictEntry

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| key | <i>int32</i> | | |
| value | <i>int64</i> | | |

acs7.ChainInitializationConsensusInfo

| Field | Type | Description | Label |
|------------------------|--------------|-------------------------|-------|
| initial_consensus_data | <i>bytes</i> | Initial consensus data. | |

acs7.ChainInitializationData

| Field | Type | Description | Label |
|-------------------------------------|---|---|-------|
| chain_id | <i>int32</i> | The id of side chain. | |
| creator | <i>aelf.Address</i> | The side chain creator. | |
| creation_timestamp | <i>google.protobuf.Timestamp</i> | The timestamp for side chain creation. | |
| creation_height_on_parent_chain | <i>int64</i> | The height of side chain creation on parent chain. | |
| chain_creator_privilege_preserved | <i>bool</i> | Creator privilege boolean flag: True if chain creator privilege preserved, otherwise false. | |
| parent_chain_token_contract_address | <i>aelf.Address</i> | Parent chain token contract address. | |
| chain_initialization_consensus_info | <i>ChainInitializationConsensusInfo</i> | Initial consensus information. | |
| native_token_info_data | <i>bytes</i> | The native token info. | |
| resource_token_info | <i>ResourceTokenInfo</i> | The resource token information. | |
| chain_primary_token_info | <i>ChainPrimaryTokenInfo</i> | The chain primary token information. | |

acs7.ChainPrimaryTokenInfo

| Field | Type | Description | Label |
|-------------------------------------|-----------------------------------|--|----------|
| chain_primary_token_data | <i>bytes</i> | The side chain primary token data. | |
| side_chain_token_initial_issue_list | <i>SideChainTokenInitialIssue</i> | The side chain primary token initial issue list. | repeated |

acs7.CreateSideChainInput

| Field | Type | Description | Label |
|-----------------------------|---------------------------------|---|-------|
| side_chain_creation_request | <i>SideChainCreationRequest</i> | The request information of the side chain creation. | |
| proposer | <i>aelf.Address</i> | The proposer of the side chain creation. | |

acs7.CrossChainBlockData

| Field | Type | Description | Label |
|------------------------------|-----------------------------|--|----------|
| side_chain_block_data_list | <i>SideChainBlockData</i> | The side chain block data list to index. | repeated |
| parent_chain_block_data_list | <i>ParentChainBlockData</i> | The parent chain block data list to index. | repeated |

acs7.CrossChainExtraData

| Field | Type | Description | Label |
|-------------------------------------|------------------|---|-------|
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | Merkle tree root of side chain block transaction status root. | |

acs7.CrossChainIndexingDataProposedEvent

| Field | Type | Description | Label |
|---------------------------|----------------------------|--|-------|
| proposed_cross_chain_data | <i>CrossChainBlockData</i> | Proposed cross chain data to be indexed. | |
| proposal_id | <i>aelf.Hash</i> | The proposal id. | |

acs7.CrossChainMerkleProofContext

| Field | Type | Description | Label |
|-------------------------------|------------------------|--|-------|
| bound_parent_chain_height | <i>int64</i> | The height of parent chain bound up with side chain. | |
| merkle_path_from_parent_chain | <i>aelf.MerklePath</i> | The merkle path generated from parent chain. | |

acs7.IndexedParentChainBlockData

| Field | Type | Description | Label |
|------------------------------|-----------------------------|---|----------|
| local_chain_height | <i>int64</i> | The height of the local chain when indexing the parent chain. | |
| parent_chain_block_data_list | <i>ParentChainBlockData</i> | Parent chain block data. | repeated |

acs7.IndexedSideChainBlockData

| Field | Type | Description | Label |
|----------------------------|---------------------------|------------------------|----------|
| side_chain_block_data_list | <i>SideChainBlockData</i> | Side chain block data. | repeated |

acs7.ParentChainBlockData

| Field | Type | Description | Label |
|-------------------------------------|--|--|----------|
| height | <i>int64</i> | The height of parent chain. | |
| cross_chain_extra_data | <i>CrossChainExtraData</i> | The merkle tree root computing from side chain roots. | |
| chain_id | <i>int32</i> | The parent chain id. | |
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | The merkle tree root computing from transactions status in parent chain block. | |
| indexed_merkle_path | <i>ParentChainBlockData.IndexedMerklePathEntry</i> | Indexed block height from side chain and merkle path for this side chain block | repeated |
| extra_data | <i>ParentChainBlockData.ExtraDataEntry</i> | Extra data map. | repeated |

acs7.ParentChainBlockData.ExtraDataEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

acs7.ParentChainBlockData.IndexedMerklePathEntry

| Field | Type | Description | Label |
|-------|------------------------|-------------|-------|
| key | <i>int64</i> | | |
| value | <i>aelf.MerklePath</i> | | |

acs7.RechargeInput

| Field | Type | Description | Label |
|----------|--------------|---------------------------|-------|
| chain_id | <i>int32</i> | The chain id to recharge. | |
| amount | <i>int64</i> | The amount to recharge. | |

acs7.ReleaseCrossChainIndexingProposalInput

| Field | Type | Description | Label |
|---------------|--------------|-------------------------------|----------|
| chain_id_list | <i>int32</i> | List of chain ids to release. | repeated |

acs7.ReleaseSideChainCreationInput

| Field | Type | Description | Label |
|-------------|------------------|---|-------|
| proposal_id | <i>aelf.Hash</i> | The proposal id of side chain creation. | |

acs7.ResourceTokenInfo

| Field | Type | Description | Label |
|---------------------------|--|------------------------------------|----------|
| re-source_token_list_data | <i>bytes</i> | The resource token information. | |
| initial_resource_amount | <i>ResourceToken-Info.InitialResourceAmountEntry</i> | The initial resource token amount. | repeated |

acs7.ResourceTokenInfo.InitialResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

acs7.SideChainBlockData

| Field | Type | Description | Label |
|-------------------------------------|------------------|--|-------|
| height | <i>int64</i> | The height of side chain block. | |
| block_header_hash | <i>aelf.Hash</i> | The hash of side chain block. | |
| transaction_status_merkle_tree_root | <i>aelf.Hash</i> | The merkle tree root computing from transactions status in side chain block. | |
| chain_id | <i>int32</i> | The id of side chain. | |

acs7.SideChainBlockDataIndexed**acs7.SideChainCreationRequest**

| Field | Type | Description | Label |
|-----------------------------------|--|---|----------|
| indexing_price | <i>int64</i> | The cross chain indexing price. | |
| locked_token_amount | <i>int64</i> | Initial locked balance for a new side chain. | |
| is_privilege_preserved | <i>bool</i> | Creator privilege boolean flag: True if chain creator privilege preserved, otherwise false. | |
| side_chain_token_creation_request | <i>SideChainTokenCreationRequest</i> | Side chain token information. | |
| side_chain_token_initial_issue | <i>SideChainTokenInitialIssue</i> | A list of accounts and amounts that will be issued when the chain starts. | repeated |
| initial_resource_amount | <i>SideChainCreationRequest.InitialResourceAmountEntry</i> | The initial rent resources. | repeated |

acs7.SideChainCreationRequest.InitialResourceAmountEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int32</i> | | |

acs7.SideChainIndexingInformation

| Field | Type | Description | Label |
|----------------|--------------|---------------------|-------|
| chain_id | <i>int32</i> | The side chain id. | |
| indexed_height | <i>int64</i> | The indexed height. | |

acs7.SideChainIndexingInformationList

| Field | Type | Description | Label |
|---------------------------|-------------------------------------|--|----------|
| indexing_information_list | <i>SideChainIndexingInformation</i> | A list contains indexing information of side chains. | repeated |

acs7.SideChainTokenCreationRequest

| Field | Type | Description | Label |
|-------------------------------|---------------|--|-------|
| side_chain_token_symbol | <i>string</i> | Token symbol of the side chain to be created | |
| side_chain_token_name | <i>string</i> | Token name of the side chain to be created | |
| side_chain_token_total_supply | <i>int64</i> | Token total supply of the side chain to be created | |
| side_chain_token_decimals | <i>int32</i> | Token decimals of the side chain to be created | |

acs7.SideChainTokenInitialIssue

| Field | Type | Description | Label |
|---------|---------------------|----------------------------------|-------|
| address | <i>aelf.Address</i> | The account that will be issued. | |
| amount | <i>int64</i> | The amount that will be issued. | |

acs7.VerifyTransactionInput

| Field | Type | Description | Label |
|---------------------|------------------------|--|-------|
| transaction_id | <i>aelf.Hash</i> | The cross chain transaction id to verify. | |
| path | <i>aelf.MerklePath</i> | The merkle path of the transaction. | |
| parent_chain_height | <i>int64</i> | The height of parent chain that indexing this transaction. | |
| verified_chain_id | <i>int32</i> | The chain id to verify. | |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.8.2 Example

ACS7 declares methods for the scenes about cross chain. AElf provides the implementation for ACS7, CrossChainContract. You can refer to the implementation of the [Cross chain contract api](#).

23.9 ACS8 - Transaction Resource Token Fee Standard

ACS8 has some similarities to ACS1, both of them are charge transaction fee standard.

The difference is that ACS1 charges the user a transaction fee, ACS8 charges the called contract, and the transaction fee charged by ACS8 is the specified four tokens: WRITE, READ, NET, TRAFFIC.

In another word, if a contract declares that it inherits from ACS8, each transaction in this contract will charge four kinds of resource token.

23.9.1 Interface

Only one method is defined in the acs8.proto file:

Methods

| Method Name | Request Type | Response Type | Description |
|------------------|---|------------------------------------|--|
| BuyResourceToken | <code>acs8.BuyResourceTokenInput</code> | <code>google.protobuf.Empty</code> | Buy one of the four resource coins, which consumes the ELF balance in the contract account (you can recharge it yourself, or you can collect the user's ELF tokens as a profit to be self-sufficient). |

Types

acs8.BuyResourceTokenInput

| Field | Type | Description | Label |
|-----------|---------------------|--|-------|
| symbol | <code>string</code> | The symbol token you want to buy. | |
| amount | <code>int64</code> | The amount you want to buy. | |
| pay_limit | <code>int64</code> | Limit of cost. If the token required for buy exceeds this value, the buy will be abandoned. And 0 is no limit. | |

23.9.2 Usage

The contract inherited from ACS1 uses a pre-plugin transaction called `ChargeTransactionFees` for charging transaction fee.

Because the specific charge amount is determined by the actual consumption of the transaction, the post-plugin generates `ChargeResourceToken` transaction to charge resource token.

The implementation of `ChargeResourceToken` is also similar to it of `ChargeTransactionFees`:

```
public override Empty ChargeResourceToken(ChargeResourceTokenInput input)
{
    Context.LogDebug(() => string.Format("Start executing ChargeResourceToken.{0}",
    ↪input));
    if (input.Equals(new ChargeResourceTokenInput()))
    {
        return new Empty();
    }
    var bill = new TransactionFeeBill();
    foreach (var pair in input.CostDic)
    {
        Context.LogDebug(() => string.Format("Charging {0} {1} tokens.", pair.Value,
    ↪pair.Key));
        var existingBalance = GetBalance(Context.Sender, pair.Key);
        Assert(existingBalance >= pair.Value,
            string.Format("Insufficient resource of {0}. Need balance: {1}; Current
    ↪balance: {2}.", pair.Key, pair.Value, existingBalance));
        bill.FeesMap.Add(pair.Key, pair.Value);
    }
    foreach (var pair in bill.FeesMap)
    {
        Context.Fire(new ResourceTokenCharged
        {
            Symbol = pair.Key,
            Amount = pair.Value,
            ContractAddress = Context.Sender
        });
        if (pair.Value == 0)
        {
            Context.LogDebug(() => string.Format("Maybe incorrect charged resource fee
    ↪of {0}: it's 0.", pair.Key));
        }
    }
    return new Empty();
}
```

The amount of each resource token should be calculated by `AElf.Kernel.FeeCalculation`. In detail, A data structure named `CalculateFeeCoefficients` is defined in `token_contract.proto`, whose function is to save all coefficients of a polynomial, and every three coefficients are a group, such as a, b, c , which means $(b / c) * x^a$. Each resource token has a polynomial that calculates it. Then according to the polynomial and the actual consumption of the resource, calculate the cost of the resource token. Finally, the cost is used as the parameter of `ChargeResourceToken` to generate this post-plugin transaction.

In addition, the method of the contract that has been owed cannot be executed before the contract top up resource token. As a result, a pre-plugin transaction is added, similar to the ACS5 pre-plugin transaction, which checks the contract's resource token balance, and the transaction's method name is `CheckResourceToken` :

```

public override Empty CheckResourceToken(Empty input)
{
    foreach (var symbol in Context.Variables.GetStringArray(TokenContractConstants.
↪PayTxFeeSymbolListName))
    {
        var balance = GetBalance(Context.Sender, symbol);
        var owningBalance = State.OwningResourceToken[Context.Sender][symbol];
        Assert(balance > owningBalance,
            string.Format("Contract balance of {0} token is not enough. Owning {1}.",
↪symbol, owningBalance));
    }
    return new Empty();
}

```

23.10 ACS9 - Contract profit dividend standard

On the AElf's side chain, the contract needs to declare where its profits are going, and implement ACS9.

23.10.1 Interface

ACS9 contains an method which does not have to be implemented:

Methods

| Method Name | Request Type | Response Type | Description |
|---------------------|--|------------------------------|---|
| TakeContractProfits | <i>acs9.TakeContractProfitsRequest</i> | <i>google.protobuf.Empty</i> | Used for the developer to collect the profits from the contract and the profits will be distributed in this method. |
| GetProfitConfig | <i>google.protobuf.Empty</i> | <i>acs9.ProfitConfig</i> | Query the config of profit. |
| GetProfitsAmount | <i>google.protobuf.Empty</i> | <i>acs9.ProfitsMap</i> | Query the profits of the contract so far. |

Types

acs9.ProfitConfig

| Field | Type | Description | Label |
|----------------------------|---------------|--|----------|
| donation_parts_per_hundred | <i>int32</i> | The portion of the profit that will be donated to the dividend pool each time the developer receives the profit. | |
| profits_token_symbol_list | <i>string</i> | The profit token symbol list. | repeated |
| staking_token_symbol | <i>string</i> | The token symbol that the user can lock them to claim the profit. | |

acs9.ProfitsMap

| Field | Type | Description | Label |
|-------|------------------------------|--------------------------------------|----------|
| value | <i>ProfitsMap.ValueEntry</i> | The profits, token symbol -> amount. | repeated |

acs9.ProfitsMap.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs9.TakeContractProfitsInput

| Field | Type | Description | Label |
|--------|---------------|---------------------------|-------|
| symbol | <i>string</i> | The token symbol to take. | |
| amount | <i>int64</i> | The amount to take. | |

23.10.2 Implementation

Here we define a contract. The contract creates a token called APP at the time of initialization and uses the TokenHolder contract to create a token holder bonus scheme with the lock token is designated to APP.

