blockchain-core Documentation

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Contents

CHAPTER 1

Getting Started

The blockchain core is a helper library, that offers helpers for interacting with the evan.network blockchain. It is written in TypeScript and offers several (up to a certain degree) stand-alone modules, that can be used for

- creating and updating contracts
- managing user profiles
- en- and decryption
- distributed filesystem file handling
- key exchange and key handling
- ENS domain handling
- sending and receiving bmails

1.1 Adding blockchain core

First you need to get blockchain core into your project. This can be done using the following methods:

- npm: `npm install @evan.network/api-blockchain-core`

After that you need to create a blockchain core runtime with a predefined configuration.

Node.js version >= 10 is supported. The framework has been tested with Node.js 10, 11 and 12.

1.2 Configuring and initializing blockchain core

```
// require blockchain-core dependencies
const Web3 = require('web3');

// require blockchain-core
```

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```
const { Ipfs, createDefaultRuntime } = require('@evan.network/api-blockchain-core');

const runtimeConfig = {
  // account map to blockchain accounts with their private key
  accountMap: {
    'ACCOUNTID':
      'PRIVATE KEY',
  },
  // key configuration for private data handling
  keyConfig: {
    'ACCOUNTID': 'PASSWORD',
  },
  // ipfs configuration for evan.network storage
  ipfs: {host: 'ipfs.test.evan.network', port: '443', protocol: 'https'},
  // web3 provider config (currently evan.network testcore)
  web3Provider: 'wss://testcore.evan.network/ws',
};


async function init() {
  // initialize dependencies
  const provider = new Web3.providers.WebsocketProvider(
    runtimeConfig.web3Provider,
    { clientConfig: { keepalive: true, keepaliveInterval: 5000 } });
  const web3 = new Web3(provider, null, { transactionConfirmationBlocks: 1 });
  const dfs = new Ipfs({ dfsConfig: runtimeConfig.ipfs });

  // create runtime
  const runtime = await createDefaultRuntime(web3, dfs, { accountMap: runtimeConfig.
↪accountMap, keyConfig: runtimeConfig.keyConfig });
  console.dir(runtime);
}

init();
```

or you can initialize the api-blockchain-core runtime with your mnemonic and your password previously created on evan.network

```
// require blockchain-core dependencies
const Web3 = require('web3');

// require blockchain-core
const { Ipfs, createDefaultRuntime } = require('@evan.network/api-blockchain-core');

// ipfs configuration for evan.network testnet storage
const ipfsConfig = {host: 'ipfs.test.evan.network', port: '443', protocol: 'https'};
// web3 provider config (currently evan.network testcore)
const web3Provider = 'wss://testcore.evan.network/ws'

async function init() {
  // initialize dependencies
  const provider = new Web3.providers.WebsocketProvider(
    web3Provider,
    { clientConfig: { keepalive: true, keepaliveInterval: 5000 } });
  const web3 = new Web3(provider, null, { transactionConfirmationBlocks: 1 });
  const dfs = new Ipfs({ dfsConfig: ipfsConfig });
```

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```
  // create runtime
  const runtime = await createDefaultRuntime(
    web3,
    dfs,
    {
      mnemonic: 'YOUR_MNEMNONIC',
      password: 'YOUR_PASSWORD'
    }
  );
  console.dir(runtime);
}

init();
```

That's it! Now you can use the `runtime` object and interact with the evan.network blockchain.

The blockchain-core api is a set of modules which can be plugged in individually. So the above `runtime` is a full blown entry point to the api. You can also plug your own runtime with needed modules together.

1.3 Create a new profile on evan.network via API

When you want to create profiles programatically via our API, you can use the "Onboarding" class on the api-blockchain-core with the function `createNewProfile`. To create a new profile you have the following prerequirements:

1. A previously created profile on the testnet (https://dashboard.test.evan.network) or the mainnet (https://dashboard.evan.network)
2. At least 1.01 EVE on this profile when you want to create a new one as the creation process will be initiated with your existing account.

You can also generate your custom mnemonic from the Onboarding class as well.

The only thing that should be defined is a password and an alias for the profile.

```
const Web3 = require('web3');

// require blockchain-core
const { Ipfs, createDefaultRuntime, Onboarding } = require('@evan.network/api-
↪blockchain-core');

// ipfs configuration for evan.network testnet storage
const ipfsConfig = {host: 'ipfs.test.evan.network', port: '443', protocol: 'https'};
// web3 provider config (currently evan.network testcore)
const web3Provider = 'wss://testcore.evan.network/ws'


// DEFINED VARIABLES FROM USER
const existingMnemonic = 'YOUR_MNEMNONIC';
const existingPassword = 'YOUR_PASSWORD';

const newProfileAlias = 'CUSTOM_ALIAS';
const newProfilePassword = 'CUSTOM_PASSWORD';
```

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```
async function initRuntime() {
  // initialize dependencies
  const provider = new Web3.providers.WebsocketProvider(
    web3Provider,
    { clientConfig: { keepalive: true, keepaliveInterval: 5000 } });
  const web3 = new Web3(provider, null, { transactionConfirmationBlocks: 1 });
  const dfs = new Ipfs({ dfsConfig: ipfsConfig });

  // create runtime
  const runtime = await createDefaultRuntime(
    web3,
    dfs,
    {
      mnemonic: existingMnemonic,
      password: existingPassword
    }
  );

  return runtime;
}

async function createProfile() {
  // initialize existing runtime
  const runtime = await initRuntime();
  // generate a new random mnemnoic
  const mnemonic = Onboarding.createMnemonic();
  // alias for the new profile
  const profileAlias = 'autogenerated profile';
  // create a profile for a mnemonic and a given password
  const profile = await Onboarding.createNewProfile(
    runtime,
    mnemonic,
    newProfilePassword,
    {
      accountDetails: {
        profileType: 'user',
        accountName: newProfileAlias,
      },
    });
  console.log('Profile created successfully!');
  console.dir(profile);
}

createProfile();
```

When all functions have run successfully, a message like the following will be shown and you can then log in with the new mnemonic and password on the respective dashboard:

```
Profile created successfully
{ mnemonic:
   'penalty end car fit figure spell hero over equip hill found cage',
  password: 'CUSTOM_PASSWORD',
  runtimeConfig:
   { accountMap:
      { '0x5163B751E6C06102B37234fe1c126542375dEa80':
         'b92fe68e7cb5e697596bb979da5608b9b5c37b2062b36ef2219cf64fc52d11f9' },
```

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```
    keyConfig:
     { '0x82a911d010ef625d05ff9212b599088425ba51adc6b8d383c13db17a029c7982':
        'f312ee3cfd634969910642b3d3686858364bc48740d76b993187a225ce1e967e',
       '0x402ed1f201d74382ad51a5ae45e5d6f0c76d037a1dc4e573bfe032f387d46860':
        'f312ee3cfd634969910642b3d3686858364bc48740d76b993187a225ce1e967e' } } }
```

CHAPTER 2

Identity Based Profile

On the evan.network a profile is simply a Data Contract. The data can initially only be edited by the owner of the profile but when permissions are granted other members can also edit the data.

An identity based profile is also a data contract but the owner of the data contract is another contract which we shall call the identity contract. The previous implementations were all account based profiles on the evan.network but now all new users will be using identity based profiles.

When an account requests for an identity based profile, several steps occur:

- a new identity smart contract (VerificationHolder) is generated
- a new profile smart contract (Data Contract) is generated
- identity contract becomes owner of profile contract and is mapped in a registry (V00_UserRegistry) as such
- requesting account becomes the owner of this identity

When using identities we will come across three important terminologies. *activeIdentity* and *underlyingAccount* and *activeAccount*. A single user can have multiple identities and the identity being used is known as the *activeIdentity*. The account which is used to execute the transaction for the identity is known as the *underlyingAccount*. Finally the label *activeAccount* is a bit older and had been used before transactions were done through identities. It was a mixture of *activeIdentity* (as it was the acting instance) and *underlyingAccount* (as it was the account paying for transactions). The usage of *activeAccount* is by now deprecated in favor of the more specific terms *activeIdentity* and *underlyingAccount*.

Furthermore these identities can be converted into DIDs using the DID module and they can issue and be issued verifiable credentials using the VC module.

2.1 Configuring to use identity based profile

Identity based profiles are the entities which act on behalf of an account. All transactions are done via the the underlying account for the identity however the transaction objects are prepared using the identity. Configuring a runtime to use identity based profile is similar to the process of creating a runtime which uses account based profile as discussed in (getting started)[/getting-started.html#create-a-new-profile-on-evan-network-via-api]

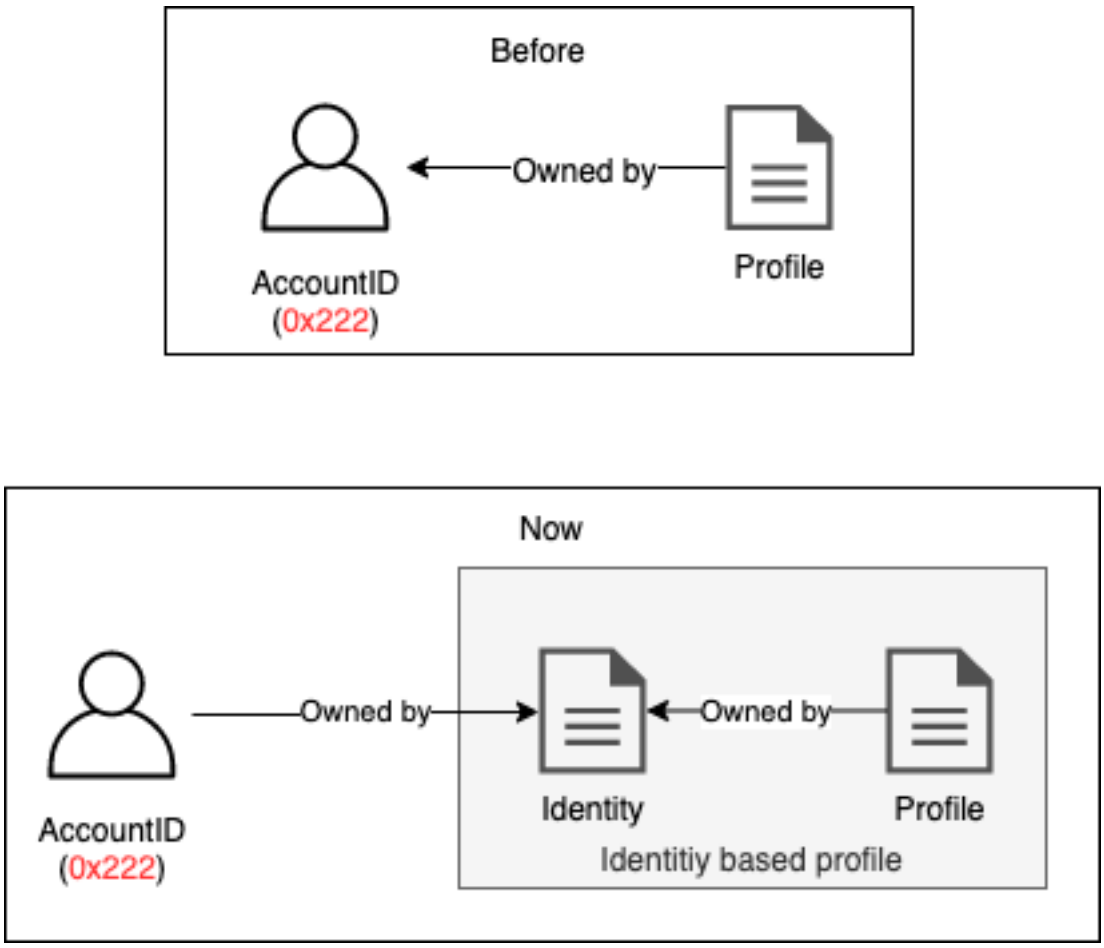

Fig. 1: identity based profile

```
// require blockchain-core dependencies
const Web3 = require('web3');

// require blockchain-core
const { Ipfs, createDefaultRuntime } = require('@evan.network/api-blockchain-core');

const runtimeConfig = {
  // account map to blockchain accounts with their private key
  accountMap: {
    'ACCOUNTID':
      'PRIVATE KEY',
  },
  // key configuration for private data handling
  keyConfig: {
    'ACCOUNTID': 'PASSWORD',
  },
  // use identity flag for using identity based profiles
  useIdentity: true,
  // ipfs configuration for evan.network storage
  ipfs: {host: 'ipfs.test.evan.network', port: '443', protocol: 'https'},
  // web3 provider config (currently evan.network testcore)
  web3Provider: 'wss://testcore.evan.network/ws',
};


async function init() {
  // initialize dependencies
  const provider = new Web3.providers.WebsocketProvider(
    runtimeConfig.web3Provider,
    { clientConfig: { keepalive: true, keepaliveInterval: 5000 } });
  const web3 = new Web3(provider, null, { transactionConfirmationBlocks: 1 });
  const dfs = new Ipfs({ dfsConfig: runtimeConfig.ipfs });

  // create runtime
  const runtime = await createDefaultRuntime(web3, dfs, { accountMap: runtimeConfig.
↪accountMap, keyConfig: runtimeConfig.keyConfig, useIdentity: runtimeConfig.
↪useIdentity });
  console.dir(runtime);
}

init();
```

Now you can use an a *runtime* object which uses an identity as an execution point to interact with the evan.network blockchain. Remember to use *runtime.activeIdentity* when you want to specify who is doing an an action when using the API.

2.2 getRuntimeForIdentity

```
getRuntimeForIdentity(existingRuntime, identity)
```

Creates a runtime for a specific identity, based on another runtime. The context of this runtime needs a profile with the corresponding encryptionKeys saved using *setIdentityAccess* or the correct set encryptionKey within the *runtime.keyConfig*.

2.2.1 Parameters

1. `existingRuntime` - `Runtime`: existing runtime instance
2. `identity` - `string`: identity address

2.2.2 Returns

`Promise` returns `Runtime`: runtime instance for identity

2.2.3 Example

```
await getRuntimeForIdentity(runtime, identities[1]);
```

CHAPTER 3

Blockchain

3.1 Executor

Class Name	Executor
Extends	Logger
Source	executor.ts
Examples	executor.spec.ts

The executor is used for

- making contract calls
- executing contract transactions
- creating contracts
- send EVEs to another account or contract

The signer requires you to have a contract instance, either by

- loading the contract via Description helper (if the contract has an abi at its description)
- loading the contract via ContractLoader helper (if the contract has not abi at its description)
- directly via web3.js.

3.1.1 constructor

```
new Executor(options);
```

Creates a new Executor instance.

The Executor allows to pass the `defaultOptions` property to its constructor. This property contains options for transactions and calls, that will be used if no other properties are provided in calls/transactions. Explicitly passed options always overwrite default options.

Parameters

1. **`options` - `ExecutorOptions`: options for ServiceContract constructor.**
    - `config` - `any`: configuration object for the executor instance
    - `defaultOptions` - `any` (optional): default options for web3 transactions/calls
    - `eventHub` - `EventHub`: `EventHub` instance
    - `signer` - `SignerInterface`: `SignerInterface` instance
    - `web3` - `Web3`: `Web3` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Executor` instance

Example

```
const executor = new Executor({
    config,
    eventHub,
    signer,
    web3
  });
```

3.1.2 init

```
executor.init(name);
```

Initialize executor.

Parameters

1. **`options` - `any`: object with the property "eventHub" (of the type EventHub)**
    - `eventHub` - `EventHub`: The initialized EventHub Module.

Returns

`void`.

Example

```
runtime.executor.init({eventHub: runtime.eventHub})
```

3.1.3 executeContractCall

```
executor.executeContractCall(contract, functionName, ...args);
```

Run the given call from contract.

Parameters

1. `contract` - `any`: the target contract
2. `functionName` - `string`: name of the contract function to call
3. `...args` - `any[]`: optional array of arguments for contract call. if last arguments is {Object}, it is used as the options parameter

Returns

`Promise` resolves to `any`: contract calls result.

Example

```
const greetingMessage = await runtime.executor.executeContractCall(
  contract,                                  // web3.js contract instance
  'greet'                                    // function name
);
```

3.1.4 executeContractTransaction

```
executor.executeContractTransaction(contract, functionName, inputOptions, ...
↪functionArguments);
```

Execute a transaction against the blockchain, handle gas exceeded and return values from contract function.

Parameters

1. `contract` - `any`: contract instance
2. `functionName` - `string`: name of the contract function to call
3. **`inputOptions` - `any`: options object**
    - `from` - `string` (mandatory): The address the call "transaction" should be made from.
    - `gas` - `number` (optional): The amount of gas provided with the transaction.

- `event` - `any` (optional): object with two properties `target` (contract name) and `eventName`
- `getEventResult` - `function` (optional): callback function which will be called when the event is triggered. First argument is the full event info, second argument is an options with the event arguments.
- `eventTimeout` - `number` (optional): timeout (in ms) to wait for a event result before the transaction is marked as error
- `estimate` - `boolean` (optional): Should the amount of gas be estimated for the transaction (overwrites `gas` parameter)
- `force` - `string` (optional): Forces the transaction to be executed. Ignores estimation errors
- `autoGas` - `number` (optional): enables autoGas 1.1 ==> adds 10% to estimated gas costs. value capped to current block.
- `value`- `number` (optional): Allows to specify the amount of funds for transfer

4. `...functionArguments` - `any[]`: optional arguments to pass to contract transaction

Returns

`Promise` resolves to: `no result` (if no event to watch was given), `the event` (if event but no getEventResult was given), `the` value returned by getEventResult(eventObject, arguments).

Because an estimation is performed, even if a fixed gas cost has been set, failing transactions are rejected before being executed. This protects users from executing transactions, that consume all provided gas and fail, which is usually not intended, especially if a large amount of gas has been provided. To prevent this behavior for any reason, add a `force: true` to the options, though it is **not advised to do so**.

To allow to retrieve the result of a transaction, events can be used to receive values from a transaction. If an event is provided, the transaction will only be fulfilled, if the event is triggered. To use this option, the executor needs to have the `eventHub` property has to be set. Transactions, that contain event related options and are passed to an executor without an `eventHub` will be rejected immediately.

Example

```
const accountId = '0x...';
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, },                     // perform transaction with this account
  123,                                      // arguments after the options are passed
↪to the contract
);
```

Provided gas is estimated automatically with a fault tolerance of 10% and then used as *gas* limit in the transaction. For a different behavior, set *autoGas* in the transaction options:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, autoGas: 1.05, },      // 5% fault tolerance
  123,                                      // arguments after the options are passed
↪to the contract
);
```

or set a fixed gas limit:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, gas: 100000, },        // fixed gas limit
  123,                                      // arguments after the options are passed
↪to the contract
);
```

Using events for getting return values:

```
const contractId = await runtime.executor.executeContractTransaction(
  factory,
  'createContract', {
    from: accountId,
    autoGas: 1.1,
    event: { target: 'FactoryInterface', eventName: 'ContractCreated', },
    getEventResult: (event, args) => args.newAddress,
  },
);
```

3.1.5 executeSend

```
executor.executeSend(options);
```

Send EVEs to target account.

Parameters

1. **`options` - `any`: the target contract**
    - `from` - `string`: The address the call "transaction" should be made from.
    - `to` - `string`: The address where the eve's should be send to.
    - `value` - `number`: Amount to send in Wei

Returns

`Promise` resolves to `void`: resolved when done.

Example

```
await runtime.executor.executeSend({
  from: '0x...',                            // send from this account
  to: '0x...',                              // receiving account
  value: web3.utils.toWei('1'),             // amount to send in Wei
});
```

3.1.6 createContract

```
executor.createContract(contractName, functionArguments, options);
```

Creates a contract by contstructing creation transaction and signing it with private key of options.from.

Parameters

1. `contractName` - `string`: contract name (must be available withing contract loader module)
2. `functionArguments` - `any[]`: arguments for contract creation, pass empty Array if no arguments
3. **`options` - `any`: options object**
    - `from` - `string`: The address the call "transaction" should be made from.
    - `gas` - `number`: Provided gas amout for contract creation.

Returns

`Promise` resolves to `any`: new contract.

Example

```
const newContractAddress = await runtime.executor.createContract(
  'Greeter',                                // contract name
  ['I am a demo greeter! :3'],              // constructor arguments
  { from: '0x...', gas: 100000, },          // gas has to be provided with a fixed value
);
```

3.2 ExecutorAgent

Class Name	ExecutorAgent
Extends	Executor
Source	executor-agent.ts
Examples	executor-agent.spec.ts

The `ExecutorAgent` module is designed to cover basically the same tasks as the Executor module. While the last one performs the transactions directly with an identity or account, that is given as inputOptions, the `ExecutorAgent` module wraps those transactions by submitting them to a smart agent.

The smart agent receives those transactions and performs them with its own identity or account, if a valid token has been passed to it alongside the transaction data. Tokens for transactions can be issued at the smart agent as well (a password is required for this).

Using the `ExecutorAgent` allows to delegate transactions to users that do not have their own blockchain identity or account. Delegating those transactions requires that smart agent user to be invited into the contract instead of the users, that will interact with the contract.

Users without identity or account are then interacting with the front-end the same way as regular users, but do not submit their transactions themselves, they make a REST request against a smart agent server. To prevent spamming

and scamming, the users use tokens for their transactions. Tokens are basically like prepaid telephone card and allows to perform a limited set of functions for a limited amount of times. Tokens can only be created with a valid password.

Let's say, we have created a DataContract, that contains three questions, that should be answered by someone without an own blockchain identity or account (think of a customer survey or something similar).

To allow that, first invite the corresponding smart agent identity or account into the contract. Smart agent identities or accounts for this should be known to the party, that wants to delegate transactions and their funds are maintained by this party, we'll use an example address for this here.

For abbreviation we assume, we have the following values:

```
let dataContractInstance;                       // our data contract with the survey␣
↪questions
let contractOwner;                              // 'we' - the contract creator and owner
let businessCenterDomain = 'testbc.evan';       // contracts business center
let smartAgentId;                               // account id of our smart agent
let password;                                   // password, for token generation
```

So let's invite the smart agent to our contract:

```
await dataContract.inviteToContract(
  businessCenterDomain,
  dataContractInstance.options.address,
  contractOwner,
  smartAgentId,
);
```

Now with the smart agent being able to perform transactions, create a token for transaction delegation. We want the user to be able to:

1. accept the invitation
2. write three answers
3. mark their state as "done"

```
const txToken = await executor.generateToken(
  password, [
  { contract: dataContractInstance, functionName: 'changeConsumerState', count: 2, },
  { contract: dataContractInstance, functionName: 'addListEntry', count: 3, },
]);
```

Allowing `addListEntry` three time is to allow them to write three answers. One of the `changeConsumerState` times is for accepting the contract, which is done by setting the own state to `Active`. The other one is for marking editing as done (setting the own state to `Terminated`).

The resulting token `txToken` is a string, that can be handed over to our users without an identity or account. This is usually done by sending them an email with a link, that contains the token and skips the login step for them and routes them directly to the contract, they should respond to.

Let's switch sides. The next steps are performed in the front-end by a user without a blockchain identity or account, that has received the token.

To make transaction via a smart agent, create an instance of the `ExecutorWallet` and assign the token from before as `token` .

```
const executor = new ExecutorAgent({
  agentUrl
  config,
```

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```
  eventHub,
  signer,
  web3
});
executor.token = txToken;
```

To use the `ExecutorWallet` instance created this way in your other modules, hand it over to their contstructor like instead of a normal `Executor` instance. Then use your modules, that have the `ExeutorWallet` instance like you would use them for making transactions with your own identity or account.

