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# merkle-bridge

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## What is the Aergo Merkle bridge ?

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The Aergo Merkle bridge is an efficient and decentralized way of connecting blockchains.

Release blog article: <https://medium.com/aergo/the-aergo-merkle-bridge-explained-d95f7dcec510>.

In order to transfer an asset from one blockchain to another blockchain, it should be locked on it's origin chain and minted on the destination chain. At all times the minted assets should be pegged to the locked assets.

The Aergo Merkle Bridge enables decentralized custody and efficient minting of assets.

At regular intervals, a proposer publishes the block state root of each chain on the other connected chain's oracle contract. The state root is recorded only if it has been signed by 2/3 of validators. Validators only sign the general block state root, and the proposer creates a Merkle proof, proving that the bridge contract storage state is included in the general block state. Users can then independently mint assets on the destination bridge contract by verifying a merkle proof of their locked assets with the anchored storage root.

The proposers do not need to watch and validate user transfers: the benefit of the merkle bridge design comes from the fact that validators simply make sure that the state roots they sign are correct. Since onchain signature verification is only done once per root anchor, it is possible to use a large number of validators for best safety and censorship resistance.

## 1.1 Getting started

### 1.1.1 Download

```
$ git clone git@github.com:aergoio/merkle-bridge.git
```

### 1.1.2 Install

Install dependencies

```
$ cd merkle-bridge
$ virtualenv -p python3 venv
$ source venv/bin/activate
$ pip install -r requirements.txt
```

### Optional dev dependencies (lint, testing...)

```
$ pip install -r dev-dependencies.txt
```

Now you can start using the bridge tools to:

- create a configuration file with the cli
- deploy a new bridge
- start a proposer
- start a validator
- update bridge settings
- transfer assets through the bridge with the cli

## 1.2 Using the Aergo CLI

### 1.2.1 CLI for the proposer/validator

Start the cli:

```
$ python3 -m aergo_cli.main
```

The first step is to create a config file or load an existing one

[illegible]

Then the main menu appears with cli functionality:

```
? Do you have a config.json?  Yes, find it with the path
? Path to config.json (path/to/config.json)  test_config.json
? What would you like to do ?  (Use arrow keys)
> Check pending transfer
  Check balances
  Initiate transfer (Lock/Burn)
  Finalize transfer (Mint/Unlock)
  Settings (Register Assets and Networks)
  Back
```

These are the settings available from the cli

```
? What would you like to do ? Settings (Register Assets and Networks)
? What would you like to do ? (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new set of validators
  Update anchoring periode
  Update finality
  Back
```

## Creating a config file from scratch

```
▶ python3 -m aergo_cli.main

Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json? No, create one from scratch
Let's register 2 networks, validators(optional) and a private key for interacting with each network.
? Network name net1
? Network IP ...
? Network name net2
? Network IP ...
? Would you like to register a bridge ? Yes
Bridge between net1 and net2
? Bridge contract address on net1
? Anchoring periode of net2 on net1 10
? Finality of net2 15
? Oracle address on net1
? Bridge contract address on net2
? Anchoring periode of net1 on net2 20
? Finality of net1 25
? Oracle address on net2
? Would you like to register validators ? (not needed for bridge users) Yes
WARNING : Validators must be registered in the correct order
? Aergo Address AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ
? Validator ip ...
? Add next validator ? Yes
? Aergo Address ...
? Validator ip ...
? Add next validator ? No
Register a private key for net1
? Give your key a short descriptive name proposer
? Encrypted exported key string 47sDAWjMFTP7r2JP2BJ29PJRFy13yUTtVvoljAf8knH4GryQrpMJotQscDjed1YPHVZXY4sN
? Aergo address matching private key AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU
? Path to save new config file config.json
```

## Registering a new bridge

```
(venv)
Python_workspace/aergoio/merkle-bridge master x
▶ python3 -m aergo_cli.main

Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json? Yes, find it with the path
? Path to config.json (path/to/config.json) dummy.json
? What would you like to do ? Settings (Register Assets and Networks)
? What would you like to do ? Register new bridge
? Departure network mainnet
? Destination network sidechain2
Bridge between mainnet and sidechain2
? Bridge contract address on mainnet AmgQqVWX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEeoAukRC26hxmW
? Anchoring periode of sidechain2 on mainnet 6
? Finality of sidechain2 4
? Bridge contract address on sidechain2 AmgQqVWX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEeoAukRC26hxmW
? Anchoring periode of mainnet on sidechain2 7
? Finality of mainnet 5
? What would you like to do ? (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back
```

## Updating bridge settings

```
? What would you like to do ? Update anchoring periode
? Departure network mainnet
? Destination network sidechain2
? New anchoring periode (nb of blocks) of mainnet onto sidechain2 7
? What would you like to do ? (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back
```

If the new anchoring periode reached validator consensus, it can then be automatically updated in the bridge contract by the proposer.

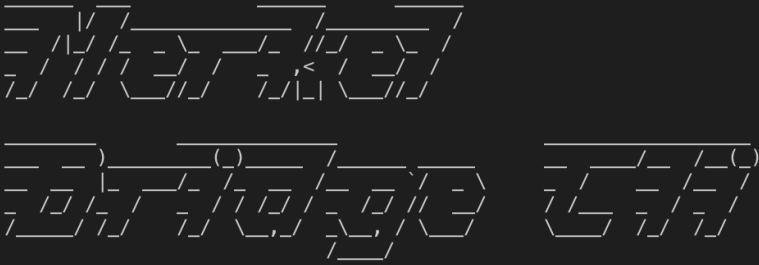
```
proposer: mainnet: "Anchoring periode update requested: 7"
proposer: mainnet: " tAnchorUpdate success"
```



## 1.2.2 CLI for asset transfers

### Registering a new asset in config file

```
(venv)
Python_workspace/aergoio/merkle-bridge master x
▶ python3 -m aergo_cli.main
```

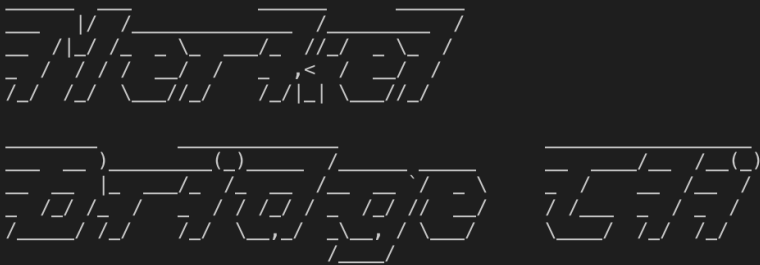


```
Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json?  Yes, find it with the path
? Path to config.json (path/to/config.json)  dummy.json
? What would you like to do ?  Settings (Register Assets and Networks)
? What would you like to do ?  Register new asset
? Asset name ('aergo' is reserved for the real Aergo)  token1
? Origin network (where the token was originally issued)  mainnet
? Asset address  AmgpYGMMPEnb7ukcJkhpGCGJXwqEq2MgpneN47hHrbBS7C3AjDke
? Add pegged asset on another network  Yes
? Pegged network  sidechain2
? Asset address  AmhoYqbizfrTLCx1QCXKoQuywtjyWQRwVEfVPMPLkZJECAY2nSa
? Add another pegged asset on another network  No
All pegged assets are registered in know networks
? What would you like to do ?  (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back
```