The user will be given 10 APP when to sign up.

Users can purchase 1 APP with 1 ELF using method Deposit, and they can redeem the ELF using the method Withdraw.

When the user sends the Use transaction, the APP token is consumed.

Contract initialization is as follows:

```
public override Empty Initialize(InitializeInput input)
{
    State.TokenHolderContract.Value =
        Context.GetContractAddressByName(SmartContractConstants.
↪TokenHolderContractSystemName);
    State.TokenContract.Value =
        Context.GetContractAddressByName(SmartContractConstants.TokenContractSystemName);
    State.DividendPoolContract.Value =
        Context.GetContractAddressByName(input.DividendPoolContractName.Value.
↪ToBase64());
    State.Symbol.Value = input.Symbol == string.Empty ? "APP" : input.Symbol;
    State.ProfitReceiver.Value = input.ProfitReceiver;
    CreateToken(input.ProfitReceiver);
    // To test TokenHolder Contract.
    CreateTokenHolderProfitScheme();
    // To test ACS9 workflow.
    SetProfitConfig();
    State.ProfitReceiver.Value = input.ProfitReceiver;
    return new Empty();
}
```

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```

}
private void CreateToken(Address profitReceiver, bool isLockWhiteListIncludingSelf =
    false)
{
    var lockWhiteList = new List<Address>
        {Context.GetContractAddressByName(SmartContractConstants.
            TokenHolderContractSystemName)};
    if (isLockWhiteListIncludingSelf)
        lockWhiteList.Add(Context.Self);
    State.TokenContract.Create.Send(new CreateInput
    {
        Symbol = State.Symbol.Value,
        TokenName = "DApp Token",
        Decimals = ACS9DemoContractConstants.Decimal,
        Issuer = Context.Self,
        IsBurnable = true,
        IsProfitable = true,
        TotalSupply = ACS9DemoContractConstants.TotalSupply,
        LockWhiteList =
        {
            lockWhiteList
        }
    });
    State.TokenContract.Issue.Send(new IssueInput
    {
        To = profitReceiver,
        Amount = ACS9DemoContractConstants.TotalSupply / 5,
        Symbol = State.Symbol.Value,
        Memo = "Issue token for profit receiver"
    });
}
private void CreateTokenHolderProfitScheme()
{
    State.TokenHolderContract.CreateScheme.Send(new CreateTokenHolderProfitSchemeInput
    {
        Symbol = State.Symbol.Value
    });
}
private void SetProfitConfig()
{
    State.ProfitConfig.Value = new ProfitConfig
    {
        DonationPartsPerHundred = 1,
        StakingTokenSymbol = "APP",
        ProfitsTokenSymbolList = {"ELF"}
    };
}
}

```

The State.symbol is a singleton of type string, state.Profitconfig is a singleton of type ProfitConfig, and state.profitreceiver is a singleton of type Address.

The user can use the SignUp method to register and get the bonus. Besides, it will create an archive for him:

```

/// <summary>
/// When user sign up, give him 10 APP tokens, then initialize his profile.
/// </summary>
/// <param name="input"></param>
/// <returns></returns>
public override Empty SignUp(Empty input)
{
    Assert(State.Profiles[Context.Sender] == null, "Already registered.");
    var profile = new Profile
    {
        UserAddress = Context.Sender
    };
    State.TokenContract.Issue.Send(new IssueInput
    {
        Symbol = State.Symbol.Value,
        Amount = ACS9DemoContractConstants.ForNewUser,
        To = Context.Sender
    });
    // Update profile.
    profile.Records.Add(new Record
    {
        Type = RecordType.SignUp,
        Timestamp = Context.CurrentBlockTime,
        Description = string.Format("{0} +{1}", State.Symbol.Value,
        ACS9DemoContractConstants.ForNewUser)
    });
    State.Profiles[Context.Sender] = profile;
    return new Empty();
}

```

Recharge and redemption:

```

public override Empty Deposit(DepositInput input)
{
    // User Address -> DApp Contract.
    State.TokenContract.TransferFrom.Send(new TransferFromInput
    {
        From = Context.Sender,
        To = Context.Self,
        Symbol = "ELF",
        Amount = input.Amount
    });
    State.TokenContract.Issue.Send(new IssueInput
    {
        Symbol = State.Symbol.Value,
        Amount = input.Amount,
        To = Context.Sender
    });
    // Update profile.
    var profile = State.Profiles[Context.Sender];
    profile.Records.Add(new Record
    {
        Type = RecordType.Deposit,

```

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```

        Timestamp = Context.CurrentBlockTime,
        Description = string.Format("{0} +{1}", State.Symbol.Value, input.Amount)
    });
    State.Profiles[Context.Sender] = profile;
    return new Empty();
}
public override Empty Withdraw(WithdrawInput input)
{
    State.TokenContract.TransferFrom.Send(new TransferFromInput
    {
        From = Context.Sender,
        To = Context.Self,
        Symbol = State.Symbol.Value,
        Amount = input.Amount
    });
    State.TokenContract.Transfer.Send(new TransferInput
    {
        To = Context.Sender,
        Symbol = input.Symbol,
        Amount = input.Amount
    });
    State.TokenHolderContract.RemoveBeneficiary.Send(new
    ↪ RemoveTokenHolderBeneficiaryInput
    {
        Beneficiary = Context.Sender,
        Amount = input.Amount
    });
    // Update profile.
    var profile = State.Profiles[Context.Sender];
    profile.Records.Add(new Record
    {
        Type = RecordType.Withdraw,
        Timestamp = Context.CurrentBlockTime,
        Description = string.Format("{0} -{1}", State.Symbol.Value, input.Amount)
    });
    State.Profiles[Context.Sender] = profile;
    return new Empty();
}

```

In the implementation of Use, 1/3 profits are directly transferred into the token holder dividend scheme:

```

public override Empty Use(Record input)
{
    State.TokenContract.TransferFrom.Send(new TransferFromInput
    {
        From = Context.Sender,
        To = Context.Self,
        Symbol = State.Symbol.Value,
        Amount = ACS9DemoContractConstants.UseFee
    });
    if (input.Symbol == string.Empty)
        input.Symbol = State.TokenContract.GetPrimaryTokenSymbol.Call(new Empty()).Value;
}

```

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```

var contributeAmount = ACS9DemoContractConstants.UseFee.Div(3);
State.TokenContract.Approve.Send(new ApproveInput
{
    Spender = State.TokenHolderContract.Value,
    Symbol = input.Symbol,
    Amount = contributeAmount
});
// Contribute 1/3 profits (ELF) to profit scheme.
State.TokenHolderContract.ContributeProfits.Send(new ContributeProfitsInput
{
    SchemeManager = Context.Self,
    Amount = contributeAmount,
    Symbol = input.Symbol
});
// Update profile.
var profile = State.Profiles[Context.Sender];
profile.Records.Add(new Record
{
    Type = RecordType.Withdraw,
    Timestamp = Context.CurrentBlockTime,
    Description = string.Format("{0} -{1}", State.Symbol.Value,
↪ACS9DemoContractConstants.UseFee),
    Symbol = input.Symbol
});
State.Profiles[Context.Sender] = profile;
return new Empty();
}

```

The implementation of this contract has been completed. Next, implement ACS9 to perfect the profit distribution:

```

public override Empty TakeContractProfits(TakeContractProfitsInput input)
{
    var config = State.ProfitConfig.Value;
    // For Side Chain Dividends Pool.
    var amountForSideChainDividendsPool = input.Amount.Mul(config.
↪DonationPartsPerHundred).Div(100);
    State.TokenContract.Approve.Send(new ApproveInput
    {
        Symbol = input.Symbol,
        Amount = amountForSideChainDividendsPool,
        Spender = State.DividendPoolContract.Value
    });
    State.DividendPoolContract.Donate.Send(new DonateInput
    {
        Symbol = input.Symbol,
        Amount = amountForSideChainDividendsPool
    });
    // For receiver.
    var amountForReceiver = input.Amount.Sub(amountForSideChainDividendsPool);
    State.TokenContract.Transfer.Send(new TransferInput
    {
        To = State.ProfitReceiver.Value,

```

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```

        Amount = amountForReceiver,
        Symbol = input.Symbol
    });
    // For Token Holder Profit Scheme. (To distribute.)
    State.TokenHolderContract.DistributeProfits.Send(new DistributeProfitsInput
    {
        SchemeManager = Context.Self
    });
    return new Empty();
}
public override ProfitConfig GetProfitConfig(Empty input)
{
    return State.ProfitConfig.Value;
}
public override ProfitsMap GetProfitsAmount(Empty input)
{
    var profitsMap = new ProfitsMap();
    foreach (var symbol in State.ProfitConfig.Value.ProfitsTokenSymbolList)
    {
        var balance = State.TokenContract.GetBalance.Call(new GetBalanceInput
        {
            Owner = Context.Self,
            Symbol = symbol
        }).Balance;
        profitsMap.Value[symbol] = balance;
    }
    return profitsMap;
}

```

23.10.3 Test

Since part of the profits from the ACS9 contract transfer to the Token contract and the other transfer to the dividend pool, a TokenHolder Stub and a contract implementing ACS10 Stub are required in the test. Accordingly, the contracts that implements ACS9 or ACS10 need to be deployed. Before the test begins, the contract implementing ACS9 can be initialized by interface IContractInitializationProvider, and sets the dividend pool's name to the other contract's name:

```

public class ACS9DemoContractInitializationProvider : IContractInitializationProvider
{
    public List<InitializeMethod> GetInitializeMethodList(byte[] contractCode)
    {
        return new List<InitializeMethod>
        {
            new InitializeMethod
            {
                MethodName = nameof(ACS9DemoContract.Initialize),
                Params = new InitializeInput
                {
                    ProfitReceiver = Address.FromPublicKey(SampleECKeypairs.KeyPairs.
↪Skip(3).First().PublicKey),
                    DividendPoolContractName = ACS10DemoSmartContractNameProvider.Name
                }
            }
        }
    }
}

```

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```

        }.ToString()
    }
};
}
public Hash SystemSmartContractName { get; } = ACS9DemoSmartContractNameProvider.
↪Name;
public string ContractCodeName { get; } = "AElf.Contracts.ACS9DemoContract";
}

```

Prepare a user account:

```

protected List<ECPKeyPair> UserKeyPairs => SampleECPKeyPairs.KeyPairs.Skip(2).Take(3).
↪ToList();

```

Prepare some Stubs:

```

var keyPair = UserKeyPairs[0];
var address = Address.FromPublicKey(keyPair.PublicKey);
// Prepare stubs.
var acs9DemoContractStub = GetACS9DemoContractStub(keyPair);
var acs10DemoContractStub = GetACS10DemoContractStub(keyPair);
var userTokenStub =
    GetTester<TokenContractImplContainer.TokenContractImplStub>(TokenContractAddress,
↪UserKeyPairs[0]);
var userTokenHolderStub =
    GetTester<TokenHolderContractContainer.TokenHolderContractStub>
↪(TokenHolderContractAddress,
    UserKeyPairs[0]);

```

Then, transfer ELF to the user (TokenContractStub is the Stub of the initial bp who has much ELF) :

```

// Transfer some ELFs to user.
await TokenContractStub.Transfer.SendAsync(new TransferInput
{
    To = address,
    Symbol = "ELF",
    Amount = 1000_000000000
});

```

Have the user call SignUp to check if he/she has got 10 APP tokens:

```

await acs9DemoContractStub.SignUp.SendAsync(new Empty());
// User has 10 APP tokens because of signing up.
(await GetFirstUserBalance("APP")).ShouldBe(10_000000000);

```

Test the recharge method of the contract itself:

```

var elfBalanceBefore = await GetFirstUserBalance("ELF");
// User has to Approve an amount of ELF tokens before deposit to the DApp.
await userTokenStub.Approve.SendAsync(new ApproveInput
{
    Amount = 1000_000000000,
    Spender = ACS9DemoContractAddress,

```

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```

        Symbol = "ELF"
    });
    await acs9DemoContractStub.Deposit.SendAsync(new DepositInput
    {
        Amount = 100_00000000
    });
    // Check the change of balance of ELF.
    var elfBalanceAfter = await GetFirstUserBalance("ELF");
    elfBalanceAfter.ShouldBe(elfBalanceBefore - 100_00000000);
    // Now user has 110 APP tokens.
    (await GetFirstUserBalance("APP")).ShouldBe(110_00000000);

```

The user locks up 57 APP via the TokenHolder contract in order to obtain profits from the contract:

```

// User lock some APP tokens for getting profits. (APP -57)
await userTokenHolderStub.RegisterForProfits.SendAsync(new RegisterForProfitsInput
{
    SchemeManager = ACS9DemoContractAddress,
    Amount = 57_00000000
});

```

The Use method is invoked 10 times and 0.3 APP is consumed each time, and finally the user have 50 APP left:

```

await userTokenStub.Approve.SendAsync(new ApproveInput
{
    Amount = long.MaxValue,
    Spender = ACS9DemoContractAddress,
    Symbol = "APP"
});
// User uses 10 times of this DApp. (APP -3)
for (var i = 0; i < 10; i++)
{
    await acs9DemoContractStub.Use.SendAsync(new Record());
}
// Now user has 50 APP tokens.
(await GetFirstUserBalance("APP")).ShouldBe(50_00000000);

```

Using the TakeContractProfits method, the developer attempts to withdraw 10 ELF as profits. The 10 ELF will be transferred to the developer in this method:

```

const long baseBalance = 0;
{
    var balance = await TokenContractStub.GetBalance.CallAsync(new GetBalanceInput
    {
        Owner = UserAddresses[1], Symbol = "ELF"
    });
    balance.Balance.ShouldBe(baseBalance);
}
// Profits receiver claim 10 ELF profits.
await acs9DemoContractStub.TakeContractProfits.SendAsync(new TakeContractProfitsInput
{
    Symbol = "ELF",
    Amount = 10_0000_0000

```

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```
});
// Then profits receiver should have 9.9 ELF tokens.
{
    var balance = await TokenContractStub.GetBalance.CallAsync(new GetBalanceInput
    {
        Owner = UserAddresses[1], Symbol = "ELF"
    });
    balance.Balance.ShouldBe(baseBalance + 9_9000_0000);
}
```

Next check the profit distribution results. The dividend pool should be allocated 0.1 ELF:

```
// And Side Chain Dividends Pool should have 0.1 ELF tokens.
{
    var scheme = await TokenHolderContractStub.GetScheme.
    CallAsync(ACS10DemoContractAddress);
    var virtualAddress = await ProfitContractStub.GetSchemeAddress.CallAsync(new
    SchemePeriod
    {
        SchemeId = scheme.SchemeId,
        Period = 0
    });
    var balance = await TokenContractStub.GetBalance.CallAsync(new GetBalanceInput
    {
        Owner = virtualAddress,
        Symbol = "ELF"
    });
    balance.Balance.ShouldBe(1000_0000);
}
```

The user receives 1 ELF from the token holder dividend scheme:

```
// Help user to claim profits from token holder profit scheme.
await TokenHolderContractStub.ClaimProfits.SendAsync(new ClaimProfitsInput
{
    Beneficiary = UserAddresses[0],
    SchemeManager = ACS9DemoContractAddress,
});
// Profits should be 1 ELF.
(await GetFirstUserBalance("ELF")).ShouldBe(elfBalanceAfter + 1_0000_0000);
```

Finally, let's test the Withdraw method.