```
const surveyAnswer = {
  foo: 'sample',
  bar: 123,
};
await dataContract.addListEntries(dataContractInstance, ['surveyAnswers'],␣
↪[sampleValue], smartAgentId);
```

Note, that the last sample uses the smartAgentId as the performing identity or account. Because transactions are estimated before being executed and in some cases the underlying modules require an "active" identity or account, that is used as the users identity, this has to match the smart agents identity or account. The smart agent identity or account is passed alongside the token via the link in the email for users without blockchain accounts. References, that would point to a users identity or account have to be replaced with this smart agent identity or account.

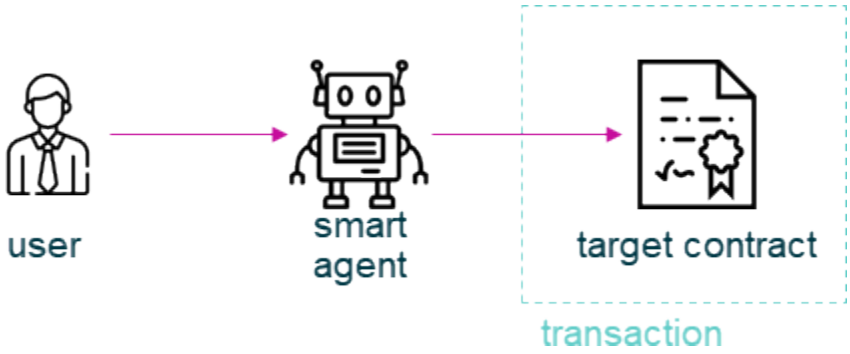

Fig. 1: transaction flow in agent based transactions

3.2.1 constructor

```
new ExecutorAgent(options);
```

Creates a new ExecutorAgent instance.

The ExecutorAgent allows to pass the `defaultOptions` property to its constructor. This property contains options for transactions and calls, that will be used if no other properties are provided in calls/transactions. Explicitly passed options always overwrite default options.

Parameters

1. **`options` - `ExecutorAgentOptions`: options for ServiceContract constructor.**
    - `config` - `any`: configuration object for the executor instance
    - `defaultOptions` - `any` (optional): default options for web3 transactions/calls

- `eventHub` - `EventHub`: `EventHub` instance
- `signer` - `SignerInterface`: `SignerInterface` instance
- `web3` - `Web3`: `Web3` instance
- `agentUrl` - `string` (optional): agent url, including protocol, host and port, defaults to `'http://localhost:8080'`
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`ExecutorAgent` instance

Example

```
const executor = new ExecutorAgent({
    agentUrl
    config,
    eventHub,
    signer,
    web3
  });
```

3.2.2 init

```
executor.init(name);
```

initialize executor

Parameters

1. **`options` - `any`: object with the property "eventHub" (of the type EventHub)**
    - `eventHub` - `EventHub`: The initialized EventHub Module.

Returns

`void`.

Example

```
runtime.executor.init({eventHub: runtime.eventHub})
```

3.2.3 executeContractCall

```
executor.executeContractCall(contract, functionName, ...args);
```

run the given call from contract

this is done as a rest call against the smart agent

a token is not required for performing calls

Parameters

1. `contract` - `any`: the target contract
2. `functionName` - `string`: name of the contract function to call
3. `...args` - `any[]`: optional array of arguments for contract call. if last arguments is {Object}, it is used as the options parameter

Returns

`Promise` resolves to `any`: contract calls result.

Example

```
const greetingMessage = await runtime.executor.executeContractCall(
  contract,                                  // web3.js contract instance
  'greet'                                    // function name
);
```

3.2.4 executeContractTransaction

```
executor.executeContractTransaction(contract, functionName, inputOptions, ...
↪functionArguments);
```

execute a transaction against the blockchain, handle gas exceeded and return values from contract function

this is done as a rest call against the smart agent

transactions, that transfer EVEs to a target identity or account, will be rejected

this requires a valid token issued with `generateToken` beforehand, tokens can be set at the executor with:

```
executor.token = someToken;
```

Parameters

1. `contract` - `any`: contract instance
2. `functionName` - `string`: name of the contract function to call
3. **`inputOptions` - `any`: options object**

- `from` - `string` (optional): The address the call "transaction" should be made from.
- `gas` - `number` (optional): The amount of gas provided with the transaction.
- `event` - `string` (optional): The event to wait for a result of the transaction,
- `getEventResult` - `function` (optional): callback function which will be called when the event is triggered.
- `eventTimeout` - `number` (optional): timeout (in ms) to wait for a event result before the transaction is marked as error
- `estimate` - `boolean` (optional): Should the amount of gas be estimated for the transaction (overwrites `gas` parameter)
- `force` - `string` (optional): Forces the transaction to be executed. Ignores estimation errors
- `autoGas` - `number` (optional): enables autoGas 1.1 ==> adds 10% to estimated gas costs. value capped to current block.

4. `...functionArguments` - `any[]`: optional arguments to pass to contract transaction

Returns

`Promise` resolves to: `no result` (if no event to watch was given), `the event` (if event but no getEventResult was given), `the` value returned by getEventResult(eventObject).

Because an estimation is performed, even if a fixed gas cost has been set, failing transactions are rejected before being executed. This protects users from executing transactions, that consume all provided gas and fail, which is usually not intended, especially if a large amount of gas has been provided. To prevent this behavior for any reason, add a `force: true` to the options, though it is **not advised to do so**.

To allow to retrieve the result of a transaction, events can be used to receive values from a transaction. If an event is provided, the transaction will only be fulfilled, if the event is triggered. To use this option, the executor needs to have the `eventHub` property has to be set. Transactions, that contain event related options and are passed to an executor without an `eventHub` will be rejected immediately.

Example

```
const accountId = '0x...';
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, },                     // perform transaction with this account
  123,                                      // arguments after the options are passed␣
↪to the contract
);
```

Provided gas is estimated automatically with a fault tolerance of 10% and then used as *gas* limit in the transaction. For a different behavior, set *autoGas* in the transaction options:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, autoGas: 1.05, },      // 5% fault tolerance
  123,                                      // arguments after the options are passed␣
↪to the contract
);
```

or set a fixed gas limit:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, gas: 100000, },        // fixed gas limit
  123,                                      // arguments after the options are passed
↪to the contract
);
```

Using events for getting return values:

```
const contractId = await runtime.executor.executeContractTransaction(
  factory,
  'createContract', {
    from: accountId,
    autoGas: 1.1,
    event: { target: 'FactoryInterface', eventName: 'ContractCreated', },
    getEventResult: (event, args) => args.newAddress,
  },
);
```

3.2.5 executeSend

```
executor.executeSend(options);
```

creating contracts directly is not supported by the walled based executor, use a regular Executor for such tasks

---

3.2.6 createContract

```
executor.createContract(contractName, functionArguments, options);
```

creates a contract by contstructing creation transaction and signing it with private key of options.from

this is done as a rest call against the smart agent

transactions, that transfer EVEs to a target identity or account, will be rejected

this requires a valid token issued with `generateToken` beforehand, tokens can be set at the executor with:

```
executor.token = someToken;
```

Parameters

1. `contractName` - `string`: contract name (must be available withing contract loader module)
2. `functionArguments` - `any[]`: arguments for contract creation, pass empty Array if no arguments
3. **`options` - `any`: options object**
    - `from` - `string`: The address the call "transaction" should be made from.
    - `gas` - `number`: Provided gas amout for contract creation.

Returns

`Promise` resolves to `any`: new contract.

Example

```
const newContractAddress = await runtime.executor.createContract(
  'Greeter',                                // contract name
  ['I am a demo greeter! :3'],              // constructor arguments
  { from: '0x...', gas: 100000, },          // gas has to be provided with a fixed value
);
```

3.2.7 generateToken

```
executor.generateToken(password, functions);
```

generate a new token for transactions (or contract creations)

this generates a new token for the given functions, this token can be used for each requested function (either only once or multiple times, if a count > 1 has been requested)

Parameters

1. `password` - `string`: password for token creation
2. `functions` - `any[]`: array of function signatures as abi objects

Returns

`Promise` returns `string`: token for given transactions

Example

Tokens can be created for transactions by passing the contract and the function name to it:

```
const txToken = await executor.generateToken(
  password, [{ contract: contract, functionName: 'addListEntry', }]);
```

When the token should be able to perform those transactions multiple times, pass a count alongside:

```
const txToken = await executor.generateToken(
  password, [{ contract: contract, functionName: 'addListEntry', count: 3, }]);
```

When wanting to perform a contract creation without a factory contract, this contract has to be known to the smart agent. Then the contract name can be passed as 'signature':

```
cosnt ccToken = await executor.generateToken(
  password, [{ signature: 'Owned', }]);
```

3.3 ExecutorWallet

Class Name	ExecutorWallet
Extends	Executor
Source	executor-wallet.ts
Examples	executor-wallet.spec.ts

The `ExecutorWallet` module is designed to cover basically the same tasks as the `Executor` module. While the last one performs the transactions directly with an identity or account, that is given as inputOptions, the `ExecutorWallet` module wraps those transactions by submitting them to a configured wallet contract.

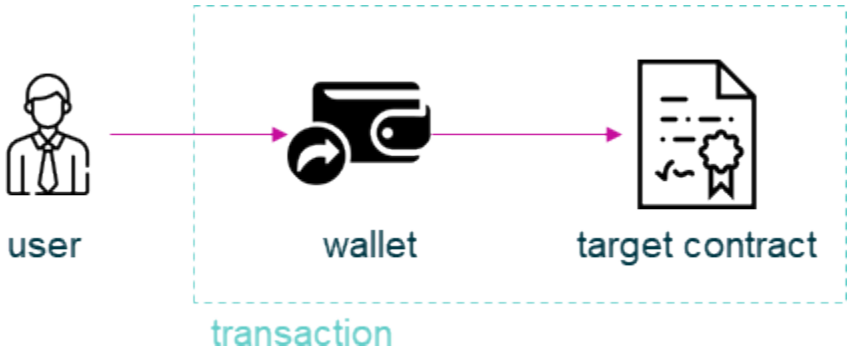

Fig. 2: transaction flow in wallet based transactions

The wallet is a smart contract and the identity or account, that performs the transactions against the target contracts on the blockchain. Transactions are wrapped by using the `Wallet` module, see details on how to transactions are performed internally at the documentation page of the `Wallet` module.

Because transactions are performed via the `Wallet` module, they have the same limitations in regards to en- and decryption as described in the introduction section of the `Wallet`.

3.3.1 constructor

```
new ExecutorWallet(options);
```

Creates a new `ExecutorWallet` instance.

The ExecutorWallet allows to pass the `defaultOptions` property to its constructor. This property contains options for transactions and calls, that will be used if no other properties are provided in calls/transactions. Explicitly passed options always overwrite default options.

Parameters

1. **`options` - `ExecutorWalletOptions`: options for ServiceContract constructor.**
    - `accountId` - `string`: account, that is used for making transactions against wallet contract
    - `config` - `any`: configuration object for the executor instance
    - `eventHub` - `EventHub`: `EventHub` instance
    - `signer` - `SignerInterface`: `SignerInterface` instance

- `wallet` - `Wallet`: `Wallet` instance with a loaded wallet contract
- `web3` - `Web3`: `Web3` instance
- `defaultOptions` - `any` (optional): default options for web3 transactions/calls
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`ExecutorWallet` instance

Example

```
const executor = new ExecutorWallet({
    accountId,
    config,
    eventHub,
    signer,
    wallet,
    web3
  });
```

3.3.2 init

```
executor.init(name);
```

initialize executor

Parameters

1. **`options` - `any`: object with the property "eventHub" (of the type EventHub)**
    - `eventHub` - `EventHub`: The initialized EventHub Module.

Returns

`void`.

Example

```
runtime.executor.init({eventHub: runtime.eventHub})
```

3.3.3 executeContractCall

```
executor.executeContractCall(contract, functionName, ...args);
```

run the given call from contract

note, that if a from is used, this from is replaced with the wallets address

Parameters

1. `contract` - `any`: the target contract
2. `functionName` - `string`: name of the contract function to call
3. `...args` - `any[]`: optional array of arguments for contract call. if last arguments is {Object}, it is used as the options parameter

Returns

`Promise` resolves to `any`: contract calls result.

Example

```
const greetingMessage = await runtime.executor.executeContractCall(
  contract,                                // web3.js contract instance
  'greet'                                  // function name
);
```

3.3.4 executeContractTransaction

```
executor.executeContractTransaction(contract, functionName, inputOptions, ...
↪functionArguments);
```

execute a transaction against the blockchain, handle gas exceeded and return values from contract function,

note, that a from passed to this function will be replaced with the wallets address and that transactions, that transfer EVEs to a target identity or account, will be rejected

Parameters

1. `contract` - `any`: contract instance
2. `functionName` - `string`: name of the contract function to call
3. **`inputOptions` - `any`: options object**
    - `from` - `string` (optional): The address the call "transaction" should be made from.
    - `gas` - `number` (optional): The amount of gas provided with the transaction.
    - `event` - `string` (optional): The event to wait for a result of the transaction,

- `getEventResult` - `function` (optional): callback function which will be called when the event is triggered.
- `eventTimeout` - `number` (optional): timeout (in ms) to wait for a event result before the transaction is marked as error
- `estimate` - `boolean` (optional): Should the amount of gas be estimated for the transaction (overwrites `gas` parameter)
- `force` - `string` (optional): Forces the transaction to be executed. Ignores estimation errors
- `autoGas` - `number` (optional): enables autoGas 1.1 ==> adds 10% to estimated gas costs. value capped to current block.

4. `...functionArguments` - `any[]`: optional arguments to pass to contract transaction

Returns

`Promise` resolves to: `no result` (if no event to watch was given), `the event` (if event but no getEventResult was given), `the` value returned by getEventResult(eventObject).

Because an estimation is performed, even if a fixed gas cost has been set, failing transactions are rejected before being executed. This protects users from executing transactions, that consume all provided gas and fail, which is usually not intended, especially if a large amount of gas has been provided. To prevent this behavior for any reason, add a `force: true` to the options, though it is **not advised to do so**.

To allow to retrieve the result of a transaction, events can be used to receive values from a transaction. If an event is provided, the transaction will only be fulfilled, if the event is triggered. To use this option, the executor needs to have the `eventHub` property has to be set. Transactions, that contain event related options and are passed to an executor without an `eventHub` will be rejected immediately.

Example

```
const accountId = '0x...';
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, },                     // perform transaction with this account
  123,                                      // arguments after the options are passed␣
↪to the contract
);
```

Provided gas is estimated automatically with a fault tolerance of 10% and then used as *gas* limit in the transaction. For a different behavior, set *autoGas* in the transaction options:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, autoGas: 1.05, },      // 5% fault tolerance
  123,                                      // arguments after the options are passed␣
↪to the contract
);
```

or set a fixed gas limit:

```
const greetingMessage = await runtime.executor.executeContractTransaction(
  contract,                                 // web3.js contract instance
  'setData',                                // function name
  { from: accountId, gas: 100000, },        // fixed gas limit
  123,                                      // arguments after the options are passed
↪to the contract
);
```

Using events for getting return values:

```
const contractId = await runtime.executor.executeContractTransaction(
  factory,
  'createContract', {
    from: accountId,
    autoGas: 1.1,
    event: { target: 'FactoryInterface', eventName: 'ContractCreated', },
    getEventResult: (event, args) => args.newAddress,
  },
);
```

3.3.5 executeSend

```
executor.executeSend(options);
```

sending funds is not supported by the walled based executor, use a regular Executor for such tasks

---

3.3.6 createContract

```
executor.createContract(contractName, functionArguments, options);
```

creating contracts directly is not supported by the walled based executor, use a regular Executor for such tasks

3.4 Signer Identity

Class Name	SignerIdentity
Implements	SignerInterface
Extends	Logger
Source	signer-idenitity.ts

The signers are used to create contract transactions and are used internally by the Executor. The default runtime uses the SignerInternal helper to sign transaction.

In most cases, you won't have to use the Signer objects directly yourself, as the Executor is your entry point for performing contract transactions. *SignerIdentity* may be an exception to this rule, as it can be used to check currently used identity and account.

Note, that this signer supports using accounts and identities. If the *.from* property in the options is given as configured *activeIdentity*, transaction will be made via this identity, which requires the *underlyingAccount* to be in control of this

identity. If *.from* is given as *underlyingAcccount*, transactions will be made directly from this account. Also keep in mind, that in both cases *underlyingAccount* needs to have enough funds to pay for the transactions, as this account is used to pay for them.

3.4.1 Public Properties

1. `activeIdentity` - `string`: identity used for transactions, usually controlled by *underlyingAccount*
2. `underlyingAccount` - `string`: account, that pays for transactions used for transactions, usually controlling *activeIdentity*

3.4.2 constructor

```
new SignerIdentity(options, config);
```

Creates a new *SignerInternal* instance. *config* can be set up later on with *updateConfig*, if required (e.g. when initializing a circular structure).

Parameters

1. **`options` - `SignerIdentityOptions`: options for SignerIdentity constructor (runtime like object)**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `verifications` - `Verifications`: `Verifications` instance
    - `web3` - `Web3`: `Web3` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
2. **`config` - `SignerIdentityConfig` (optional): custom config for *SignerIdentity* instance**
    - `activeIdentity` - `string`: identity used for transactions, usually controlled by *underlyingAccount*
    - `underlyingAccount` - `string`: account, that pays for transactions used for transactions, usually controlled by *underlyingAccount*
    - `underlyingSigner` - `SignerInterface`: an instance of a `SignerInterface` implementation; usually a `SignerInternal` instance

Returns

`SignerIdentity` instance

Example

```
const signer = new SignerIdentity(
  {
    contractLoader,
    verifications,
    web3,
  },
  {
    activeIdentity: await verifications.getIdentityForAccount(accounts[0], true),
    underlyingAccount: accounts[0],
    underlyingSigner,
  },
);
```

3.4.3 signAndExecuteSend

```
signer.signAndExecuteSend(options, handleTxResult);
```

Performs a value transfer transaction. This will send specified funds to identity, which will send it to target. Funds are returned if transaction fails.

Parameters

1. **`options` - any:**
    - `from` - `string`: The address the call "transaction" should be made from.
    - `to` - `string`: The address where the eve's should be send to.
    - `value` - `number`: Amount to send in Wei
2. `handleTxResult` - `function(error, receipt)`: callback when transaction receipt is available or error

Example

```
const patchedInput = runtime.signer.signAndExecuteSend({
  from: '0x...',                          // send from this identity/account
  to: '0x...',                            // receiving account
  value: web3.utils.toWei('1'),           // amount to send in Wei
}, (err, receipt) => {
  console.dir(arguments);
});
```

3.4.4 signAndExecuteTransaction

```
signer.signAndExecuteTransaction(contract, functionName, functionArguments, options,␣
↪handleTxResult);
```

Create, sign and submit a contract transaction.

Parameters

1. `contract` - `any`: contract instance from api.eth.loadContract(...)
2. `functionName` - `string`: function name
3. `functionArguments` - `any[]`: arguments for contract creation, pass empty Array if no arguments
4. **`options` - `any`:**
    - `from` - `string`: The address (identity/account) the call "transaction" should be made from.
    - `gas` - `number`: Amount of gas to attach to the transaction
    - `to` - `string` (optional): The address where the eve's should be send to.
    - `value` - `number` (optional): Amount to send in Wei
5. `handleTxResult` - `function(error, receipt)`: callback when transaction receipt is available or error

---

3.4.5 createContract

```
signer.createContract(contractName, functionArguments, options);
```

Creates a smart contract.

Parameters

1. `contractName` - `any`: contractName from contractLoader
2. `functionArguments` - `any[]`: arguments for contract creation, pass empty Array if no arguments
3. **`options` - `any`:**
    - `from` - `string`: The address the call "transaction" should be made from.
    - `gas` - `number`: Amount of gas to attach to the transaction

Returns

`Promise` resolves to `any`: web3 instance of new contract.

3.4.6 signMessage

```
signer.signMessage(accountId, message);
```

Sign given message with accounts private key, does not work for identity.

Parameters

1. `accountId` - `string`: accountId to sign with, **cannot be done with activeIdentity**
2. `message` - `string`: message to sign

Returns

`Promise` resolves to `string`: signature

Example

```
const signature = await signer.signMessage(accountId, messageToSign);
```

3.4.7 updateConfig

```
signer.updateConfig(partialOptions, config);
```

Update config of *SignerIdentity* can also be used to setup verifications and accounts after initial setup and linking with other modules.

Parameters

1. `partialOptions` - `{ verifications: Verifications }`: object with *verifications* property, e.g. a runtime
2. **`config` - `SignerIdentityConfig`: custom config for *SignerIdentity* instance**
    - `activeIdentity` - `string`: identity used for transactions, usually controlled by *underlyingAccount*
    - `underlyingAccount` - `string`: account, that pays for transactions used for transactions, usually controlled by *underlyingAccount*
    - `underlyingSigner` - `SignerInterface`: an instance of a `SignerInterface` implementation; usually a `SignerInternal` instance

Returns

`Promise` returns `void`: resolved when done

Example

```
// create new instance
const signer = new SignerIdentity(
  {
    contractLoader,
    verifications,
    web3,
  },
);

// use instance, e.g. reference it in other components like `verifications`
// ...

// now set verfications instance and account in signer
```

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```
signer.updateConfig(
  { verifications },
  {
    activeIdentity,
    underlyingAccount,
    underlyingSigner: signerInternal,
  },
);
```

3.4.8 getGasPrice

```
signer.getGasPrice();
```

get gas price (either from config or from api.eth.web3.eth.gasPrice (gas price median of last blocks) or api.config.eth.gasPrice; unset config value or set it to falsy for median gas price

Returns

`string`: hex string with gas price.

Example

```
const gasPrice = await signer.getGasPrice();
// returns 0x2e90edd000
```

3.5 Account Store

Class Name	AccountStore
Implements	KeyStoreInterface
Extends	Logger
Source	account-store.ts

The AccountStore implements the KeyStoreInterface and is a wrapper for a storage, where evan.network account ids are stored. The default AccountStore takes an account –> private key mapping as a pojo as its arguments and uses this to perform lookups, when the *getPrivateKey* function is called. This lookup needs to be done, when transactions are signed by the InternalSigner (see Signer).

Note that the return value of the *getPrivateKey* function is a promise. This may not be required in the default AccountStore, but this allows you to implement own implementations of the KeyStoreInterface, which may enforce a more strict security behavior or are able to access other sources for private keys.

3.5.1 constructor

```
new AccountStore(options);
```

Creates a new AccountStore instance.

Parameters

1. **`options` - `AccountStoreOptions`: options for AccountStore constructor.**
    - `accounts` - `any`: object with accountid/privatekey mapping
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`AccountStore` instance

Example

```
const accountStore = new AccountStore({
    accounts: {
      '0x1234': '12479abc3df'
    }
  });
```

3.5.2 getPrivateKey

```
accountStore.getPrivateKey(accountId);
```

get private key for given account

Parameters

1. `accountId` - `string`: eth accountId

Returns

Promise resolves to `string`: private key for this account

Example

```
const privateKey = await runtime.accountStore.getPrivateKey(
↪'0x0000000000000000000000000000000000000002');
```

3.6 Event Hub

Class Name	EventHub
Extends	Logger
Source	event-hub.ts

The EventHub helper is wrapper for using contract events. These include - contract events (e.g. contract factory may trigger an event, announcing the address of the new contract) - global events (some contracts in the evan.network economy, like the *MailBox* use such global events)

3.6.1 constructor

```
new EventHub(options);
```

Creates a new EventHub instance.

Parameters

1. **`options` - `EventHubOptions`: options for EventHub constructor.**
    - `config` - `any`: configuration object for the eventhub module
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `eventWeb3` - `Web3` (optional): `Web3` instance used for event handling (metamask web3 can't handle events correct)
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`EventHub` instance

Example

```
const eventHub = new EventHub({
    config,
    nameResolver,
    contractLoader,
  });
```

3.6.2 subscribe

```
eventHub.subscribe(contractName, contractAddress, eventName, filterFunction, onEvent,␣
↪fromBlock);
```

subscribe to a contract event or a global EventHub event

Parameters

1. `contractName` - `string`: target contract name (must be available within `ContractLoader`)
2. `contractAddress` - `string`: target contract address
3. `eventName` - `string`: name of the event to subscribe to
4. `filterFunction` - `function`: a function that returns true or a Promise that resolves to true if onEvent function should be applied
5. `onEvent` - `function`: executed when event was fired and the filter matches, gets the event as its parameter
6. `fromBlock` - `string` (optional): get all events from this block, defaults to `latest`

Returns

`Promise` resolves to `string`: event subscription.

Example

```
// subscribe to the 'ContractEvent' at the EventHub located at
↪'0000000000000000000000000000000deadbeef'
runtime.eventHub
          .subscribe(
            'EventHub',
            '0000000000000000000000000000000deadbeef',
            'ContractEvent',
            (event) => true,
            (event) => {
              console.dir(event)
            }
          )
          .then((result) => { subscription = result; })
```

3.6.3 once

```
eventHub.once(contractName, contractAddress, eventName, filterFunction, onEvent,␣
↪fromBlock);
```

subscribe to a contract event or a global EventHub event, remove subscription when filterFunction matched

Parameters

1. `toRemove` - `any`:
2. `contractAddress` - `string`: target contract address
3. `eventName` - `string`: name of the event to subscribe to
4. `filterFunction` - `function`: a function that returns true or a Promise that resolves to true if onEvent function should be applied
5. `onEvent` - `function`: executed when event was fired and the filter matches, gets the event as its parameter
6. `fromBlock` - `string` (optional): get all events from this block, defaults to `latest`

Returns

`Promise` resolves to `string`: event subscription.

Example

```
// subscribe to the 'ContractEvent' at the EventHub located at
↪'0000000000000000000000000000000deadbeef'
runtime.eventHub
          .once(
            'EventHub',
            '0000000000000000000000000000000deadbeef',
            'ContractEvent',
            (event) => true,
            (event) => {
              console.dir(event)
            }
          )
          .then((result) => { subscription = result; })
```

3.6.4 unsubscribe

```
eventHub.unsubscribe(toRemove);
```

unsubscribe an event subscription

Parameters

1. **`contractName` - `string`: target contract name (must be available within `ContractLoader`)**
    - `subscription` - `string`: target guid for the subscription that should be removed
    - `contractId` - `string`: target contractId where all subscriptions should be removed (can be 'all')

Returns

`Promise` resolves to `void`: resolved when done.

Example

```
// subscribe to the 'ContractEvent' at the EventHub located at
↪'0000000000000000000000000000000deadbeef'
runtime.eventHub
          .unsubscribe({
            subscription: 'f0315d39-5e03-4e82-b765-df1c03037b3a'
          })
```

3.7 Name Resolver

Class Name	NameResolver
Extends	Logger
Source	name-resolver.ts
Examples	name-resolver.spec.ts

The NameResolver is a collection of helper functions, that can be used for ENS interaction. These include:

- setting and getting ENS addresses
- setting and getting ENS content flags, which is used when setting data in distributed file system, especially in case of setting a description for an *ENS* address

3.7.1 constructor

```
new NameResolver(options);
```

Creates a new NameResolver instance.

Parameters

1. **`options` - `NameResolverOptions`: options for NameResolver constructor.**
    - `config` - `any`: configuration object for the NameResolver instance
    - `executor` - `Executor`: `Executor` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `web3` - `Web3`: `Web3` instance

- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`NameResolver` instance

Example

```
const nameResolver = new NameResolver({
    cryptoProvider,
    dfs,
    executor,
    keyProvider,
    nameResolver,
    contractLoader,
    web3,
  });
```

3.7.2 getAddressOrContent

```
nameResolver.getAddressOrContent(name, type);
```

get address or content of an ens entry

Parameters

1. `name` - `string`: ens domain name (plain text)
2. `type` - `string`: content type to get (address or content)

Returns

`Promise` resolves to `string`: address, returns null if not available

Example

```
const testEvanAddress = await runtime.nameResolver.getAddressOrContent('test.evan',
↪'address');
// returns 0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49
```

3.7.3 getAddress

```
nameResolver.getAddress(name);
```

get address of an ens entry

Parameters

1. `name` - `string`: ens domain name (plain text)

Returns

`Promise` resolves to `string`: address, returns null if not available

Example

```
const testEvanAddress = await runtime.nameResolver.getAddress('test.evan');
// returns 0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49
```

3.7.4 getContent

```
nameResolver.getContent(name);
```

get content of an ens entry

Parameters

1. `name` - `string`: ens domain name (plain text)

Returns

`Promise` resolves to `string`: content, returns null if not available

Example

```
const testEvanAddress = await runtime.nameResolver.getContent('test.evan');
// returns  (encoded ipfs hash) 0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49
```

3.7.5 setAddressOrContent