## Transferring a registered asset

```
(venv)
Python_workspace/aergoio/merkle-bridge master x
> python3 -m aergo_cli.main
```



```
Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json? Yes, find it with the path
? Path to config.json (path/to/config.json) test_config.json
? What would you like to do ? Initiate transfer (Lock/Burn)
? Departure network mainnet
? Destination network sidechain2
? Name of asset to transfer token1
? Receiver of assets on other side of bridge AmNMFbiVsqr6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5
? Amount of assets to transfer 1.2
? Choose account to sign transaction : default
Lock transfer summary:
Departure chain: mainnet (AmgQqVwX3JADRBvKvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Destination chain: sidechain2 (AmgQqVwX3JADRBvKvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Asset name: token1 (AmgpYGMMPEnb7ukcJkhpGCGJXwqEq2MgpneN47hHrbBS7C3AjDke)
Receiver at destination: AmNMFbiVsqr6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5
Amount: 1200000000000000000

? Confirm you want to execute tranfer tx Yes, execute transfer

mainnet -> sidechain2
Decrypt exported private key 'default'
Password:
🔑 token1 balance on origin before transfer: 499999790.8
🔒 Lock success: 9ir2BnaJaAs73BZEzydXD3rtwX4uDcbrxTrZe1exhEgT
🔑 remaining token1 balance on origin after transfer: 499999789.6
Transaction Hash : 9ir2BnaJaAs73BZEzydXD3rtwX4uDcbrxTrZe1exhEgT
Block Height : 2441

? What would you like to do ? Finalize transfer (Mint/Unlock)
? Choose a pending transfer ['mainnet', 'sidechain2', 'token1', 'AmNMFbiVsqr6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5', 2441]
? Choose account to sign transaction : default
Mint transfer summary:
Departure chain: mainnet (AmgQqVwX3JADRBvKvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Destination chain: sidechain2 (AmgQqVwX3JADRBvKvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Asset name: token1 (AmgpYGMMPEnb7ukcJkhpGCGJXwqEq2MgpneN47hHrbBS7C3AjDke)
Receiver at destination: AmNMFbiVsqr6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5
Block height of lock/burn/freeze: 2441

? Confirm you want to execute tranfer tx Yes, execute transfer

mainnet -> sidechain2
Decrypt exported private key 'default'
Password:
🔑 token1 balance on destination before transfer : 0.0
🔒 Built lock proof
🔑 Mint success: HQkYL9EHjoKE53NycqezgkaD3sZFQwTm6A4zaAndFtt5
🔑 token1 balance on destination after transfer : 2.4
? What would you like to do ? (Use arrow keys)
> Check pending transfer
  Check balances
  Initiate transfer (Lock/Burn)
  Finalize transfer (Mint/Unlock)
  Settings (Register Assets and Networks)
  Back
```

## Check pending transfers

It is possible to check withdrawable balances of pending transfer between chains.

```
Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merkle bridge and manage wallet settings (config.json)

? Do you have a config.json?  Yes, find it with the path
? Path to config.json (path/to/config.json)  test_config.json
? What would you like to do ?  Initiate transfer (Lock/Burn)
? Departure network  mainnet
? Destination network  sidechain2
? Name of asset to transfer  token1
? Receiver of assets on other side of bridge  AmNMFBiVsQy6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5
? Amount of assets to transfer  2.3
? Choose account to sign transaction :  default
Lock transfer summary:
Departure chain: mainnet (AmgQqVwX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Destination chain: sidechain2 (AmgQqVwX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEoAukRC26hxmW)
Asset name: token1 (AmgPYGMMPEnb7ukcJkhpGCGJXwqEq2MgpneN47hHrbBS7C3AjDke)
Receiver at destination: AmNMFBiVsQy6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5
Amount: 2300000000000000000

? Confirm you want to execute transfer tx  Yes, execute transfer

mainnet -> sidechain2
Decrypt exported private key 'default'
Password:
💰 token1 balance on origin before transfer: 499999789.6
🔒 Lock success: H91rbqFAuAQEFKmfL6XF9Ppx6rX3LUANufrFv4trQUS4
💰 remaining token1 balance on origin after transfer: 499999787.3
Transaction Hash : H91rbqFAuAQEFKmfL6XF9Ppx6rX3LUANufrFv4trQUS4
Block Height : 2660

? What would you like to do ?  Check pending transfer
? Choose a pending transfer  ['mainnet', 'sidechain2', 'token1', 'AmNMFBiVsQy6vg4njsTjgy7bKPFHFYhLV4rzQyrENUS9AM1e3tw5', 2660]
Withdrawable: 2.3 Pending: 0.0
? What would you like to do ?  (Use arrow keys)
> Check pending transfer
  Check balances
  Initiate transfer (Lock/Burn)
  Finalize transfer (Mint/Unlock)
  Settings (Register Assets and Networks)
  Back
```

If a transfer was made with the cli, the transfer parameters are recorded but it is also possible to check the withdrawable balance of a custom transfer between any chain. ‘Withdrawable’ is the balance that can be immediately withdrawn on the other side of the bridge. ‘Pending’ is the balance that was deposited in the bridge contract but the anchor has not happened on the other side of the bridge so it is not yet withdrawable.

Pending transfers are recorded as an array of [departure chain, destination chain, asset name, receiver, block height of lock/burn]. All pending transfer are store in cli/pending\_transfers.json and deleted once finalized.

## 1.3 Proposer

A proposer connects to all validators and requests them to sign a new anchor with the GetAnchorSignature rpc request. To prevent downtime, anybody can become a proposer and request signatures to validators. It is the validator’s responsibility to only sign correct anchors. The bridge contracts will not update the state root if the anchoring time is not reached (t\_anchor).

### 1.3.1 Starting a Proposer

```
$ python3 -m aergo_bridge_operator.proposer_client --help

usage: proposer_client.py [-h] -c CONFIG_FILE_PATH --net1 NET1 --net2 NET2
                        [--privkey_name PRIVKEY_NAME]
                        [--privkey_pwd PRIVKEY_PWD] [--anchoring_on]
```

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```

                                [--auto_update] [--oracle_update]

Start a proposer between 2 Aergo networks.

optional arguments:
-h, --help                show this help message and exit
-c CONFIG_FILE_PATH, --config_file_path CONFIG_FILE_PATH
                           Path to config.json
--net1 NET1                Name of Aergo network in config file
--net2 NET2                Name of Aergo network in config file
--privkey_name PRIVKEY_NAME
                           Name of account in config file to sign anchors
--privkey_pwd PRIVKEY_PWD
                           Password to decrypt privkey_name
--anchoring_on             Enable anchoring (can be diseabled when wanting to
                           only update settings)
--auto_update             Update bridge contract when settings change in config
                           file
--oracle_update            Update bridge contract when validators or oracle addr
                           change in config file