```
// Withdraw
var beforeBalance =
    await userTokenStub.GetBalance.CallAsync(new GetBalanceInput
    {
        Symbol = "APP",
        Owner = UserAddresses[0]
    });
var withdrawResult = await userTokenHolderStub.Withdraw.
    SendAsync(ACS9DemoContractAddress);
withdrawResult.TransactionResult.Status.ShouldBe(TransactionResultStatus.Mined);
```

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```

var resultBalance = await userTokenStub.GetBalance.CallAsync(new GetBalanceInput
{
    Symbol = "APP",
    Owner = UserAddresses[0]
});
resultBalance.Balance.ShouldBe(beforeBalance.Balance + 57_000000000);

```

23.11 ACS10 - Dividend Pool Standard

ACS10 is used to construct a dividend pool in the contract.

23.11.1 Interface

To construct a dividend pool, you can implement the following interfaces optionally:

Methods

| Method Name | Request Type | Response Type | Description |
|---------------------------|------------------------------|------------------------------|--|
| Donate | <i>acs10.DonateInput</i> | <i>google.protobuf.Empty</i> | Donate tokens from the caller to the treasury. If the tokens are not native tokens in the current chain, they will be first converted to the native token. |
| Release | <i>acs10.ReleaseInput</i> | <i>google.protobuf.Empty</i> | Release dividend pool according the period number. |
| SetSymbol-List | <i>acs10.SymbolList</i> | <i>google.protobuf.Empty</i> | Set the token symbols dividend pool supports. |
| GetSymbol-List | <i>google.protobuf.Empty</i> | <i>acs10.SymbolList</i> | Query the token symbols dividend pool supports. |
| GetUndistributedDividends | <i>google.protobuf.Empty</i> | <i>acs10.DividendQuery</i> | Query the balance of undistributed tokens whose symbols are included in the symbol list. |
| GetDividends | <i>google.protobuf.Empty</i> | <i>acs10.DividendQuery</i> | Query the dividend information according to the height. |

Types

acs10.Dividends

| Field | Type | Description | Label |
|-------|-----------------------------|----------------------------------|----------|
| value | <i>Dividends.ValueEntry</i> | The dividends, symbol -> amount. | repeated |

acs10.Dividends.ValueEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>int64</i> | | |

acs10.DonateInput

| Field | Type | Description | Label |
|--------|---------------|-----------------------------|-------|
| symbol | <i>string</i> | The token symbol to donate. | |
| amount | <i>int64</i> | The amount to donate. | |

acs10.DonationReceived

| Field | Type | Description | Label |
|---------------|---------------------|-------------------------------|-------|
| from | <i>aelf.Address</i> | The address of donors. | |
| pool_contract | <i>aelf.Address</i> | The address of dividend pool. | |
| symbol | <i>string</i> | The token symbol Donated. | |
| amount | <i>int64</i> | The amount Donated. | |

acs10.ReleaseInput

| Field | Type | Description | Label |
|---------------|--------------|-------------------------------|-------|
| period_number | <i>int64</i> | The period number to release. | |

acs10.SymbolList

| Field | Type | Description | Label |
|-------|---------------|------------------------|----------|
| value | <i>string</i> | The token symbol list. | repeated |

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>int64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.11.2 Usage

ACS10 only unifies the standard interface of the dividend pool, which does not interact with the AElf chain.

23.11.3 Implementation

With the Profit contract

A Profit Scheme can be created using the CreateScheme method of Profit contract:

```
State.ProfitContract.Value =
    Context.GetContractAddressByName(SmartContractConstants.ProfitContractSystemName);
var schemeToken = HashHelper.ComputeFrom(Context.Self);
State.ProfitContract.CreateScheme.Send(new CreateSchemeInput
{
    Manager = Context.Self,
    CanRemoveBeneficiaryDirectly = true,
    IsReleaseAllBalanceEveryTimeByDefault = true,
    Token = schemeToken
});
State.ProfitSchemeId.Value = Context.GenerateId(State.ProfitContract.Value, schemeToken);
```

The Context.GenerateId method is a common method used by the AElf to generate Id. We use the address of the Profit contract and the schemeToken provided to the Profit contract to calculate the Id of the scheme, and we set this id to State.ProfitSchemeId (SingletonState<Hash>).

After the establishment of the dividend scheme:

- ContributeProfits method of Profit can be used to implement the method Donate in ACS10.
- The Release in the ACS10 can be implemented using the method DistributeProfits in the Profit contract;
- Methods such as AddBeneficiary and RemoveBeneficiary can be used to manage the recipients and their weight.
- AddSubScheme, RemoveSubScheme and other methods can be used to manage the sub-dividend scheme and its weight;
- The SetSymbolList and GetSymbolList can be implemented by yourself. Just make sure the symbol list you set is used correctly in Donate and Release.
- GetUndistributedDividends returns the balance of the token whose symbol is included in symbol list.

With TokenHolder Contract

When initializing the contract, you should create a token holder dividend scheme using the CreateScheme in the TokenHolder contract(Token Holder Profit Scheme)

```
State.TokenHolderContract.Value =
    Context.GetContractAddressByName(SmartContractConstants.
    ↪TokenHolderContractSystemName);
State.TokenHolderContract.CreateScheme.Send(new CreateTokenHolderProfitSchemeInput
{
    Symbol = Context.Variables.NativeSymbol,
```

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```

        MinimumLockMinutes = input.MinimumLockMinutes
    });
    return new Empty();

```

In a token holder dividend scheme, a scheme is bound to its creator, so SchemeId is not necessary to compute (in fact, the scheme is created via the Profit contract).

Considering the GetDividends returns the dividend information according to the input height, so each Donate need update dividend information for each height . A Donate can be implemented as:

```

public override Empty Donate(DonateInput input)
{
    State.TokenContract.TransferFrom.Send(new TransferFromInput
    {
        From = Context.Sender,
        Symbol = input.Symbol,
        Amount = input.Amount,
        To = Context.Self
    });
    State.TokenContract.Approve.Send(new ApproveInput
    {
        Symbol = input.Symbol,
        Amount = input.Amount,
        Spender = State.TokenHolderContract.Value
    });
    State.TokenHolderContract.ContributeProfits.Send(new ContributeProfitsInput
    {
        SchemeManager = Context.Self,
        Symbol = input.Symbol,
        Amount = input.Amount
    });
    Context.Fire(new DonationReceived
    {
        From = Context.Sender,
        Symbol = input.Symbol,
        Amount = input.Amount,
        PoolContract = Context.Self
    });
    var currentReceivedDividends = State.ReceivedDividends[Context.CurrentHeight];
    if (currentReceivedDividends != null && currentReceivedDividends.Value.
    ContainsKey(input.Symbol))
    {
        currentReceivedDividends.Value[input.Symbol] =
            currentReceivedDividends.Value[input.Symbol].Add(input.Amount);
    }
    else
    {
        currentReceivedDividends = new Dividends
        {
            Value =
            {
                {
                    input.Symbol, input.Amount

```

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```

        }
    };
}
State.ReceivedDividends[Context.CurrentHeight] = currentReceivedDividends;
Context.LogDebug(() => string.Format("Contributed {0} {1}s to side chain dividends.↵pool.", input.Amount, input.Symbol));
return new Empty();
}

```

The method Release directly sends the TokenHolder's method DistributeProfits transaction:

```

public override Empty Release(ReleaseInput input)
{
    State.TokenHolderContract.DistributeProfits.Send(new DistributeProfitsInput
    {
        SchemeManager = Context.Self
    });
    return new Empty();
}

```

In the TokenHolder contract, the default implementation is to release what token is received, so SetSymbolList does not need to be implemented, and GetSymbolList returns the symbol list recorded in dividend scheme:

```

public override Empty SetSymbolList(SymbolList input)
{
    Assert(false, "Not support setting symbol list.");
    return new Empty();
}
public override SymbolList GetSymbolList(Empty input)
{
    return new SymbolList
    {
        Value =
        {
            GetDividendPoolScheme().ReceivedTokenSymbols
        }
    };
}
private Scheme GetDividendPoolScheme()
{
    if (State.DividendPoolSchemeId.Value == null)
    {
        var tokenHolderScheme = State.TokenHolderContract.GetScheme.Call(Context.Self);
        State.DividendPoolSchemeId.Value = tokenHolderScheme.SchemeId;
    }
    return Context.Call<Scheme>(
        Context.GetContractAddressByName(SmartContractConstants.
↵ProfitContractSystemName),
        nameof(ProfitContractContainer.ProfitContractReferenceState.GetScheme),
        State.DividendPoolSchemeId.Value);
}

```

The implementation of `GetUndistributedDividends` is the same as described in the previous section, and it returns the balance:

```
public override Dividends GetUndistributedDividends(Empty input)
{
    var scheme = GetDividendPoolScheme();
    return new Dividends
    {
        Value =
        {
            scheme.ReceivedTokenSymbols.Select(s => State.TokenContract.GetBalance.
↪Call(new GetBalanceInput
            {
                Owner = scheme.VirtualAddress,
                Symbol = s
            }).ToDictionary(b => b.Symbol, b => b.Balance)
        }
    };
}
```

In addition to the `Profit` and `TokenHolder` contracts, of course, you can also implement a dividend pool on your own contract.

23.11.4 Test

The dividend pool, for example, is tested in two ways with the `TokenHolder` contract.

One way is for the dividend pool to send `Donate`, `Release` and a series of query operations;

The other way is to use an account to lock up, and then take out dividends.

Define the required Stubs:

```
const long amount = 10_00000000;
var keyPair = SampleECKeypairs.KeyPairs[0];
var address = Address.FromPublicKey(keyPair.PublicKey);
var acs10DemoContractStub =
    GetTester<ACS10DemoContractContainer.ACS10DemoContractStub>(DAppContractAddress, ↪
↪keyPair);
var tokenContractStub =
    GetTester<TokenContractContainer.TokenContractStub>(TokenContractAddress, keyPair);
var tokenHolderContractStub =
    GetTester<TokenHolderContractContainer.TokenHolderContractStub>
↪(TokenHolderContractAddress,
    keyPair);
```

Before proceeding, You should Approve the `TokenHolder` contract and the dividend pool contract.

```
await tokenContractStub.Approve.SendAsync(new ApproveInput
{
    Spender = TokenHolderContractAddress,
    Symbol = "ELF",
    Amount = long.MaxValue
});
```

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```
await tokenContractStub.Approve.SendAsync(new ApproveInput
{
    Spender = DAppContractAddress,
    Symbol = "ELF",
    Amount = long.MaxValue
});
```

Lock the position, at which point the account balance is reduced by 10 ELF:

```
await tokenHolderContractStub.RegisterForProfits.SendAsync(new RegisterForProfitsInput
{
    SchemeManager = DAppContractAddress,
    Amount = amount
});
```

Donate, at which point the account balance is reduced by another 10 ELF:

```
await acs10DemoContractStub.Donate.SendAsync(new DonateInput
{
    Symbol = "ELF",
    Amount = amount
});
```

At this point you can test the GetUndistributedDividends and GetDividends:

```
// Check undistributed dividends before releasing.
{
    var undistributedDividends =
        await acs10DemoContractStub.GetUndistributedDividends.CallAsync(new Empty());
    undistributedDividends.Value["ELF"].ShouldBe(amount);
}
var blockchainService = Application.ServiceProvider.GetRequiredService
    <IBlockchainService>();
var currentBlockHeight = (await blockchainService.GetChainAsync()).BestChainHeight;
var dividends =
    await acs10DemoContractStub.GetDividends.CallAsync(new Int64Value {Value =
        currentBlockHeight});
dividends.Value["ELF"].ShouldBe(amount);
```

Release bonus, and test GetUndistributedDividends again:

```
await acs10DemoContractStub.Release.SendAsync(new ReleaseInput
{
    PeriodNumber = 1
});
// Check undistributed dividends after releasing.
{
    var undistributedDividends =
        await acs10DemoContractStub.GetUndistributedDividends.CallAsync(new Empty());
    undistributedDividends.Value["ELF"].ShouldBe(0);
}
```

Finally, let this account receive the dividend and then observe the change in its balance:

```

var balanceBeforeClaimForProfits = await tokenContractStub.GetBalance.CallAsync(new
    ↳GetBalanceInput
{
    Owner = address,
    Symbol = "ELF"
});
await tokenHolderContractStub.ClaimProfits.SendAsync(new ClaimProfitsInput
{
    SchemeManager = DAppContractAddress,
    Beneficiary = address
});
var balanceAfterClaimForProfits = await tokenContractStub.GetBalance.CallAsync(new
    ↳GetBalanceInput
{
    Owner = address,
    Symbol = "ELF"
});
balanceAfterClaimForProfits.Balance.ShouldBe(balanceBeforeClaimForProfits.Balance +
    ↳amount);

```

23.11.5 Example

The dividend pool of the main chain and the side chain is built by implementing ACS10.

The dividend pool provided by the Treasury contract implementing ACS10 is on the main chain.

The dividend pool provided by the Consensus contract implementing ACS10 is on the side chain.

23.12 ACS11 - Cross Chain Consensus Standard

ACS11 is used to customize consensus mechanisms for cross chain.

23.12.1 Interface

The contract inherited from ACS11 need implement the following interfaces:

Methods

| Method Name | Request Type | Response Type | Description |
|-----------------------------------|-----------------------------------|-----------------------------------|---|
| UpdateInformationFrom-CrossChain | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.Empty</i> | Update the consensus information of the side chain. |
| GetChainInitializationInformation | <i>google.protobuf.BytesValue</i> | <i>google.protobuf.BytesValue</i> | Get the current miner list and consensus round information. |
| CheckCrossChainIndexingPermission | <i>aelf.Address</i> | <i>google.protobuf.BoolValue</i> | Verify that the input address is the current miner. |

Types

aelf.Address

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.BinaryMerkleTree

| Field | Type | Description | Label |
|------------|--------------|-------------------------|----------|
| nodes | <i>Hash</i> | The leaf nodes. | repeated |
| root | <i>Hash</i> | The root node hash. | |
| leaf_count | <i>int32</i> | The count of leaf node. | |

aelf.Hash

| Field | Type | Description | Label |
|-------|--------------|-------------|-------|
| value | <i>bytes</i> | | |

aelf.LogEvent

| Field | Type | Description | Label |
|-------------|----------------|--|----------|
| address | <i>Address</i> | The contract address. | |
| name | <i>string</i> | The name of the log event. | |
| indexed | <i>bytes</i> | The indexed data, used to calculate bloom. | repeated |
| non_indexed | <i>bytes</i> | The non indexed data. | |

aelf.MerklePath

| Field | Type | Description | Label |
|-------------------|-----------------------|------------------------|----------|
| merkle_path_nodes | <i>MerklePathNode</i> | The merkle path nodes. | repeated |

aelf.MerklePathNode

| Field | Type | Description | Label |
|--------------------|-------------|----------------------------------|-------|
| hash | <i>Hash</i> | The node hash. | |
| is_left_child_node | <i>bool</i> | Whether it is a left child node. | |

aelf.SInt32Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint32</i> | | |

aelf.SInt64Value

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| value | <i>sint64</i> | | |

aelf.ScopedStatePath

| Field | Type | Description | Label |
|---------|------------------|--|-------|
| address | <i>Address</i> | The scope address, which will be the contract address. | |
| path | <i>StatePath</i> | The path of contract state. | |

aelf.SmartContractRegistration

| Field | Type | Description | Label |
|--------------------|---------------|---------------------------------------|-------|
| category | <i>sint32</i> | The category of contract code(0: C#). | |
| code | <i>bytes</i> | The byte array of the contract code. | |
| code_hash | <i>Hash</i> | The hash of the contract code. | |
| is_system_contract | <i>bool</i> | Whether it is a system contract. | |
| version | <i>int32</i> | The version of the current contract. | |

aelf.StatePath

| Field | Type | Description | Label |
|-------|---------------|-------------------------------------|----------|
| parts | <i>string</i> | The partial path of the state path. | repeated |

aelf.Transaction

| Field | Type | Description | Label |
|------------------|----------------|--|-------|
| from | <i>Address</i> | The address of the sender of the transaction. | |
| to | <i>Address</i> | The address of the contract when calling a contract. | |
| ref_block_number | <i>uint64</i> | The height of the referenced block hash. | |
| ref_block_prefix | <i>bytes</i> | The first four bytes of the referenced block hash. | |
| method_name | <i>string</i> | The name of a method in the smart contract at the To address. | |
| params | <i>bytes</i> | The parameters to pass to the smart contract method. | |
| signature | <i>bytes</i> | When signing a transaction it's actually a subset of the fields: from/to and the target method as well as the parameter that were given. It also contains the reference block number and prefix. | |

aelf.TransactionExecutingStateSet

| Field | Type | Description | Label |
|---------|--|---------------------|----------|
| writes | <i>TransactionExecutingStateSet.WritesEntry</i> | The changed states. | repeated |
| reads | <i>TransactionExecutingStateSet.ReadsEntry</i> | The read states. | repeated |
| deletes | <i>TransactionExecutingStateSet.DeletesEntry</i> | The deleted states. | repeated |

aelf.TransactionExecutingStateSet.DeletesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.ReadsEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bool</i> | | |

aelf.TransactionExecutingStateSet.WritesEntry

| Field | Type | Description | Label |
|-------|---------------|-------------|-------|
| key | <i>string</i> | | |
| value | <i>bytes</i> | | |

aelf.TransactionResult

| Field | Type | Description | Label |
|----------------|----------------------------------|--|----------|
| transaction_id | <i>Hash</i> | The transaction id. | |
| status | <i>Transaction-Result-Status</i> | The transaction result status. | |
| logs | <i>LogEvent</i> | The log events. | repeated |
| bloom | <i>bytes</i> | Bloom filter for transaction logs. A transaction log event can be defined in the contract and stored in the bloom filter after the transaction is executed. Through this filter, we can quickly search for and determine whether a log exists in the transaction result. | |
| return_value | <i>bytes</i> | The return value of the transaction execution. | |
| block_number | <i>number</i> | The height of the block that packages the transaction. | |
| block_hash | <i>hash</i> | The hash of the block that packages the transaction. | |
| error | <i>string</i> | Failed execution error message. | |

aelf.TransactionResultStatus

| Name | Number | Description |
|------------------------|--------|---|
| NOT_EXISTED | 0 | The execution result of the transaction does not exist. |
| PENDING | 1 | The transaction is in the transaction pool waiting to be packaged. |
| FAILED | 2 | Transaction execution failed. |
| MINED | 3 | The transaction was successfully executed and successfully packaged into a block. |
| CONFLICT | 4 | When executed in parallel, there are conflicts with other transactions. |
| PENDING_VALIDATION | 5 | The transaction is waiting for validation. |
| NODE_VALIDATION_FAILED | 6 | Transaction validation failed. |

23.12.2 Example

ACS11 declares methods for the scenes about customize consensus mechanisms for cross chain. AElf provides the implementation for ACS11, AEDPoS Contract. You can refer to the implementation of the [AEDPoS contract api](#).

23.13 ACS12 - User Contract Standard

ACS12 is used to manage user contract.

23.13.1 Types

acs12.UserContractMethodFees

| Field | Type | Label | Description |
|------------------|-------------------------------------|----------|--|
| fees | <i>acs12.UserContractMethodFees</i> | repeated | List of fees to be charged. |
| is_size_fee_free | <i>bool</i> | | Optional based on the implementation of SetConfiguration method. |

acs12.UserContractMethodFee

| Field | Type | Label | Description |
|-----------|---------------|-------|-------------------------------------|
| symbol | <i>string</i> | | The token symbol of the method fee. |
| basic_fee | <i>int64</i> | | The amount of fees to be charged. |

COMMAND LINE INTERFACE

24.1 Introduction to the CLI

The **aelf-command** tool is a CLI tool built for interacting with an AElf node. This section will walk you through some of the most commonly used features and show you how to install the tool.

24.1.1 Features

- Get or Set common configs, `endpoint`, `account`, `datadir`, `password`.
- For new users who are not familiar with the CLI parameters, any missing parameters will be asked in a prompting way.
- Create a new `account`.
- Load an account from a given `private key` or `mnemonic`.
- Show `wallet` details which include `private key`, `address`, `public key` and `mnemonic`.
- Encrypt account info into `keyStore` format and save to file.
- Get current `Best Height` of the chain.
- Get `block info` by a given `height` or `block hash`.
- Get `transaction result` by a given `transaction id`.
- Send a `transaction` or call a `read-only method` on a `smart contract`.
- Deploy a `smart contract`.
- Open a `REPL` for using `JavaScript` to interact with the chain.
- Friendly interactions, beautify with `chalk & ora`.
- Get current chain status.
- Create a `proposal` on any `contract method`.
- Deserialize the result returned by executing a `transaction`.
- Start a `socket.io` server for supplying services for `dApps`.

24.1.2 Install aelf-command

```
npm i aelf-command -g
```

24.1.3 Using aelf-command

First Step

You need to create a new account or load a account by a private key or mnemonic you already have.

- Create a new wallet

```
$ aelf-command create
Your wallet info is :
Mnemonic           : great mushroom loan crisp ... door juice embrace
Private Key         : e038eea7e151eb451ba2901f7...b08ba5b76d8f288
Public Key          : 0478903d96aa2c8c0...
                    ↪ 6a3e7d810cacd136117ea7b13d2c9337e1ec88288111955b76ea
Address             : 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
✓ Save account info into a file? ... no / yes
✓ Enter a password ... *****
✓ Confirm password ... *****
✓
Account info has been saved to "/Users/young/.local/share/aelf/keys/
                    ↪ 2Ue31YTuB5Szy7cnr...Gi5uMQBYarYUR5oGin1sys6H.json"
```

- Load wallet from private key

```
$ aelf-command load e038eea7e151eb451ba2901f7...b08ba5b76d8f288
Your wallet info is :
Private Key         : e038eea7e151eb451ba2901f7...b08ba5b76d8f288
Public Key          : 0478903d96aa2c8c0...
                    ↪ 6a3e7d810cacd136117ea7b13d2c9337e1ec88288111955b76ea
Address             : 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
✓ Save account info into a file?
✓ Enter a password ... *****
✓ Confirm password ... *****
✓
Account info has been saved to "/Users/young/.local/share/aelf/keys/
                    ↪ 2Ue31YTuB5Szy7cnr...Gi5uMQBYarYUR5oGin1sys6H.json"
```

- show wallet info you already have

```
$ aelf-command wallet -a 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
Your wallet info is :
Private Key         : e038eea7e151eb451ba2901f7...b08ba5b76d8f288
Public Key          : 0478903d96aa2c8c0...
                    ↪ 6a3e7d810cacd136117ea7b13d2c9337e1ec88288111955b76ea
Address             : 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
```

Here you can get the account info and decide whether to encrypt account info and save into a file.

Examples:

```
$ aelf-command console -a 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
✓ Enter the the URI of an AElf node: http://127.0.0.1:8000
✓ Enter the password you typed when creating a wallet ... *****
✓ Succeed!
Welcome to aelf interactive console. Ctrl + C to terminate the program. Double tap Tab
↳ to list objects
```

| NAME | DESCRIPTION |
|----------|--|
| AElf | imported from aelf-sdk |
| aelf | the instance of an aelf-sdk, connect to http://127.0.0.1:8000 |
| _account | the instance of an AElf wallet, address is 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR... 5oGin1sys6H |

Any missed parameters you did not give in CLI parameters will be asked in a prompting way

```
$ aelf-command console
✓ Enter the the URI of an AElf node: http://127.0.0.1:8000
✓ Enter a valid wallet address, if you don't have, create one by aelf-command create
↳ ... 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
✓ Enter the password you typed when creating a wallet ... *****
✓ Succeed!
Welcome to aelf interactive console. Ctrl + C to terminate the program. Double tap Tab
↳ to list objects
```

| NAME | DESCRIPTION |
|----------|--|
| AElf | imported from aelf-sdk |
| aelf | the instance of an aelf-sdk, connect to http://13.231.179.27:8000 |
| _account | the instance of an AElf wallet, address is 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR... 5oGin1sys6H |

Help

Type

```
$ aelf-command -h
Usage: aelf-command [command] [options]

Options:
  -v, --version                output the version number
  -e, --endpoint <URI>        The URI of an AElf node. Eg:
    ↪ http://127.0.0.1:8000
  -a, --account <account>     The address of AElf wallet
  -p, --password <password>   The password of encrypted
    ↪ keyStore
  -d, --datadir <directory>   The directory that contains
    ↪ the AElf related files. Defaults to {home}/.local/share/aelf
  -h, --help                  output usage information

Commands:
  call [contract-address|contract-name] [method] [params]  Call a read-only method on
    ↪ a contract.
  send [contract-address|contract-name] [method] [params]  Execute a method on a
    ↪ contract.
  get-blk-height                                           Get the current block
    ↪ height of specified chain
  get-chain-status                                         Get the current chain
    ↪ status
  get-blk-info [height|block-hash] [include-txs]          Get a block info
  get-tx-result [tx-id]                                    Get a transaction result
  console                                                  Open a node REPL
  create [options] [save-to-file]                         Create a new account
  wallet                                                  Show wallet details which
    ↪ include private key, address, public key and mnemonic
  load [private-key|mnemonic] [save-to-file]              Load wallet from a private
    ↪ key or mnemonic
  proposal [proposal-contract] [organization] [expired-time] Send a proposal to an
    ↪ origination with a specific contract method
  deploy [category] [code-path]                           Deprecated! Please use
    ↪ `aelf-command send`, check details in aelf-command `README.md`
  config <flag> [key] [value]                             Get, set, delete or list
    ↪ aelf-command config
  event [tx-id]                                           Deserialize the result
    ↪ returned by executing a transaction
  dapp-server [options]                                   Start a dAPP SOCKET.IO
    ↪ server
```

in your terminal and get useful information.

Any sub-commands such as call, you can get help by typing this

```
$ aelf-command call -h
Usage: aelf-command call [options] [contract-address|contract-name] [method] [params]

Call a read-only method on a contract.
```

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Options:

`-h, --help` output usage information

Examples:

`aelf-command call <contractName|contractAddress> <method> <params>``aelf-command call <contractName|contractAddress> <method>``aelf-command call <contractName|contractAddress>``aelf-command call``$ aelf-command console -h`Usage: `aelf-command console [options]`

Open a node REPL

Options:

`-h, --help` output usage information

Examples:

`aelf-command console``...`

24.2 Commands

24.2.1 Common options

- `datadir`: The directory that contains `aelf-command` files, such as encrypted account info `keyStore` files. Default to be `{home}/.local/share/aelf`
- `endpoint`: The endpoint for the RPC service.
- `account`: The account to be used to interact with the blockchain endpoint.
- `password`: The password for unlocking the given account.

You can specified options above in several ways, and the priority is in the order of low to high.

1. export variables in shell.