```
nameResolver.setAddressOrContent(name, value, accountId, domainOwnerId, type);
```

set ens name. this can be a root level domain domain.test or a subdomain sub.domain.test

Parameters

1. `name` - `string`: ens domain name (plain text)
2. `value` - `string`: ethereum address
3. `accountId` - `string`: owner of the parent domain
4. `domainOwnerId` - `string`: owner of the address to set
5. `type` - `string`: content type to set

Returns

`Promise` resolves to `void`: resolves when done

Example

```
const testEvanAddress = await runtime.nameResolver
  .setAddressOrContent(
    'test.evan',
    '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49',
    '0x0000000000000000000000000000000000000beef',
    '0x0000000000000000000000000000000000000beef',
    'address'
  );
// returns  (encoded ipfs hash) 0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49
```

3.7.6 setAddress

```
nameResolver.setAddress(name, address, accountId, domainOwnerId);
```

set address for ens name. this can be a root level domain domain.test or a subdomain sub.domain.test

Parameters

1. `name` - `string`: ens domain name (plain text)
2. `address` - `string`: ethereum address
3. `accountId` - `string`: owner of the parent domain
4. `domainOwnerId` - `string`: owner of the address to set

Returns

`Promise` resolves to `void`: resolves when done

Example

```
const testEvanAddress = await runtime.nameResolver
  .setAddress(
    'test.evan',
    '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49',
    '0x0000000000000000000000000000000000000beef',
    '0x0000000000000000000000000000000000000beef'
  );
```

3.7.7 setContent

```
nameResolver.setContent(name, content, accountId, domainOwnerId);
```

set content for ens name. this can be a root level domain domain.test or a subdomain sub.domain.test

Parameters

1. `name` - `string`: ens domain name (plain text)
2. `content` - `string`: ethereum address
3. `accountId` - `string`: owner of the parent domain
4. `domainOwnerId` - `string`: owner of the address to set

Returns

`Promise` resolves to `void`: resolves when done

Example

```
const testEvanAddress = await runtime.nameResolver
  .setContent(
    'test.evan',
    '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49',
    '0x0000000000000000000000000000000000000beef',
    '0x0000000000000000000000000000000000000beef'
  );
```

3.7.8 claimAddress

```
nameResolver.claimAddress(name, executingAddress[, domainOwnerId, price]);
```

Tries to claim node ownership from parent nodes owner, this assumes, that the parent node owner is a registar, that supports claiming address from it (FIFS registrar or PayableRegistrar).

Parameters

1. `name` - `string`: domain name to set (plain text)
2. `executingAddress` - `string`: identity or account executing the transaction
3. `domainOwnerId` - `string` (optional): owner of the new domain, defaults to `executingAddress`
4. `value` - `string|number` (optional): value to send (if registrar is payable)

Returns

`Promise` returns `void`: resolved when done

Example

```
// claim '123test.fifs.registrar.test.evan' with identities[0] for identities[1] from␣
↪FIFS registrar
const domain = '123test.fifs.registrar.test.evan';
await nameResolver.claimAddress(domain, identities[0], identities[1]);

// claim '123test.payable.registrar.test.evan' with identities[0] for identities[1]␣
↪from payable registrar
const domain = '123test.fifs.registrar.test.evan';
const price = await nameResolver.getPrice(domain);
await nameResolver.claimAddress(domain, identities[0], identities[1], price);
```

3.7.9 claimPermanentAddress

```
nameResolver.claimPermanentAddress(name, executingAddress[, domainOwnerId]);
```

Registers a permanent domain via registrar, can only be done by registrar owner.

Parameters

1. `name` - `string`: domain name to set (plain text)
2. `executingAddress` - `string`: identity or account, that executes the transaction, has to be registrar owner
3. `domainOwnerId` - `string` (optional): owner of the new domain, defaults to `executingAddress`

Returns

`Promise` returns `void`: resolved when done

Example

```
// claim '123sample.evan' with identities[0] for identities[1] from registrar
const domain = '123sample.evan';
await nameResolver.claimPermanentAddress(domain, identities[0], identities[1]);
```

3.7.10 setPrice

```
nameResolver.setPrice(name, executingAddress, newPrice);
```

Set price for a registrar at a domain.

Parameters

1. `name` - `string`: ENS address of a domain owned by a registrar (e.g. 'sample.payable.test.evan')
2. `executingAddress` - `string`: identity or account that performs the action (needs proper permisions for registrar)
3. `newPrice` - `number|string` (optional): new price in Wei

Returns

`Promise` returns `void`: resolved when done

Example

```
await nameResolver.setPrice(
  'payable.registrar.test.evan',
  '0x1111111111111111111111111111111111111111',
  web3.utils.toWei('5', 'ether'),
);
```

3.7.11 getPrice

```
nameResolver.getPrice(name);
```

Get price for domain (if domain is payable).

Parameters

1. `name` - `string`: a domain to check price for (e.g. 'sample.payable.test.evan')

Returns

`Promise` returns `string`: price in Wei

Example

```
console.log(await nameResolver.getPrice('payable.registrar.test.evan'));
// Output:
// 5000000000000000000
```

3.7.12 setValidUntil

```
nameResolver.setValidUntil(name, executingAddress, newPrice);
```

Set duration, that an address is valid; resolval stops after this, depending on configuration of the ENS an extra period, where owner is still available, can be granted; notice that this can only be done by parent owner of given domain.

Parameters

1. `name` - `string`: ENS address of a domain owned by a registrar (e.g. 'sample.payable.test.evan')
2. `executingAddress` - `string`: identity or account that performs the action; must be parent owner of given domain
3. `validUntil` - `number|string`: js timestamp, when name resolution stops

Returns

`Promise` returns `void`: resolved when done

Example

```
await nameResolver.setValidUntil(
  'payable.registrar.test.evan',
  '0x1111111111111111111111111111111111111111',
  Date.now() + 60000,
);
```

3.7.13 getValidUntil

```
nameResolver.getValidUntil(name);
```

Get timestamp, when domain will stop resolval.

Parameters

1. `name` - `string`: domain to get valid until for

Returns

`Promise` returns `string`: js timestamp, when resolver lookup will expire

Example

```
console.log(await nameResolver.getValidUntil('payable.registrar.test.evan'));
// Output:
// 1544630375417
```

3.7.14 claimFunds

```
namerResolver.claimFunds(name, executingAddress);
```

Verification funds for domain.

Parameters

1. `name` - `string`: ENS address of a domain owned by a registrar (e.g. 'sample.payable.test.evan')
2. `executingAddress` - `string`: identity or account that performs the action (needs proper permisions for registrar)

Returns

`Promise` returns `void`: resolved when done

Example

```
await nameResolver.claimFunds(
  'payable.registrar.test.evan',
  '0x1111111111111111111111111111111111111111',
);
```

3.7.15 getFactory

```
nameResolver.getFactory(contractName);
```

helper function for retrieving a factory address (e.g. 'tasks.factory.evan')

Parameters

1. `contractName` - `string`: name of the contract that is created by the factory

Returns

`string`: address of the contract factory

Example

```
const taskFactory = await runtime.nameResolver.getFactory('tasks');
// returns '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49';
```

3.7.16 getDomainName

```
nameResolver.getDomainName(domainConfig, ...subLabels);
```

builds full domain name based on the provided domain config a module initalization.

Parameters

1. `domainConfig` - `string[] | string`: The domain configuration
2. `...subLabels` - `string[]`: array of domain elements to be looked up and added at the lefthand

Returns

`string`: the domain name

Example

```
const domain = runtime.nameResolver.getDomainName(['factory', 'root'], 'task');
// returns 'task.factory.evan';
```

3.7.17 getArrayFromIndexContract

```
nameResolver.getArrayFromIndexContract(indexContract, listHash, retrievers, chain,␣
↪triesLeft);
```

retrieve an array with all values of a list from an index contract.

Parameters

1. `indexContract` - `any`: Ethereum contract address (DataStoreIndex)
2. `listHash` - `string`: bytes32 namehash like api.nameResolver.sha3('ServiceContract')
3. `retrievers` - `any` (optional): overwrites for index or index like contract property retrievals defaults to:

```
{
  listEntryGet: 'listEntryGet',
  listLastModified: 'listLastModified',
  listLength: 'listLength',
}
```

1. `chain` - `Promise`: Promise, for chaining multiple requests (should be omitted when called 'from outside', defaults to Promise.resolve())
2. `triesLeft` - `number`: tries left before quitting defaults to `10`

Returns

`Promise` resolves to `string[]`: list of addresses

3.7.18 getArrayFromListContract

```
nameResolver.getArrayFromListContract(indexContract, count, offset, reverse, chain,␣
↪triesLeft);
```

retrieve an array with all values of a list from an index contract.

Parameters

1. `indexContract` - `any`: Ethereum contract address (DataStoreIndex)
2. `count` - `number` (optional): how many items should be returned, defaults to `10`
3. `offset` - `number` (optional): how many items should be skipped, defaults to `0`
4. `reverse` - `boolean` (optional): should the list be iterated reverse, defaults to `false`
5. `chain` - `Promise` (optional): Promise, for chaining multiple requests (should be omitted when called 'from outside', defaults to Promise.resolve())
6. `triesLeft` - `number` (optional): tries left before quitting defaults to `10`

Returns

`Promise` resolves to `string[]`: list of addresses

3.7.19 getArrayFromUintMapping

```
nameResolver.getArrayFromUintMapping(contract, countRetriever, elementRetriever[,␣
↪count, offset, reverse]);
```

retrieve elements from a contract using a count and element retriever function.

Parameters

1. `contract` - `any`: Ethereum contract address (DataStoreIndex)
2. `countRetriever` - `Function` : function which returns the count of the retrieved elements
3. `elementRetriever` - `Function` : function which returns the element of the retrieved elements
4. `count` - `number` (optional): number of elements to retrieve, defaults to `10`
5. `offset` - `number` (optional): skip this many items when retrieving, defaults to `0`
6. `reverse` - `boolean` (optional): retrieve items in reverse order, defaults to `false`

Returns

`Promise` resolves to `string[]`: list of addresses

3.7.20 sha3

```
nameResolver.sha3(input);
```

sha3 hashes an input, substitutes web3.utils.sha3 from geth console

Parameters

1. `input` - `string | buffer`: input text or buffer to hash

Returns

`string`: hashed output

3.7.21 soliditySha3

```
nameResolver.soliditySha3(...args);
```

Will calculate the sha3 of given input parameters in the same way solidity would. This means arguments will be ABI converted and tightly packed before being hashed.

Parameters

1. `args` - `string | buffer`: arguments for hashing

Returns

`string`: hashed output

3.7.22 namehash

```
nameResolver.namehash(inputName);
```

hash ens name for usage in contracts

Parameters

1. `inputName` - `string`: inputName ens name to hash

Returns

`string`: name hash

3.7.23 bytes32ToAddress

```
nameResolver.bytes32ToAddress(hash);
```

converts a bytes32 hash to address

Parameters

1. `hash` - `string`: bytes32 hash

Returns

`string`: converted address

3.8 Description

Class Name	Description
Extends	Description
Source	description.ts
Examples	description.spec.ts

The Description module is the main entry point for interacting with contract descriptions. It allows you to:

- get and set descriptions
- work with contracts and ENS descriptions
- create web3.js contract instances directly from an Ethereum address and its description
- The main use cases for interacting with a contracts description in your application will most probably be reading a contracts description and loading contracts via their description.

The examples folder folder contains some samples for getting started. With consuming or setting contract descriptions.

When setting descriptions to contracts, these contracts have to support the `Executor` interface.

A simple flow for working with description may look like following:

We already have smart contract, that supports the zz interface and set a description to it.

```
const address = '0x...'; // or 'test.evan' as ens name
const accountId = '0x...';
const description = {
  "public": {
    "name": "DBCP sample contract",
    "description": "DBCP sample contract description",
    "author": "dbcp test",
    "tags": [
      "example",
      "greeter"
    ],
    "version": "0.1.0",
    "dbcpVersion": 2
  }
};
await runtime.description.setDescription(address, description, accountId);
```

Now we have made some updates to our contract and we want to update its version to `0.2.0`.

// get description const retrieved = await runtime.description.getDescription(address, accountId);

// update version const accountId = '0x0000000000000000000000000000000000000beef'; retrieved.public.version = '0.2.0'; await runtime.description.setDescription(address, retrieved, accountId);

3.8.1 constructor

```
new Description(options);
```

Creates a new Description instance.

Parameters

1. **`options` - `DescriptionOptions`: options for Description constructor.**
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `executor` - `Executor`: `Executor` instance
    - `keyProvider` - `KeyProvider`: `KeyProvider` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `web3` - `Web3`: `Web3` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`

- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Description` instance

Example

```
const description = new Description({
    cryptoProvider,
    dfs,
    executor,
    keyProvider,
    nameResolver,
    contractLoader,
    web3,
  });
```

3.8.2 getDescription

```
description.getDescription(address, accountId);
```

loads description envelope from ens or contract if an ENS address has a contract set as well and this contract has a defintion, the contract definition is preferred over the ENS definition and therefore returned

Parameters

1. `address` - `string`: The ens address or contract address where the description is stored
2. `accountId` - `string`: identity or account that is allowed to read the description

Returns

`Promise` returns `Envelope`: description as an Envelope.

Example

```
const address = '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49';
const accountId = '0x000000000000000000000000000000000000beef';
const description = await runtime.description.getDescription(address, accountId);
console.dir(description);
// Output:
// { public:
//    { name: 'DBCP sample greeter',
//      description: 'smart contract with a greeting message and a data property',
//      author: 'dbcp test',
```

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```
//       tags: [ 'example', 'greeter' ],
//       version: '0.1.0',
//       dbcpVersion: 2,
//       abis: { own: [Array] } } }
```

3.8.3 setDescription

```
description.setDescription(address, envelope, accountId);
```

set description, can be used for contract addresses and ENS addresses

Parameters

1. `address` - `string`: contract address or ENS address
2. `envelope` - `Envelope`: description as an envelope
3. `accountId` - `string`: identity or account supposed to encrypt the description

Returns

`Promise` returns `void`: resolved when done.

Example

```
const address = '0x...'; // or 'test.evan' as ens name
const accountId = '0x...';
const description = {
  "public": {
    "name": "DBCP sample contract",
    "description": "DBCP sample contract description",
    "author": "dbcp test",
    "tags": [
      "example",
      "greeter"
    ],
    "dbcpVersion": 2,
    "version": "0.1.0"
  }
};
await runtime.description.setDescription(address, description, accountId);
```

3.8.4 validateDescription

Descriptions are validated when setting them. A list of known DBCP definition schemas is maintained in description.schema.ts . If a description is set, its property *dbcpVersion* will be used for validating the description, if *dbcpVersion* is not provided, version 1 is used and a warning is logged.

Descriptions can be checked against the validator before setting them.

```
description.validateDescription(envelope);
```

try to validate description envelope; throw Error if validation fails

Parameters

1. `envelope` - `Envelope`: envelop with description data; private has to be unencrypted

Returns

`Promise` returns `boolean|any[]`: true if valid or array of issues.

Example

```
const brokenDescription = {
  "public": {
    "name": "DBCP sample contract with way to few properties",
  }
};
console.log(runtime.description.validateDescription(brokenDescription));
// Output:
// [ { keyword: 'required',
//     dataPath: '',
//     schemaPath: '#/required',
//     params: { missingProperty: 'description' },
//     message: 'should have required property \'description\'' },
//   { keyword: 'required',
//     dataPath: '',
//     schemaPath: '#/required',
//     params: { missingProperty: 'author' },
//     message: 'should have required property \'author\'' },
//   { keyword: 'required',
//     dataPath: '',
//     schemaPath: '#/required',
//     params: { missingProperty: 'version' },
//     message: 'should have required property \'version\'' } ]
```

```
const workingDescription = {
  "public": {
    "name": "DBCP sample contract",
    "description": "DBCP sample contract description",
    "author": "dbcp test",
    "tags": [
      "example",
      "greeter"
    ],
```

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```
    "version": "0.1.0"
  }
};
console.log(runtime.description.validateDescription(workingDescription));
// Output:
// true
```

3.8.5 = Contract =

3.8.6 getDescriptionFromContract

```
description.getDescriptionFromContract(address, myIdentity);
```

loads description envelope from contract

Parameters

1. `address` - `string`: The contract address where the description is stored
2. `readerAddress` - `string`: identity or account that is allowed to read the description

Returns

`Promise` returns `Envelope`: description as an Envelope.

Example

```
const address = '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49';
const identityId = '0x000000000000000000000000000000000000beef';
const description = await runtime.description.getDescriptionFromContract(address,␣
↪identityId);
console.dir(description);
// Output:
// { public:
//    { name: 'DBCP sample greeter',
//      description: 'smart contract with a greeting message and a data property',
//      author: 'dbcp test',
//      tags: [ 'example', 'greeter' ],
//      version: '0.1.0',
//      dbcpVersion: 2,
//      abis: { own: [Array] } } }
```

3.8.7 setDescriptionToContract

```
description.setDescriptionToContract(contractAddress, envelope, myIdentity);
```

store description at contract

Parameters

1. `contractAddress` - `string`: The contract address where description will be stored
2. `envelope` - `Envelope`: description as an envelope
3. `encryptorAddress` - `string`: identity or account that is supposed to encrypt the description

Returns

`Promise` returns `void`: resolved when done.

Example

```
const address = '0x...';
const myIdentity = '0x...';
const description = {
  "public": {
    "name": "DBCP sample contract",
    "description": "DBCP sample contract description",
    "author": "dbcp test",
    "tags": [
      "example",
      "greeter"
    ],
    "version": "0.1.0",
    "dbcpVersion": 2
  }
};
await runtime.description.setDescriptionToContract(address, description, myIdentity);
```

3.8.8 = ENS =

ENS addresses are able to hold multiple values at once. So they may be holding a contract address and a description. If this is the case and the contract at the ENS address has another description, the contracts description is preferred over the ENS description. If you explicitly intend to retrieve an ENS endpoints description and want to ignore the contracts description, use the function *getDescriptionFromEns*.

3.8.9 getDescriptionFromEns

```
description.getDescriptionFromEns(address);
```

loads description envelope from ens

Parameters

1. `ensAddress` - `string`: The ens address where the description is stored

Returns

`Promise` returns `Envelope`: description as an Envelope.

Example

```
const address = '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49';
const accountId = '0x000000000000000000000000000000000000beef';
const description = await runtime.description.getDescriptionFromContract(address,␣
↪accountId);
console.dir(description);
// Output:
// { public:
//    { name: 'DBCP sample greeter',
//      description: 'smart contract with a greeting message and a data property',
//      author: 'dbcp test',
//      tags: [ 'example', 'greeter' ],
//      version: '0.1.0',
//      dbcpVersion": 2,
//      abis: { own: [Array] } } }
```

3.8.10 setDescriptionToEns

```
description.setDescriptionToEns(ensAddress, envelope, accountId);
```

store description at contract

Parameters

1. `contractAddress` - `string`: The ens address where description will be stored
2. `envelope` - `Envelope`: description as an envelope
3. `accountId` - `string`: identity or account that is supposed to encrypt the description

Returns

`Promise` returns `void`: resolved when done.

Example

```
const address = '0x...';
const accountId = '0x...';
const description = {
  "public": {
    "name": "DBCP sample contract",
    "description": "DBCP sample contract description",
    "author": "dbcp test",
    "tags": [
```

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```
      "example",
      "greeter"
    ],
    "version": "0.1.0",
    "dbcpVersion": 2
  }
};
await runtime.description.setDescriptionToEns(address, description, accountId);
```

3.9 Wallet

Class Name	Wallet
Extends	Logger
Source	wallet.ts
Examples	wallet.spec.ts

The `Wallet` module is a wrapper for the MultiSigWallet and allows to create wallets, manage owners and execte transactions with it. One of the common use cases is setting confirmation count to 1 (which is the default value). This basically makes the wallets a multiowned account, where all parties are able to perform transactions on their own.

The `Wallet` module is bound to a wallet contract instance. This instace can be loaded, which requires an existing MultiSigWallet contract and a user, that is able to work with it:

```
wallet.load('0x0123456789012345678901234567890123456789');
```

If no wallet exists, a new wallet can be created with:

```
// account id, that creates the wallet
const accountId = '0x0000000000000000000000000000000000000001';
// account, that will be able to manage the new wallet
const manager = '0x0000000000000000000000000000000000000001';
// wallet owners
const owners = [
  '0x0000000000000000000000000000000000000001',
  '0x0000000000000000000000000000000000000002',
];
await wallet.create(accountId, manager, owners);
```

The last example creates a wallet

- with the account `0x0000000000000000000000000000000000000001` (used as `accountId`)
- that can be managed (adding/removing owners) by `0x0000000000000000000000000000000000000001` (used as `manager`)
- that allows the accounts `0x0000000000000000000000000000000000000001` and `0x0000000000000000000000000000000000000002` to perform transactions (used as `owners`)

Creating wallets via the `Wallet` module loads them to the module as well, so there is no need to call the `load` function after that.

So now we have a valid and working wallet loaded to our module and start performing calls. Let's say, we have an instance of an owned contract and want to transfer its ownership, we can do:

```
const accountId = '0x0000000000000000000000000000000000000001';
const newOwner = '0x0000000000000000000000000000000000000002';
await wallet.submitTransaction(ownedContract, 'transferOwnership', { from: accountId,␣
↪}, newOwner);
```

Looks pretty simple, but comes with a few things to consider:

- `accountId` is the identity or account, that performs the transaction from the "outside perspective" (if you look into a chain explorer like the evan.network Test-Explorer you'll see, that identity or account `accountId` is actually performing the transaction and not the wallet contract)
- `accountId` pays the gas cost for the transaction (obviously, when considering the last point)
- from the perspective of the target contract `ownedContract`, the wallet contract (either loaded or created beforehand) is performing the transaction
- taken our example transaction `transferOwnership`, **the wallet contract has to be the current owner** and not the identity or account `accountId`

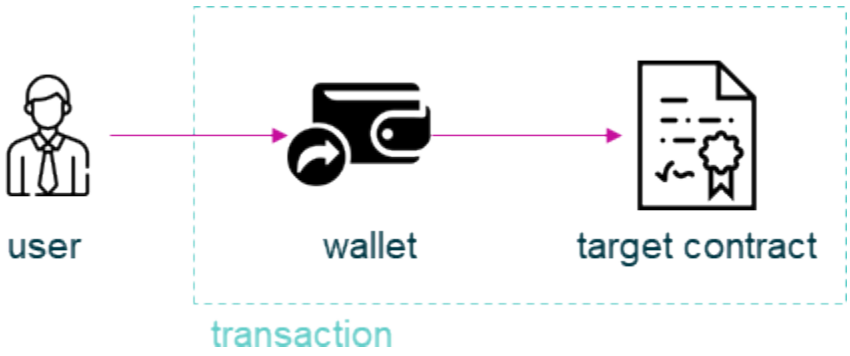

Fig. 3: transaction flow in wallet based transactions

An implementation of an `Executor` module, that uses a wallet for contract execution, has been created as `ExecutorWallet`. Because the profiles are (externally owned) account based and many modules rely on profiles for data encryption and decryption, the `ExecutorWallet` module should be used with care, when dealing with operations, that require en- or decryption.

3.9.1 constructor

```
new Wallet(options);
```

Creates a new Wallet instance.

Parameters

1. **`options` - `WalletOptions`: options for Wallet constructor.**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `description` - `Description`: `Description` instance
    - `eventHub` - `EventHub`: `EventHub` instance
    - `executor` - `Executor`: `Executor` instance

- `nameResolver` - `NameResolver`: `NameResolver` instance

Returns

`Wallet` instance

Example

```
const wallet = new Wallet({
  contractLoader,
  description,
  eventHub,
  executor,
  nameResolver,
});
```

3.9.2 = Contract Management =

3.9.3 create

```
wallet.create(accountId, manager, owners);
```

Create a new wallet contract and uses it as its wallet contract.

Parameters

1. `accountId` - `string`: identity or account, that creates the wallet
2. `manager` - `string`: identity or account, that will be able to manage the new wallet
3. `owners` - `string[]`: wallet owners
4. `confirmations` - `number` (optional): number of confirmations required to complete a transaction, defaults to `1`

Returns

`Promise` returns `void`: resolved when done

Example

```
await wallet.create(accounts[0], accounts[0], [accounts[0]]);
```

3.9.4 load

```
wallet.load(contractId[, walletType]);
```

Load wallet contract from address and uses it as its wallet contract.

Parameters

1. `contractid` - `string`: a wallet contract address
2. `walletType` - `string` (optional): wallet contract type, defaults to `MultiSigWallet`

Returns

`Promise` returns `void`: resolved when done

Example

```
wallet.load('0x0123456789012345678901234567890123456789');
```

3.9.5 = Transactions =

3.9.6 submitTransaction

```
wallet.submitTransaction(target, functionName, inputOptions[, ...functionArguments]);
```

Submit a transaction to a wallet, as required is fixed to 1, this will immediately execute the transaction.

Parameters

1. `target` - `any`: contract of the submitted transaction
2. `functionName` - `string`: name of the contract function to call
3. `inputOptions` - `any`: currently supported: from, gas, value, event, getEventResult, eventTimeout, estimate, force
4. `functionArguments` - `any[]`: optional arguments to pass to contract transaction

Returns

`Promise` returns `any`: status information about transaction

Example

```
await wallet.submitTransaction(testContract, 'transferOwnership', { from: accounts[0],
↪ }, accounts[1]);
```

3.9.7 = Account Management =

3.9.8 addOwner

```
wallet.addOwner(accountId, toAdd);
```

Function description

Parameters

1. `accountId` - `string`: identity or account with management permissions on wallet
2. `toAdd` - `string`: identity or account to add as an owner

Returns

`Promise` returns `void`: resolved when done

Example

```
await wallet.addOwner(accounts[0], accounts[1]);
```

3.9.9 removeOwner

```
initializedModule.removeOwner(arguments);
```

Remove an owner from a wallet contract.