$ python3 -m aergo_bridge_operator.proposer_client -c './test_config.json' --net1
→ 'mainnet' --net2 'sidechain2' --privkey_name "proposer" --anchoring_on

proposer: MainThread: "mainnet Validators: [
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ']"
proposer: MainThread: "sidechain2 (t_final=4) -> mainnet : t_anchor=7"
proposer: MainThread: "Set Sender Account"
proposer: MainThread: "mainnet Proposer Address:␣
→ AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU"
proposer: MainThread: "sidechain2 Validators: [
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
→ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ']"
proposer: MainThread: "mainnet (t_final=5) -> sidechain2 : t_anchor=7"
proposer: MainThread: "Set Sender Account"
proposer: MainThread: "sidechain2 Proposer Address:␣
→ AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU"
proposer: sidechain2: "Current mainnet -> sidechain2 anchor: height: 3585, root:␣
→ 0x0x4abe990463eeaf2ebb98971c5358bf0a1e8e33cbc8a75c05222cb324cd503705, nonce: 245"
proposer: mainnet: "Current sidechain2 -> mainnet anchor: height: 3585, root:␣
→ 0x0x5b5b2ebddf46829d05ba0efbc756c53dbd6603413c9557e3d720e8d5c37ccf94, nonce: 315"
proposer: sidechain2: " Gathering validator signatures for: root:␣
→ 0x36b7ed1f97ff9fb4af052d3c36a80a00961f0e0be569d8012a08678dc8d27a98, height: 3604"
proposer: mainnet: " Gathering validator signatures for: root:␣
→ 0x3bd469d09fdc0e195063b811c59e88c4d72af53f69d85b783927c76aac34d4cc, height: 3605"
proposer: mainnet: " Anchor success, wait until next anchor time: 7s..."
proposer: sidechain2: " Anchor success, wait until next anchor time: 7s..."

```

```

from aergo_bridge_operator.proposer_client import BridgeProposerClient

proposer = BridgeProposerClient(
    './test_config.json', 'mainnet', 'sidechain2', privkey_name='proposer',
    anchoring_on=True

```

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```
)
proposer.run()
```

## 1.3.2 Updating bridge settings

Bridge settings are updated when the config file changes and the proposer is started with `--auto_update`. The proposer will then try to gather signatures from validators to make the update on chain.

```
? What would you like to do ?   Update anchoring periode
? Departure network   mainnet
? Destination network  sidechain2
? New anchoring periode (nb of blocks) of mainnet onto sidechain2  7
? What would you like to do ?   (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back
```

If the new anchoring periode reached validator consensus, it can then be automatically updated in the bridge contract by the proposer.

```
proposer: mainnet: "Anchoring periode update requested: 7"
proposer: mainnet: " tAnchorUpdate success"
```

## 1.4 Validator

A validator will sign any state root from any proposer via the `GetAnchorSignature` rpc request as long as it is valid. Therefore a validator must run a full node. Assets on the sidechain are secure as long as 2/3 of the validators validate both chains and are honest. Since signature verification only happens when anchoring (and not when transferring assets), the number of validators can be very high as the signature verification cost is necessary only once per anchor.

### 1.4.1 Starting a Validator

```
$ python3 -m aergo_bridge_operator.validator_server --help

usage: validator_server.py [-h] -c CONFIG_FILE_PATH --net1 NET1 --net2 NET2 -i
                           VALIDATOR_INDEX [--privkey_name PRIVKEY_NAME]
                           [--anchoring_on] [--auto_update] [--oracle_update]
                           [--local_test]

Start a validator between 2 Aergo networks.

optional arguments:
  -h, --help            show this help message and exit
  -c CONFIG_FILE_PATH, --config_file_path CONFIG_FILE_PATH
                        Path to config.json
  --net1 NET1           Name of Aergo network in config file
  --net2 NET2           Name of Aergo network in config file
  -i VALIDATOR_INDEX, --validator_index VALIDATOR_INDEX
```

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```

                                Index of the validator in the ordered list of
                                validators
--privkey_name PRIVKEY_NAME      Name of account in config file to sign anchors
--anchoring_on                  Enable anchoring (can be disabled when wanting to
                                only update settings)
--auto_update                   Update bridge contract when settings change in config
                                file
--oracle_update                 Update bridge contract when validators or oracle addr
                                change in config file
--local_test                    Start all validators locally for convenient testing

$ python3 -m aergo_bridge_operator.validator_server -c './test_config.json' --net1
↪ 'mainnet' --net2 'sidechain2' --validator_index 1 --privkey_name "validator" --
↪ anchoring_on

    "Bridge validators : ['AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
↪ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
↪ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ']]"
    "mainnet <- sidechain2 (t_final=4) : t_anchor=6"
    "mainnet (t_final=5) -> sidechain2 : t_anchor=7"
    "WARNING: This validator will vote for settings update in config.json"
    Decrypt exported private key 'validator'
    Password:
    "Validator Address: AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ"
    server 1 started
    {"val_index": 1, "signed": true, "type": " anchor", "value": {"root":
↪ "0xff7c55cb10790c3476cfe141b7579338fdc5ef623788ba634c958b8974c9109", "height":
↪ 3965}, "destination": "sidechain2", "nonce": 281}
    {"val_index": 1, "signed": true, "type": " anchor", "value": {"root":
↪ "0x86a270e930624ffd614e211019c0d613320bedad4f3b464759a24b41120061df", "height":
↪ 3971}, "destination": "mainnet", "nonce": 358}

```

```

from aergo_bridge_operator.validator_server import ValidatorServer

validator = ValidatorServer(
    './test_config.json', 'mainnet', 'sidechain2', privkey_name='validator',
    validator_index=2, anchoring_on=True
)
validator.run()

```

## 1.4.2 Updating bridge settings

The information (validator set, anchoring periods, finality of blockchains) contained in the config file will be used by the validator to vote on changes if `--auto_update` is enabled. Be careful that the information in config file is correct as any proposer can request a signature of that information. If the proposer gathers 2/3 signatures for the same information then the bridge settings can be updated.

```

? What would you like to do ?   Update anchoring periode
? Departure network   mainnet
? Destination network   sidechain2
? New anchoring periode (nb of blocks) of mainnet onto sidechain2  7
? What would you like to do ?   (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back

```

## 1.5 Deploying a new bridge

### 1.5.1 Process

- 1- Each Validator generates a private key and address to sign bridge messages (anchors, settings update...) and shares the address and validator ip with the bridge Proposer.
- 2- Proposer creates a config.json file draft. (See [Create a new config file](#) below).
- 3- Proposer deploys the eth-merkle-bridge.lua contract on bridged networks (See [Deploy the bridge contracts](#) below).
- 4- Proposer deploys the oracle.lua on both networks and transfers bridge controle to oracles (See [Transfer control of the bridge to the multisig oracle](#) below).
- 5- Proposer removes his private key registered in config.json, and shares config.json with Validators.
- 6- Each Validator adds his private key to his config.json.
- 7- The Validators start validating (see validator docs) with the correct validator index (see position of validator in config.json).
- 8- Proposer starts operating the bridge (see proposer docs).

### 1.5.2 Create a new config file

A config file can be created with the cli tool or manually.