```
# This is datadir
$ export AELF_CLI_DATADIR=/Users/{you}/.local/share/aelf
# This is endpoint
$ export AELF_CLI_ENDPOINT=http://127.0.0.1:8000
# This is account
$ export AELF_CLI_ACCOUNT=2Ue31YTuB5Szy7c...gtGi5uMQBYarYUR5oGin1sys6H
```

2. `aelf-command` global `.aelfrc` config file

The global config file is stored in the `<datadir>/.aelfrc` file, you can read the config file, but better not modify it by yourself.

Modify this config file by `aelf-command config`.

- set: set and save config in the file, remember just set the datadir, endpoint, account, password four keys.

```
$ aelf-command config set endpoint http://127.0.0.1:8000
✓ Succeed!

$ aelf-command config -h
Usage: aelf-command config [options] <flag> [key] [value]

get, set, delete or list aelf-command config

Options:
  -h, --help  output usage information

Examples:

aelf-command config get <key>
aelf-command config set <key> <value>
aelf-command config delete <key>
aelf-command config list
```

- get: get the value of given key from global .aelfrc file

```
$ aelf-command config get endpoint
http://127.0.0.1:8000
```

- delete: delete the <key, value> from global .aelfrc file by a given key

```
$ aelf-command config delete endpoint
✓ Succeed!
```

- list: get the list of all configs stored in global .aelfrc file

```
$ aelf-command config list
endpoint=http://127.0.0.1:8000
password=password
```

Remember config command only can be used to modify the global .aelfrc file for now, more usages such as modify working directory will be implemented in later.

3. aelf-command working directory .aelfrc file

The current working directory of aelf-command can have a file named .aelfrc and store configs, the format of this file is like global .aelfrc file:

```
endpoint http://127.0.0.1:8000
password yourpassword
```

each line is <key, value> config and a whitespace is needed to separate them.

4. aelf-command options.

You can give common options by passing them in CLI parameters.

```
aelf-command console -a sadaf -p password -e http://127.0.0.1:8000
```

Notice the priority, the options given in higher priority will overwrite the lower priority.

24.2.2 create - Create a new account

This command will create a new account.

```
$ aelf-command create -h
Usage: aelf-command create [options] [save-to-file]

create a new account

Options:
  -c, --cipher [cipher]  Which cipher algorithm to use, default to be aes-128-ctr
  -h, --help              output usage information

Examples:

aelf-command create <save-to-file>
aelf-command create
```

Example:

- Specify the cipher way to encrypt account info by passing option `-c [cipher]`, such as:

```
aelf-command create -c aes-128-cbc
```

24.2.3 load - Load an account by a given private key or mnemonic

This command allow you load an account from backup.

```
# load from mnemonic
$ aelf-command load 'great mushroom loan crisp ... door juice embrace'
# load from private key
$ aelf-command load 'e038eea7e151eb451ba2901f7...b08ba5b76d8f288'
# load from prompting
$ aelf-command load
? Enter a private key or mnemonic > e038eea7e151eb451ba2901f7...b08ba5b76d8f288
...
```

24.2.4 wallet - Show wallet details which include private key, address, public key and mnemonic

This command allows you to print wallet info.

```
$ aelf-command wallet -a C91b1SF5mMbenHZTfdfbJSkJcK7HMjeiuw...8qYjGsESanXR
AElf [Info]: Private Key      : 97ca9fbece296231f26bee0e493500810f...
↳cbd984f69a8dc22ec9ec89ebb00
AElf [Info]: Public Key      : 04c30dd0c3b5abfc85a11b15dabd0de926...
↳74fe04e92eabf2e4fef6445d9b9b11efe6f4b70c8e86644b72621f9987dc00bb1eab44a9bd7512ea53f93937a5d0
AElf [Info]: Address        : C91b1SF5mMbenHZTfdfbJSkJcK7HMjeiuw...8qYjGsESanXR
```

24.2.5 proposal - Create a proposal

There are three kinds of proposal contracts in AElf:

- AElf.ContractNames.Parliament
- AElf.ContractNames.Referendum
- AElf.ContractNames.Association

depending on your needs you can choose one and create a proposal.

- Get an organization address or create one

Get the default organization's address with the parliament contract (AElf.ContractNames.Parliament):

```
$ aelf-command call AElf.ContractNames.Parliament GetDefaultOrganizationAddress
✓ Fetching contract successfully!
✓ Calling method successfully!
AElf [Info]:
Result:
"BkcXRkykRC2etHp9hgFbw2ec1edx7ERBxYtbC97z3Q2bNCwc"
✓ Succeed!
```

BkcXRkykRC2etHp9hgFbw2ec1edx7ERBxYtbC97z3Q2bNCwc is the default organization address.

The default organization is an organization that contains all miners; every proposal under AElf.ContractNames.Parliament can only be released when it has got over 2/3 miners approval.

Create an organization with the Referendum contract (AElf.ContractNames.Referendum):

```
$ aelf-command send AElf.ContractNames.Referendum
✓ Fetching contract successfully!
? Pick up a contract method: CreateOrganization

If you need to pass file contents as a parameter, you can enter the relative or absolute
↳ path of the file

Enter the params one by one, type `Enter` to skip optional parameters:
? Enter the required param <tokenSymbol>: ELF
? Enter the required param <proposalReleaseThreshold.minimalApprovalThreshold>: 666
? Enter the required param <proposalReleaseThreshold.maximalRejectionThreshold>: 666
? Enter the required param <proposalReleaseThreshold.maximalAbstentionThreshold>: 666
? Enter the required param <proposalReleaseThreshold.minimalVoteThreshold>: 666
? Enter the required param <proposerWhiteList.proposers>: [
↳ "2hxDg6Pd2d4yU1A16PTZVMMrEDYEPR8oQojMDwWdax5LSBaxX"]
The params you entered is:
{
  "tokenSymbol": "ELF",
  "proposalReleaseThreshold": {
    "minimalApprovalThreshold": 666,
    "maximalRejectionThreshold": 666,
    "maximalAbstentionThreshold": 666,
    "minimalVoteThreshold": 666
  },
  "proposerWhiteList": {
    "proposers": [
```

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```

    "2hxDg6Pd2d4yU1A16PTZVMMrEDYEPR8oQojMDwWdax5LsBaxX"
  ]
}
}
✓ Succeed!
AElf [Info]:
Result:
{
  "TransactionId": "273285c7e8825a0af5291dd5d9295f746f2bb079b30f915422564de7a64fc874"
}
✓ Succeed!

```

- Create a proposal

```

$ aelf-command proposal
? Pick up a contract name to create a proposal: AElf.ContractNames.Parliament
? Enter an organization address: BkcXRkykRC2etHp9hgFfbw2ec1edx7ERBxYtbC97z3Q2bNCwc
? Select the expired time for this proposal: 2022/09/23 22:06
? Optional, input an URL for proposal description:
? Enter a contract address or name: AElf.ContractNames.Token
✓ Fetching contract successfully!
? Pick up a contract method: Transfer

If you need to pass file contents to the contractMethod, you can enter the relative or
↳ absolute path of the file instead

Enter required params one by one:
? Enter the required param <to>: 2hxDg6Pd2d4yU1A16PTZVMMrEDYEPR8oQojMDwWdax5LsBaxX
? Enter the required param <symbol>: ELF
? Enter the required param <amount>: 1000000000
? Enter the required param <memo>: test
AElf [Info]:
{ TransactionId:
  '09c8c824d2e3aeald6cd15b7bb6cefe4e236c5b818d6a01d4f7ca0b60fe99535' }
✓ loading proposal id...
AElf [Info]: Proposal id:
↳ "baf83ca4ec5b2a2f1e8016d09b21362c9345954a014379375f1a90b7afb43fb".
✓ Succeed!

```

You can get the proposal id, then get the proposal's status.

- Get proposal status

```

$ aelf-command call AElf.ContractNames.Parliament GetProposal
↳ baf83ca4ec5b2a2f1e8016d09b21362c9345954a014379375f1a90b7afb43fb
{
  ...
  "expiredTime": {
    "seconds": "1663942010",
    "nanos": 496000
  },
  "organizationAddress": "BkcXRkykRC2etHp9hgFfbw2ec1edx7ERBxYtbC97z3Q2bNCwc",
  "proposer": "2tj7Ea67fuQfVAtQZ3WBmTv7AAJ8S9D2L4g6PpRRJei6JXk7RG",

```

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```
"toBeReleased": false
}
```

✓ Succeed!

toBeReleased indicates whether you can release this proposal. By default, a proposal needs over 2/3 BP nodes approval.

- Release a proposal

You can release a proposal when it got approved.

```
$ aelf-command send AElf.ContractNames.Parliament Release
↳ bafe83ca4ec5b2a2f1e8016d09b21362c9345954a014379375f1a90b7afb43fb
AElf [Info]:
{ TransactionId:
  '09c8c824d2e3aea1d...cefe4e236c5b818d6a01d4f7ca0b60fe99535' }
```

Get the transaction result

```
$ aelf-command get-tx-result 09c8c824d2e3aea1d...cefe4e236c5b818d6a01d4f7ca0b60fe99535
AElf [Info]: {
  "TransactionId": "09c8c824d2e3aea1d...cefe4e236c5b818d6a01d4f7ca0b60fe99535",
  "Status": "MINED",
  "Logs": [
    {
      "Address": "25CecrU94dmMdbhC3LWMKxtoaL4Wv8PChGvVJM6PpkHAYvXEhB",
      "Name": "Transferred",
      "Indexed": [
        "CiIKIJTPGZ24g4eHwSVNLit8jgjFJeeYCEEYLDpFiCeCT0Bf",
        "EiIKIO0jJRxjHdRQmUTby8klRVsQYpwh0yUsnXYV3IrQg8N1",
        "GgNFTEY="
      ],
      "NonIndexed": "IICgt4fpBSomVC00MzFkMjc0Yi0zNWJjLTrjYzgtOGExZC1iODhhZTgxYzU2Zjc="
    }
  ],
  "Bloom":
  "AAAAAAAAABAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA",
  "BlockNumber": 28411,
  "BlockHash": "fa22e4eddf12a728895a608db99d40a4b21894f7c07df1a4fa8f0625eb914a2",
  "Transaction": {
    "From": "2tj7Ea67fuQfVatQZ3WBmTv7AAJ8S9D2L4g6PpRRJei6JXk7RG",
    "To": "29RDBXTqwnpWSPHGaTysQXW2E17YrQUCj7QhcEZDnhPb6ThHW",
    "RefBlockNumber": 28410,
    "RefBlockPrefix": "0P+eTw==",
    "MethodName": "Release",
    "Params": "\"ad868c1e0d74127dd746ccdf3443a09459c55cf07d247df053ddf718df258c86\"",
    "Signature": "DQcv55EBWunEFPXAbqZG200LO5T0Sq/s0A+/iuwv1TdQqIV4318HrqFLsGpx9m3+sp5mzhAnMlrG7CSxM6EuIgA="
  },
  "ReturnValue": "",
  "Error": null
}
```

If you want to call a contract method by creating a proposal and released it, the released transaction result could be confusing, you can use another `aelf-command` sub-command to get the readable result;

Take the example above which has transferred token by proposal, transferred result can be viewed by decoding the Logs field in the transaction result. Use `aelf-command event` to decode the results.

Pass the transaction id as a parameter:

```
$ aelf-command event 09c8c824d2e3aea1d...cefe4e236c5b818d6a01d4f7ca0b60fe99535
[Info]:
The results returned by
Transaction: 09c8c824d2e3aea1d...cefe4e236c5b818d6a01d4f7ca0b60fe99535 is:
[
  {
    "Address": "25CecrU94dmMdbhC3LWMKxtoaL4Wv8PChGvVJM6PxkHAYvXEhB",
    "Name": "Transferred",
    "Indexed": [
      "CiIKIJTPGZ24g4eHwSVNLit8jgjFJeeYCEEYLDpFiCeCT0Bf",
      "EiIKIO0jJRxjHdRQmUTby8klRVsqYpwhOyUsnXYV3IrQg8N1",
      "GgNFTEY="
    ],
    "NonIndexed": "IICgt4fpBSomVC00MzFkMjc0Yi0zNWJjLTrjYzgtOGExZC1iODhhZTgxYzU2Zjc=",
    "Result": {
      "from": "28Y8JA1i2cN6oHvdv7EraXJr9a1gY6D1PpJXw9QtRMRwKcBQMK",
      "to": "2oSMWm1tjRqVdfmrDL8dgrRvhWu1FP8wcZidjS6wPbuoVtxhEz",
      "symbol": "ELF",
      "amount": "2000000000000",
      "memo": "T-431d274b-35bc-4cc8-8a1d-b88ae81c56f7"
    }
  }
]
```

The `Result` field is the decoded result.

For more details, check the descriptions of `aelf-command event`.

24.2.6 deploy - Deploy a smart contract

This command has been deprecated, use `aelf-command send` or `aelf-command proposal` instead

Examples:

1. Use Genesis Contract to deploy a new smart contract

```
$ aelf-command get-chain-status
✓ Succeed
{
  "ChainId": "AELF",
  "Branches": {
    "41a8a1ebf037197b7e2f10a67d81f741d46a6af41775bcc4e52ab855c58c4375": 8681551,
    "ed4012c21a2fbf810db52e9869ef6a3fb0629b36d23c9be2e3692a24703b3112": 8681597,
    "13476b902ef137ed63a4b52b2902bb2b2fa5dbe7c256fa326c024a73dc63bcb3": 8681610
  },
  "NotLinkedBlocks": {},
}
```

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```

"LongestChainHeight": 8681610,
"LongestChainHash":
→ "13476b902ef137ed63a4b52b2902bb2b2fa5dbe7c256fa326c024a73dc63bcb3",
"GenesisBlockHash":
→ "cd5ce1bfa0cd97a1dc34f735c57bea2fcb9d88fc8f76bece2592fe7d82d5660c",
"GenesisContractAddress": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8",
"LastIrreversibleBlockHash":
→ "4ab84cdfe0723b191eedcf4d2ca86b0f64e57105e61486c21d98d562b14f2ab0",
"LastIrreversibleBlockHeight": 8681483,
"BestChainHash": "0dbc2176aded950020577552c92c82e66504ea109d4d6588887502251b7e932b
→ ",
"BestChainHeight": 8681609
}

# use GenesisContractAddress as a parameter of aelf-command send
# use contract method `DeploySmartContract` if the chain you are connecting to
→ requires no limit of authority
$ aelf-command send 2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8
→ DeploySmartContract
✓ Fetching contract successfully!

If you need to pass file contents as a parameter, you can enter the relative or
→ absolute path of the file

Enter the params one by one, type `Enter` to skip optional param:
? Enter the required param <category>: 0
? Enter the required param <code>: /Users/test/contract.dll
...

# use contract method `ProposeNewContract` if the chain you are connecting to
→ requires create new propose when deploying smart contracts
$ aelf-command send 2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8
→ ProposeNewContract
✓ Fetching contract successfully!

If you need to pass file contents as a parameter, you can enter the relative or
→ absolute path of the file

Enter the params one by one, type `Enter` to skip optional param:
? Enter the required param <category>: 0
? Enter the required param <code>: /Users/test/contract.dll
...