Parameters

1. `accountId` - `string`: identity or account with management permissions on wallet
2. `toAdd` - `string`: identity or account to remove from wallet owners

Returns

`Promise` returns `void`: resolved when done

Example

```
await wallet.removeOwner(accounts[0], accounts[1]);
```

3.9.10 getOwners

```
wallet.getOwners();
```

Get all owners of a wallet.

Parameters

(none)

Returns

`Promise` returns `string[]`: array of identities or accounts

Example

```
console.dir(await wallet.getOwners())
// Output:
// [ '0x0123456789012345678901234567890123456789' ]
```

3.10 Votings

Class Name	Wallet
Extends	Logger
Source	votings.ts
Examples	votings.spec.ts

The votings helper allows to hold votes over decisions and execute them, if enough votes have been submitted.

The usual flow for proposals has the following steps:

0. if not already created, create a voting contract with *createContract* (this doesn't have to be done when using a central voting contract (e.g. from a well known ENS address))
1. create a proposal for a change with *createProposal*
2. let participants vote with *vote*
3. if enough time has passed and you have enough votes, you can finally execute your proposal with *execute*

3.10.1 constructor

```
new Votings(options);
```

Creates a new Votings instance.

Parameters

1. **`options` - `VotingsOptions`: options for Votings constructor.**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `executor` - `Executor`: `Executor` instance

Returns

`Votings` instance

Example

```
const votings = new Votings({
  contractLoader,
  executor,
});
```

3.10.2 = Contract =

3.10.3 createContract

```
votings.createContract(creator, votingsContractOptions);
```

Create new voting contract instance.

Parameters

1. `creator` - `string`: identity or account that should create and own the contract
2. `votingsContractOptions` - *`VotingsContractOptions`*: additional options for votings contract

Returns

`Promise` returns `void`: resolved when done

Example

```
const votingsContract = await votings.createContract(
  '0x1111111111111111111111111111111111111111',
  {
    minimumQuorumForProposals: 2,
    minutesForDebate: 1,
    marginOfVotesForMajority: 0,
  },
);
```

3.10.4 = Members =

3.10.5 addMember

```
votings.addMember(votingsContract, votingsOwner, toInvite, memberOptions);
```

Add member to voting contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `executingAddress` - `string`: identity or account that performs the action (usually the voting owner)
3. `invitee` - `string`: identity or account to add to votings contract
4. `memberOptions` - *`MemberOptions`*: options for new member

Returns

`Promise` returns `void`: resolved when done

Example

```
await votings.addMember(
  '0x000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  '0x2222222222222222222222222222222222222222',
  { name: 'Member Number 2' },
);
```

3.10.6 removeMember

```
votings.removeMember(votingsContract, votingsOwner, toRemove);
```

Remove member from votings contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `remover` - `string`: identity or account that performs the action
3. `removee` - `string`: identity or account to remove from votings contract

Returns

`Promise` returns `void`: resolved when done

Example

```
await votings.removeMember(
  '0x0000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  '0x2222222222222222222222222222222222222222',
);
```

3.10.7 getMemberInfo

```
votings.getMemberInfo(votingsContract, target);
```

Get info of a member.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `target` - `string`: identity or account to get info for

Returns

`Promise` returns *`MemberInfo`*: member info

Example

```
console.dir(await votings.getMemberInfo(
  '0x0000000000000000000000000000000c0274ac7',
  '0x2222222222222222222222222222222222222222',
));
// Output:
// {
//   address: '0x2222222222222222222222222222222222222222',
//   name: 'Member Number 2',
//   memberSince: 1544092270556
// }
```

3.10.8 isMember

```
votings.isMember(votingsContract, target);
```

Checks if a given identity or account is member in voting contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `target` - `string`: identity or account to get info for

Returns

`Promise` returns `bool`: true if member

Example

```
console.dir(await votings.isMember(
  '0x000000000000000000000000000000000c0274ac7',
  '0x2222222222222222222222222222222222222222',
));
// Output:
// true
```

3.10.9 = Proposals =

3.10.10 createProposal

```
votings.createProposal(votingsContract, proposalCreator, proposalOptions);
```

Create a new proposal in votings contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `proposalCreator` - `string`: identity or account to create the proposal
3. `proposalOptions` - *`ProposalOptions`*: options for proposal

Returns

`Promise` returns `string`: id of new proposal

Example

```
// make a proposal about a suggestion (text only)
const textProposal = await votings.createProposal(
  '0x000000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  { description: 'Change voting time to 2 hours.' },
);

// propose a transaction
const txProposal = await votings.createProposal(
  '0x000000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  {
    description: 'set data of this contract to "def"',
    data: '0x47064d6a' +
```

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```
      '0000000000000000000000000000000000000000000000000000000000000020' +
      '0000000000000000000000000000000000000000000000000000000000000003' +
      '6465660000000000000000000000000000000000000000000000000000000000',
    to: '0x000000000000000000000000a2074340c0274ac7',
  },
);
```

3.10.11 getProposalCount

```
votings.getProposalCount(contract);
```

Get number of proposals in votings contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address

Returns

`Promise` returns `number`: number of proposals

Example

```
await votings.createProposal(
  '0x000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  {
    description: 'set data of this contract to "def"',
    data: '0x47064d6a' +
      '0000000000000000000000000000000000000000000000000000000000000020' +
      '0000000000000000000000000000000000000000000000000000000000000003' +
      '6465660000000000000000000000000000000000000000000000000000000000',
    to: '0x000000000000000000000000a2074340c0274ac7',
  },
);
const count = await votings.getProposalCount(
↪'0x000000000000000000000000000000c0274ac7');
console.log(count);
// Output:
// 1
```

3.10.12 getProposalInfo

```
votings.getProposalInfo(votingsContract, proposalId);
```

Gets info about a given proposal in contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `proposalId` - `string`: id of proposal to retrieve info for

Returns

`Promise` returns *`ProposalInfo`*: info about proposal

Example

```
console.dir(await votings.getProposalInfo(
  '0x000000000000000000000000000000000c0274ac7',
  '0',
));
// Output:
// {
//   currentResult: '0',
//   description: 'Change voting time to 2 hours.',
//   executed: false,
//   minExecutionDate: 1544093505000,
//   numberOfVotes: '0',
//   proposalHash: '0xa86d54e9aab41ae5e520ff0062ff1b4cbd0b2192bb01080a058bb170d84e6457
↪',
//   proposalPassed: false,
//   to: '0x0000000000000000000000000000000000000000',
//   value: '0'
// }
```

3.10.13 getProposalInfos

```
votings.getProposalInfos(contract[, count, offset, reverse]);
```

Get multiple proposals from votings contract.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `count` - `number` (optional): number of items to retrieve, defaults to `10`
3. `offset` - `number` (optional): skip this many entries, defaults to `0`
4. `reverse` - `boolean` (optional): fetch entries, starting with last entry, defaults to `true`

Returns

`Promise` returns *`ProposalInfos`*: proposals listing

Example

```
  await votings.createProposal(
  '0x0000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  {
    description: 'set data of this contract to "def"',
    data: '0x47064d6a' +
      '0000000000000000000000000000000000000000000000000000000000000020' +
      '0000000000000000000000000000000000000000000000000000000000000003' +
      '6465660000000000000000000000000000000000000000000000000000000000',
    to: '0x000000000000000000000000a2074340c0274ac7',
  },
);
const proposals = await votings.getProposalInfos(
↪'0x0000000000000000000000000000000c0274ac7');
console.log(proposals.results.length);
// Output:
// 1
```

3.10.14 vote

```
votings.vote(votingsContract, voter, proposal, accept[, comment]);
```

Vote for a proposal.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `voter` - `string`: identity or account that performs the action
3. `proposal` - `string`: id of proposal to vote for
4. `accept` - `boolean`: accept proposal or not
5. `comment` - `string` (optional): comment for vote, left empty if omitted

Returns

`Promise` returns `void`: resolved when done

Example

```
await votings.vote(
  '0x0000000000000000000000000000000c0274ac7',
  '0x2222222222222222222222222222222222222222',
  '1',
  true,
);
```

3.10.15 execute

```
votings.execute(votingsContract, proposalExecutor, proposal[, data]);
```

Execute a proposal.

Parameters

1. `contract` - `string|any`: web3 voting contract instance or contract address
2. `proposalExecutor` - `string`: identity or account to execute the proposal
3. `proposal` - `string`: id of proposal to vote for
4. `data` - `string` (optional): transaction input bytes as string (*0x${functionhash}${argumentsData}*), defaults to `0x`

Returns

`Promise` returns `void`: resolved when done

Example

```
// execute proposal about a suggestion (text only)
await votings.execute(
  '0x0000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  '0',
);

// execute proposal about a transaction
await votings.execute(
  '0x0000000000000000000000000000000c0274ac7',
  '0x1111111111111111111111111111111111111111',
  '1',
  '0x47064d6a' +
    '0000000000000000000000000000000000000000000000000000000000000020' +
    '0000000000000000000000000000000000000000000000000000000000000003' +
    '6465660000000000000000000000000000000000000000000000000000000000',
);
```

3.10.16 = Additional Components =

3.10.17 Interfaces

MemberInfo

1. `address` - `string`: member's identity or account
2. `name` - `string`: description text of member
3. `memberSince` - `string`: date of joining votings contract

MemberOptions

1. `name` - `string`: description text of member

ProposalInfo

1. `currentResult` - `number`: current number of positive votes
2. `description` - `string`: description text
3. `executed` - `boolean`: true if already executed
4. `minExecutionData` - `number`: earliest day of execution
5. `numberOfVotes` - `number`: number of submitted votes
6. `proposalHash` - `string`: checksum of proposal: keccak256(beneficiary, weiAmount, transactionBytecode)
7. `proposalPassed` - `boolean`: true if executed and proposal passed
8. `to` - `string`: target of proposal (contract/identity/account to send transaction to)
9. `value` - `string`: amount of Wei to send to target

ProposalInfos

1. `results` - *`ProposalInfo[]`*: proposals of current page (length is 10)
2. `totalCount` - `number`: total number of results

ProposalOptions

1. `description` - `string`: description text
2. `data` - `string` (optional): input data for proposal, defaults to `0x`
3. `to - string` (optional): target of proposal (contract/account to send transaction to), defaults to `0x0000000000000000000000000000000000000000`
4. `value` - `string` (optional): amount of Wei to send to target, defaults to `0`

VotingsContractOptions

1. `minimumQuorumForProposals` - `number`: votes that must have been given before any proposal is accepted; updates to this may affect running proposals
2. `minutesForDebate` - `number`: time to have passed before a proposal can be accepted; updates to this do not affect running proposals
3. `marginOfVotesForMajority` - `number`: accepting votes that must have been given before any proposal is accepted; updates to this may affect running proposals

3.11 Payments

Class Name	Payments
Extends	Logger
Source	payments.ts
Examples	payments.spec.ts

Payments are a Service to open unidirectional payment channels to other accounts. You can open a payment channel to another account and do some micropayments offchain.

The heart of the system lies in its sender -> receiver off-chain transactions. They offer a secure way to keep track of the last verified channel balance. The channel balance is calculated each time the sender pays for a resource. He is prompted to sign a so-called balance proof, i.e., a message that provably confirms the total amount of transferred tokens. This balance proof is then sent to the receiver's server. If the balance proof checks out after comparing it with the last received balance and verifying the sender's signature, the receiver replaces the old balance value with the new one.

3.11.1 constructor

```
new Payments(options);
```

Creates a new Payments instance.

Parameters

1. **`options` - `PaymentOptions`: options for Votings constructor.**
    - `accountStore` - `AccountStore`: `AccountStore` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `executor` - `Executor`: `Executor` instance
    - `web3` - `Web3`: `Web3` instance

Returns

`Payments` instance

Example

```
const payments = new Payments({
  accountStore,
  contractLoader,
  executor,
  web3,
});
```

3.11.2 closeChannel

```
payments.closeChannel(closingSig);
```

Closes a given payment channel, when a closing signature is available, the channel will be closed cooperately, otherwise the the channel will be close uncooperately and the sender or receiver has to wait a given amount of blocks (500) to get the funds out of the payment channel

Parameters

1. `closingSig` - `string` (optional): Cooperative-close signature from receiver

Returns

`Promise` returns `void`: resolved when done

Example

```
await payments.closeChannel('0x00000000000000000000000000000000c0274ac7');
```

3.11.3 confirmPayment

```
payments.confirmPayment(proof);
```

Persists next_proof to proof. This method must be used after successful payment request, or right after signNewProof is resolved, if implementation don't care for request status

Parameters

1. `proof` - *`MicroProof`*: given microproof object after calling incrementBalanceAndSign

Returns

`Promise` returns `void`: resolved when done

Example

```
payments.confirmPayment({
  balance: 1,
  sig: '0x1234567899'
});
```

3.11.4 getChannelInfo

```
payments.getChannelInfo(channel);
```

Get channel details such as current state (one of opened, closed or settled), block in which it was set and current deposited amount

Parameters

1. `channel` - *MicroChannel*: Channel to get info from. Default to channel

Returns

`Promise` returns *MicroChannelInfo*: member info

Example

```
await payments.getChannelInfo();
```

3.11.5 getChallengePeriod

```
payments.getChallengePeriod();
```

Get contract's configured challenge's period. As it calls the contract method, can be used for validating that contract's address has code in current network

Parameters

Returns

`Promise` returns `number`: challenge period number, in blocks

Example

```
console.dir(await payments.getChallengePeriod());
// Output:
// 500
```

3.11.6 getClosingSig

```
payments.getClosingSig(signerId);
```

Get the closing balance signature signed from the defined account. This signature can be used to transfer it from the recevier to the sender when the sender wants to close the payment channel. Otherwise when the receiver wants to close the channel cooperative he uses the closign signature to close th channel directly.

Parameters

1. `signerId` - `string`: identity or account which should sign the closing signature (mostly the current active identity/account)

Returns

`Promise` returns `string`: signed closing signature

Example

```
console.dir(await payments.getClosingSig(account));
// Output:
// 0x1234567890ABCDEF
```

3.11.7 isChannelValid

```
payments.isChannelValid(channel);
```

Health check for currently configured channel info

Parameters

1. `channel` - *`MicroChannel`*: Channel to get info from. Default to channel

Returns

`boolean`: True if channel is valid, false otherwise

Example

```
console.dir(payments.isChannelValid(channel));
// Output:
// True
```

3.11.8 incrementBalanceAndSign

```
payments.incrementBalanceAndSign(amount);
```

Ask user for signing a payment, which is previous balance incremented of amount. Warnings from signNewProof applies.

Parameters

1. `amount` - `BigNumber|string`: Amount to increment in current balance

Returns

`Promise` returns `string`: signed signature

Example

```
console.dir(await payments.incrementBalanceAndSign(new BigNumber(1)));
// Output:
// 0x1234567890ABCDEF
```

3.11.9 loadChannelFromBlockchain

```
payments.loadChannelFromBlockchain(sender, receiver);
```

Scan the blockchain for an open channel, and load it with 0 balance. The 0 balance may be overwritten with setBalance if server replies with a updated balance on first request. It should ask user for signing the zero-balance proof. Throws/reject if no open channel was found. Additionally a starting block can be provided to avoid starting from block 0 when looking for payment channels.

Parameters

1. `sender` - `string`: identity or account of sender/client
2. `receiver` - `string`: Receiver/server's account address
3. `startBlock` - `number` (optional): block to start scanning for transactions, defaults to `0`

Returns

`Promise` returns *`MicroChannel`*: channel info, if a channel was found

Example

```
await payments.loadChannelFromBlockchain('0x2222222222222222222222222222222222222222',
↪ '0x2222222222222222222222222222222222222223');
```

3.11.10 openChannel

```
payments.openChannel(account, receiver, deposit);
```

Open a channel for account to receiver, depositing some EVE on it. Replaces current channel data

Parameters

1. `account` - `string`: Sender/client's identity or account
2. `receiver` - `string`: Receiver/server's account address
3. `deposit` - `BigNumber|string`: deposit in WEI

Returns

`Promise` returns *`MicroChannel`*: channel info

Example

```
await payments.openChannel('0x2222222222222222222222222222222222222222',
↪'0x2222222222222222222222222222222222222223', new BigNumber(5));
```

3.11.11 setChannelManager

```
payments.setChannelManager(channelManager);
```

sets a new channelmanager contract to the current instance

Parameters

1. `channelManager` - `string`: the new channelmanager address

Returns

void

Example

```
payments.setChannelManager('0x2222222222222222222222222222222222222222');
```

3.11.12 setChannel

```
payments.setChannel(channel);
```

Set channel info. Can be used to externally [re]store an externally persisted channel info

Parameters

1. `channelManager` - *`MicroChannel`*: Channel info to be set

Returns

void

Example

```
payments.setChannel({
  account: '0x1234',
  receiver: '0x1234'
  block: 12346,
  proof: {
    balance: 1,
    sig: '0x12345677899'
  }
});
```

3.11.13 signNewProof

```
payments.signNewProof(proof);
```

Ask user for signing a channel balance. Notice it's the final balance, not the increment, and that the new balance is set in next_proof, requiring a confirmPayment call to persist it, after successful request.

Implementation can choose to call confirmPayment right after this call resolves, assuming request will be successful after payment is signed.

Parameters

1. `proof` - *`MicroProof`* (optional): Balance proof to be signed

Returns

`Promise` returns *`MicroProof`*: signature

Example

```
payments.signNewProof({
  balance: 1,
  sig: '0x12345677899'
});
```

3.11.14 signMessage

```
payments.signMessage(msg);
```

Ask user for signing a string with eth_accounts_sign

Parameters

1. `msg` - `string`: Data to be signed

Returns

`Promise` returns `string`: signed data

Example

```
await payments.signMessage('This is a message');
```

3.11.15 topUpChannel

```
payments.topUpChannel(deposit);
```

Top up current channel, by depositing some [more] EVE to it

Parameters

1. `deposit` - `BigNumber|string`: EVE (in wei) to be deposited in the channel

Returns

`Promise` returns `void`: resolved when done

Example

```
await payments.topUpChannel(new BigNumber(5));
```

3.11.16 = Additional Components =

3.11.17 Interfaces

MicroProof

1. `balance` - `BigNumber`: balance value
2. `sig` - `string` (optional): balance signature

MicroChannel

1. `account` - `string`: Sender/client's account address
2. `receiver` - `string`: Receiver/server's account address
3. `block` - `number`: Open channel block number
4. `proof` - *`MicroProof`*: Current balance proof
5. `next_proof` - *`MicroProof`* (optional): Next balance proof, persisted with confirmPayment
6. `closing_sig` - `string` (optional): Cooperative close signature from receiver

MicroChannelInfo

1. `state` - `string`: Current channel state, one of 'opened', 'closed' or 'settled'
2. `block` - `number`: Block of current state (opened=open block number, closed=channel close requested block number, settled=settlement block number)
3. `deposit` - `BigNumber`: Current channel deposited sum
4. `withdrawn` - `BigNumber`: Value already taken from the channel

This section contains modules, that deal with basic blockchain interactions, like

- performing calls and transaction to contracts
- signing transactions
- handle account private keys
- use on-chain services, like ENS name resolver and event emitting contracts
- describe contracts and ENS addresses

CHAPTER 4

Common

4.1 Logger

Class Name	Logger
Source	logger.ts

The Logger class is used throughout the package for logging events, updates and errors. Logs can be written by classes, that inherit from the Logger class, by using the *this.log* function. A log level can be set by its second parameter:

```
   this.log('hello log', 'debug');

All log messages without a level default to level 'info'. If not configured otherwise,
↪ the following behavior is used:
```

- drop all log messages but errors
- log errors to console.error

It can be useful for analyzing issues to increase the log level. You can do this in two ways:

- Set the environment variable *DBCP_LOGLEVEL* to a level matching your needs, which increases the log level for all modules and works with the default runtime. For example:

```
export DBCP_LOGLEVEL=info
```

- When creating a custom runtime, set the *logLevel* property to a value matching your needs, when creating any module instance. This allows you to change log level for single modules, but requires you to create a custom runtime, e.g.:

```
const { ContractLoader } = require('@evan.network/dbcp');
const Web3 = require('web3');

// web3 instance for ContractLoader
```

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```
const provider = new Web3.providers.WebsocketProvider({ '...' });
const web3 = new Web3(provider, null, { transactionConfirmationBlocks: 1 });

// custom log level 'info'
const contractLoader = new ContractLoader({ web3, logLevel: 'info', });
```

All loggers can have a custom LogLog storage where all logmessages with a given level will be stored. You can access the storage for the current logger module at the property `logLog`. All messages are stored with the following markup:

```
{
  timestamp, // current date in millis
  level, // loglevel of the message
  message // log message
}
```

You can configure the current LogLogLevel at the property `logLogLevel` at instantiation of your module.

4.1.1 constructor

```
new Logger(options);
```

Creates a new Logger instance.

Parameters

1. **`options` - `LoggerOptions`: options for Logger constructor.**
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Logger` instance

Example

```
const logger = new Logger();
```

4.1.2 log

```
logger.log(message, level);
```

log message with given level

Parameters

1. `message` - `string`: log message
2. `level` - `string`: log level as string, defaults to 'info'

Example

```
runtime.executor.log('test', 'error');
```

4.1.3 = Additional Components =

Interfaces

LogLogInterface

A different LogLog storage can be attached to the logger instance of the module. The storage must implement the following functions (default array like instance)

```
export interface LogLogInterface {
  push: Function;
  map: Function;
  filter: Function;
};
```

Enums

LogLevel

Available LogLevels for the logger instance, free definable between error and gasLog

```
export enum LogLevel {
  debug,
  info,
  notice,
  warning,
  error,

  gasLog = 100,
  disabled = 999,
};
```

4.2 Validator

Class Name	Validator
Extends	Logger
Source	validator.ts
Examples	validator.spec.ts

The Validator module can be used to verfiy given JSON schemas.

4.2.1 constructor

```
new Validator(options);
```

Creates a new Validator instance.

Parameters

1. **`options` - `ValidatorOptions`: options for Validator constructor.**
    - `schema` - `any`: the validation schema definition
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Validator` instance

Example

```
const nameResolver = new Validator({
  schema
});
```

4.2.2 isSchemaCorrect

```
Validator.isSchemaCorrect(schema);
```

Checks if the given ajv schema is correct and returns an array of ajv errors, when the schema is invalid.

Parameters

1. `schema` - `any`: schema to be validated

Returns

`bool` | `AjvError`: true if data is valid, array of object if validation is failed

---

4.2.3 validate

```
validator.validate(data);
```

validate a given data object with the instantiated schema

Parameters

1. `data` - `any`: to be validated data

Returns

`bool` | `AjvError`: true if data is valid, array of object if validation is failed

---

4.2.4 getErrorsAsText

```
validator.getErrorsAsText();
```

returns errors as text if previous validation was failed

Returns

`string`: all previous validation errors concatenated as readable string

4.3 Utils

Source	utils.ts

Utils contain helper functions which are used across the whole project

---

4.3.1 promisify

```
utils.promisify(funThis, functionName, ...args);
```

run given function from this, use function(error, result) {...} callback for promise resolve/reject

Parameters

1. `funThis` - `any`: the functions 'this' object
2. `functionName` - `string`: name of the contract function to call
3. `...args` - `any`: any addtional parameters that should be passed to the called function

Returns

Promise resolves to `any`: the result from the function(error, result) {...} callback.

Example

```
runtime.utils
  .promisify(fs, 'readFile', 'somefile.txt')
  .then(content => console.log('file content: ' + content))
```

4.3.2 obfuscate

```
utils.obfuscate(text);
```

obfuscates strings by replacing each character but the last two with 'x'

Parameters

1. `text` - `string`: text to obfuscate

Returns

`string`: obfuscated text

Example

```
const obfuscated = runtime.utils.obfuscate('sample text');
// returns 'sample texx'
```

4.3.3 getSmartAgentAuthHeaders

```
utils.getSmartAgentAuthHeaders(runtime[, message]);
```

create auth header data to authenticate with active account or underlying account of active identity against a smart agent server

Parameters

1. `runtime` - `Runtime`: an initialized runtime
2. `message` - `string` (optional): message to sign, defaults to current timestamp
3. `identity` - `string` (optional): identity address that is controlled by the underlying account of the runtime, uses activeIdentity as default

Returns

Promise resolves to `string`: auth header value as string

Example

```
const authData = await getSmartAgentAuthHeaders(runtime);
console.log(authData);
// Output:
// EvanAuth 0x001De828935e8c7e4cb56Fe610495cAe63fb2612,EvanIdentity␣
↪0x0d87204C3957D73b68AE28d0AF961d3c72403906,EvanMessage 1566569193297,
↪EvanSignedMessage␣
↪0x4ce5c94b3fb77e6fbd7dcbbedc564058d841c849020f11514b7e525776b033eb6cb54f480b604ae7dccb9858eb116267
```

This section contains modules, that are used througout the code, the `Logger` for example is the base class for almost every module and enables them to log in a structured manner.

CHAPTER 5

Contracts

5.1 Contract Loader

Class Name	ContractLoader
Extends	Logger
Source	contract-loader.ts
Examples	contract-loader.spec.ts

The ContractLoader is used when loading contracts without a DBCP description or when creating new contracts via bytecode. In both cases additional information has to be passed to the ContractLoader constructor.

Loading contracts requires an abi interface as a JSON string and creating new contracts requires the bytecode as hex string. Compiling Ethereum smart contracts with solc provides these.

Abis, that are included by default are:

- AbstractENS
- Described
- EventHub
- Owned
- PublicResolver

Bytecode for these contracts is included by default:

- Described
- Owned

Following is an example for loading a contract with a custom abi. The contract is a Greeter Contract and a shortened interface containing only the *greet* function is used here.

They can be side-loaded into an existing contract loader instance, e.g. into a runtime:

```
runtime.contractLoader.contracts['Greeter'] = {
  "interface": "[{\"constant\":true,\"inputs\":[],\"name\":\"greet\",\"outputs\":[{\
↪"name\":\"\",\"type\":\"string\"}],\"payable\":false,\"stateMutability\":\"view\",\
↪"type\":\"function\"}]",
};
```

5.1.1 getCompiledContract

```
contractLoader.getCompiledContract(name);
```

gets contract from a solc compilation

Parameters

1. `name` - `string`: Contract name

Returns

`any`: The compiled contract.