```

▶ python3 -m aergo_cli.main

Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json?  No, create one from scratch
Let's register 2 networks, validators(optional) and a private key for interacting with each network.
? Network name  net1
? Network IP   ...
? Network name  net2
? Network IP   ...
? Would you like to register a bridge ?  Yes
Bridge between net1 and net2
? Bridge contract address on net1
? Anchoring periode of net2 on net1  10
? Finality of net2  15
? Oracle address on net1
? Bridge contract address on net2
? Anchoring periode of net1 on net2  20
? Finality of net1  25
? Oracle address on net2
? Would you like to register validators ? (not needed for bridge users)  Yes
WARNING : Validators must be registered in the correct order
? Aergo Address  AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ
? Validator ip   ...
? Add next validator ?  Yes
? Aergo Address  ...
? Validator ip   ...
? Add next validator ?  No
Register a private key for net1
? Give your key a short descriptive name  proposer
? Encrypted exported key string  47sDAWjMFTp7r2JP2BJ29PJRfY13yUTtVvoLjAf8knH4GryQrpMJotqscDjed1YPHVZXY4sN
? Aergo address matching private key  AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU
? Path to save new config file  config.json

```

### 1.5.3 Deploy the bridge contracts

The sender of the deployment tx will be the bridge owner. Ownership is then transfered to the multisig oracle.

```

$ python3 -m aergo_bridge_operator.bridge_deployer --help

usage: bridge_deployer.py [-h] -c CONFIG_FILE_PATH --net1 NET1 --net2 NET2
                        [--privkey_name PRIVKEY_NAME] [--local_test]

Deploy bridge contracts between 2 Aergo networks.

optional arguments:
  -h, --help            show this help message and exit
  -c CONFIG_FILE_PATH, --config_file_path CONFIG_FILE_PATH
                        Path to config.json
  --net1 NET1           Name of Aergo network in config file
  --net2 NET2           Name of Aergo network in config file
  --privkey_name PRIVKEY_NAME
                        Name of account in config file to sign anchors

```

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```
--local_test          Start all validators locally for convenient testing

$ python3 -m aergo_bridge_operator.bridge_deployer -c './test_config.json' --net1
→ 'mainnet' --net2 'sidechain2' --privkey_name "proposer"

DEPLOY BRIDGE
Decrypt exported private key 'proposer'
Password:
----- DEPLOY BRIDGE BETWEEN mainnet & sidechain2 -----
----- Connect AERGO -----
----- Set Sender Account -----
> Sender Address: AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU
----- Deploy SC -----
> result[G412HSrJUKbEL3P5QLuXn7mt5DxkGvdwMgmdujQz1w3W] : TX_OK
> result[HVtjZC4r3fB3PYztJjLsmnfdnA29i17aJHLVwebYoX2v] : TX_OK
----- Check deployment of SC -----
> Bridge Address mainnet: AmgQqVWX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEeoAukRC26hxmW
> Bridge Address sidechain2: AmgQqVWX3JADRBEVkvCM4CyWdoeXuumeYGGJJxEeoAukRC26hxmW
----- Store bridge addresses in config.json -----
----- Disconnect AERGO -----
```

### 1.5.4 Transfer control of the bridge to the multisig oracle

The oracle\_deployer script will deploy the oracle contract (with validators previously registered in config.json), and transfer ownership to the newly deployed contract.

```
$ python3 -m aergo_bridge_operator.oracle_deployer --help

DEPLOY ORACLE
usage: oracle_deployer.py [-h] -c CONFIG_FILE_PATH --net1 NET1 --net2 NET2
                        [--privkey_name PRIVKEY_NAME] [--local_test]

Deploy oracle contracts to controle the bridge between 2 Aergo networks.

optional arguments:
-h, --help            show this help message and exit
-c CONFIG_FILE_PATH, --config_file_path CONFIG_FILE_PATH
                        Path to config.json
--net1 NET1           Name of Aergo network in config file
--net2 NET2           Name of Aergo network in config file
--privkey_name PRIVKEY_NAME
                        Name of account in config file to sign anchors
--local_test          Start all validators locally for convenient testing

$ python3 -m aergo_bridge_operator.oracle_deployer -c './test_config.json' --net1
→ 'mainnet' --net2 'sidechain2' --privkey_name "proposer"

DEPLOY ORACLE
Decrypt exported private key 'proposer'
Password:
----- DEPLOY ORACLE BETWEEN mainnet & sidechain2 -----
----- Connect AERGO -----
----- Set Sender Account -----
> Sender Address: AmPxVdu993eosN3UjnPDdN3wb7TNbHeiHDvn2dvZUcH8KXDK3RLU
```

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```

----- Deploy SC -----
  validators : ['AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
↪ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ',
↪ 'AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAx1RvfTKLSBsQ']
    > result[GG6THEXUbmj6E2SDxVri67iF1ExLeUoS5WRgCi5vH5zF] : TX_OK
    > result[42dqiZrkb5tn6tDiNGL2ePdAd6akoVs3LVYytuD7iNR9] : TX_OK
----- Check deployment of SC -----
> Oracle Address mainnet: AmhXrQ7KdNA4naBi2sTwHj13aBzVBohRhxy262nXsPbV2YbULXUR
> Oracle Address sidechain2: AmhXrQ7KdNA4naBi2sTwHj13aBzVBohRhxy262nXsPbV2YbULXUR
----- Store bridge addresses in config.json -----
----- Transfer bridge control to oracles -----
----- Disconnect AERGO -----

```

## 1.6 Configuration file

The config.json file is used by bridge operators, the wallet and the cli to store information about node connections, validator connections, bridge parameters, assets and private keys.

It can be created and updated manually or with the help of the cli.