```

- You must input contract method parameters in the prompting way, note that you can input a relative or absolute path of contract file to pass a file to aelf-command, aelf-command will read the file content and encode it as a base64 string.
- After call ProposeNewContract, you can get proposal id and proposedContractInputHash later by running

```

$ aelf-command event
→ 34184cbc27c95bbc0a1bd676192c3afc380740ab61626e5d428ae17faf9ea984
[Info]:

```

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```

The results returned by
Transaction: 34184cbc27c95bbc0a1bd676192c3afc380740ab61626e5d428ae17faf9ea984 is:
[
...
{
  "Address": "pykr77ft9UUKJZLVq15wCH8PinBSjVRQ12sD1Ayq92mKFsj1i",
  "Name": "ContractProposed",
  "Indexed": [],
  "NonIndexed": "CiIKIK0dKXkwu/HDpZUf/tzjJSfcZ5XznUrE/C0XMtp4liqo",
  "Result": {
    "proposedContractInputHash":
    ↪ "ad1d297930bbf1c3a5951ffedce32527dc6795f39d4ac4fc2d1732da78962aa8"
  },
{
  "Address": "2JT8xzjR5zJ8xnBvdgBZdSjfbokFSbF5hDdpUCbXeWajfPDmsK",
  "Name": "ProposalCreated",
  "Indexed": [
    "EiIKIEknWCUo4/KJS/vDAf7u1R6JmLEfAcapRY1BZ9yogawl"
  ],
  "NonIndexed": "CiIKIFb/RK9tR/SjJn0z7d4AjUvw288KCwTRyXSYMMryQuC2",
  "Result": {
    "organizationAddress": "ZDcYStbBRACaEQh6K1nqPb2SHKPCTggB9E66onthFoGrVnkfi",
    "proposalId":
    ↪ "56ff44af6d47f4a3267d33edde008d4bf0dbcf0a0b04d1c9749830caf242e0b6"
  }
}
]

```

- Wait for the organization members to approve your proposal and you can release your proposal by calling `ReleaseApprovedContract`

```

$ aelf-command send 2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8
✓ Fetching contract successfully!
? Pick up a contract method: ReleaseApprovedContract

If you need to pass file contents as a parameter, you can enter the relative or
↪ absolute path of the file

Enter the params one by one, type `Enter` to skip optional param:
? Enter the required param <proposalId>: proposalId
? Enter the required param <proposedContractInputHash>: proposedContractInputHash
The params you entered is:
{
  "proposalId": proposalNewContract proposalId,
  "proposedContractInputHash": proposedContractInputHash
}
✓ Succeed!

```

- And then you can get code check proposal id from event of `ReleaseApprovedContract` transaction.

```
....
```

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```
{
  "Address": "2JT8xzjR5zJ8xnBvdgBZdSjfbokFSbF5hDdpUCbXeWaJfPDmsK",
  "Name": "ProposalCreated",
  "Indexed": [
    "EiIKIEknWCUo4/KJS/vDAf7u1R6JmLEfAcapRY1BZ9yogawl"
  ],
  "NonIndexed": "CiIKIAfOf/a3zIillggQjSl2N0Y3aEh8bRGK5ppBrc14CKSn",
  "Result": {
    "organizationAddress": "ZDcYStbBRACaEQh6K1nqPb2SHKPCTggB9E66onthFoGrVnkfi",
    "proposalId":
    ↪ "07ce7ff6b7cc88a59608108d297637463768487c6d118ae69a41adcd7808a4a7"
  }
}
```

- Wait for the code check pass, then you can release code check proposal by calling ReleaseCodeCheck

```
$ aelf-command send 2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8 -a
↪ 28Y8JA1i2cN6oHvdv7EraXJr9a1gY6D1PpJXw9QtRMRwKcBQMK -p 123
✓ Fetching contract successfully!
? Pick up a contract method: ReleaseCodeCheckedContract

If you need to pass file contents as a parameter, you can enter the relative
↪ or absolute path of the file

Enter the params one by one, type `Enter` to skip optional param:
? Enter the required param <proposalId>:
↪ 07ce7ff6b7cc88a59608108d297637463768487c6d118ae69a41adcd7808a4a7
? Enter the required param <proposedContractInputHash>:
↪ ad1d297930bbf1c3a5951ffedce32527dc6795f39d4ac4fc2d1732da78962aa8

The params you entered is:
{
  "proposalId":
  ↪ 07ce7ff6b7cc88a59608108d297637463768487c6d118ae69a41adcd7808a4a7,
  "proposedContractInputHash": proposedContractInputHash
}
✓ Succeed!
```

- Finally, you can get deployed contract address later by from event of ReleaseCodeCheckedContract transaction.

```
....
{
  ""Address"": ""pykr77ft9UUKJZLVq15wCH8PinBSjVRQ12sD1Ayq92mKFsJ1i"",
  ""Name"": ""ContractDeployed"",
  ""Indexed"": [
    "CiIKIJTPGZ24g4eHwSVNLit8jgjFJeeYCEEYLDpFiCeCT0Bf",
    "EiIKICAU/M9E2AWln6XZSUFRtWR1tXud95vPX1peinPpF7nC"
  ],
  ""NonIndexed"": ""GiIKIK/s1HKVrx1RU5ei3DVJvgc1muE6h2+xyCROHBTfsRqIIAE="",
  ""Result"": {
    ""author"": ""28Y8JA1i2cN6oHvdv7EraXJr9a1gY6D1PpJXw9QtRMRwKcBQMK"",
```

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```

        ""codeHash"": "
    ↪ "2014fccf44d805a59fa5d949416b4d6475b57b9df79bcf5f5a5e8a73e917b9c2"",
        ""address"": ""2LUmicHyH4RXrMjG4beDwuDsiWJESyLkgkwPdGTR8kahRzq5XS"",
        ""version"": 1
    }
}

```

24.2.7 event - Deserialize the result return by executing a transaction

Only transaction id is required as the parameter.

```

$ aelf-command event fe1974fde291e44e16c55db666f2c747323cdc584d616de05c88c8bae18ecceb
[Info]:
The results returned by
Transaction: fe1974fde291e44e16c55db666f2c747323cdc584d616de05c88c8bae18ecceb is:
[
  {
    "Address": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8",
    "Name": "ContractDeployed",
    "Indexed": [
      "CiIKIN206lDDGWbgbkomYr6+9+2B0JpHsuses3KfLwzHgSmu",
      "EiIKIDXZGwZLKqm78WpYDXuBlyd6Dv+RMjrgOUEnwamfIA/z"
    ],
    "NonIndexed": "GiIKIN206lDDGWbgbkomYr6+9+2B0JpHsuses3KfLwzHgSmu",
    "Result": {
      "author": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8",
      "codeHash": "35d91b064b2aa9bbf16a580d7b8197277a0eff91323ae0394127c1a99f200ff3",
      "address": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8"
    }
  }
]
✓ Succeed!

```

This command get the Log field of a transaction result and deserialize the Log field with the correspond protobuf descriptors.

A transaction may be related with several Contract Method's events, so the transaction result can include several Logs.

In each item:

- **Address:** the contract address.
- **Name:** name of event published from related contract method.
- **Indexed:** indexed data of event in type of base64
- **NoIndexed:** no indexed data of event in type of base64.
- **Result:** the decoded result, this is readable and you can use it and get what the fields means inside the Result by reading the contract documents or contract related protobuf files. In this example, you can read the [protobuf file](#);

24.2.8 send - Send a transaction

```
$ aelf-command send
✓ Enter the the URI of an AElf node ... http://13.231.179.27:8000
✓ Enter a valid wallet address, if you do not have, create one by aelf-command create.
→ ... D3vSjRYL8MpeRpvUDy85ktXijnBe2tHn8NTACsggUVteQCNGP
✓ Enter the password you typed when creating a wallet ... *****
✓ Enter contract name (System contracts only) or the address of contract ... AElf.
→ ContractNames.Token
✓ Fetching contract successfully!
? Pick up a contract method: Transfer

If you need to pass file contents as a parameter, you can enter the relative or absolute.
→ path of the file

Enter the params one by one, type `Enter` to skip optional param:
? Enter the required param <to>: C91b1SF5mMbenHZTfdfbJSkJcK7HMjeiuwfQu8qYjGsESanXR
? Enter the required param <symbol>: ELF
? Enter the required param <amount>: 1000000000
? Enter the required param <memo>: 'test command'
The params you entered is:
{
  "to": "C91b1SF5mMbenHZTfdfbJSkJcK7HMjeiuwfQu8qYjGsESanXR",
  "symbol": "ELF",
  "amount": 1000000000,
  "memo": "'test command'"
}
✓ Succeed!
AElf [Info]:
Result:
{
  "TransactionId": "85d4684cb6e4721a63893240f73f675ac53768679c291abeb54974ff4e063bb5"
}
✓ Succeed!
```

```
aelf-command send AElf.ContractNames.Token Transfer '{"symbol": "ELF", "to":
→ "C91b1SF5mMbenHZTfdfbJSkJcK7HMjeiuwfQu8qYjGsESanXR", "amount": "1000000"}'
```

24.2.9 call - Call a read-only method on a contract

```
$ aelf-command call
✓ Enter the the URI of an AElf node ... http://13.231.179.27:8000
✓ Enter a valid wallet address, if you do not have, create one by aelf-command create.
→ ... D3vSjRYL8MpeRpvUDy85ktXijnBe2tHn8NTACsggUVteQCNGP
✓ Enter the password you typed when creating a wallet ... *****
✓ Enter contract name (System contracts only) or the address of contract ... AElf.
→ ContractNames.Token
✓ Fetching contract successfully!
? Pick up a contract method: GetTokenInfo

If you need to pass file contents as a parameter, you can enter the relative or absolute.
```

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↪ path of the file

Enter the params one by one, `type`Enter`` to skip optional param:

? Enter the required param <symbol>: ELF

The params you entered is:

```
{
  "symbol": "ELF"
}
```

✓ Calling method successfully!

AElf [Info]:

Result:

```
{
  "symbol": "ELF",
  "tokenName": "Native Token",
  "supply": "99732440917954549",
  "totalSupply": "100000000000000000",
  "decimals": 8,
  "issuer": "FAJcKnSpbViZfAufBFzX4nC8HtuT93rxUS4VCMACUwXWYurC2",
  "isBurnable": true,
  "issueChainId": 9992731,
  "burned": "267559132045477"
}
```

✓ Succeed!

```
aelf-command call AElf.ContractNames.Token GetTokenInfo '{"symbol":"ELF"}'
```

24.2.10 get-chain-status - Get the current status of the block chain

\$ aelf-command get-chain-status

✓ Succeed

```
{
  "ChainId": "AELF",
  "Branches": {
    "59937e3c16860dedf0c80955f4995a5604ca43ccf39cd52f936fb4e5a5954445": 4229086
  },
  "NotLinkedBlocks": {},
  "LongestChainHeight": 4229086,
  "LongestChainHash": "59937e3c16860dedf0c80955f4995a5604ca43ccf39cd52f936fb4e5a5954445",
  "GenesisBlockHash": "da5e200259320781a1851081c99984fb853385153991e0f00984a0f5526d121c",
  "GenesisContractAddress": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8",
  "LastIrreversibleBlockHash":
  ↪ "497c24ff443f5cbd33da24a430f5c6c5e0be2f31651bd89f4ddf2790bcbb1906",
  "LastIrreversibleBlockHeight": 4229063,
  "BestChainHash": "59937e3c16860dedf0c80955f4995a5604ca43ccf39cd52f936fb4e5a5954445",
  "BestChainHeight": 4229086
}
```

24.2.11 get-tx-result - Get a transaction result

```
$ aelf-command get-tx-result
✓ Enter the the URI of an AElf node ... http://13.231.179.27:8000
✓ Enter a valid transaction id in hex format ...  

↳ 7b620a49ee9666c0c381fdb33f94bd31e1b5eb0fdffa081463c3954e9f734a02
✓ Succeed!
{ TransactionId:
  '7b620a49ee9666c0c381fdb33f94bd31e1b5eb0fdffa081463c3954e9f734a02',
  Status: 'MINED',
  Logs: null,
  Bloom:
    ↳ 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
    ↳ ',
  BlockNumber: 7900508,
  BlockHash:
    'a317c5ecf4a22a481f88ab08b8214a8e8c24da76115d9ddcef4afc9531d01b4b',
  Transaction:
    { From: 'D3vSjRYL8MpeRpvUDy85ktXijnBe2tHn8NTACsggUVteQCNGP',
      To: 'WnV9Gv3gioSh3Vgaw8SSB96nV8fWUNxuVozCf6Y14e7RXyGaM',
      RefBlockNumber: 7900503,
      RefBlockPrefix: 'Q6WLSQ==',
      MethodName: 'GetTokenInfo',
      Params: '{ "symbol": "ELF" }',
      Signature:
        ↳ 'JtSpWbMX13tiJD0klMSJQyPBa0aRNFY4hTh3hltdWqhBpv4IRTbjjZfQj39lbBSC0y68vnLg6rUerEcyCsqwfgE=
        ↳ ' },
  ReadableReturnValue:
    '{ "symbol": "ELF", "tokenName": "elf token", "supply": "10000000000", "totalSupply":
    ↳ "10000000000", "decimals": 2, "issuer":
    ↳ "2gaQh4uxg6tzzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8", "isBurnable": true }',
  Error: null }
```

24.2.12 get-blk-height - Get the block height

```
$ aelf-command get-blk-height
✓ Enter the the URI of an AElf node ... http://13.231.179.27:8000
> 7902091
```

24.2.13 get-blk-info - Get the block info by a block height or a block hash

You can pass a block height or a block hash to this sub-command.