Example

```
const address = '0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49';
const accountId = '0x0000000000000000000000000000000000000beef';
const description = await runtime.description.getDescription(address, accountId);
console.dir(description);
// Output:
// { public:
//    { name: 'DBCP sample greeter',
//      description: 'smart contract with a greeting message and a data property',
//      author: 'dbcp test',
//      tags: [ 'example', 'greeter' ],
//      version: '0.1.0',
//      abis: { own: [Array] } } }
```

5.1.2 loadContract

```
contractLoader.loadContract(name, address);
```

creates a contract instance that handles a smart contract at a given address

Parameters

1. `name` - `string`: Contract name
2. `address` - `string`: Contract address

Returns

`any`: contract instance.

Example

```
const greeter = runtime.contractLoader.loadContract('Greeter',
↪'0x9c0Aaa728Daa085Dfe85D3C72eE1c1AdF425be49');
```

5.2 Rights and Roles

Class Name	RightsAndRoles
Extends	Logger
Source	rights-and-roles.ts
Examples	rights-and-roles.spec.ts

The RightsAndRoles module follows the approach described in the evan.network wik at:

- Function Permissions
- Operation Permissions

It allows to manage permissions for contracts, that use the authority DSRolesPerContract.sol for as its permission approach.

Contracts, that use DSRolesPerContract and therefore allow to configure its permissions with the `RightsAndRoles` module are:

- BaseContract
- DataContract
- ServiceContract
- Shared
- Described
- BusinessCenter

Also have a look at the Smart Contract Permissioning section in the evan.network wiki.

5.2.1 constructor

```
new RightsAndRole(options);
```

Creates new RightsAndRole instance.

Parameters

1. **`options` - `RightsAndRolesOptions`: options for RightsAndRole constructor.**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `executor` - `Executor`: `Executor` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `web3` - `Web3`: `Web3` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`RightsAndRoles` instance

Example

```
const rightsAndRoles = new RightsAndRoles({
  contractLoader,
  executor,
  nameResolver,
  web3,
});
```

5.2.2 addAccountToRole

```
rightsAndRoles.addAccountToRole(contract, accountId, targetAccountId, role);
```

Adds the target identity or account to a specific role.

The main principle is that an identity or account can be assigned to roles and those roles can be granted capabilities. *Function Permissions* are basically the capability to call specific functions if the calling identity or account belongs to a certain role. To add an identity or account to the role 'member'.

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing identity or account
3. `targetAccountId` - `string`: target identity or account
4. `role` - `number`: roleId

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const newMember = '0x0000000000000000000000000000000000000002';
const memberRole = 1;
await rightsAndRoles.addAccountToRole(
  contract,                   // contract to be updated
  contractOwner,              // account, that can change permissions
  newMember,                  // add this account to role
  memberRole,                 // role id, uint8 value
);
```

5.2.3 removeAccountFromRole

```
rightsAndRoles.removeAccountFromRole(contract, accountId, targetAccountId, role);
```

Removes target identity or account from a specific role.

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing identity or account
3. `targetAccountId` - `string`: target identity or account
4. `role` - `number`: roleId

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const newMember = '0x0000000000000000000000000000000000000002';
const memberRole = 1;
await rightsAndRoles.removeAccountFromRole(
  contract,                   // contract to be updated
  contractOwner,              // account, that can change permissions
  newMember,                  // remove this account from role
  memberRole,                 // role id, uint8 value
);
```

5.2.4 getMembers

```
rightsAndRoles.getMembers(contract);
```

Returns all roles with all members.

The DSRolesPerContract authority tracks used roles and their members and allows to retrieve an overview with all roles and their members. To get this information, you can use the `getMembes` function.

Parameters

1. `contract` - `string|any`: contractId or contract instance

Returns

`Promise` returns `any`: Object with mapping roleId -> [accountId, accountId,...]

Example

```
const members = await rightsAndRoles.getMembers(contract);
console.log(members);
// Output:
// {
//   "0": [
//     "0x0000000000000000000000000000000000000001"
//   ],
//   "1": [
//     "0x0000000000000000000000000000000000000001",
//     "0x0000000000000000000000000000000000000002"
//   ]
// }
```

The contract from this example has an owner (`0x0000000000000000000000000000000000000001`) and a member (`0x0000000000000000000000000000000000000002`). As the owner identity or account has the member role as well, it is listed among the members.

5.2.5 setFunctionPermission

```
rightsAndRoles.setFunctionPermission(contract, accountId, role, functionSignature,␣
↪allow);
```

Allows or denies contract function for the identity or account.

"Function permissions" are granted or denied by allowing a certain role to execute a specific function. The function is specified as the unhashed function selector and must follow its guidelines (no spaces, property typenames, etc.) for the function to be able to generate valid hashes for later validations. E.g. to grant the role "member" the permission to use the function *addListEntries*, that has two arguments (a `bytes32` array and a `bytes32` value), the function permission for `addListEntries(bytes32[],bytes32[])` has to be granted.

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing identity or account
3. `role` - `number`: role id
4. `functionSignature` - `string`: 4 Bytes function signature
5. `allow` - `boolean`: allow or deny function

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const memberRole = 1;
await rightsAndRoles.setFunctionPermission(
  contract,                                  // contract to be updated
  contractOwner,                             // account, that can change permissions
  memberRole,                                // role id, uint8 value
  'addListEntries(bytes32[],bytes32[])',     // (unhashed) function selector
  true,                                      // grant this capability
);
```

5.2.6 setOperationPermission

```
rightsAndRoles.setOperationPermission(contract, accountId, role, propertyName,␣
↪propertyType, modificationType, allow);
```

Allows or denies setting properties on a contract.

"Operation Permissions" are capabilities granted per contract logic. They have a `bytes32` key, that represents the capability, e.g. in a DataContract a capability to add values to a certain list can be granted.

The way, those capability hashes are build, depends on the contract logic and differs from contract to contract. For example a capability check for validation if a member is allowed to add an item to the list "example" in a DataContract has four arguments, in this case:

- which role is allowed to do? (e.g. a member)
- what type of element is modified? (–> a list)
- which element is modified? (name of the list –> "example")
- type of the modification (–> "set an item" (== "add an item"))

These four values are combined into one `bytes32` value, that is used when granting or checking permissions, the `setOperationPermission` function takes care of that.

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing identity or account
3. `role` - `number`: roleId
4. `propertyName` - `string`: target property name
5. `propertyType` - `PropertyType`: list or entry
6. `modificationType` - `ModificationType`: set or remove
7. `allow` - `boolean`: allow or deny

Returns

`Promise` returns `void`: resolved when done

Example

```
// make sure, you have required the enums from rights-and-roles.ts
import { ModificationType, PropertyType } from '@evan.network/api-blockchain-core';
const contractOwner = '0x0000000000000000000000000000000000000001';
const memberRole = 1;
await rightsAndRoles.setOperationPermission(
  contract,                   // contract to be updated
  contractOwner,              // account, that can change permissions
  memberRole,                 // role id, uint8 value
  'example',                  // name of the object
  PropertyType.ListEntry,     // what type of element is modified
  ModificationType.Set,       // type of the modification
  true,                       // grant this capability
);
```

5.2.7 hasUserRole

```
rightsAndRoles.hasUserRole(contract, accountId, targetAccountId, role);
```

Returns true or false, depending on if the identity or account has the specific role.

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing accountId
3. `targetAccountId` - `string`: to be checked accountId
4. `role` - `number`: roleId

Returns

`Promise` returns `void`: resolved when done

Example

```
const accountToCheck = '0x0000000000000000000000000000000000000002';
const memberRole = 1;
const hasRole = await rightsAndRoles.hashUserRole(contract, null, accountToCheck,␣
↪memberRole);
console.log(hasRole);
// Output:
// true
```

5.2.8 transferOwnership

```
rightsAndRoles.transferOwnership();
```

Function description

Parameters

1. `contract` - `string|any`: contractId or contract instance
2. `accountId` - `string`: executing identity or account
3. `targetAccountId` - `string`: target identity or account

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const newOwner = '0x0000000000000000000000000000000000000002';
await rightsAndRoles.transferOwnership(
  contract,                  // contract to be updated
  contractOwner,             // current owner
  newOwner,                  // this account becomes new owner
);
```

5.3 Sharing

Class Name	Sharing
Extends	Logger
Source	sharing.ts
Examples	sharing.spec.ts

For getting a better understanding about how Sharings and Multikeys work, have a look at Security in the evan.network wiki.

Following is a sample for a sharing info with these properties:

- three users
  - `0x01` - owner of a contract
  - `0x02` - member of a contract
  - `0x03` - another member with differing permissions
- two timestamps
  - block 82745 - first sharing
  - block 90000 - splitting data, update sharings
- three sections
  - `*` generic "catch all" used in first sharing
  - `secret area` - available for all members
  - `super secret area` - available for `0x03`

Keep in mind, that an actual sharings object only stores the sha3-hashes of every property. For example, sharings for the user *0x01* were actually to be found at the property *"0x5fe7f977e71dba2ea1a68e21057beebb9be2ac30c6410aa38d4f3fbe41dcffd2"*. For the sake of understanding, the following sample uses clear text properties. For an example of an actual sharings object, please refer to the *getSharings* example section.

```
{
  "0x01": {
    "*": {
      "82745": {
        "private": "secret for 0x01, starting from block 82745 for all data",
        "cryptoInfo": {
          "originator": "0x01,0x01",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    },
    "secret area": {
      "90000": {
        "private": "secret for 0x01, starting from block 90000 for 'secret area'",
        "cryptoInfo": {
          "originator": "0x01,0x01",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    },
    "super secret area": {
      "90000": {
        "private": "secret for 0x01, starting from block 90000 for 'super secret area'
↪",
        "cryptoInfo": {
          "originator": "0x01,0x01",
          "keyLength": 256,
```

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```
          "algorithm": "aes-256-cbc"
        }
      }
    }
  },
  "0x02": {
    "*": {
      "82745": {
        "private": "secret for 0x02, starting from block 82745 for all data",
        "cryptoInfo": {
          "originator": "0x01,0x02",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    },
    "secret area": {
      "90000": {
        "private": "secret for 0x02, starting from block 90000 for 'secret area'",
        "cryptoInfo": {
          "originator": "0x01,0x02",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    },
    "super secret area": {
      "90000": {
        "private": "secret for 0x02, starting from block 90000 for 'super secret area'
↪",
        "cryptoInfo": {
          "originator": "0x01,0x02",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    }
  },
  "0x03": {
    "secret area": {
      "90000": {
        "private": "secret for 0x03, starting from block 90000 for 'secret area'",
        "cryptoInfo": {
          "originator": "0x01,0x03",
          "keyLength": 256,
          "algorithm": "aes-256-cbc"
        }
      }
    }
  }
}
```

More information about sharings can be found at the evan.network wiki.

There are two functions to share keys with another user:

- *addSharing* is used for easily sharing keys to another user. There is no need to explicitly share hash keys to this other user as this is automatically covered here. This approach make up to two transaction (1 for hash key and 1

for the content key), which may sum up to a whole bunch of transactions when sharing multiple keys to multiple users.

- *extendSharing* is used to edit a sharings configuration that has been pulled or "checked out" with *getSharingsFromContract*. Hash keys have to be shared manually, if required. *extendSharing* make no transaction, so the contract isn't updated - this has to be done with *saveSharingsToContract*. See function documentation *below* for an example with hash key and storing updates.

Be careful when performing multiple updates to sharings synchronously. As sharings are retrieved as a single file from a smart contract, updated and then saved back to it, doing two or more updates in parallel may overwrite each other and lead to unexpected and most probably undesired results.

Perform sharing updates for the same contracts **one after another**, this goes for *addSharing* **and** for *extendSharing*. When wishing to speed things up, *extendSharing* can be used, but its updates need to be performed synchronously as well. Keep in mind, that single updates will be made off-chain and therefore be performed much faster than multiple updates with *addSharing*.

5.3.1 constructor

```
new Sharing(options);
```

Creates a new Sharing instance.

Parameters

1. **`options` - `SharingOptions`: options for Sharing constructor.**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `description` - `Description`: `Description` instance
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `executor` - `Executor`: `Executor` instance
    - `keyProvider` - `KeyProvider`: `KeyProvider` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `defaultCryptoAlgo` - `string` (optional): crypto algorith name from `CryptoProvider`, defaults to `aes`
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Sharing` instance

Example

```
const sharing = new Sharing({
  contractLoader,
  cryptoProvider,
  description,
  executor,
  dfs,
  keyProvider,
  nameResolver,
  defaultCryptoAlgo: 'aes',
});
```

5.3.2 addSharing

```
sharing.addSharing(address, originator, partner, section, block, sharingKey[, context,
↪ isHashKey, sharingId]);
```

Add a sharing to a contract or an ENS address.

This function is primarily used for sharing single keys with one other users, when sharing multiple keys and/or sharing with multiple users, have a look at *extendSharing*.

Parameters

1. `address` - `string`: contract address or ENS address
2. `originator` - `string`: Ethereum account id of the sharing user
3. `partner` - `string`: identity or account for which key shall be added
4. `section` - `string`: data section the key is intended for or '*'
5. `block` - `number|string`: starting with this block, the key is valid
6. `sharingKey` - `string`: key to share
7. `context` - `string` (optional): context to share key in
8. `isHashKey` - `bool` (optional): indicates if given key already is a hash key, defaults to `false`
9. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used)

Returns

`Promise` returns `void`: resolved when done

Example

```
// two sample users, user1 wants to share a key with user2
const user1 = '0x0000000000000000000000000000000000000001';
const user2 = '0x0000000000000000000000000000000000000002';
// create a sample contract
```

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```
// usually you would have an existing contract, for which you want to manage the␣
↪sharings
const contract = await executor.createContract('Shared', [], { from: user1, gas:␣
↪500000, });
// user1 shares the given key with user2
// this key is shared for all contexts ('*') and valid starting with block 0
await sharing.addSharing(contract.options.address, user1, user2, '*', 0, 'i am the␣
↪secred that will be shared');
```

5.3.3 extendSharing

```
sharing.extendSharing(address, originator, partner, section, block, sharingKey[,␣
↪context, isHashKey]);
```

Extend an existing sharing info with given key.

This is done on a sharings object and does not perform a transaction on its own. This function extends a sharing object retrieved from *getSharingsFromContract* and does not update sharings at the smart contract. For updating smart contracts sharing use *saveSharingsToContract*.

This function is primarily used to prepare updates for multiple keys and/or multiple users and submitting the result in one single transaction. For simpler sharing scenarios have a look at *addSharing*.

Parameters

1. `sharings` - `any`: object with sharings info
2. `originator` - `string`: identity or account of the sharing user
3. `partner` - `string`: identity or account for which key shall be added
4. `section` - `string`: data section the key is intended for or '*'
5. `block` - `number|string`: starting with this block, the key is valid
6. `sharingKey` - `string`: key to share
7. `context` - `string` (optional): context to share key in

Returns

`Promise` returns `any`: updated sharings info

Example

```
// two sample users, user1 wants to share a key with user2
const user1 = '0x0000000000000000000000000000000000000001';
const user2 = '0x0000000000000000000000000000000000000002';

// get current sharings
const sharings = await sharing.getSharingsFromContract(contract);
```

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```
// if receiver of sharing hasn't been added to the contract yet, share hash key as␣
↪well
const hashKeyToShare = await sharing.getHashKey(contract.options.address, user1);
await sharing.extendSharings(sharings, user1, user2, '*', 'hashKey', hashKeyToShare,␣
↪null);

// get current block number, keys will be available starting from this block
const blockNr = await web3.eth.getBlockNumber();

// get current key for field or in this case fallback '*'
const contentKey = sharing.getKey(contract.options.address, user1, '*', blockNr);

// share this key
await sharing.extendSharings(sharings, user1, user2, '*', blockNr, contentKey);

// finally store to contract
await sharing.saveSharingsToContract(contract.options.address, sharings, user1);
```

5.3.4 trimSharings

```
sharing.trimSharings(sharings, partner[, partner, section, block);
```

Removes properties from given sharing. If a block is given, the specific blocks key is removed, if no block is given, all keys for this section are removed. The same goes for section and partner. Note that only the last properties can be omitted and not properties in between can be set to null. So for example it is not possible to remove the same field for all identities or accounts by just setting partner to null.

Parameters

1. `sharings` - `any`: sharings to trim
2. `partner` - `string`: identity or account to remove keys for
3. `section` - `string`: data section the key is intended for or '*'
4. `block` - `number|string`: block to remove keys for

Returns

`Promise` returns `void`: resolved when done

Example

```
// this sample will undo undo the changes from the last example (extendSharings)
// two sample users, user1 wants to share a key with user2
const user1 = '0x0000000000000000000000000000000000000001';
const user2 = '0x0000000000000000000000000000000000000002';

// get current sharings
const sharings = await sharing.getSharingsFromContract(contract);
```

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```
// remove key from last time
await sharing.trim(sharings, user2, '*', blockNr);

// finally store to contract
await sharing.saveSharingsToContract(contract.options.address, sharings, user1);
```

5.3.5 bumpSharings

```
sharing.bumpSharings(address, originator, partners, section, block, sharingKey);
```

Bump keys for given identity or account by adding given key to it's sharings. This is basically a shorthand version for adding the new key for every identity or account in the `partners` array in a single transaction.

`context`, `hashKeys` and `sharingId` are currently not supported.

Parameters

1. `address` - `string`: contract address or ENS address
2. `originator` - `string`: identity or account of the sharing user
3. `partner` - `string`: identity or account for which key shall be added
4. `section` - `string`: data section the key is intended for or '*'
5. `block` - `number|string`: starting with this block, the key is valid
6. `sharingKey` - `string`: key to share

Returns

`Promise` returns `void`: resolved when done

Example

```
// two sample users, user1 wants to bump keys for user2 and user3
const user1 = '0x0000000000000000000000000000000000000001';
const user2 = '0x0000000000000000000000000000000000000002';
const user3 = '0x0000000000000000000000000000000000000003';
// assume we have a contract with sharings for those accounts
const contractId = '0x000000000000000000000000000000c027rac7';
await sharing.bumpSharings(contractId, user1, [ user2, user3 ], '*', 0, 'i am a bump␣
↪key');
```

5.3.6 getKey

```
sharing.getKey(address, partner, section[, block, sharingId]);
```

Get a content key from the sharing of a contract.

Parameters

1. `address` - `string`: contract address or ENS address
2. `partner` - `string`: identity or account for which key shall be retrieved
3. `section` - `string`: data section the key is intended for or '*'
4. `block` - `number|string` (optional): starting with this block, the key is valid, defaults to `Number.MAX_SAFE_INTEGER`
5. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used), defaults to `null`

Returns

`Promise` returns `string`: matching key

Example

```
// a sample user
const user2 = '0x0000000000000000000000000000000000000002';
// user2 wants to read a key after receiving a sharing
// the key requested should be valid for all contexts ('*') and valid up to and␣
↪including block 100
const key = await sharing.getKey(contract.options.address, user2, '*', 100);
```

5.3.7 getKeyHistory

```
sharing.getKeyHistory(address, partner, section[, sharingId]);
```

Get history of keys for an identity or account and a section.

Parameters

1. `address` - `string`: contract address or ENS address
2. `partner` - `string`: Ethereum account id for which key shall be retrieved
3. `section` - `string`: data section the key is intended for or '*'
4. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used), defaults to `null`

Returns

`Promise` returns `any`: object with key: blockNr, value: key

Example

```
// a sample user
const user2 = '0x0000000000000000000000000000000000000002';
// user2 wants to retrieve all keys for '*'
const keyHistory = await sharing.getKeyHistory(contract.options.address, user2, '*');
```

5.3.8 ensureHashKey

```
sharing.ensureHashKey(address, originator, partner, hashKey[, context, sharingId]);
```

Give hash key "hashKey" to identity or account "partner", if this identity or account does not have a hash key already.

Parameters

1. `address` - `string`: contract address or ENS address
2. `originator` - `string`: identity or account of the sharing user
3. `partner` - `string`: identity or account for which key shall be added
4. `hashKey` - `string`: key for DFS hashes
5. `context` - `string` (optional): context to share key in
6. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used)

Returns

`Promise` returns `void`: resolved when done

Example

```
const hashCryptor = cryptoProvider.getCryptorByCryptoAlgo('aesEcb');
const hashKey = await hashCryptor.generateKey();
await sharing.ensureHashKey(contract.options.address, accounts[0], accounts[1],␣
↪hashKey);
```

5.3.9 getHashKey

```
sharing.getHashKey(address, partner[, sharingid]);
```

Function description

Parameters

1. `address` - `string`: contract address or ENS address
2. `partner` - `string`: identity or account for which key shall be retrieved
3. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used)

Returns

`Promise` returns `string`: matching key

Example

```
const hashCryptor = cryptoProvider.getCryptorByCryptoAlgo('aesEcb');
const hashKey = await hashCryptor.generateKey();
await sharing.ensureHashKey(contract.options.address, accounts[0], accounts[1],␣
↪hashKey);
const retrieved = sharing.getHashKey(contract.options.address, accounts[1]);
console.log(hashKey === retrieved);
// Output:
// true
```

5.3.10 getSharings

```
sharing.getSharings(address[, _partner, _section, _block, sharingId]);
```

Get sharing from a contract, if _partner, _section, _block matches.

Sharings can also be retrieved using ENS address.

Parameters

1. `address` - `string`: contract address or ENS address
2. `_partner` - `string` (optional): identity or account for which key shall be retrieved
3. `_section` - `string` (optional): data section the key is intended for or '*'
4. `_block` - `number` (optional): starting with this block, the key is valid
5. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used)

Returns

`Promise` returns `any`: sharings as an object. For more details, refer to the *example at the top of the page*.

Example

```
const randomSecret = `super secret; ${Math.random()}`;
await sharing.addSharing(testAddress, accounts[1], accounts[0], '*', 0, randomSecret);
await sharing.addSharing(testAddress, accounts[1], accounts[0], 'test', 100,␣
↪randomSecret);
const sharings = await sharing.getSharings(contract.options.address, null, null, null,
↪ sharingId);
/* Output:
{
'0x2260228fd705cd9420a07827b8e64e808daba1b6675c3956783cc09fcc56a327': { //␣
↪sha3(contract owner)
  '0x04994f67dc55b09e814ab7ffc8df3686b4afb2bb53e60eae97ef043fe03fb829': { hashKey:␣
↪[Object] },
  '0x9c22ff5f21f0b81b113e63f7db6da94fedef11b2119b4088b89664fb9a3cb658': { '0':␣
↪[Object] }, // sha3('test')
  '0x02016836a56b71f0d02689e69e326f4f4c1b9057164ef592671cf0d37c8040c0': { '0':␣
↪[Object] } // additional unshared field
},
'0xb45ce1cd2e464ce53a8102a5f855c112a2a384c36923fe5c6e249c2a9286369e': { //␣
↪sha3(accounts[1])
  '0x04994f67dc55b09e814ab7ffc8df3686b4afb2bb53e60eae97ef043fe03fb829': { hashKey:␣
↪[Object] }, // '*'
  '0x9c22ff5f21f0b81b113e63f7db6da94fedef11b2119b4088b89664fb9a3cb658': { // sha3(
↪'test')
      '100': [Object] // Valid from block 100
  }
}
*/
```

5.3.11 removeSharing

```
sharing.removeSharing(address, originator, partner, section[, sharingId]);
```

Remove a sharing key from a contract with sharing info.

Parameters

1. `address` - `string`: contract address or ENS address
2. `originator` - `string`: identity or account of the sharing user
3. `partner` - `string`: identity or account for which key shall be removed
4. `section` - `string`: data section of the key
5. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used), defaults to `null`

Returns

`Promise` returns `void`: resolved when done

Example

```
await sharing.addSharing(contract.options.address, accounts[0], accounts[1], '*', 0,␣
↪randomSecret);

let sharings = await sharing.getSharings(contract.options.address);
console.log(Object.keys(sharings[nameResolver.soliditySha3(accounts[1])]).length);
// Output:
// 1

await sharing.removeSharing(contract.options.address, accounts[0], accounts[1], '*');

let sharings = await sharing.getSharings(contract.options.address);
console.log(Object.keys(sharings[nameResolver.soliditySha3(accounts[1])]).length);
// Output:
// 0
```

5.3.12 getSharingsFromContract

```
sharing.getSharingsFromContract(contract[, sharingId]);
```

Get encrypted sharings from smart contract.

The encrypted sharings are usually used in combination with other functions for purposes of adding, removing, extending sharings etc. For Example: This can be used in combination with *saveSharingsToContract* to bulk editing sharing info.