```

{
  "networks": { // list of registered networks
    "mainnet": { // name of blockchain network
      "bridges": { // bridge contracts to other networks
        "sidechain2": { // name of the network being connected
          "addr": "AmgEZebmD4BcV4dhKq6h2HcJS2E8vvy5CEYPyrTvuohjQMiJqMC4", /
↪ // bridge contract (on mainnet) address to sidechain
          "oracle": "AmgQdbUqDuoX5krsmvSEHc9X3apBuXyJTQ4mimfWzejEsYScTo3f", ↪
↪ // oracle controlling bridge contract 'addr'
          "t_anchor": 25, // anchoring periode of sidechain to mainnet
          "t_final": 5 // minimum finality time of sidechain
        },
        "ip": "localhost:7845", // ip of a mainnet node for herapy
        "tokens": { // tokens issued on this network
          "token1": { // name of token issued on mainnet
            "addr": "AmghHtk2gpcpMa6bjlv59qCBfNmKZTi8qDGeuMNg5meJuXGTa2Y1", /
↪ // address of token issued on mainnet
            "pegs": { // other networks where this token exists (pegged)
              "sidechain2":
↪ "AmgssNKd5xXoCguDUnF9Bzhh78W5arwnMtTgDvPZxaAViGDCWa3m" // token contract of the ↪
↪ asset pegged on another chain
            }
          },
          "sidechain2": { // name of blockchain network
            "bridges": { // bridge contracts to other networks
              "mainnet": { // name of the network being connected
                "addr": "Amho9dBsJZdbqClnG4Vztgy7HWfkc6mxiRKjxMUrjPx6kgszdrsa", /
↪ // bridge contract (on sidechain) address to mainnet
                "oracle": "AmgQdbUqDuoX5krsmvSEHc9X3apBuXyJTQ4mimfWzejEsYScTo3f", ↪
↪ // oracle controlling bridge contract 'addr'
                "id": "3e688cb882552b4f7d9032e0ae55d9", // bridge id used to ↪
↪ prevent bridge update replay
              }
            }
          }
        }
      }
    }
  }
}

```

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```

        "t_anchor": 10, // anchoring periode of mainnet to sidechain2
        "t_final": 10 // minimum finality time of mainnet
    }
    },
    "ip": "localhost:8845", // ip of a sidechain2 node for herapy
    "tokens": {} // tokens issued on this network
}
},
"validators": [ // array of validators that can update the bridge contracts
↪ (order is important)
    {
        "addr": "AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAxlRvfTKLSBsQ", //
↪ address of the validator's signing private key
        "ip": "localhost:9841" // ip address of the validator server signing
↪ anchors
    },
    {
        "addr": "AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAxlRvfTKLSBsQ",
        "ip": "localhost:9842"
    },
    {
        "addr": "AmNLjcxUDmxeGZL7F8bqyaGt3zqog5HAoJmFBEZAxlRvfTKLSBsQ",
        "ip": "localhost:9843"
    }
],
"wallet": { // named accounts
    "broadcaster": { // name of account
        "addr": "AmMQNBFXuSqiN97rv2m1NoxWu7D2UKAojKCpWqrLmZh676GgfRGG", //
↪ address matching the private key
        "keystore": "keystore/
↪ AmMQNBFXuSqiN97rv2m1NoxWu7D2UKAojKCpWqrLmZh676GgfRGG__2020-01-20T04:13:16__keystore.
↪ json" // path to keystore file
    },
    "default": {
        "addr": "AmNPWDJMjU4g98Scm4AikW8JwQMGwWMztM7Qy8ggxNTkhgZMJHFp",
        "keystore": "keystore/
↪ AmNPWDJMjU4g98Scm4AikW8JwQMGwWMztM7Qy8ggxNTkhgZMJHFp__2020-01-20T04:13:06__keystore.
↪ json"
    },
}
}
}

```

## 1.7 Python wallet

The Python wallet can be used as a python command line tool for making simple transfers, bridge transfers, quering balances ... The merkle-bridge/aergo\_wallet repository can also be used as a module for other applications as the tools are separate and don't need config.json to be used.

### 1.7.1 Create / Register a new account

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

# create a new account (new private key),
# you will be requested to create a password
# (DO NOT LOSE IT, it is the only way to decrypt your private key)
wallet.create_account("default")

# if you already have an exported private key (created by aergocli for example)
wallet.register_account('default', "exported_private_key", addr="Address_of_private_
↪key")
```

## 1.7.2 Balance query

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

# get Aer balance of the default account on 'mainnet'
balance, _ = wallet.get_balance('aergo', 'mainnet')

# get Aer balance of Aer minted on 'sidechain2'
balance, _ = wallet.get_balance('aergo', 'sidechain2',
                                asset_origin_chain='mainnet')
```

## 1.7.3 Deploy a test token

```
from aergo_wallet.wallet import AergoWallet

# load the compiled bytecode
with open("./contracts/token_bytecode.txt", "r") as f:
    bytecode = f.read()[:-1]


# create a wallet
wallet = AergoWallet("./config.json")

total_supply = 500*10**18
token_name = "my_token"
# deploy the token and store the address in config.json
wallet.deploy_token(bytecode, token_name, total_supply, "mainnet")
```

## 1.7.4 Register an already deployed token

This can be done with `aergo_cli`

```
(venv)
Python_workspace/aergoio/merkle-bridge master x
▶ python3 -m aergo_cli.main
```



```

Welcome to the Merkle Bridge Interactive CLI.
This is a tool to transfer assets across the Aergo Merke bridge and manage wallet settings (config.json)

? Do you have a config.json?  Yes, find it with the path
? Path to config.json (path/to/config.json)  dummy.json
? What would you like to do ?  Settings (Register Assets and Networks)
? What would you like to do ?  Register new asset
? Asset name ('aergo' is reserved for the real Aergo)  token1
? Origin network (where the token was originally issued)  mainnet
? Asset address  AmgpYGMMPEnb7ukcJkhpGCGJXwqEq2MgpneN47hHrbBS7C3AjDke
? Add pegged asset on another network  Yes
? Pegged network  sidechain2
? Asset address  AmhoYqbizfrTLCx1QCXKoQuywtjyWQRwVEfVPMPkZJECAY2nSa
? Add another pegged asset on another network  No
All pegged assets are registered in know networks
? What would you like to do ?  (Use arrow keys)
> Register new asset
  Register new network
  Register new bridge
  Register new encrypted private key
  Update validators set
  Update anchoring periode
  Update finality
  Back

```

or by editing config.json directly.

```
{
  "tokens": {
    "my_token": {
      "addr": "AmgY8WARSNfjgCnFhFJBv145wkHJRTC7YR5MeJGAMvKzVD9kKeFz",
      "pegs": {
        "sidechain2": "AmheFWQf5decPrKZE1dnjh1EFwDq7qqAmobPbrUt4XeNK9QNCyxK"
      }
    }
  }
}
```

or with the wallet:

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

" Register a 'mainnet' token and it's pegged self on 'sidechain2'
wallet.register_asset("my_token", "mainnet", "Address on mainnet",
                      pegged_chain_name="sidechain2",
                      addr_on_pegged_chain="Address on sidechain2")
```

## 1.7.5 Simple Transfers

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

# simple asset transfer on 'mainnet'
wallet.transfer(2*10**18, to_address, asset_name="my_token", network_name="mainnet")

# simple asset transfer of 'mainnet' assets pegged on 'sidechain'
wallet.transfer(2*10**18, to_address, asset_name="my_token", network_name="sidechain",
               asset_origin_chain="mainnet")
```

## 1.7.6 Bridge Transfers

The `bridge_transfer` method calls `transfer_to_sidechain` or `transfer_from_sidechain` depending whether the token was minted or not.

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

amount = 1*10**18
asset = 'token1'
# transfer aergo from 'mainnet' to 'sidechain2'
wallet.bridge_transfer('mainnet',
                      'sidechain2',
                      asset,
                      amount)
```

The `transfer_to_sidechain` method performs the following:

- lock assets in the bridge contract
- wait for the next anchor on sidechain
- create a merkle proof of lock in the anchored state
- mint the asset on the sidechain with the merkle proof

The `transfer_from_sidechain` method performs the following:

- burn assets in the bridge contract
- wait for the next anchor on mainnet
- create a merkle proof of burn in the anchored state
- unlock the asset on the mainnet with the merkle proof

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

amount = 1*10**18
asset = 'token1'
```

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```
# transfer aergo from 'mainnet' to 'sidechain2'
wallet.transfer_to_sidechain('mainnet',
                             'sidechain2',
                             asset,
                             amount)

# transfer minted aergo from sidechain2 mainnet
wallet.transfer_from_sidechain('sidechain2',
                              'mainnet',
                              asset,
                              amount)
```

It is also possible to perform the lock/burn and mint/unlock operations individually.