```
$ aelf-command get-blk-info
✓ Enter the the URI of an AElf node: http://13.231.179.27:8000
✓ Enter a valid height or block hash: 123
✓ Include transactions whether or not: no / yes
{ BlockHash:
```

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| | |
|----------|---|
| aelf | instance of aelf-sdk, connect to |
| | http://13.231.179.27:8000 |
| _account | instance of AElf wallet, wallet address |
| | is |
| | 2Ue31YTuB5Szy7cncr3SCEGU2gtGi5uMQBYarYUR... |
| | 5oGin1sys6H |

24.2.15 dapp-server - Start a socket.io server for supplying services for dApps

If you're developing a dApp and you need an environment to hold wallet info and connect to the AElf chain, you can use this sub-command to start a server for dApp local development.

```
$ aelf-command dapp-server
AElf [Info]: DApp server is listening on port 35443

# or listen on a specified port
$ aelf-command dapp-server --port 40334
AElf [Info]: DApp server is listening on port 40334
```

This server uses Socket.io to listen on local port 35443 and you can use [aelf-bridge](#) to connect to this server like this:

```
import AElfBridge from 'aelf-bridge';
const bridgeInstance = new AElfBridge({
  proxyType: 'SOCKET.IO',
  socketUrl: 'http://localhost:35443',
  channelType: 'ENCRYPT'
});
// connect to dapp-server
bridgeInstance.connect().then(console.log).catch(console.error);
```

checkout more information in [aelf-bridge](#) and [aelf-bridge-demo](#).

WALLET AND BLOCK EXPLORER

25.1 Explorer

[Github](#)

Currently, the explorer provides functions such as viewing blocks, transactions, purchasing resources, voting and node campaigning as well as viewing contracts.

25.2 iOS/Android Wallet

iOS/Android Wallet provides basic asset management and cross-chain trading capabilities. It also provides an open application platform for developers to access the wallet according to the usage document of the wallet SDK.

25.3 Web Wallet

[Github](#)

The Web Wallet provides basic transaction related functionality.

25.3.1 Explorer-api

To get more information by code

Block

Get Block List

```
URL: api/all/blocks?limit={limit}&page={page}
Method: GET
SuccessResponse:
{
  "total": 5850,
  "blocks": [
    {
      "block_hash":
      ↪ "7e1c2fb6d3cc5e8c2cef7d75de9c1adf0e25e9d17d4f22e543fa20f5f23b20e9",
```

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```

        "pre_block_hash":
        ↪ "6890fa74156b1a88a3ccef1fef72f4f78ff2755ffcd4fb5434ed7b3c153061f5",
        "chain_id": "AELF",
        "block_height": 5719,
        "tx_count": 1,
        "merkle_root_tx":
        ↪ "47eabbc7a499764d0b25c7216ba75fe39717f9866a0716c8a0d1798e64852d84",
        "merkle_root_state":
        ↪ "d14e78dc3c7811b7c17c8b04ebad9e547c35b3faa8bfcc9189b8c12e9f6a4aae",
        "time": "2019-04-27T02:00:34.691118Z"
    },
    {
        "block_hash":
        ↪ "6890fa74156b1a88a3ccef1fef72f4f78ff2755ffcd4fb5434ed7b3c153061f5",
        "pre_block_hash":
        ↪ "f1098bd6df58acf74d8877529702dffcf444cb401fc8236519606aa9165d945ae",
        "chain_id": "AELF",
        "block_height": 5718,
        "tx_count": 1,
        "merkle_root_tx":
        ↪ "b29b416148b4fb79060eb80b49bb6ac25a82da2d7a1c5d341e0bf279a7c57362",
        "merkle_root_state":
        ↪ "4dbef401f6d9ed303cf1b5e609a64b1c06a7fb77620b9d13b0e4649719e2fe55",
        "time": "2019-04-27T02:00:34.691118Z"
    },
    {
        "block_hash":
        ↪ "f1098bd6df58acf74d8877529702dffcf444cb401fc8236519606aa9165d945ae",
        "pre_block_hash":
        ↪ "1fbdf3a4fb3c41e9ddf25958715815d9d643dfb39e1aaa94631d197e9b1a94bb",
        "chain_id": "AELF",
        "block_height": 5717,
        "tx_count": 1,
        "merkle_root_tx":
        ↪ "776abba03d66127927edc6437d406f708b64c1653a1cc22af9c490aa4f0c22dc",
        "merkle_root_state":
        ↪ "ccc32ab23d619b2b8e0e9b82a53bb66b3a6d168993188b5d3f7f0ac2cb17206f",
        "time": "2019-04-27T02:00:26.690003Z"
    },
]
}

```

Get Block List By Block Hash

```

URL: api/block/transactions?limit={limit}&page={page}&order={order}&block_hash={block_
↳hash}
Method: GET
SuccessResponse:
{
  "transactions": [
    {
      "tx_id": "209ceb8ee8eeb2c55db7783c48ec0b1adf6badba89fc7ddb86e968601027cbb",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 590,
      "address_from": "csoxW4vTJNT9gdvyWS6W7UqEdkSo9pWyJqBoGSnUHXVnj4ykJ",
      "address_to": "2gaQh4uxg6tzyH1ADLoDxvHA14FMpzEiMqsQ6sDG5iHT8cmjp8",
      "params": "",
      "method": "DeploySmartContract",
      "block_hash":
↳"79584a99b7f5da5959a26ff02cbe174d632eb5ef3c6c8d5192de48b6f5584c8d",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T06:47:00.265604Z"
    },
    {
      "tx_id": "d9398736920a5c87ea7cae46c265efa84ac7be4cf8edd37bea54078abef1b44c",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 590,
      "address_from": "2EyPedNTscFK5EwR8FqTrCeW2LZzuPQ7vr18Y5QWuEUApdCkM6",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "NextRound",
      "block_hash":
↳"79584a99b7f5da5959a26ff02cbe174d632eb5ef3c6c8d5192de48b6f5584c8d",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T06:47:00.265604Z"
    }
  ]
}

```

Transactions

Get Transactions List

```

URL: api/all/transactions?limit={limit}&page={limit}
Method: GET
SuccessResponse:
{
  "total": 1179,
  "transactions": [

```

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```

    {
      "tx_id": "c65d1206e65aaf2e7e08cc818c372ff2c2947cb6cbec746efe6a5e20b7adefa9",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1064,
      "address_from": "grSAEQ5vJ7UfCN2s1v4fJJnk98bu4SHa2hpQkQ9HT88rmaZLz",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "NextRound",
      "block_hash":
      ↪ "8c922b20164ad3774b56d19673154f383ed89656cbd56433d1681c8c3a4dcab9",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T07:18:36.636701Z"
    },
    {
      "tx_id": "4780a7b2737b6f044894719b9bb4cb09862c0b4a7cae267131a0b5c3e7c12850",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1063,
      "address_from": "QUYYqzTQmugruHYmuJVftwmVjnUM82pXnMTnT5jh55qwZKrMw",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "UpdateValue",
      "block_hash":
      ↪ "381114b86b09886f59956851a1d47d8442b29f44f3785dade3c667ca320e23bb",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T07:18:36.636701Z"
    },
    {
      "tx_id": "0230385e3f060059d2a62addac09ad6d01f96d32ec076cfbf44c6a3b70c6e092",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1062,
      "address_from": "zizPhdDpQCZxMChMxn1oZ4ttJGJUo61Aocg5BpTYvzLQGmBjT",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "NextRound",
      "block_hash":
      ↪ "06a3ceb783480f4cf5b8402f6749617093d9ea5f9a053f65e86554aeed6d98f4",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T07:18:28.635113Z"
    }
  ],
}

```


Get Transactions List By Address

```

URL: api/address/transactions?contract_address={contract_address}&limit={limit}&page=
    ↳ {page}&address={address}
Method: GET
SuccessResponse:
{
  "total": 1179,
  "transactions": [
    {
      "tx_id": "c65d1206e65aaf2e7e08cc818c372ff2c2947cb6cbec746efe6a5e20b7adefa9",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1064,
      "address_from": "grSAEQ5vJ7UfCN2s1v4fJJnk98bu4SHa2hpQkQ9HT88rmaZLz",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "NextRound",
      "block_hash":
    ↳ "8c922b20164ad3774b56d19673154f383ed89656cbd56433d1681c8c3a4dcab9",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T07:18:36.636701Z"
    },
    {
      "tx_id": "4780a7b2737b6f044894719b9bb4cb09862c0b4a7cae267131a0b5c3e7c12850",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1063,
      "address_from": "QUYYqzTQmugruHYmuJVftwmVjnUM82pXnMTnT5jh55qwZKrMw",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "UpdateValue",
      "block_hash":
    ↳ "381114b86b09886f59956851a1d47d8442b29f44f3785dade3c667ca320e23bb",
      "quantity": 0,
      "tx_status": "Mined",
      "time": "2019-04-26T07:18:36.636701Z"
    },
    {
      "tx_id": "0230385e3f060059d2a62addac09ad6d01f96d32ec076cfbf44c6a3b70c6e092",
      "params_to": "",
      "chain_id": "AELF",
      "block_height": 1062,
      "address_from": "zizPhdDpQCZxMChMxn1oZ4ttJGJUo61Aocg5BpTYvzLQGmBjT",
      "address_to": "xw6U3FRE5H8rU3z8vAgF9ivnWSkxULK5cibdZzMC9UWf7rPJf",
      "params": "",
      "method": "NextRound",
      "block_hash":
    ↳ "06a3ceb783480f4cf5b8402f6749617093d9ea5f9a053f65e86554aeed6d98f4",
      "quantity": 0,
      "tx_status": "Mined",
    }
  ]
}

```

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```

        "time": "2019-04-26T07:18:28.635113Z"
    },
]
}

```

TPS

Get TPS Record

URL: `api/tps/list?start_time={unix_timestamp}&end_time={unix_timestamp}&order={order}`

Method: GET

SuccessResponse:

```

{
  "total": 178,
  "tps": [
    {
      "id": 12498,
      "start": "2019-11-22T01:12:14Z",
      "end": "2019-11-22T01:13:14Z",
      "txs": 1878,
      "blocks": 120,
      "tps": 31,
      "tpm": 1878,
      "type": 1
    },
    {
      "id": 12499,
      "start": "2019-11-22T01:13:14Z",
      "end": "2019-11-22T01:14:14Z",
      "txs": 1889,
      "blocks": 117,
      "tps": 31,
      "tpm": 1889,
      "type": 1
    },
    {
      "id": 12500,
      "start": "2019-11-22T01:14:14Z",
      "end": "2019-11-22T01:15:14Z",
      "txs": 1819,
      "blocks": 114,
      "tps": 30,
      "tpm": 1819,
      "type": 1
    },
    {
      "id": 12501,
      "start": "2019-11-22T01:15:14Z",
      "end": "2019-11-22T01:16:14Z",
      "txs": 1779,

```

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```
        "blocks": 105,  
        "tps": 30,  
        "tpm": 1779,  
        "type": 1  
    }  
]  
}
```


AELF-WEB-EXTENSION

You can get more information in [Github](#)

26.1 For User

release version, please waiting

dev version

If you are using qq browser,etc, you can add the extention too.

26.1.1 Notice

Note: Using [File:///](#) protocol may can not use the extension // https://developer.chrome.com/extensions/match_patterns Note: Access to file URLs isn't automatic. The user must visit the extensions management page and opt in to file access for each extension that requests it.

26.2 For Dapp Developers

26.2.1 Interaction Flow

- Make sure the user get the Extension
- Connect Chain
- Initialize Contract
- Call contract methods

26.2.2 How to use

If you need complete data structure. you can [click here](#)

- *Check Extension Demo*
- *GET_CHAIN_STATUS*
- *CALL_AELF_CHAIN*
- *LOGIN*
- *INIT_AELF_CONTRACT*
- *CALL_AELF_CONTRACT / CALL_AELF_CONTRACT_READONLY*
- *CHECK_PERMISSION*
- *SET_CONTRACT_PERMISSION*
- *REMOVE_CONTRACT_PERMISSION*
- *REMOVE_METHODS_WHITELIST*

26.3 Data Format

```
NightElf = {
  histories: [],
  keychain: {
    keypairs: [
      {
        name: 'your keypairs name',
        address: 'your keypairs address',
        mnemonic: 'your keypairs mnemonic',
        privateKey: 'your keypairs privateKey',
        publicKey: {
          x: 'you keupairs publicKey',
          y: 'you keupairs publicKey'
        }
      }
    ],
    permissions: [
      {
        chainId: 'AELF',
        contractAddress: 'contract address',
        contractName: 'contract name',
        description: 'contract description',
        github: 'contract github',
        whitelist: {
          Approve: {
            parameter1: 'a',
            parameter2: 'b',
            parameter3: 'c'
          }
        }
      }
    ]
  }
}
```

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```

    }
  }
}

```

26.3.1 Demo of Checking the Extension

```

let nightElfInstance = null;
class NightElfCheck {
  constructor() {
    const readyMessage = 'NightElf is ready';
    let resovleTemp = null;
    this.check = new Promise((resolve, reject) => {
      if (window.NightElf) {
        resolve(readyMessage);
      }
      setTimeout(() => {
        reject({
          error: 2000001,
          message: 'timeout / can not find NightElf / please install the_
↪extension'
        });
      }, 1000);
      resovleTemp = resolve;
    });
    document.addEventListener('NightElf', result => {
      console.log('test.js check the status of extension named nightElf: ',_
↪result);
      resovleTemp(readyMessage);
    });
  }
  static getInstance() {
    if (!nightElfInstance) {
      nightElfInstance = new NightElfCheck();
      return nightElfInstance;
    }
    return nightElfInstance;
  }
}
const nightElfCheck = NightElfCheck.getInstance();
nightElfCheck.check.then(message => {
  // connectChain -> Login -> initContract -> call contract methods
});

```

26.3.2 GET_CHAIN_STATUS

You can see the demo [./devDemos/test.html](#). [demo.js just a draft]

If you want to check Token Transfer Demo. You can [click here](#)

The methods calls act the same as the methods call of the `aelf-sdk.js`

Note: '...' stands for omitted data.