Parameters

1. `contact` - `any`: contract with sharing info
2. `sharingId` - `string` (optional): id of a sharing in mutlisharings, defaults to `null`

Returns

`Promise` returns `any`: sharings as an object

Example

```
// get sharings (encrypted)
const sharings = await sharing.getSharingsFromContract(serviceContract, callIdHash);
// Output:
{ '0x6760305476495b089868ae42c2293d5e8c1c7bf9bfe51a9ad85b36d85f4113cb':
 { '0x04994f67dc55b09e814ab7ffc8df3686b4afb2bb53e60eae97ef043fe03fb829': { hashKey:␣
↪[Object] } }

// make changes to sharing
await sharing.extendSharings(sharings, accountId, target, section, 0,␣
↪contentKeyToShare, null);
await sharing.extendSharings(sharings, accountId, target, '*', 'hashKey',␣
↪hashKeyToShare, null);
```

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```
// commit changes
await sharing.saveSharingsToContract(serviceContract.options.address, sharings,␣
↪accountId, callIdHash);
```

5.3.13 saveSharingsToContract

```
sharing.saveSharingsToContract(contract, sharings, originator[, sharingId]);
```

Save sharings object with encrypted keys to contract.

This can be used to pull sharings, edit them offline and commit changes in a bulk. See example section for usage.

Parameters

1. `contract` - `string|any`: contract address or instance
2. `sharings` - `any`: sharings object with encrypted keys
3. `originator` - `string`: identity or account of the sharing user
4. `sharingId` - `string` (optional): id of a sharing (when multi-sharings is used)

Returns

`Promise` returns `void`: resolved when done

Example

```
// get sharings (encrypted)
const sharings = await sharing.getSharingsFromContract(serviceContract, callIdHash);

// make changes to sharing
await sharing.extendSharings(sharings, accountId, target, section, 0,␣
↪contentKeyToShare, null);
await sharing.extendSharings(sharings, accountId, target, '*', 'hashKey',␣
↪hashKeyToShare, null);

// commit changes
await sharing.saveSharingsToContract(serviceContract.options.address, sharings,␣
↪accountId, callIdHash);
```

5.3.14 addHashToCache

```
sharing.addHashToCache(address, sharingHash[, sharingId]);
```

Add a hash to to cache, can be used to speed up sharing key retrieval, when sharings hash is already known.

Parameters

1. `address` - `string`: contract address
2. `sharingHash` - `string`: bytes32 hash of a sharing
3. `sharingId` - `string` (optional): id of a multisharing, defaults to `null`

Example

```
sharing.addHashToCache(contract.options.address, sharingHash, sharingId);
```

5.3.15 clearCache

```
sharing.clearCache();
```

Clear caches and fetch new hashes and sharing on next request.

When sharings are fetched and not all results could be read, the result would stay the same in following requests due to the internal caching mechanism, even if a proper key has been shared with the user later on. To prevent such old values from showing up, the cache can be cleared.

Example

```
sharing.clearCache();
```

5.4 Base Contract

Class Name	BaseContract
Extends	Logger
Source	base-contract.ts
Examples	base-contract.spec.ts

The BaseContract is the base contract class used for

- *DataContracts*
- *ServiceContracts*

Contracts, that inherit from `BaseContracts`, are able to:

- manage a list of contract participants (called "members")
- manage the own state (a flag, that indicate its own life cycle status)
- manage members state (a flag, that indicate the members state in the contract)

What members can do, what non-members cannot do depends of the implementatin of the inheriting contracts.

5.4.1 constructor

```
new BaseContract(options);
```

Creates a new BaseContract instance.

Parameters

1. **`options` - `BaseContractOptions`: options for BaseContract constructor.**
    - `executor` - `Executor`: `Executor` instance
    - `loader` - `ContractLoader`: `ContractLoader` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`BaseContract` instance

Example

```
const baseContract = new BaseContract({
  executor,
  loader,
  nameResolver,
});
```

5.4.2 createUninitialized

```
baseContract.createUninitialized(factoryName, accountId[, businessCenterDomain,␣
↪descriptionDfsHash]);
```

Create new contract but do not initialize it yet.

The API supports creating contracts, that inhert from `BaseContract`. This is done by calling the respective factory. The factory calls are done via a function with this interface:

```
/// @notice create new contract instance
/// @param businessCenter address of the BusinessCenter to use or 0x0
/// @param provider future owner of the contract
/// @param _contractDescription DBCP definition of the contract
/// @param ensAddress address of the ENS contract
function createContract(
    address businessCenter,
    address provider,
```

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```
    bytes32 contractDescription,
    address ensAddress) public returns (address);
```

The API supports creating contracts with this function. Contracts created this way may not be ready to use and require an additional function at the contract to be called before usage. This function is usually called `init` and its arguments and implementation depends of the specific contract.

The `createUninitialized` function performs a lookup for the respective factory contract and calls the `createContract` function at it.

Parameters

1. `factoryName` - `string`: contract factory name, used for ENS lookup; if the factory name contains periods, it is threaded as an absolute ENS domain and used as such, if not it will be used as `${factoryName}.factory.${businessCenterDomain}`
2. `accountId` - `string`: identity or account to create contract with
3. `businessCenterDomain` - `string` (optional): business center in which the contract will be created; use `null` when working without business center
4. `descriptionDfsHash` - `string` (optional): bytes32 hash for description in dfs

Returns

`Promise` returns `string`: Ethereum id of new contract

Example

```
const contractOwner = '0x...';
const businessCenterDomain = 'testbc.evan';
const contractId = await baseContract.createUninitialized(
  'testdatacontract',                    // factory name
  contractOwner,                         // account, that will be owner of the new␣
↪contract
  businessCenterDomain,                  // business center, where the new contract␣
↪will be created
);
```

5.4.3 inviteToContract

```
baseContract.inviteToContract(businessCenterDomain, contract, inviterId, inviteeId);
```

Invite user to contract. To allow accounts to work with contract resources, they have to be added as members to the contract. This function does exactly that.

Parameters

1. `businessCenterDomain` - `string` : ENS domain name of the business center the contract was created in; use null when working without business center
2. `contract` - `string` : Ethereum id of the contract
3. `inviterId` - `string` : identity or account id of inviting user
4. `inviteeId` - `string` : identity or account id of invited user

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const invitee = '0x0000000000000000000000000000000000000002';
const businessCenterDomain = 'testbc.evan';
const contract = loader.loadContract('BaseContractInterface', contractId);
await baseContract.inviteToContract(
  businessCenterDomain,
  contractId,
  contractOwner,
  invitee,
);
```

To check if an account is a member of a contract, the contract function `isMember` can be used:

```
const isMember = await executor.executeContractCall(contract, 'isConsumer', invitee);
console.log(isMember);
// Output:
// true
```

5.4.4 removeFromContract

```
baseContract.removeFromContract(businessCenterDomain, contract, accountId,␣
↪idToBeRemoved);
```

Remove user from contract. To deny previously invited accounts to work with contract resources, they have to be removed as members from the contract. This function does exactly that.

Parameters

1. `businessCenterDomain` - `string` : ENS domain name of the business center the contract was created in; use null when working without business center
2. `contract` - `string` : Ethereum id of the contract
3. `accountId` - `string` : identity or account id of executing user
4. `idToBeRemoved` - `string` : identity or account id which should be removed

Returns

`Promise` returns `void`: resolved when done

Example

```
const contractOwner = '0x0000000000000000000000000000000000000001';
const idToBeRemoved = '0x0000000000000000000000000000000000000002';
const businessCenterDomain = 'testbc.evan';
const contract = loader.loadContract('BaseContractInterface', contractId);
await baseContract.removeFromContract(
  businessCenterDomain,
  contractId,
  contractOwner,
  idToBeRemoved,
);
```

To check if an account is a member of a contract, the contract function `isMember` can be used:

```
const isMember = await executor.executeContractCall(contract, 'isConsumer',␣
↪idToBeRemoved);
console.log(isMember);
// Output:
// false
```

5.4.5 changeConsumerState

```
baseContract.changeContractState(contract, accountId, consumerId, state);
```

set state of a consumer. A members state reflects this members status in the contract. These status values can for example be be Active, Draft or Terminated.

Parameters

1. `contract` - `string|any`: contract instance or contract id
2. `accountId` - `string`: identity or account which will change state
3. `consumerId` - `string`: identity or account whose state will change
4. `state` - `ConsumerState`: new state

Returns

`Promise` returns `void`: resolved when done

Example

```
await baseContract.changeConsumerState(contractId, accountId, consumerId,␣
↪ConsumerState.Active);
```

`ConsumerState` is an enum in the BaseContract class, that holds the same state values as the BaseContract.sol. Alternatively integer values matching the enum in BaseContractInterface.sol can be used.

5.4.6 changeContractState

```
baseContract.changeContractState(contract, accountId, state);
```

Set state of the contract. The contracts state reflects the current state and how other members may be able to interact with it. So for example, a contract for tasks cannot have its tasks resolved, when the contract is still in Draft state. State transitions are limited to configured roles and allow going from one state to another only if configured for this role.

Parameters

1. `contract` - `string|any`: contract instance or contract id
2. `accountId` - `string`: identity or account which will change state
3. `state` - `ContractState`: new state

Returns

`Promise` returns `void`: resolved when done

Example

```
await baseContract.changeContractState(contractId, contractOwner, ContractState.
↪Active);
```

`ContractState` is an enum in the BaseContract class, that holds the same state values as the BaseContract.sol. Alternatively integer values matching the enum in BaseContractInterface.sol can be used.

5.4.7 Additional Components

Enums

ContractState

Describes contracts overall state.

In most cases, this property can only be set by the contract owner.

```
export enum ContractState {
  Initial,
  Error,
  Draft,
  PendingApproval,
```

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```
  Approved,
  Active,
  VerifyTerminated,
  Terminated,
};
```

ConsumerState

Describes the state of a consumer or owner in a contract.

In most cases, this can be set the the member, thats status is updated or by a more privileged role, like a contract owner.

```
export enum ConsumerState {
  Initial,
  Error,
  Draft,
  Rejected,
  Active,
  Terminated
};
```

5.5 Data Contract

Class Name	DataContract
Extends	BaseContract
Source	data-contract.ts
Examples	data-contract.spec.ts

The DataContract is a secured data storage contract for single properties and lists. If created on its own, DataContracts cannot do very much. They rely on their authority to check which entries or lists can be used.

The following functions support the `encryptionContext` argument:

- *addListEntries*
- *setEntry*
- *setMappingValue*

If this argument is set, the data key in the data contracts sharing is encrypted by using a context key instead of the communication key between owner and contract member. This allows to omit key exchanges between contract owner and members and therefore enables the owner to write content to the smart contract, that can be used by a group of identities/accounts, which only needs to hold the context key. So the `encryptionContext` can be used to address a group of accounts/identities instead of single account/identity.

For more information about DataContracts purpose and their authorities see Data Contract in the evan.network wiki.

5.5.1 constructor

```
new DataContract(options);
```

Creates a new DataContract instance.

Parameters

1. **`options` - `DataContractOptions`: options for DataContract constructor.**
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `defaultCryptoAlgo` - `string` (optional): crypto algorith name from `CryptoProvider`, defaults to `aes`
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `executor` - `Executor`: `Executor` instance
    - `loader` - `ContractLoader`: `ContractLoader` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `sharing` - `Sharing`: `Sharing` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`DataContract` instance

Example

```
const dataContract = new DataContract({
  cryptoProvider,
  description,
  dfs,
  executor,
  loader,
  nameResolver,
  sharing,
  web3,
});
```

5.5.2 create

```
dataContract.create(factoryName, accountId[, businessCenterDomain,␣
↪contractDescription, allowConsumerInvite, sharingsHash]);
```

Create and initialize new contract.

Parameters

1. `factoryName` - `string`: contract factory name, used for ENS lookup; if the factory name contains periods, it is threaded as an absolute ENS domain and used as such, if not it will be used as `${factoryName}.factory.${businessCenterDomain}`
2. `accountId` - `string`: owner(identity/account) of the new contract and transaction executor
3. `businessCenterDomain` - `string` (optional): ENS domain name of the business center
4. `contractDescription` - `string|any` (optional): bytes32 hash of DBCP description or a schema object
5. `allowConsumerInvite` - `bool` (optional): true if consumers are allowed to invite other consumer
6. `sharingsHash` - `string` (optional): existing sharing to add, defaults to `null`

Returns

`Promise` returns `any`: contract instance

Example

Let's say, we want to create a DataContract for a business center at the domain "samplebc.evan" and this business center has a DataContractFactory named "testdatacontract". We want to have two users working in our DataContract, so we get these sample values:

```
const factoryName = 'testdatacontract';
const businessCenterDomain = 'samplebc.evan';
const accounts = [
  '0x0000000000000000000000000000000000000001',
  '0x0000000000000000000000000000000000000002',
];
```

Now create a contract with:

```
const contract = await dataContract.create(factoryName, accounts[0],␣
↪businessCenterDomain);
```

Okay, that does not provide a description for the contract. Let's add a description to the process. The definition is a DBCP contract definition and is stored in an `Envelope` (see *Encryption*):

```
const definition: Envelope = {
  "public": {
    "name": "Data Contract Sample",
    "description": "reiterance oxynitrate sat alternize acurative",
    "version": "0.1.0",
    "author": "evan GmbH",
    "dataSchema": {
      "list_settable_by_member": {
        "$id": "list_settable_by_member_schema",
        "type": "object",
        "additionalProperties": false,
        "properties": {
          "foo": { "type": "string" },
          "bar": { "type": "integer" }
        }
      },
```

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```
      "entry_settable_by_member": {
        "$id": "entry_settable_by_member_schema",
        "type": "integer",
      }
    }
  }
};
definition.cryptoInfo = cryptoProvider.getCryptorByCryptoAlgo('aes').
↪getCryptoInfo(accounts[0]);
const contract = await dataContract.create('testdatacontract', accounts[0],␣
↪businessCenterDomain, definition);
```

Now we have a DataContract with a description. This contract is now able to be understood by other components, that understand the dbcp. And on top of that, we provided data schemas for the two properties `list_settable_by_member` and `entry_settable_by_member` (written for ajv). This means, that when someone adds or sets entries to or in those properties, the incoming data is validated before actually encrypting and storing it.

To allow other users to work on the contract, they have to be invited with:

```
await dataContract.inviteToContract(businessCenterDomain, contract.options.address,␣
↪accounts[0], accounts[1]);
```

Now the user `accounts[1]` can use functions from the contract, but to actually store data, the user needs access to the data key for the DataContract. This can be done via updating the contracts sharing:

```
const blockNr = await web3.eth.getBlockNumber();
const contentKey = await sharing.getKey(contract.options.address, accounts[0], '*',␣
↪blockNr);
await sharing.addSharing(contract.options.address, accounts[0], accounts[1], '*',␣
↪blockNr, contentKey);
```

Now the contract has been created, has a sharing and another user has been granted access to it. Variable names from this section will be used in the rest of the document as example values.

5.5.3 createSharing

```
dataContract.createSharing(accountId);
```

Create initial sharing for contract.

Parameters

1. `accountId` - `string`: identity or account which is owner of the new contract

Returns

`Promise` returns `any`: sharing info with { contentKey, hashKey, sharings, sharingsHash, }

Example

```
const sharing = await dataContract.createSharing(profileReceiver);
```

5.5.4 = Entries =

5.5.5 setEntry

```
dataContract.setEntry(contract, entryName, value, accountId[, dfsStorage,␣
↪encryptedHashes, encryption);
```

Set entry for a key.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `entryName` - `string`: entry name
3. `value` - `any`: value to set
4. `accountId` - `string`: identity or account
5. `dfsStorage` - `Function` (optional): store values in dfs, defaults to `true`
6. `encryptedHashes` - `boolean` (optional): encrypt hashes from values, defaults to `true`
7. `encryption` - `string` (optional): encryption algorithm to use, defaults to `defaultCryptoAlgo` (set in constructor)
8. `encryptionContext` - `string` (optional): plain text name of an encryption context, defaults to `accountId`

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleValue = 123;
await dataContract.setEntry(contract, 'entry_settable_by_owner', sampleValue,␣
↪accounts[0]);
```

Entries are automatically encrypted before setting it in the contract. If you want to use values as is, without encrypting them, you can add them in raw mode, which sets them as `bytes32` values:

```
const sampleValue = '0x000000000000000000000000000000000000007b';
await dataContract.setEntry(contract, 'entry_settable_by_owner', sampleValue,␣
↪accounts[0], true);
```

5.5.6 getEntry

```
dataContract.getEntry(contract, entryName, accountId[, dfsStorage, encryptedHashes]);
```

Return entry from contract.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `entryName` - `string`: entry name
3. `accountId` - `string`: identity or account
4. `dfsStorage` - `Function` (optional): store values in dfs, defaults to `true`
5. `encryptedHashes` - `boolean` (optional): decrypt hashes from values, defaults to `true`

Returns

`Promise` returns `any`: entry

Example

Entries can be retrieved with:

```
const retrieved = await dataContract.getEntry(contract, 'entry_settable_by_owner',␣
↪accounts[0]);
```

Raw values can be retrieved in the same way:

```
const retrieved = await dataContract.getEntry(contract, 'entry_settable_by_owner',␣
↪accounts[0], true);
```

5.5.7 = List Entries =

5.5.8 addListEntries

```
dataContract.addListEntries(contract, listName, values, accountId[, dfsStorage,␣
↪encryptedHashes, encryption]);
```

Add list entries to lists.

List entries support the raw mode as well. To use raw values, pass `true` in the same way as wehn using the entries functions.

List entries can be added in bulk, so the value argument is an array with values. This array can be arbitrarily large **up to a certain degree**. Values are inserted on the blockchain side and adding very large arrays this way may take more gas during the contract transaction, than may fit into a single transaction. If this is the case, values can be added in chunks (multiple transactions).

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listName` - `string`: name of the list in the data contract
3. `values` - `any[]`: values to add
4. `accountId` - `string`: identity or account
5. `dfsStorage` - `string` (optional): store values in dfs, defaults to `true`
6. `encryptedHashes` - `boolean` (optional): encrypt hashes from values, defaults to `true`
7. `encryption` - `string` (optional): encryption algorithm to use, defaults to `defaultCryptoAlgo` (set in constructor)
8. `encryptionContext` - `string` (optional): plain text name of an encryption context, defaults to `accountId`

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleValue = {
  foo: 'sample',
  bar: 123,
};
await dataContract.addListEntries(contract, 'list_settable_by_member', [sampleValue],␣
↪accounts[0]);
```

When using lists similar to tagging list entries with metadata, entries can be added in multiple lists at once by passing an array of list names:

```
const sampleValue = {
  foo: 'sample',
  bar: 123,
};
await dataContract.addListEntries(contract, ['list_1', 'list_2'], [sampleValue],␣
↪accounts[0]);
```

5.5.9 getListEntryCount

```
dataContract.getListEntryCount(contract, listName, index, accountId[, dfsStorage,␣
↪encryptedHashes]);
```

Return number of entries in the list. Does not try to actually fetch and decrypt values, but just returns the count.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listName` - `string`: name of the list in the data contract

Returns

`Promise` returns `number`: list entry count

Example

```
await dataContract.getListEntryCount(contract, 'list_settable_by_member');
```

5.5.10 getListEntries

```
dataContract.getListEntries(contract, listName, accountId[, dfsStorage,␣
↪encryptedHashes, count, offset, reverse]);
```

Return list entries from contract. Note, that in the current implementation, this function retrieves the entries one at a time and may take a longer time when querying large lists, so be aware of that, when you retrieve lists with many entries.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listName` - `string`: name of the list in the data contract
3. `accountId` - `string`: identity or account
4. `dfsStorage` - `string` (optional): store values in dfs, defaults to `true`
5. `encryptedHashes` - `boolean` (optional): decrypt hashes from values, defaults to `true`
6. `count` - `number` (optional): number of elements to retrieve, defaults to `10`
7. `offset` - `number` (optional): skip this many items when retrieving, defaults to `0`
8. `reverse` - `boolean` (optional): retrieve items in reverse order, defaults to `false`

Returns

`Promise` returns `any[]`: list entries

Example

```
await dataContract.getListEntries(contract, 'list_settable_by_member', accounts[0]));
```

5.5.11 getListEntry

```
dataContract.getListEntry(contract, listName, index, accountId[, dfsStorage,␣
↪encryptedHashes]);
```

Return a single list entry from contract.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listName` - `string`: name of the list in the data contract
3. `index` - `number`: list entry id to retrieve
4. `accountId` - `string`: identity or account
5. `dfsStorage` - `string` (optional): store values in dfs, defaults to `true`
6. `encryptedHashes` - `boolean` (optional): decrypt hashes from values, defaults to `true`

Returns

`Promise` returns `any`: list entry

Example

```
const itemIndex = 0;
await dataContract.getListEntry(contract, 'list_settable_by_member', itemIndex,␣
↪accounts[0]));
```

5.5.12 removeListEntry

```
dataContract.removeListEntry(contract, listName, entryIndex, accountId);
```

Remove list entry from list.

This will reposition last list entry into emptied slot.

Attention

If the data contract was created by the *container* by the `DigitalTwin` API you need to grant the permissions for removing list entries manually. To do this you can use the `RightsAndRoles` API. The following example shows how to grant permissions to delete list entries from list *exampleList* to group 0.

```
// make sure, you have required the enums from rights-and-roles.ts
import { ModificationType, PropertyType } from '@evan.network/api-blockchain-core';
const contract = '0x0000000000000000000000000000000000000123';
const contractOwner = '0x0000000000000000000000000000000000000001';
await rightsAndRoles.setOperationPermission(
  contract,                    // contract to be updated
```

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```
  contractOwner,              // identity or account, that can change permissions
  0,                          // role id, uint8 value
  'exampleList',              // name of the object
  PropertyType.ListEntry,     // what type of element is modified
  ModificationType.Remove,    // type of the modification
  true,                       // grant this capability
);
```

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listName` - `string`: name of the list in the data contract
3. `index` - `number`: index of the entry to remove from list
4. `accountId` - `string`: identity or account

Returns

`Promise` returns `void`: resolved when done

Example

```
const listName = 'list_removable_by_owner'
const itemIndexInList = 1;
await dataContract.removeListEntry(contract, listNameF, itemIndexInList, accounts[0]);
```

5.5.13 moveListEntry

```
dataContract.moveListEntry(contract, listNameFrom, entryIndex, listNamesTo,␣
↪accountId);
```

Move one list entry to one or more lists.

Note, that moving items requires the executing account to have `remove` permissions on the list `listNameFrom`. If this isn't the case, the transaction will not be exetured and not updates will be made.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `listNameFrom` - `string`: origin list
3. `index` - `number`: index of the entry to move in the origin list
4. `listNamesTo` - `string`: lists to move data into
5. `accountId` - `string`: identity or account

Returns

`Promise` returns `void`: resolved when done

Example

```
const listNameFrom = 'list_removable_by_owner';
const listNameTo = 'list_settable_by_member';
const itemIndexInFromList = 1;
await dataContract.moveListEntry(contract, listNameFrom, itemIndexInFromList,␣
↪[listNameTo], accounts[0]);
```

5.5.14 = Mappings =

5.5.15 setMappingValue

```
dataContract.setMappingValue(contract, mappingName, entryName, value, accountId[,␣
↪dfsStorage, encryptedHashes, encryption]);
```

Set entry for a key in a mapping. Mappings are basically dictionaries in data contracts. They are a single permittable entry, that allows to set any keys to it. This can be used for properties, that should be extended during the contracts life as needed, but without the need to update its permission settings.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `mappingName` - `string`: name of a data contracts mapping property
3. `entryName` - `string`: entry name (property in the mapping)
4. `value` - `any`: value to add
5. `accountId` - `string`: identity or account
6. `dfsStorage` - `string` (optional): store values in dfs, defaults to `true`
7. `encryptedHashes` - `boolean` (optional): encrypt hashes from values, defaults to `true`
8. `encryption` - `string` (optional): encryption algorithm to use, defaults to `defaultCryptoAlgo` (set in constructor)
9. `encryptionContext` - `string` (optional): plain text name of an encryption context, defaults to `accountId`

Returns

`Promise` returns `void`: resolved when done

Example

```
await dataContract.setMappingValue(
  contract,
  'mapping_settable_by_owner',
  'sampleKey',
  'sampleValue',
  accounts[0],
  storeInDfs,
);
```

5.5.16 getMappingValue

```
dataContract.getMappingValue(contract, listName, index, accountId[, dfsStorage,␣
↪encryptedHashes]);
```

Return a value from a mapping. Looks up a single key from a mapping and returns its value.

Parameters

1. `contract` - `any|string`: contract or contractId
2. `mappingName` - `string`: name of a data contracts mapping property
3. `entryName` - `string`: entry name (property in the mapping)
4. `accountId` - `string`: identity or account
5. `dfsStorage` - `string` (optional): store values in dfs, defaults to `true`
6. `encryptedHashes` - `boolean` (optional): encrypt hashes from values, defaults to `true`
7. `encryption` - `string` (optional): encryption algorithm to use, defaults to `defaultCryptoAlgo` (set in constructor)

Returns

`Promise` returns `any`: mappings value for given key

Example

```
const value = await dataContract.getMappingValue(
  contract,
  'mapping_settable_by_owner',
  'sampleKey',
  accounts[0],
  storeInDfs,
);
```

5.5.17 = Encryption =

5.5.18 encrypt

```
dataContract.encrypt(toEncrypt, contract, accountId, propertyName, block[,␣
↪encryption]);
```

Encrypt incoming envelope.

Parameters

1. `toEncrypt` - `Envelope`: envelope with data to encrypt
2. `contract` - `any`: contract instance or contract id
3. `accountId` - `string`: identity or account
4. `propertyName` - `string`: property in contract, the data is encrypted for
5. `block` - `block`: block the data belongs to
6. `encryption` - `string`: encryption name, defaults to `defaultCryptoAlgo` (set in constructor)

Returns

`Promise` returns `string`: encrypted envelope or hash as string

Example

```
const data = {
  public: {
    foo: 'example',
  },
  private: {
    bar: 123,
  },
  cryptoInfo: cryptor.getCryptoInfo(nameResolver.soliditySha3(accounts[0])),
};
const encrypted = await dataContract.encrypt(data, contract, accounts[0], 'list_
↪settable_by_member', 12345);
```

5.5.19 decrypt

```
dataContract.decrypt(toDecrypt, contract, accountId, propertyName, block[,␣
↪encryption]);
```

Decrypt input envelope return decrypted envelope.

Parameters

1. `toDecrypt` - `string`: data to decrypt
2. `contract` - `any`: contract instance or contract id
3. `accountId` - `string`: identity or account that decrypts the data
4. `propertyName` - `string`: property in contract that is decrypted

Returns

`Promise` returns `Envelope`: decrypted envelope

Example

```
const encrypted = await dataContract.decrypt(encrypted, contract, accounts[0], 'list_
↪settable_by_member');
```

5.5.20 encryptHash

```
dataContract.encryptHash(toEncrypt, contract, accountId);
```

Encrypt incoming hash. This function is used to encrypt DFS file hashes, uses AES ECB for encryption.

Parameters

1. `toEncrypt` - `Envelope`: hash to encrypt
2. `contract` - `any`: contract instance or contract id
3. `accountId` - `string`: encrypting identity or account

Returns

`Promise` returns `string`: hash as string

Example

```
const hash = '0x1111111111111111111111111111111111111111111111111111111111111111';
const encrypted = await dataContract.encryptHash(hash, contract, accounts[0]);
```

5.5.21 decryptHash

```
dataContract.encrypt(toEncrypttoDecrypt, contract, accountId, propertyName, block[,␣
↪encryption]);
```

Decrypt input hash, return decrypted hash. This function is used to decrypt encrypted DFS file hashes, uses AES ECB for decryption.