```
from aergo_wallet.wallet import AergoWallet

# create a wallet
wallet = AergoWallet("./config.json")

amount = 1*10**18
asset = 'token1'
# lock asset in the bridge contract to 'sidechain2'
lock_height, tx_hash = wallet.initiate_transfer_lock('mainnet', 'sidechain2',
                                                    asset, amount)
# lock more assets in the bridge contract to 'sidechain2'
lock_height, tx_hash = wallet.initiate_transfer_lock('mainnet', 'sidechain2',
                                                    asset, amount)

# get the amount of assets locked but not yet minted on 'sidechain2'
pending_mint = wallet.get_mintable_balance(
    'mainnet', 'sidechain2', asset, pending=True
)

# mint the total balance of two previous locked amounts
pegged_address, tx_hash = wallet.finalize_transfer_mint(
    'mainnet', 'sidechain2', asset, lock_height=lock_height
)

# Similarly,
# wallet.initiate_transfer_burn()
# wallet.get_unlockable_balance()
# wallet.finalize_transfer_unlock()
# can be used to burn and unlock minted assets from a sidechain.
```

## 1.7.7 Wallet utils

If you wish to use the wallet as a module for other applications, the following tools are available:

- wallet\_utils.py
- transfer\_to\_sidechain.py
- transfer\_from\_sidechain.py
- token\_deployer.py

You will need to connect your own herapy instances to nodes and load your private key in herapy.

## 1.8 aergo\_bridge\_operator

```
class aergo_bridge_operator.validator_server.ValidatorService (config_file_path:  
                                                             str, aergo1: str,  
                                                             aergo2: str,  
                                                             privkey_name:  
                                                             str = None,  
                                                             privkey_pwd: str  
                                                             = None, valida-  
                                                             tor_index: int =  
                                                             0, anchoring_on:  
                                                             bool = False,  
                                                             auto_update:  
                                                             bool = False,  
                                                             oracle_update:  
                                                             bool = False)
```

Validates anchors for the bridge proposer

**GetAnchorSignature** (*anchor, context*)

Verifies the anchors are valid and signs them aergo1 and aergo2 must be trusted.

**GetOracleSignature** (*oracle\_msg, context*)

Get signature to update bridge oracle

**GetTAnchorSignature** (*tempo\_msg, context*)

Get a vote(signature) from the validator to update the t\_anchor setting in the Aergo bridge contract

**GetTFinalSignature** (*tempo\_msg, context*)

Get a vote(signature) from the validator to update the t\_final setting in the Aergo bridge contract

**GetValidatorsSignature** (*val\_msg, context*)

Get signature to update validators of anchors

**get\_oracle** (*hera: aergo.herapy.aergo.Aergo, aergo\_from: str, aergo\_to: str, oracle\_to: str, id\_to:*  
 *str, bridge\_to: str, oracle\_msg*)

Get a vote(signature) from the validator to update the oracle controlling the bridge contract

**is\_valid\_anchor** (*anchor, aergo\_from: aergo.herapy.aergo.Aergo, aergo\_to:*  
 *aergo.herapy.aergo.Aergo, oracle\_to: str*) → Optional[str]

An anchor is valid if : 1- it's height is finalized 2- it's root for that height is correct. 3- it's nonce is correct  
4- it's height is higher than previous anchored height + t\_anchor



```

class aergo_bridge_operator.proposer_client.BridgeProposerClient (config_file_path:
                                                                    str,
                                                                    aergo_mainnet:
                                                                    str,
                                                                    aergo_sidechain:
                                                                    str,
                                                                    privkey_name:
                                                                    str = None,
                                                                    privkey_pwd:
                                                                    str = None,
                                                                    anchor-
                                                                    ing_on: bool
                                                                    = False,
                                                                    auto_update:
                                                                    bool =
                                                                    False, ora-
                                                                    cle_update:
                                                                    bool = False,
                                                                    bridge_anchoring:
                                                                    bool = True)

```

The BridgeProposerClient starts proposers on both sides of the bridge