[illegible]

26.3.3 CALL_AELF_CHAIN

```
const txid = 'c45edfcc86f4f528cd8e30634fa4ac53801aae05365cfefc3bf9b652fe5768';  
aelf.chain.getTxResult(txid, (err, result) => {  
    console.log('>>>>>>>>>> getTxResult >>>>>>>>>>');  
    console.log(err, result);  
});  
  
// result = {  
//     Status: "NotExisted"  
//     TransactionId: "ff5bcd126f9b7f22bbfd0816324390776f10ccb3fe0690efc84c5fcf6bdd3fc6"  
// }
```


26.3.4 LOGIN

```
aelf.login({
  appName: 'hzzTest',
  chainId: 'AELF',
  payload: {
    method: 'LOGIN',
    contracts: [{
      chainId: 'AELF',
      contractAddress: '4rkKQpsRFt1nU6weAHuJ6CfQDqo6dxruU3K3wNUFr6ZwZYc',
      contractName: 'token',
      description: 'token contract',
      github: ''
    }, {
      chainId: 'AELF TEST',
      contractAddress: '2Xg2HKH8vusnFMQsHCXW1q3vys5JxG5ZnjiGwNDLrrpb9Mb',
      contractName: 'TEST contractName',
      description: 'contract description',
      github: ''
    }
  ]
})
}, (error, result) => {
  console.log('login>>>>>>>>>>>>', result);
});

// keychain = {
//   keypairs: [{
//     name: 'your keypairs name',
//     address: 'your keypairs address',
//     mnemonic: 'your keypairs mnemonic',
//     privateKey: 'your keypairs privateKey'
//     publicKey: {
//       x: 'f79c25eb.....',
//       y: '7fa959ed.....'
//     }
//   }],
//   permissions: [{
//     appName: 'hzzTest',
//     address: 'your keyparis address',
//     contracts: [{
//       chainId: 'AELF',
//       contractAddress: '4rkKQpsRFt1nU6weAHuJ6CfQDqo6dxruU3K3wNUFr6ZwZYc',
//       contractName: 'token',
//       description: 'token contract',
//       github: "
//     }],
//     domain: 'Dapp domain'
//   }]
// }
```

26.3.5 INIT_AELF_CONTRACT

```
// In aelf-sdk.js wallet is the really wallet.  
// But in extension sdk, we just need the address of the wallet.  
const tokenContract;  
const wallet = {  
    address: '2JqnxvDiMNzbSgme2oxpqUFpUYfMjTpNBGCLP2CsWjpbHdu'  
};  
// It is different from the wallet created by Aelf.wallet.getWalletByPrivateKey();  
// There is only one value named address;  
aelf.chain.contractAtAsync(  
    '4rkKQpsRFt1nU6weAHuJ6CfQDqo6dxruU3K3wNUFr6ZwZYc',  
    wallet,  
    (error, result) => {  
        console.log('>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>' contractAtAsync >>>>>>>>>>>>>>>>>>');  
        console.log(error, result);  
        tokenContract = result;  
    }  
);  
  
// result = {  
//     Approve: f (),  
//     Burn: f (),  
//     ChargeTransactionFees: f (),  
//     ClaimTransactionFees: f (),  
//     ....  
// }
```

26.3.6 CALL_AELF_CONTRACT / CALL_AELF_CONTRACT_READONLY

[illegible]

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```
// If you use tokenContract.GetBalance.call this method is only applicable to queries
↳ that do not require extended authorization validation.(CALL_AELF_CONTRACT_READONLY)
// If you use tokenContract.Approve this requires extended authorization validation
↳ (CALL_AELF_CONTRACT)

// tokenContract.GetBalance.call(payload, (error, result) => {})
// result = {
//     symbol: "AELF",
//     owner: "65dDNxzc35jESiidFXN5JV8Z7pCwaFnepuYQToNefSgqk9",
//     balance: 0
// }
```

26.3.7 CHECK_PERMISSION

```
aelf.checkPermission({
    appName: 'hzzTest',
    type: 'address', // if you did not set type, it always get by domain.
    address: '4WBgSL2fSem9ABD4LLZBpwP8eEymVSS1AyTBCqXjt5cfxXK'
}, (error, result) => {
    console.log('checkPermission>>>>>>>>>>>>>>', result);
});

// result = {
//     ...,
//     permissions:[
//         {
//             address: '...',
//             appName: 'hzzTest',
//             contracts: [{
//                 chainId: 'AELF',
//                 contractAddress: '4rkKQpsRFt1nU6weAHuJ6CfQDqo6dxruU3K3wNUFr6ZWZYc',
//                 contractName: 'token',
//                 description: 'token contract',
//                 github: "
//             },
//             {
//                 chainId: 'AELF TEST',
//                 contractAddress: 'TEST contractAddress',
//                 contractName: 'TEST contractName',
//                 description: 'contract description',
//                 github: "
//             }
//         ],
//         domian: 'Dapp domain'
//     ]
// }
```

26.3.8 SET_CONTRACT_PERMISSION

```

aelf.setContractPermission({
  appName: 'hzzTest',
  hainId: 'AELF',
  payload: {
    address: '2JqnxvDiMNzbSgme2oxpqUFpUYfMjTpNBGCLP2CsWjpbHdu',
    contracts: [{
      chainId: 'AELF',
      contractAddress: 'TEST contractAddress',
      contractName: 'AAAA',
      description: 'contract description',
      github: ''
    }]
  }
}, (error, result) => {
  console.log('>>>>>>>>>>>>', result);
});

// keychain = {
//   keypairs: {...},
//   permissions: [{
//     appName: 'hzzTest',
//     address: 'your keyparis address',
//     contracts: [{
//       chainId: 'AELF',
//       contractAddress: '4rkKQpsRFt1nU6weAHuJ6CfQDqo6dxruU3K3wNUFr6ZwZYc',
//       contractName: 'token',
//       description: 'token contract',
//       github: "",
//       whitelist: {}
//     }],
//     {
//       chainId: 'AELF',
//       contractAddress: 'TEST contractAddress',
//       contractName: 'AAAA',
//       description: 'contract description',
//       github: ""
//     }
//   ],
//   domain: 'Dapp domain'
// }

```


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```
//      whitelist: {}  
//      },  
//      domain: 'Dapp domain'  
//    }]  
// }
```

26.4 For Extension Developers

1. Download the code

```
git clone https://github.com/hzz780/aelf-web-extension.git
```

2. Install dependent

```
npm install
```

3. Run webpack

```
webpack -w
```

4. Add to the browser

```
open development mode, add the webpack output app/public.
```

26.5 Project Information

We use [ECDH](#) to use public key to encrypt data and private key to decrypt data.

27.1 Open source development

We want to stay as open as possible during AElf's development. For this we follow a certain amount rules and guidelines to try and keep the project as accessible as possible. Our project is open source and we publish our code as well as current issues online. It is our responsibility to make it as transparent as possible.

AElf is a collaborative project and welcomes outside opinion and requests/discussion for modifications of the code, but since we work in an open environment all collaborator need to respect a certain standard. We clarify this in the following standard:

-

We encourage collaborators that want to participate to first read the white paper and the documentations to understand the ideas surrounding AElf. Also a look at our code and architecture and the way current functionality has been implemented. After this if any questions remain, you can open an issues on GitHub stating as clearly as possible what you need to clarify.

Finally, any collaborator wanting to participate in the development should open a pull request following our rules. It will be formally reviewed and discussed through GitHub and if validated by core members of AElf, can be merged.

27.2 Deployment

For versioning we use the semver versioning system: <https://semver.org>

Daily build

Integrated with github we have cron job that will publish the latest version of devs myget packets.

- MyGet: <https://www.myget.org/gallery/aelf-project-dev>

Release branch

- Nuget: <https://www.nuget.org/profiles/AElf>

27.3 Testing

Testing is one of the most important aspects of software development. Non tested software is difficult to improve. There are two main types of testing that we perform: unit testing and performance testing. The unit testing covers functionality and protocol, which is an essential part of a blockchain system. The performance tests are also very important to show that modifications have not impacted the speed at which our nodes process incoming transactions and blocks.

27.3.1 Unit testing

To ensure the quality of our system and avoid regression, as well as permit safe modifications, we try to cover as much of our functionality as possible through unit tests. We mostly use the xUnit framework and follow generally accepted best practices when testing. Our workflow stipulates that for any new functionality, we cover it with tests and make sure other unit tests.

27.3.2 Perf testing

The performance testing is crucial to AElf since a strong point of our system is speed.

27.4 Monitoring

- Server monitoring: Zabbix monitors instances of aelf metrics like cpu, db...
- Chain monitoring: project on github with Grafana dashboard from Influxdb
- Akka monitoring: monitor actors.

QUICKSTART

28.1 Manual build & run the sources

This method is not as straightforward as the docker quickstart but is a lot more flexible. If your aim is to develop some dApps it's better you follow these more advanced ways of launching a node. This section will walk you through configuring, running and interacting with an AElf node.

First, if you haven't already done it, clone our [repository](#)

```
git clone https://github.com/AElfProject/AElf.git aelf
cd aelf/src
```

Navigate into the newly created **aelf** directory.

28.1.1 Generating the nodes account

First you need to install the **aelf-command** command packet. Open a terminal and enter the following command:

```
npm i -g aelf-command
```

Windows Note: it's possible that you get some errors about python not being installed, you can safely ignore these.

After installing **aelf-command** you can use the following command to create an account/key-pair:

```
aelf-command create
```

The command prompts for a password, enter it and don't forget it. The output of the command should look something like this:

```
Your wallet info is :
Mnemonic           : great mushroom loan crisp ... door juice embrace
Private Key        : e038eea7e151eb451ba2901f7...b08ba5b76d8f288
Public Key         : 0478903d96aa2c8c0...
↳ 6a3e7d810cacd136117ea7b13d2c9337e1ec88288111955b76ea
Address            : 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
✓ Save account info into a file? ... no / yes
✓ Enter a password ... *****
✓ Confirm password ... *****
✓
Account info has been saved to "/Users/xxx/.local/share/**aelf**/keys/2Ue31YTuB5Szy7cnr..
↳ .Gi5uMQBYarYUR5oGin1sys6H.json"
```

In the next steps of the tutorial you will need the **Public Key** and the **Address** for the account you just created. You'll notice the last line of the commands output will show you the path to the newly created key. The **aelf** is the data directory (datadir) and this is where the node will read the keys from.

Note that a more detailed section about the cli can be found [command line interface](#).

28.1.2 Node configuration

We have one last step before we can run the node, we have to set up some configuration. Navigate into the **AElf.Launcher** directory:

```
cd AElf.Launcher/
```

This folder contains the default **appsettings.json** file, with some default values already given. There's still some fields that are empty and that need configuring. This will require the information printed during the creation of the account. Open the **appsettings.json** file and edit the following sections.

The account/key-pair associated with the node we are going to run:

```
{
  "Account": {
    {
      "NodeAccount": "2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H",
      "NodeAccountPassword": "*****"
    },
  },
}
```

The *NodeAccount* field corresponds to the address, you also have to enter the password that you entered earlier.

```
{
  "InitialMinerList" : [
    "0478903d96aa2c8c0...6a3e7d810cacd136117ea7b13d2c9337e1ec88288111955b76ea"
  ],
}
```

This is a configuration that is used to specify the initial miners for the DPoS consensus, for now just configure one, it's the accounts public key that was printed during the account creation.

Note that if your Redis server is on another host listening on a different port than the default, you will also have to configure the connection strings (port/db number):

```
{
  "ConnectionStrings": {
    "BlockchainDb": "redis://localhost:6379?db=1",
    "StateDb": "redis://localhost:6379?db=1"
  },
}
```

We've created an account/key-pair and modified the configuration to use this account for the node and mining, we're now ready to launch the node.

28.1.3 Launch and test

Now we will build and run the node with the following commands:

```
dotnet build AElf.Launcher.csproj --configuration Release
dotnet bin/Release/net6.0/AElf.Launcher.dll > aelf-logs.logs &
cd ..
```

You now should have a node that's running, to check this run the following command that will query the node for its current block height:

```
aelf-command get-blk-height -e http://127.0.0.1:8000
```

28.1.4 Cleanup

To stop the node you can simply find and kill the process:

On mac/Linux:

```
ps -f | grep [A]Elf.Launcher.dll | awk '{print $2}'
```

On Windows (Powershell):

```
Get-CimInstance Win32_Process -Filter "name = 'dotnet.exe'" | select CommandLine,
↳ ProcessId | Where-Ob
ject {$_.CommandLine -like "*AElf.Launcher.dll"} | Stop-Process -ID {$_.ProcessId}
```

If needed you should also clean your redis database, with either of the following commands:

```
redis-cli FLUSHALL (clears all dbs)
```

```
redis-cli -n <database_number> FLUSHDB (clear a specified db)
```

28.1.5 Extra

For reference and after you've started a node, you can get infos about an account with the *aelf-command console* command:

```
aelf-command console -a 2Ue31YTuB5Szy7cnnr3SCEGU2gtGi5uMQBYarYUR5oGin1sys6H
```

✓ Enter the password you typed when creating a wallet ... *****

✓ Succeed!

Welcome to aelf interactive console. Ctrl + C to terminate the program. Double tap Tab↳
↳ to list objects

| NAME | DESCRIPTION |
|----------|--|
| AElf | imported from aelf-sdk |
| aelf | the instance of an aelf-sdk, connect to http://127.0.0.1:8000 |
| _account | the instance of an AElf wallet, address |

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| |
|--|
| is |
| 2Ue31YTuB5Szy7cnr3SCEGU2gtGi5uMQBYarYUR... |
| 5oGin1sys6H |