Parameters

1. `toDecrypt` - `Envelope`: hash to decrypt
2. `contract` - `any`: contract instance or contract id
3. `accountId` - `string`: identity or account that decrypts the hash

Returns

`Promise` returns `string`: decrypted hash

Example

```
const encryptedHash =
↪'0x2222222222222222222222222222222222222222222222222222222222222222';
const encrypted = await dataContract.decryptHash(encryptedHash, contract,␣
↪accounts[0]);
```

5.5.22 clearSharings

```
dataContract.clearSharings();
```

Clears cached sharing information of this contract Can be used when sharings have been updated externally and new sharings should be fetched.

Example

```
dataContract.clearSharings();
```

5.5.23 unpinFileHash

```
dataContract.unpinFileHash(hash);
```

Removes a file hash from the DFS.

Parameters

1. `hash` - `string`: reference to the DFS file, which can be either an IPFS or a bytes32 hash

Returns

`Promise` returns `void`: resolved when done

Example

```
const descriptionHash = await this.options.executor.executeContractCall(
    myDataContract,
    'contractDescription',
  );
await this.options.dataContract.unpinFileHash(descriptionHash);
```

5.5.24 getDfsContent

```
dataContract.getDfsContent(hash);
```

Gets a file's content from the DFS.

Parameters

1. `hash` - `string`: reference to the DFS file, which can be either an IPFS or a bytes32 hash

Returns

`Promise` returns `Buffer`: the content of the retrieved file

Example

```
const descriptionHash = await this.options.executor.executeContractCall(
    myDataContract,
    'contractDescription',
  );
const descriptionContent = (await this.options.dataContract.
↪getDfsContent(descriptionHash)).toString('binary');
const description = JSON.parse(
    descriptionContent,
);
```

5.6 Service Contract

Class Name	ServiceContract
Extends	Logger
Source	service-contract.ts
Examples	service-contract.spec.ts

5.6.1 constructor

```
new ServiceContract(options);
```

Creates a new ServiceContract instance.

Parameters

1. **`options` - `ServiceContractOptions`: options for ServiceContract constructor.**
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `keyProvider` - `KeyProvider`: `KeyProvider` instance
    - `sharing` - `Sharing`: `Sharing` instance
    - `web3` - `Web3`: `Web3` instance
    - `defaultCryptoAlgo` - `string` (optional): crypto algorith name from `CryptoProvider`, defaults to `aes`
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`ServiceContract` instance

Example

```
const serviceContract = new ServiceContract({
    cryptoProvide,
    dfs,
    executor,
    keyProvider,
    loader,
    nameResolver,
    sharing,
    web3,
  });
```

5.6.2 create

```
serviceContract.create(accountId, businessCenterDomain, service[,␣
↪descriptionDfsHash]);
```

create and initialize new contract

Parameters

1. `accountId` - `string`: owner(identity or account) of the new contract and transaction executor
2. `businessCenterDomain` - `string`: ENS domain name of the business center
3. `service` - `any`: service definition
4. `descriptionHash` - `string` (optional): bytes2 hash of DBCP description, defaults to `0x0000000000000000000000000000000000000000000000000000000000000000`

Returns

`Promise` returns `any`: contract instance

Example

```
const serviceContract = await serviceContract.create(accounts[0],␣
↪businessCenterDomain, sampleService);
```

5.6.3 = Service =

The service is the communication pattern definition for the `ServiceContract`. A single service contract can only have one service definition and all calls and answers must follow its defition.

To create calls and answers with different patterns, create a new `ServiceContract` and use an updated service definition there.

5.6.4 setService

```
serviceContract.setService(contract, accountId, service, businessCenterDomain[,␣
↪skipValidation]);
```

Set service description.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `service` - `any`: service to set
4. `businessCenterDomain` - `string`: domain of the business the service contract belongs to
5. `skipValidation` - `bool` (optional): skip validation of service definition, validation is enabled by default

Returns

`Promise` returns `void`: resolved when done

Example

```
await serviceContract.setService(contract, accounts[0], sampleService,␣
↪businessCenterDomain);
```

5.6.5 getService

```
serviceContract.getService(contract, accountId);
```

Gets the service of a service contract.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account

Returns

`Promise` returns `string`: service description as JSON string

Example

```
const service = await sc.getService(contract, accounts[0]);
```

5.6.6 = Calls =

Calls are the requests done by authors, that initiate a service conversation. They are basically the first part of conversations and allow answers to be added to them. Calls are usually broadcasted or multicasted.

Samples for calls are:

- capacity requests

- information requests
- information broadcasts

5.6.7 sendCall

```
serviceContract.sendCall(contract, accountId, call);
```

Send a call to a service.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `call` - `any`: call to send

Returns

`Promise` returns `number`: id of new call

Example

```
const callId = await serviceContract.sendCall(contract, accounts[0], sampleCall);
```

5.6.8 getCalls

```
serviceContract.getCalls(contract, accountId[, count, offset, reverse]);
```

Get all calls from a contract.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `count` - `number` (optional): number of elments to retrieve, defaults to `10`
4. `offset` - `number` (optional): skip this many elements, defaults to `0`
5. `reverse` - `boolean` (optional): retrieve last elements first, defaults to `false`

Returns

`Promise` returns `any[]`: the calls

Example

```
const calls = await serviceContract.getCalls(contract, accounts[0]);
```

5.6.9 getCall

```
serviceContract.getCall(contract, accountId, callId);
```

Get a call from a contract.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `callId` - `number`: index of the call to retrieve

Returns

`Promise` returns `any`: a single call

Example

```
const call = await serviceContract.getCall(contract, accounts[0], 12);
```

5.6.10 getCallCount

```
serviceContract.getCallCount(contract);
```

Get number of calls of a contract.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID

Returns

`Promise` returns `number`: number of calls

Example

```
let callCount = await serviceContract.getCallCount(contract);
console.log(callCount);
// Output:
// 2
await serviceContract.sendCall(contract, accounts[0], sampleCall);
callCount = await serviceContract.getCallCount(contract);
console.log(callCount);
// Output:
// 3
```

5.6.11 getCallOwner

```
serviceContract.getCallOwner(contract, callId);
```

Gets the owner/creator of a call.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `callId` - `number`: index of the call to retrieve owner for

Returns

`Promise` returns `string`: account id of call owner

Example

```
console.log(await serviceContract.getCallOwner(contract, 2));
// Output:
0x0000000000000000000000000000000000000001
```

5.6.12 addToCallSharing

```
serviceContract.addToCallSharing(contract, accountId, callId, to[, hashKey,␣
↪contentKey, section]);
```

Adds list of accounts to a calls sharings list.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `callId` - `number`: id of the call to retrieve

4. `to` - `string[]`: accountIds, to add sharings for
5. `hashKey` - `string` (optional): hash key to share, if omitted, key is retrieved with `accountId`
6. `contentKey` - `string` (optional): content key to share, if omitted, key is retrieved with `accountId`
7. `section` - `string` (optional): section to share key for, defaults to '*'

Returns

`Promise` returns `void`: resolved when done

Example

```
// account[0] adds accounts[2] to a sharing
await serviceContract.addToCallSharing(contract, accounts[0], callId, [accounts[2]]);
```

5.6.13 = Answers =

Answers are replies to calls. Answers can only be created as answers to calls. Answers are usually directed to the author of a call.

Examples are

- capacity replies
- information responses

5.6.14 sendAnswer

```
serviceContract.sendAnswer(contract, accountId, answer, callId, callAuthor);
```

Send answer to service contract call.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `answer` - `any`: answer to send
4. `callId` - `number`: index of the call to which the answer was created
5. `callAuthor` - `string`: Ethereum account ID of the creator of the initial call

Returns

`Promise` returns `number`: id of new answer

Example

```
await serviceContract.inviteToContract(businessCenterDomain, contract.options.address,
↪ accounts[0], accounts[2]);
const contentKey = await sharing.getKey(contract.options.address, accounts[0], '*',␣
↪0);
await sharing.addSharing(contract.options.address, accounts[0], accounts[2], '*', 0,␣
↪contentKey);
await serviceContract.sendCall(contract, accounts[0], sampleCall);
const call = await serviceContract.getCall(contract, accounts[0], 0);
const answerId = await serviceContract.sendAnswer(contract, accounts[2], sampleAnswer,
↪ 0, call.metadata.author);
```

5.6.15 getAnswers

```
serviceContract.getAnswers(contract, accountId, callid[, count, offset, reverse]);
```

Retrieves answers for a given call.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: Ethereum account ID
3. `callId` - `number`: index of the call to which the answers were created
4. `count` - `number` (optional): number of elements to retrieve, defaults to `10`
5. `offset` - `number` (optional): skip this many elements, defaults to `0`
6. `reverse` - `boolean` (optional): retrieve last elements first, defaults to `false`

Returns

`Promise` returns `any[]`: the answers

Example

```
const answers = await serviceContract.getAnswers(contract, accounts[0], 12);
```

5.6.16 getAnswer

```
serviceContract.getAnswer(contract, accountId, answerIndex);
```

Get a answer from a contract.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `accountId` - `string`: identity or account
3. `callId` - `number`: index of the call to which the answer was created
4. `answerIndex` - `number`: index of the answer to retrieve

Returns

`Promise` returns `any`: a single answer

Example

```
const answer = await serviceContract.getAnswer(contract, accounts[0], 12, 2);
```

5.6.17 getAnswerCount

```
serviceContract.getAnswerCount(contract, callId);
```

Retrieves number of answers for a given call.

Parameters

1. `contract` - `any|string`: smart contract instance or contract ID
2. `callId` - `number`: index of the call to which the answer was created

Returns

`Promise` returns `number`: number of answers

Example

```
const sampleCallId = 3;
let answerCount = await serviceContract.getAnswerCount(contract, sampleCallId);
console.log(answerCount);
// Output:
// 2
await serviceContract.sendAnswer(contract, accounts[0], sampleAnswer, sampleCallId,␣
↪accounts[1]);
answerCount = await serviceContract.getAnswerCount(contract, sampleCallId);
console.log(answerCount);
// Output:
// 3
```

5.7 Digital Twin Usage Examples

This section shows a few usage examples that can occur in common digital twin usage scenarios and cover handling of the modules *DigitalTwin* and *Container*. The examples in here are build around the management of data for heavy construction machines and cover common events link storing data, sharing data, etc.

- *manufacturer*: original manufacturer of the heavy machine
- *customer*: a user, that has bought the physical heavy machine
- *service-technician*: hired by the *customer* to perform maintenance on the heavy machine

The examples in this section use these variables for aforementioned users:

```
const manufacturer = '0x0000000000000000000000000000000000000001';
const customer = '0x0000000000000000000000000000000000000002';
const serviceTechnician = '0x0000000000000000000000000000000000000003';
```

5.7.1 Create a Digital Twin

Digital Identities are collections of data related to a "thing". A "thing" can be basically anything, a bird, a plane or someone from the planet Krypton. Jokes aside, it most commonly describes a physical object - like in our example here a heavy machine.

So let's create a digital twin four our heavy machine "Big Crane 250", which is done with the `DigitalTwin.create` function:

```
const bigCrane250 = await DigitalTwin.create(runtime, { accountId: manufacturer });
```

This creates a new digital twin for the account `manufacturer`, which can now add containers to it or set other properties.

The `DigitalTwin.create` *config* argument function supports more properties than just *accountId*.

You can **and should** give your digital twin a DBCP description. To do this pass it to the new digital twin in the *config* property.

```
const description = {
  name: 'Big Crane 250',
  description: 'Digital Twin for my heavy machine "Big Crane 250"',
  author: 'Manufacturer',
  version: '0.1.0',
  dbcpVersion: 2,
};
const bigCrane250 = await DigitalTwin.create(
  runtime, { accountId: manufacturer, description });
```

If you do not set a description, at creation time, a default description is set. This description is available at the `DigitalTwin.defaultDescription` and can be used as a starting point for your own description. A description can be updated later on as well, see `digitalTwin.setDescription`.

So let's say, we have created a digital twin four our heavy machine with the setup from the last code example. We now have the following setup:

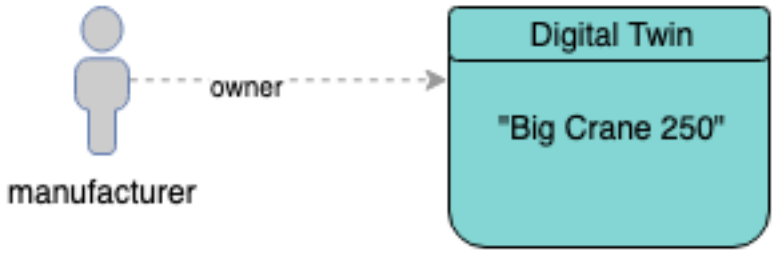

Fig. 1: manufacturer created a digital twin

5.7.2 Add Containers to Digital Twin

Continuing with the digital twin from the last section we add a container, that holds manufacturers private data with information about the production process and a link to a manual file. This can be done with the `digitalTwin.createContainers` function:

```
const { data } = await bigCrane250.createContainers({
  data: {},
});
```

The manufacturer account now has created a *Container* instance called `data`. This can be customized as described at `Container.create`.

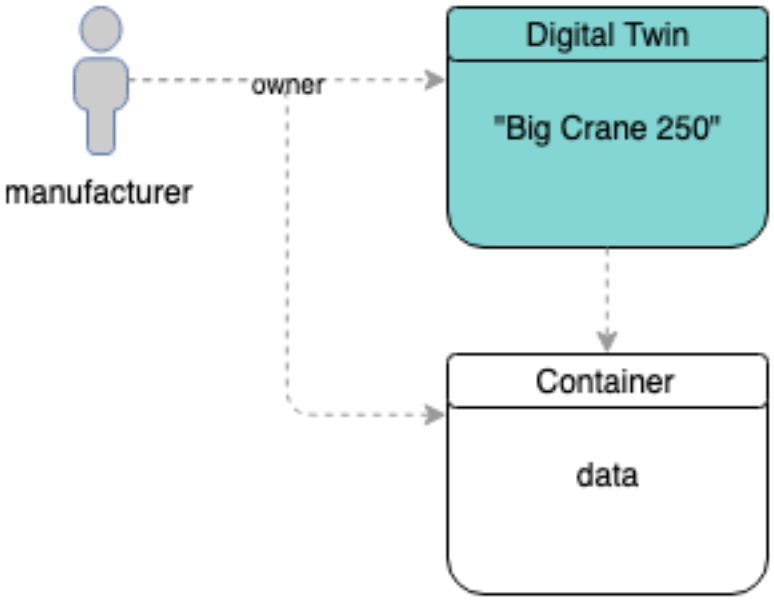

Fig. 2: manufacturer added a container to the twin

5.7.3 Add Data to the Container

Continuing the example, the manufacturer adds data to the container.

```
await data.setEntry(
  'productionProfile',
  {
    id: 'BC250-4711',
    dateOfManufacturing: '1554458858126',
    category: 'hem-c',
  },
);
await data.setEntry('manual', 'https://a-link-the-manual...');
```

As these properties are new, `container.setEntry` adds a role for each property and the owner of the digital twin joins this role. During this role `0` to `63` are skipped as they are system reserved and can be used for more complex contract role setups. So the roles `64` (for `productionProfile`) and `65` (for `manual`) are created.

For each new property a new encryption key is generated and stored in the contracts *Sharings*. When new properties are added, this key is only shared for the owner of the digital twin, so only the owner can access the data stored in the contract.

Data can be read from the containers with `container.getEntry`:

```
const productionProfile = await data.getEntry('productionProfile');
```

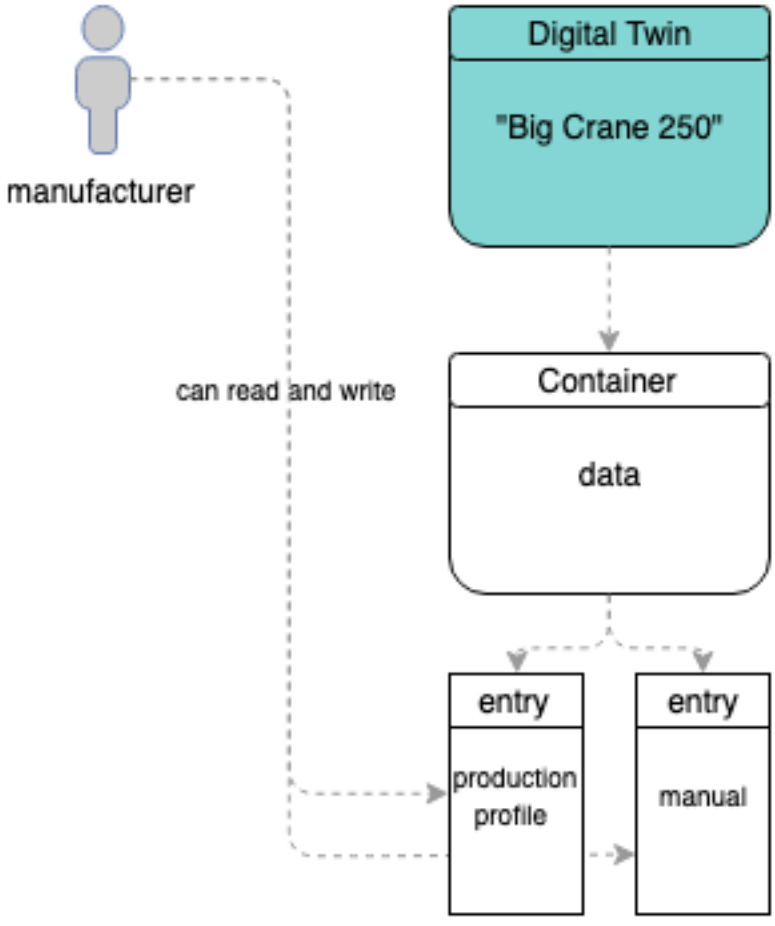

Fig. 3: manufacturer added entries to the container

5.7.4 Share Container Properties

As already said, the manufacturer wants to keep production data for own usage and share a link to the manual to the account `customer`. When not explicitly shared, properties are kept private, so nothing to do for the field `productionProfile`. To allow other accounts to access `manual`, encryption keys have to be shared, which can be done with `container.shareProperties`:

```
await data.shareProperties([
  { accountId: customer, read: ['manual'] }
]);
```

With this call, the account `customer` is added to the role `1` (member), which allows basic contract interaction but not necessarily access to the data. And because `manual` has be specified as a `read` (-only) field, this account receives an encryption key for the property `manual`, so it is now able to read data from this field.

To load data from the twins, `customer` can now fetch the container from the digital twin and load its data. Let's assume `manufacturer` has communicated the address of the digital twin (e.g. `0x00000000000000000000000000000000000000c1`) to `customer` and the customer can access the link to the manual with:

```
const bigCrane250LoadedFromCustomer = new DigitalTwin(
  runtime, { accountId: customer, address: '0x00000000000000000000000000000000000000c1
↪' });
const dataLoadedFromCustomer = await bigCrane250LoadedFromCustomer.getEntry('data');
const link = await dataLoadedFromCustomer.getEntry('manual');
```

5.7.5 Cloning Containers

If `customer` wants to re-use data from a data container or an entire data container but have ownership over it, it can clone it and use it in an own digital twin contract. This can be done with `Container.clone`:

```
const dataClone = await Container.clone(
  runtime, { accountId: customer }, dataLoadedFromCustomer);
```

This clone can be linked to a digital twin owner by `customer`. So let's create a new one and add the clone to it:

```
const customersDescription = {
  name: 'My own Big Crane 250',
  description: 'I bought a Big Crane 250 and this is my collection of data for it',
  author: 'Customer',
  version: '0.1.0',
  dbcpVersion: 2,
};
const customersBigCrane250 = await DigitalTwin.create(
  runtime, { accountId: customer, description: customersDescription });

await customersBigCrane250.setEntry(
  'machine-data',
  dataClone,
  DigitalTwinEntryType.Container,
);
```

Note that the container is not named `data` like in the original twin but called `machine-data` here. Names can be reassigned as desired.

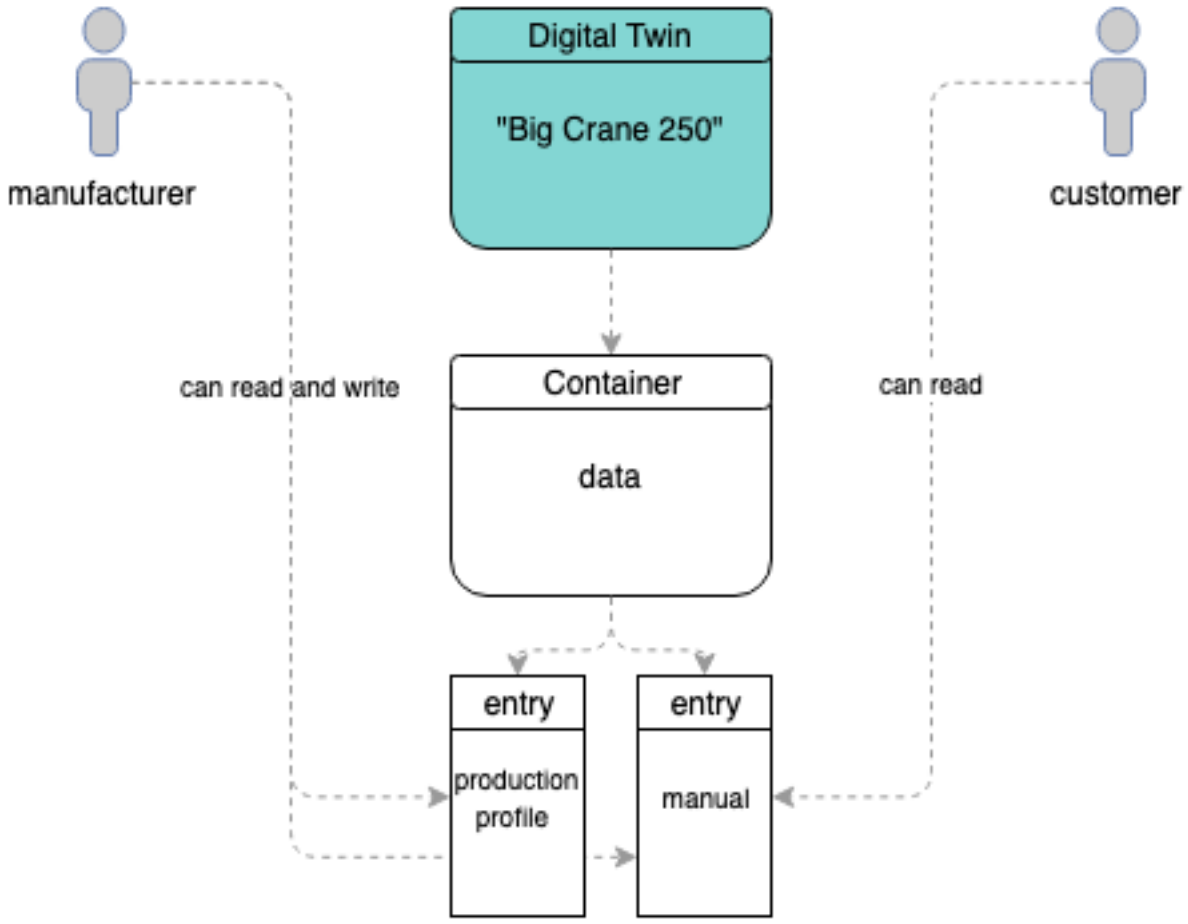

Fig. 4: customer can read entry “manual”

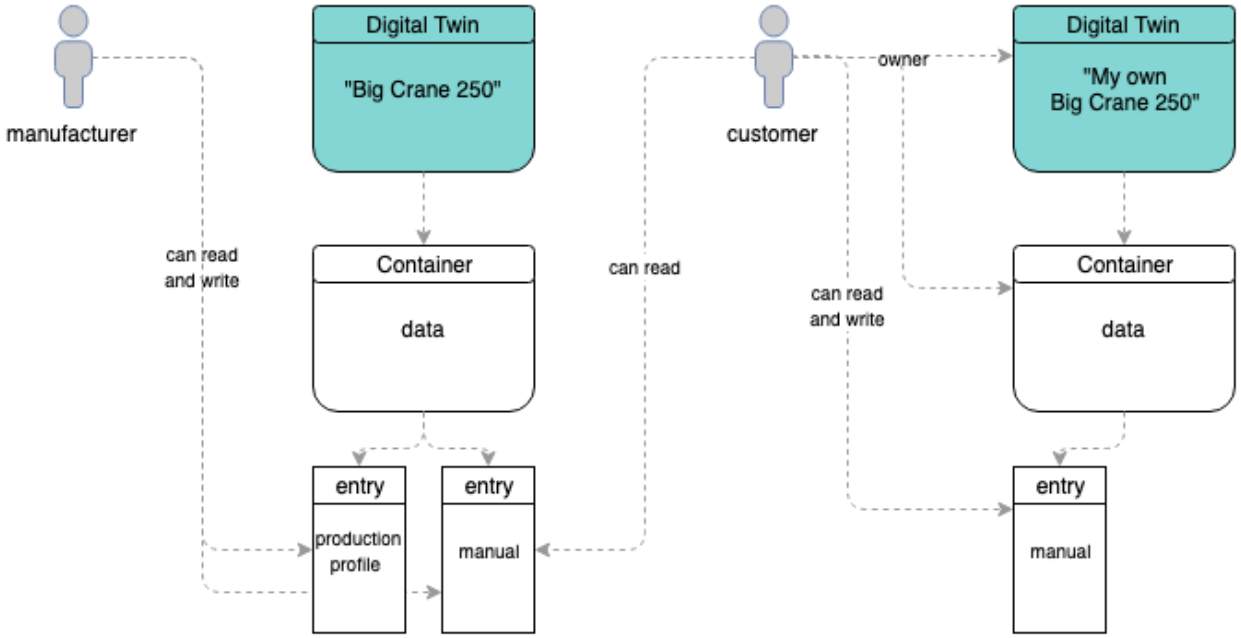

Fig. 5: customer cloned data container

5.7.6 Granting Write Access

Properties at *Containers* can be "entries" as used in the last examples or "list entries". To add data to lists call `container.addListEntries`:

```
await dataClone.addListEntries(
  'usagelog',
  [ 'I started using my new Big Crane 250' ]
);
```