```

class aergo_bridge_operator.proposer_client.ProposerClient (config_file_path:
                                                                    str, aergo_from:
                                                                    str, aergo_to: str,
                                                                    is_from_mainnet:
                                                                    bool, privkey_name:
                                                                    str = None,
                                                                    privkey_pwd: str
                                                                    = None, anchor-
                                                                    ing_on: bool = False,
                                                                    auto_update: bool =
                                                                    False, oracle_update:
                                                                    bool = False,
                                                                    bridge_anchoring:
                                                                    bool = True)

```

The proposer client periodically (every `t_anchor`) broadcasts the finalized block trie state root (after lib) on the other side of the bridge after validation by the Validator servers. It first checks the last merged height and waits until `now > lib + t_anchor` is reached, then merges the current finalised block (lib). Start again after waiting `t_anchor`.

#### Note on config\_data:

- `config_data` is used to store current validators and their ip when the proposer starts. (change validators after the proposer has started)
- After starting, when users change the `config.json`, the proposer will attempt to gather signatures to reflect the changes.
- `t_anchor` value is always taken from the bridge contract
- validators are taken from the `config_data` because ip information is not stored on chain
- when a validator set update succeeds, `self.config_data` is updated
- if another proposer updates to a new set of validators and the proposer doesn't know about it, proposer must be restarted with the new current validator set to create new connections to them.

**buildBridgeAnchorArgs** (*root: bytes*) → Tuple[str, List[str]]  
Build arguments to derive bridge storage root from the anchored state root with a merkle proof

**extract\_signatures** (*approvals: List[Any]*) → Tuple[List[str], List[int]]  
Convert signatures to hex string and keep 2/3 of them.

**get\_anchor\_signatures** (*root: str, merge\_height: int, nonce: int*) → Tuple[List[str], List[int]]  
Query all validators and gather 2/3 of their signatures.

**get\_new\_oracle\_signatures** (*oracle*)  
Request approvals of validators for the new oracle.

**get\_new\_validators\_signatures** (*validators*)  
Request approvals of validators for the new validator set.

**get\_signature\_worker** (*rpc\_service: str, request, h: bytes, index: int*) → Optional[Any]  
Get a validator's (index) signature and verify it

**get\_tempo\_signatures** (*tempo, rpc\_service, tempo\_id*)  
Request approvals of validators for the new t\_anchor or t\_final.

**monitor\_settings** ()  
Check if a modification of bridge settings is requested by seeing if the config file has been changed and try to update the bridge contract (gather 2/3 validators signatures).

**monitor\_settings\_and\_sleep** (*sleeping\_time*)  
While sleeping, periodically check changes to the config file and update settings if necessary. If another proposer updated settings it doesn't matter, validators will just not give signatures.

**new\_state\_anchor** (*root: str, next\_anchor\_height: int, validator\_indexes: List[int], sigs: List[str]*) → None  
Anchor a new root on chain

**new\_state\_and\_bridge\_anchor** (*stateRoot: str, next\_anchor\_height: int, validator\_indexes: List[int], sigs: List[str], bridge\_contract\_proto: str, merkle\_proof: List[str]*) → None  
Anchor a new state root and update bridge anchor on chain

**run** () → None  
Gathers signatures from validators, verifies them, and if 2/3 majority is acquired, set the new anchored root in bridge\_to.

**set\_oracle** (*new\_oracle, validator\_indexes, sigs*)  
Update oracle on chain

**set\_tempo** (*t\_anchor, validator\_indexes, sigs, contract\_function*) → bool  
Update t\_anchor or t\_final on chain

**set\_validators** (*new\_validators, validator\_indexes, sigs*)  
Update validators on chain

**update\_oracle** (*oracle*)  
Try to update the oracle periode registered in the bridge contract.

**update\_t\_anchor** (*t\_anchor*)  
Try to update the anchoring periode registered in the bridge contract.

**update\_t\_final** (*t\_final*)  
Try to update the anchoring periode registered in the bridge contract.

**update\_validator\_connections** ()  
Update connections to validators after a successful update of bridge validators with the validators in the config file.

**update\_validators** (*new\_validators*)

Try to update the validator set with the one in the config file.

**wait\_next\_anchor** (*merged\_height: int*) → int

Wait until *t\_anchor* has passed after merged height. Return the next finalized block after *t\_anchor* to be the next anchor

**exception** `aergo_bridge_operator.proposer_client.ValidatorMajorityError`

## 1.9 aergo\_wallet

**class** `aergo_wallet.wallet.AergoWallet` (*config\_file\_path: str, config\_data: Dict[KT, VT] = None*)

A wallet loads it's private key from config.json and implements the functionality to transfer tokens to sidechains

**config\_data** (*\*json\_path, value: Union[str, int, List[T], Dict[KT, VT]] = None*)

Get the value in nested dictionary at the end of json path if value is None, or set value at the end of the path.

**deploy\_token** (*payload\_str: str, asset\_name: str, total\_supply: int, network\_name: str, receiver: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → str

Deploy a new standard token, store the address in config\_data

**finalize\_transfer\_mint** (*from\_chain: str, to\_chain: str, asset\_name: str, receiver: str = None, lock\_height: int = 0, privkey\_name: str = 'default', privkey\_pwd: str = None*) → Tuple[str, str]

Finalize a transfer of assets to a sidechain by minting then after the lock is final and a new anchor was made. NOTE anybody can mint so sender is not necessary. The amount to mint is the difference between total deposit and already minted amount. Bridge tempo is taken from config\_data

**finalize\_transfer\_unlock** (*from\_chain: str, to\_chain: str, asset\_name: str, receiver: str = None, burn\_height: int = 0, privkey\_name: str = 'default', privkey\_pwd: str = None*) → str

Finalize a transfer of assets from a sidechain by unlocking then after the burn is final and a new anchor was made. NOTE anybody can unlock so sender is not necessary. The amount to unlock is the difference between total burn and already unlocked amount. Bridge tempo is taken from config\_data

**get\_aergo** (*network\_name: str, privkey\_name: str = 'default', privkey\_pwd: str = None, skip\_state: bool = False*) → `aergo.herapy.aergo.Aergo`

Return aergo provider with account loaded from keystore

**get\_asset\_address** (*asset\_name: str, network\_name: str, asset\_origin\_chain: str = None*) → str

Get the address of a time in config\_data given it's name

**get\_balance** (*asset\_name: str, network\_name: str, asset\_origin\_chain: str = None, account\_name: str = 'default', account\_addr: str = None*) → Tuple[int, str]

Get account name balance of asset\_name on network\_name, and specify asset\_origin\_chain for a pegged asset query,

**get\_bridge\_tempo** (*from\_chain: str, to\_chain: str, aergo: aergo.herapy.aergo.Aergo = None, bridge\_address: str = None, sync: bool = False*) → Tuple[int, int]

Return the anchoring periode of from\_chain onto to\_chain and minimum finality time of from\_chain. This information is queried from bridge\_to.

**get\_mintable\_balance** (*from\_chain: str, to\_chain: str, asset\_name: str, account\_name: str = 'default', account\_addr: str = None*) → Tuple[int, int]

Get the balance that has been locked on one side of the bridge and not yet minted on the other side

Calculates the difference between the total amount deposited and total amount withdrawn. Set pending to true to include deposits than have not yet been anchored

**get\_unlockable\_balance** (*from\_chain: str, to\_chain: str, asset\_name: str, account\_name: str = 'default', account\_addr: str = None*) → Tuple[int, int]

Get the balance that has been burnt on one side of the bridge and not yet unlocked on the other side  
Calculates the difference between the total amount deposited and total amount withdrawn. Set pending to true to include deposits than have not yet been anchored

**initiate\_transfer\_burn** (*from\_chain: str, to\_chain: str, asset\_name: str, amount: int, receiver: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → Tuple[int, str]

Initiate a transfer from a sidechain by burning the assets.

**initiate\_transfer\_lock** (*from\_chain: str, to\_chain: str, asset\_name: str, amount: int, receiver: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → Tuple[int, str]

Initiate a transfer to a sidechain by locking the asset.

**register\_account** (*account\_name: str, keystore\_path: str, password: str = None, addr: str = None*) → str

Register and exported account to config.json

**register\_asset** (*asset\_name: str, origin\_chain\_name: str, addr\_on\_origin\_chain: str, pegged\_chain\_name: str = None, addr\_on\_pegged\_chain: str = None*) → None

Register an existing asset to config.json

**transfer** (*value: int, to: str, asset\_name: str, network\_name: str, asset\_origin\_chain: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → str

Transfer aer or tokens on network\_name and specify asset\_origin\_chain for transfers of pegged assets.

**transfer\_from\_sidechain** (*from\_chain: str, to\_chain: str, asset\_name: str, amount: int, receiver: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → None

Transfer assets from from\_chain to to\_chain The asset being transfered back to the to\_chain native chain should be a minted asset on the sidechain.

**transfer\_to\_sidechain** (*from\_chain: str, to\_chain: str, asset\_name: str, amount: int, receiver: str = None, privkey\_name: str = 'default', privkey\_pwd: str = None*) → None

Transfer assets from from\_chain to to\_chain. The asset being transfered to the to\_chain sidechain should be native of from\_chain

```
aergo_wallet.transfer_to_sidechain.build_lock_proof(aergo_from: aergo.herapy.aergo.Aergo,
                                                    aergo_to: aergo.herapy.aergo.Aergo,
                                                    receiver: str, bridge_from: str,
                                                    bridge_to: str, lock_height:
                                                    int, token_origin: str) →
                                                    aergo.herapy.obj.sc_state.SCState
```

Check the last anchored root includes the lock and build a lock proof for that root

```
aergo_wallet.transfer_to_sidechain.lock(aergo_from: aergo.herapy.aergo.Aergo,
                                         bridge_from: str, receiver: str, value: int,
                                         asset: str, gas_limit: int, gas_price: int) →
                                         Tuple[int, str]
```

Lock can be called to lock aer or tokens. it supports delegated transfers when tx broadcaster is not the same as the token owner

```
aergo_wallet.transfer_to_sidechain.mint (aergo_to: aergo.herapy.aergo.Aergo, receiver: str,
lock_proof: aergo.herapy.obj.sc_state.SCState, token_origin: str, bridge_to: str, gas_limit: int,
gas_price: int) → Tuple[str, str]
```

Mint the receiver's deposit balance on aergo\_to.

```
aergo_wallet.transfer_from_sidechain.build_burn_proof (aergo_from:
aergo.herapy.aergo.Aergo,
aergo_to:
aergo.herapy.aergo.Aergo, receiver: str, bridge_from: str,
bridge_to: str, burn_height:
int, token_origin: str) →
aergo.herapy.obj.sc_state.SCState
```

Check the last anchored root includes the burn and build a burn proof for that root

```
aergo_wallet.transfer_from_sidechain.burn (aergo_from: aergo.herapy.aergo.Aergo,
bridge_from: str, receiver: str, value: int,
token_pegged: str, gas_limit: int, gas_price:
int) → Tuple[int, str]
```

Burn a minted token on a sidechain.

```
aergo_wallet.transfer_from_sidechain.unlock (aergo_to: aergo.herapy.aergo.Aergo,
receiver: str, burn_proof:
aergo.herapy.obj.sc_state.SCState, token_origin: str, bridge_to: str, gas_limit:
int, gas_price: int) → str
```

Unlock the receiver's deposit balance on aergo\_to.

```
aergo_wallet.token_deployer.deploy_token (payload_str: str, aergo:
aergo.herapy.aergo.Aergo, receiver: str, total_supply: int, fee_limit: int, fee_price: int) →
str
```

Deploy a token contract payload and give the total supply to the deployer

```
aergo_wallet.wallet_utils.build_deposit_proof (aergo_from: aergo.herapy.aergo.Aergo,
aergo_to: aergo.herapy.aergo.Aergo,
receiver: str, bridge_from: str,
bridge_to: str, deposit_height: int,
token_origin: str, key_word: str) →
aergo.herapy.obj.sc_state.SCState
```

Check the last anchored root includes the lock and build a lock proof for that root

```
aergo_wallet.wallet_utils.get_balance (account_addr: str, asset_addr: str, aergo:
aergo.herapy.aergo.Aergo) → int
```

Get an account or the default wallet balance of Aer or any token on a given network.

```
aergo_wallet.wallet_utils.transfer (value: int, to: str, asset_addr: str, aergo:
aergo.herapy.aergo.Aergo, sender: str, fee_limit: int,
fee_price: int) → str
```

Support 3 types of transfers : simple aer transfers, token transfer, and signed token transfers (token owner != tx signer)

**exception** aergo\_wallet.exceptions.**InsufficientBalanceError**

**exception** aergo\_wallet.exceptions.**InvalidArgumentsError**

**exception** aergo\_wallet.exceptions.**InvalidMerkleProofError**

**exception** aergo\_wallet.exceptions.**TxError**

**exception** `aergo_wallet.exceptions.UnknownContractError`

## 1.10 aergo\_cli

**class** `aergo_cli.main.MerkleBridgeCli` (*root\_path: str = './'*)

CLI tool for interacting with the AergoWallet.

First choose an existing config file or create one from scratch. Once a config file is chosen, the CLI provides an interface to the AergoWallet and has the following features: - edit config file settings - transfer assets between networks - check status of transfers - check balances for each asset on each network

**check\_balances** ()

Iterate every registered wallet, network and asset and query balances.

**check\_withdrawable\_balance** ()

Check the status of cross chain transfers.

**create\_config** ()

Create a new configuration file from scratch.

This tool registers 2 networks, bridge contracts, a private key for each network and bridge validators

**edit\_settings** ()

Menu for editing the config file of the currently loaded wallet

**finalize\_transfer** ()

Finalize a token transfer between 2 chains.

**finalize\_transfer\_arguments** (*prompt\_last\_deposit=True*)

Prompt the arguments needed to finalize a transfer.

The arguments can be taken from the pending transfers or inputted manually by users.

**Returns:** List of transfer arguments

**get\_registered\_assets** (*from\_chain, to\_chain*)

Get the list of registered assets on each network.

**get\_registered\_networks** ()

Get the list of networks registered in the wallet config.

**initiate\_transfer** ()

Initiate a new transfer of tokens between 2 networks.

**load\_config** ()

Load the configuration file from path and create a wallet object.

**menu** ()

Menu for interacting with network.

Users can change settings, query balances, check pending transfers, execute cross chain transactions

**prompt\_bridge\_networks** ()

Prompt user to choose 2 networks between registered networks.

**prompt\_common\_transfer\_params** ()

Prompt the common parameters necessary for all transfers.

**Returns:** List of transfer parameters : from\_chain, to\_chain, from\_assets, to\_assets, asset\_name, receiver

**prompt\_signing\_key** (*wallet\_name*)

Prompt user to select a private key.

**Note:** Keys are displayed by name and should have been registered in wallet config.

**prompt\_transfer\_networks()**

Prompt user to choose 2 networks between registered bridged networks.

**register\_asset()**

Register a new asset and it's pegs on other networks in the wallet's config.

**register\_bridge()**

Register bridge contracts between 2 already defined networks.

**register\_key()**

Register new key in wallet's config.

**register\_network()**

Register a new network in the wallet's config.

**register\_new\_validators()**

Register new validators in the wallet's config.

**start()**

Entry point of cli : load a wallet configuration file or create a new one

**store\_pending\_transfers()**

Record pending transfers in json file so they can be finalized later.

**aergo\_cli.utils.format\_amount(num: str)**

Format a float string to an integer with 18 decimals.

**Example:** '2.3' -> 230000000000000000

**aergo\_cli.utils.promptYN(q, y, n)**

Prompt user to proceed with a transfer or not.

**aergo\_cli.utils.prompt\_aergo\_keystore()**

Prompt user to register a new aergo keystore.

**Returns:**

- name of the key
- address of the key
- keystore path

**aergo\_cli.utils.prompt\_amount()**

Prompt a number of tokens to transfer.

**aergo\_cli.utils.prompt\_deposit\_height()**

Prompt the block number of deposit.

**aergo\_cli.utils.prompt\_new\_asset(networks)**

Prompt user to input a new asset by providing the following: - asset name - origin network (where it was first issued) - address on origin network - other networks where the asset exists as a peg - address of pegs

**aergo\_cli.utils.prompt\_new\_bridge(net1, net2)**

Prompt user to input bridge contracts and tempo.

For each contract on each bridged network, provide: - bridge contract address - anchoring period - finality of the anchored chain

**aergo\_cli.utils.prompt\_new\_network()**

Prompt user to input a new network's information: - Name - IP/url

`aergo_cli.utils.prompt_new_validators()`

Prompt user to input validators

**Note:** The list of validators must have the same order as defined in the bridge contracts

**Returns:** List of ordered validators

`aergo_cli.utils.prompt_number(message, formator=<class 'int'>)`

Prompt a number.



## CHAPTER 2

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