Now `customer` wants to invite `serviceTechnician` and allow this account to add entries to the list `usagelog` as well. To do this, the list is shared the same way as in the previous example, but the field is shared as `readWrite`:

```
await dataClone.shareProperties([
  { accountId: customer, readWrite: ['usagelog'] }
]);
```

`serviceTechnician` can now write to the list `usagelog` and we now have the following setup:

5.7.7 Handling Files

Containers can hold files as well. File handling follows a few simple principles:

- files are stored encrypted (as everything in containers is stored encrypted)
- files are always stored as an array of files (think of it like a folder with files)
- files are encrypted, uploaded and a reference is stored as a file at the contract (sounds like the default Hybrid Storage) approach, but is a reapplication to itself, as encrypted additional files with references to the original encrypted files are stored at the contract

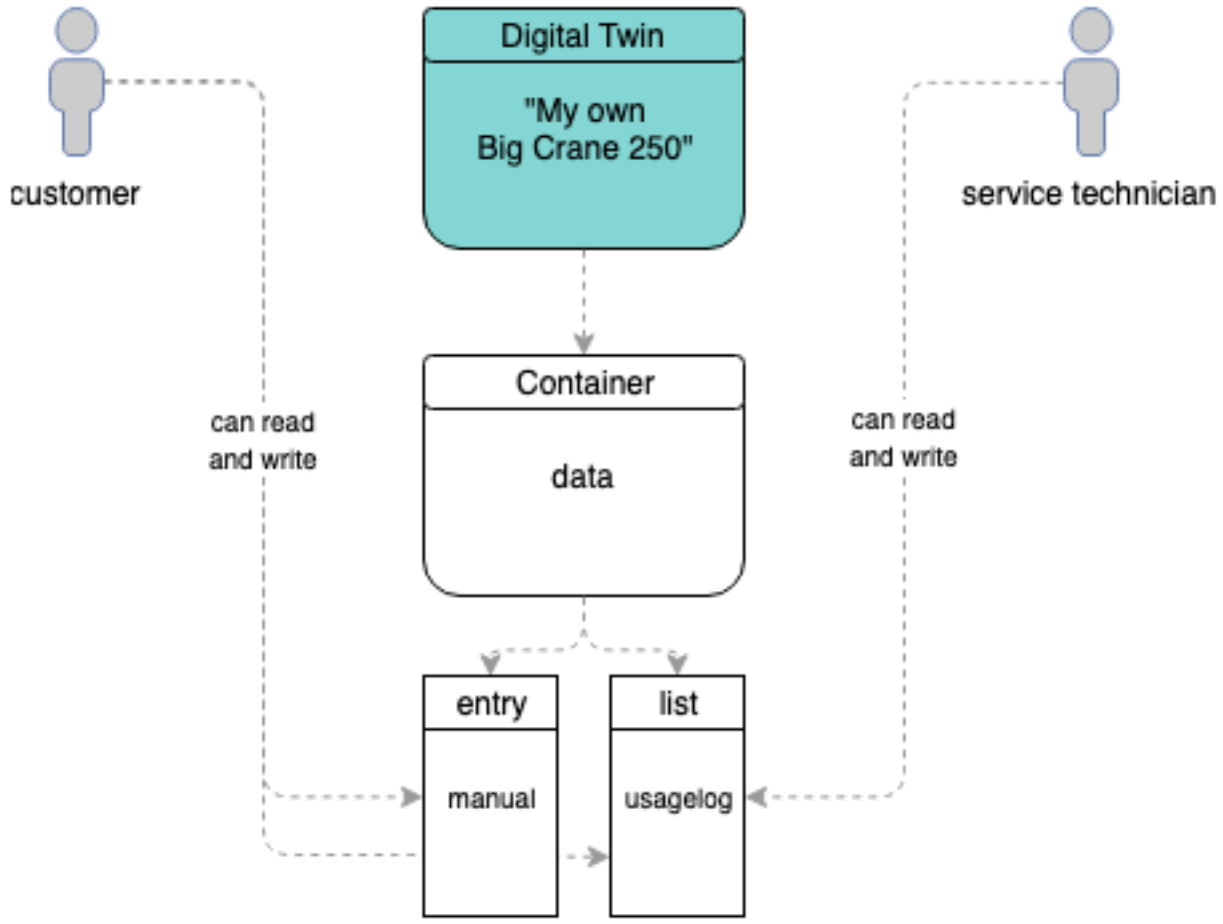

Fig. 6: customer invited service technician

Okay, let's add some files to a container (taken from our tests).

A file needs to be provided as a buffer. In NodeJs, this can be done with `fs.readFile`

```
import { promisify } from 'util';
import { readFile } from 'fs';

const file = await promisify(readFile)(
`${__dirname}/testfiles/animal-animal-photography-cat-96938.jpg`);
```

The file is expected to be wrapped in a specific container format, which is defined in the `ContainerFile` interface. So let's build such a file object and store it in an object including a property called files, as files are always provided as arrays of `ContainerFile` instances to the API:

```
const sampleFiles = {
  files:[{
    name: 'animal-animal-photography-cat-96938.jpg',
    fileType: 'image/jpeg',
    file,
  }]
};
```

If not already done, create (or load) a container:

```
const container = await Container.create(runtime, config);
```

If not already done, add a field for files to our container, for this the static property `Container.defaultTemplates` can be useful:

```
await container.ensureProperty('sampleFiles', Container.defaultSchemas.filesEntry);
```

So now everything is set up and we can store our file:

```
await container.setEntry('sampleFiles', sampleFiles);
```

And later on we can retrieve our file with:

```
await container.getEntry('sampleFiles');
```

That's it for the simple case. If you want to get fancy, you can have a look at the more complex examples in the tests. With the build in file handling you can:

- store lists of files in an entry (this example) test path: `Container/when setting entries/can handle files`
- store lists of files in complex objects (e.g. if you want to annotate them) test path: `Container/when setting entries/can handle files in complex objects`
- store a list of lists of files (hands up, who tripped, when reading this, *me too*, it's basically a list of directories), this can be used to store different versions of files or separate file groups which have no relations between them test path: `Container/when setting list entries/can handle files`
- store a list of lists of files (a combination between lists and complex objects) test path: `Container/when setting list entries/can handle files in complex objects`

5.7.8 Handling Templates and Plugins

Container definitions can be saved as plugins, so they can easy be shared and the structure can be imported by anyone else. These plugins can be combined, including a dbcp description, that represents a whole twin structure, a so called **Twin Template**.

Have a look at several example twin templates in our separated Twin Templates repository:

- Sample Twin Template.
- Car Template.
- Bicycle Template.

Steps to your own twin template:

1. Define a short description of your twin template:

```
{
  "description": {
    "name": "Heavy Machine",
    "description": "Basic Heavy Machine twin structure."
  },
  "plugins": { ... }
}
```

2. Add default plugins to your template:

```
{
  "description": { ... },
  "plugins": {
    "data": {
      "description": {
        ...
      },
      "template": {
        "properties": {
          "productionProfile": {
            "dataSchema": {
              "properties": {
                "id": {
                  "type": "string"
                },
                "dateOfManufacturing": {
                  "type": "string"
                },
                "category": {
                  "type": "string"
                }
              },
              "type": "object"
            },
            "permissions": {
              "0": [
                "set"
              ]
            },
            "type": "entry"
          }
        },
```

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```
        "type": "heavyMachineData"
      }
    },
    "plugin2": { ... },
    "pluginX": { ... },
  }
}
```

3. You can also add translations for names and descriptions to your twin template and plugins. Also labels and placeholders can be defined for fields within data sets. You can simply apply a i18n property within the description:

```
{
  "description": {
    "name": "Heavy Machine",
    "description": "Basic Heavy Machine twin structure.",
    "i18n": {
      "de": {
        "description": "Beispiel für eine Vorlage eines Digitalen Zwillings.",
        "name": "Beispiel Vorlage"
      },
      "en": {
        "description": "Example of a template for a digital twin.",
        "name": "Sample Twin Template"
      }
    }
  },
  "plugins": {
    "data": {
      "description": {
        "i18n": {
          "de": {
            "productionProfile": {
              "description": "Beschreibung Datenset",
              "name": "Datenset 1",
              "properties": {
                "id": {
                  "label": "TWIN ID",
                  "placeholder": "Bitte geben Sie eine Produktions-ID ein."
                },
                ...
              }
            },
            "description": "Generelle Daten einer Baumaschine.",
            "name": "Produktdaten"
          },
          "en": {
            "productionProfile": {
              "description": "description data set",
              "name": "dataset 1",
              "properties": {
                "id": {
                  "label": "TWIN ID.",
                  "placeholder": "Please insert production id."
                },
                ...
```

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```
              }
            },
            "description": "General information about a heavy machine.",
            "name": "Product data"
          }
        }
      },
    }
  }
}
```

4. Create a new Digital Twin using with a twin template

```
const twinTemplate = {
  "description": { ... },
  "plugins": { ... }
};
const bigCrane250 = await DigitalTwin.create(runtime, {
  accountId: manufacturer,
  ...twinTemplate
});
```

5. Export your existing twin structure to a twin template

```
const bigCraneTemplate = await bigCrane250.exportAsTemplate(true);

console.log(bigCraneTemplate);

// {
//   "description": { ... },
//   "plugins": {
//     "data": {
//       "description": {
//         ...
//       },
//       "template": {
//         ...
//       }
//     },
//     "pluginX": {
//       ...
//     }
//   }
// }
```

5.7.9 Setup plugin data structure

Data structure of the plugins is defined within the plugins template part. Each plugin will result in one container, that have several data sets, which are defined under the *properties* parameter. All data in this parameter, is defined using the ajv validator. You can also have a look at the `Container.create` documentation. Read the following points for a short conclusion about **dataSchema** and it's structure.

1. dataset1

1. dataSchema - AJV data schema definition for the entry / listentry. Could be e.g. type of string, number, files, nested objects
2. permissions - Initial permission setup, that is directly rolled out by container initialization with this plugin. You can directly define, which role is allowed to "set" or "remove" data of this entry.
3. type - type of the datacontract entry ("entry" / "list")
4. value - initial value that should be passed to the entry / added as listentries to a list

Sample AJV data type configurations are listed below and pleae keep in mind, that JSON structures can be nested using a array or a object type:

- string

```
{
  "type": "string"
}
```

- number

```
{
  "type": "number"
}
```

- files (it's evan specific)

```
{
  "type": "object",
  "$comment": "{\"isEncryptedFile\": true}",
  "properties": {
    "additionalProperties": false,
    "files": {
      "type": "array",
      "items": {
        "type": "string"
      }
    }
  },
  "required": [
    "files"
  ],
  "default": {
    "files": []
  }
}
```

- objects

```
{
  "properties": {
    "prop1": {
      "type": "string"
    },
    "prop2": {
      "type": "string"
    }
  },
  "type": "object"
}
```

- lists including objects

```
{
  "items": {
    "properties": {
      "prop1": {
        "type": "string"
      },
      "prop2": {
        "type": "string"
      }
    },
    "type": "object"
  },
  "type": "array"
}
```

5.7.10 Default values

Default values can be specified for all entries (except list entries) next to the dataSchema. The API will directly call *setEntry* for each specified default.

Example:

```
{
  "pluginXYZ": {
    "entry1": {
      "dataSchema": {
        "properties": {
          "prop1": {
            "type": "string"
          },
          "prop2": {
            "type": "string"
          }
        },
        "type": "object"
      },
      ...,
      "value": {
        "prop1": "default value for prop1"
      }
    }
  }
}
```

5.8 Digital Twin

Class Name	DigitalTwin
Extends	Logger
Source	digital-twin.ts
Examples	digital-twin.spec.ts

TL;DR: usage examples and a data flow can be found *here*.

A `DigitalTwin` is a wrapper, that holds data or references to data. This data can be

- a `Container` - This is the most common use case, actual data is stored in the container and the `DigitalTwin` merely holds a reference to the container.
- an `DigitalTwin` - DigitalTwins can be linked together, so an entry can be another `DigitalTwin`, which allows to navigate through twins to retrieve data properties from linked twins, see *getEntry*
- an identity/account address / a contract address
- `bytes32` hashes (e.g. file hashes)

5.8.1 constructor

```
new DigitalTwin(options, config);
```

Create new `DigitalTwin` instance. This will not create a smart contract contract but is used to load existing digital twins. To create a new contract, use the static *create* function.

Parameters

1. **`options` - `DigitalTwinOptions`: runtime-like object with required modules**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `dataContract` - `DataContract`: `DataContract` instance
    - `description` - `Description`: `Description` instance
    - `executor` - `Executor`: `Executor` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `profile` - `Profile`: `Profile` instance
    - `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
    - `sharing` - `Sharing`: `Sharing` instance
    - `verifications` - `Verifications`: `Verifications` instance
    - `web3` - `Web3`: `Web3` instance
2. **`config` - `DigitalTwinConfig`: digital twin related config**
    - `accountId` - `string`: identity or account of user, that interacts with digital twin
    - `containerConfig` - `ContainerConfig`: address of a `DigitalTwin` instance, can be ENS or contract address

- `address` - `string` (optional): address of an `DigitalTwin` instance, can be ENS or contract address
- `description` - `string`: description has to be passed to `.create` to apply it to to contract
- `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer digital twin factory

Returns

`DigitalTwin` instance

Example

```
const digitalTwin = new DigitalTwin(
  runtime,
  {
    accountId: '0x0000000000000000000000000000000000000000',
    address: 'sample-digital-twin.somewhere.evan',
  },
);
```

5.8.2 = Creating Digital Identities =

5.8.3 create

```
DigitalTwin.create(runtime, config);
```

Create digital twin contract.

Note, that this function is static. It is used on the `DigitalTwin` class object and returns a `DigitalTwin` class instance.

The options argument has the same structure as the options object that is passed to the constructor as it is used for the new `DigitalTwin` instance. The `config` argument requires a proper value for the property `description`.

Parameters

1. **`options` - `ContainerOptions`: runtime-like object with required modules**
   - `contractLoader` - `ContractLoader`: `ContractLoader` instance
   - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
   - `dataContract` - `DataContract`: `DataContract` instance
   - `description` - `Description`: `Description` instance
   - `executor` - `Executor`: `Executor` instance
   - `nameResolver` - `NameResolver`: `NameResolver` instance
   - `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
   - `sharing` - `Sharing`: `Sharing` instance

- `verifications` - `Verifications`: `Verifications` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

2. **`config` - `DigitalTwinConfig`: digital twin related config**
   - `accountId` - `string`: identity or account of user, that interacts with digital twin
   - `containerConfig` - `ContainerConfig`: config, that will be used, when containers are created
   - `address` - `string` (optional): ENS address used for digital twin
   - `description` - `string`: description has to be passed to `.create` to apply it to to contract
   - `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer digital twin factory
   - `plugins` - `{ [pluginName: string]: ContainerPlugin }` (optional): set of container plugins that should be applied to the twin directly with the creationg (will be passed to the *createContainers* function)

Returns

`Promise` returns `DigitalTwin`: new instance bound to new `DigitalTwin`

Example

```
const digitalTwin = await DigitalTwin.create(options, config);
console.log(await digitalTwin.getContractAddress());
// Output:
// 0x0000000000000000000000000000000000001234
```

5.8.4 = Container =

5.8.5 createContainers

```
digitalTwin.createContainers(containers);
```

Create new *Container* instances and add them as entry to twin.

When a container entry fetched with *getEntry* or *getEntry*, the value will become a `Container` instance and can be used as such.

Parameters

1. `containers` - `{ [id: string]: Partial<ContainerConfig> }`: object with containers to create, name is used as entry name in twin

Returns

`Promise` returns `{ [id: string]: Container }`: map with `Container` instances

Example

```
const containers = await twin.createContainers({
  entry1: { template: 'metadata' },
  entry2: { template: 'metadata' },
});
```

5.8.6 = Entries =

5.8.7 setEntry

```
digitalTwin.setEntry(name, value, entryType);
```

Set entry in index contract; entries are unique, setting the same name a second time will overwrite the first value.

Parameters

1. `name` - `string`: entry name
2. `value` - `string`: value to set
3. `entryType` - `DigitalTwinType`: type of given value

Returns

`Promise` returns `void`: resolved when done

Example

```
await digitalTwin.setEntry('myId', accountId, DigitalTwinEntryType.AccountId);
console.log((await digitalTwin.getEntry('myId')).value);
// Output:
// 0x0000000000000000000000000000000000000001
```

5.8.8 setEntries

```
digitalTwin.setEntries(arguments);
```

Set multiple entries at index contract.

Parameters

1. `entries` - `{[id: string]: DigitalTwinIndexEntry}`: entries to set

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleContractId = '0x000000000000000000000000000000c0274ac7';
await digitalTwin.setEntries({
  'account': { value: accountId, entryType: DigitalTwinEntryType.AccountId },
  'contract': { value: sampleContractId, entryType: DigitalTwinEntryType.
↪GenericContract },
});

const result = (await digitalTwin.getEntries()).map(entry => value);
console.log(result.account.value);
// Output:
// 0x0000000000000000000000000000000000000001
console.log(result.contract.value);
// Output:
// 0x000000000000000000000000000000c0274ac7
```

5.8.9 getEntry

```
digitalTwin.getEntry(name);
```

Get single entry from index contract.

When this twin has other twins as its entries, properties from those can be selected by building a path of properties.

For example a twin called `car` may have a link to another twin under the name `tire`. The twin `tire` has an entry called `metadata`. It is possible to retrieve this entry from the twin `car` with:

```
const tireMetadata = await car.getEntry('tire/metadata');
```

Parameters

1. `name` - `string`: entry name or path to data in linked twin

Returns

`Promise` returns `DigitalTwinIndexEntry`: entry object

Example

```
await digitalTwin.setEntry('myId', accountId, DigitalTwinEntryType.AccountId);
console.log((await digitalTwin.getEntry('myId')).value);
// Output:
// 0x0000000000000000000000000000000000000001
```

5.8.10 getEntries

```
digitalTwin.getEntries();
```

Get all entries from index contract.

Returns

`Promise` returns `{[id: string]: DigitalTwinIndexEntry}`: key-value map with all entries

Example

```
const sampleContractId = '0x00000000000000000000000000000000c0274ac7';
await digitalTwin.setEntries({
  'account': { value: accountId, entryType: DigitalTwinEntryType.AccountId },
  'contract': { value: sampleContractId, entryType: DigitalTwinEntryType.
↪GenericContract },
});

const result = (await digitalTwin.getEntries()).map(entry => value);
console.log(result.account.value);
// Output:
// 0x0000000000000000000000000000000000000001
console.log(result.contract.value);
// Output:
// 0x00000000000000000000000000000000c0274ac7
```

5.8.11 = Verifications =

5.8.12 addVerifications

```
digitalTwin.addVerifications(verifications);
```

Add verifications to this twin; this will also add verifications to contract description.

If the calling account is the owner of the identity of the digital twin

- the description will is automatically updated with tags for verifications
- verifications issued with this function will be accepted automatically

See interface `DigitalTwinVerificationEntry` for input data format.

Parameters

1. `verifications` - `DigitalTwinVerificationEntry[]`: list of verifications to add

Returns

`Promise` returns `void`: resolved when done

Example

```
await digitalTwin.addVerifications([{ topic: 'exampleVerification' }]);
```

5.8.13 getVerifications

```
digitalTwin.getVerifications();
```

Gets verifications from description and fetches list of verifications for each of them.

See `Verifications` documentation for details on output data format.

Returns

`Promise` returns `any`: list of verification lists from `Verifications`, `getVerifications`

Example

```
await digitalTwin.addVerifications([{ topic: 'exampleVerification' }]);
const verifications = await digitalTwin.getVerifications());
```

5.8.14 = Descriptions =

5.8.15 getDescription

```
digitalTwin.getDescription();
```

Returns description from digital twin.

Returns

`Promise` returns `any`: public part of the description

Example

```
const description = await container.getDescription();
console.dir(description);
// Output:
// { name: 'test twin',
//   description: 'twin from test run',
//   author: 'evan GmbH',
//   version: '0.1.0',
//   dbcpVersion: 2,
//   tags: [ 'evan-digital-twin' ],
//   identity:
//    '0x1a496043385fec8d52f61e2b700413f8e12eb6e7e11649f80c8f4716c1063d06' }
```

5.8.16 setDescription

```
digitalTwin.setDescription(description);
```

Write given description to digital twins DBCP.

Parameters

1. `description` - `any`: description (public part)

Returns

`Promise` returns `void`: resolved when done

Example

```
// get current description
const description = await digitalTwin.getDescription();
console.dir(description);
// Output:
// { name: 'test twin',
//   description: 'twin from test run',
//   author: 'evan GmbH',
//   version: '0.1.0',
//   dbcpVersion: 2,
//   tags: [ 'evan-digital-twin' ],
//   identity:
//    '0x1a496043385fec8d52f61e2b700413f8e12eb6e7e11649f80c8f4716c1063d06' }

// update description
description.version = '0.1.1';
await digitalTwin.setDescription(description);

// fetch again
console.dir(await digitalTwin.getDescription());
// Output:
// { name: 'test twin',
//   description: 'twin from test run',
```

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```
//   author: 'evan GmbH',
//   version: '0.1.1',
//   dbcpVersion: 2,
//   tags: [ 'evan-digital-twin' ],
//   identity:
//    '0x1a496043385fec8d52f61e2b700413f8e12eb6e7e11649f80c8f4716c1063d06' }
```

5.8.17 = Profile =

5.8.18 addAsFavorite

```
digitalTwin.addAsFavorite();
```

Add the digital twin with given address to profile.

Returns

`Promise` returns `void`: resolved when done

Example

```
const digitalTwin = new DigitalTwin(options.config);
if (await digitalTwin.isFavorite()) {
  console.log('I know this digital twin!');
} else {
  await digitalTwin.addToFavorites();
  console.log('bookmarked digital twin');
}
```

5.8.19 getFavorites

```
DigitalTwin.getFavorites();
```

Gets bookmarked twins from profile.

Note, that this function is called on the Class DigitalTwin and not on an instance of it.

Parameters

1. **`options` - `ContainerOptions`: runtime-like object with required modules**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `dataContract` - `DataContract`: `DataContract` instance
    - `description` - `Description`: `Description` instance

- `executor` - `Executor`: `Executor` instance
- `nameResolver` - `NameResolver`: `NameResolver` instance
- `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
- `sharing` - `Sharing`: `Sharing` instance
- `verifications` - `Verifications`: `Verifications` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Promise` returns `void`: resolved when done

Example

```
const favorites = await DigitalTwin.getFavorites(options);
console.dir(favorites);
// Output:
// [
//  'example.somewhere.evan',
//  'another.example.somewhere.else.evan',
//  '0x0000000000000000000000000000000000001234'
// ]
```

5.8.20 isFavorite

```
digitalTwin.isFavorite();
```

Check if this digital twin is bookmarked in profile.

Returns

`Promise` returns `boolean`: true if bookmarked

Example

```
const digitalTwin = new DigitalTwin(options.config);
if (await digitalTwin.isFavorite()) {
  console.log('I know this digital twin!');
} else {
  await digitalTwin.addToFavorites();
```

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```
  console.log('bookmarked digital twin');
}
```

5.8.21 removeFromFavorites

```
digitalTwin.removeFromFavorites();
```

Removes the current twin from the favorites in profile.

Returns

`Promise` returns `void`: resolved when done

Example

```
const digitalTwin = new DigitalTwin(options.config);
if (await digitalTwin.isFavorite()) {
  await digitalTwin.removeFromFavorites();
  console.log('removed digital twin from favorites');
}
```

5.8.22 = Utilities =

5.8.23 getValidity

```
DigitalTwin.getValidity(options, ensAddress);
```

Check if a valid contract is located under the specified address, which allows to check for twins before actually loading them.

Return value properties have the following meaning:

- `valid`: `true` if contract could not be found or if it doesn't have the tag "evan-digital-twin"
- `exists`: `true` if a contract address could be found at given ENS address
- `error`: an error object, if one of the other properties is `false`

Note, that this function is called on the Class DigitalTwin and not on an instance of it.

Parameters

1. **`options` - `DigitalTwinOptions`: twin runtime options**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance

- `dataContract` - `DataContract`: `DataContract` instance
- `description` - `Description`: `Description` instance
- `executor` - `Executor`: `Executor` instance
- `nameResolver` - `NameResolver`: `NameResolver` instance
- `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
- `sharing` - `Sharing`: `Sharing` instance
- `verifications` - `Verifications`: `Verifications` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

2. `ensAddress` - `string`: ens address that should be checked

Returns

`Promise` returns `{ valid: boolean, exists: boolean, error: Error }`: resolved when done

Example

```
const { valid } = await DigitalTwin.getValidity(runtime, address);
if (!valid) {
  throw new Error(`no valid digital twin found at "${address}"`);
}
```

5.8.24 ensureContract

```
digitalTwin.ensureContract();
```

Check if digital twin contract already has been loaded, load from address / ENS if required. Throws if contract could not be loaded.

This function is more commonly used for internal checks in the `DigitalTwin` module. For checking, if a given address can be used, it is recommended to use *getValidity*.

Returns

`Promise` returns `void`: resolved when done

Example

```
let digitalTwin;
try {
  digitalTwin = new DigitalTwin(options, config);
  await digitalTwin.ensureContract();
  // use digital twin
} catch (ex) {
  console.error(`could use digital twin; ${ex.message || ex}`);
}
```

5.8.25 exportAsTemplate

```
digitalTwin.exportAsTemplate();
```

Exports the twin template definition for this twin. Includes the twins dbcp descriptions and all plugins, created out of the twin containers definitions. Can also export container values within the plugin definitions.

You can find a sample twin template here: `TwinTemplate`

Returns

`Promise` returns `DigitalTwinTemplate`: digital twin template definition

- `descriptions` - `any`: digital twin description
- `plugins` - ‘‘ { [pluginName: string]: ContainerPlugin }‘‘: plugins for all containers

Example

```
const configWithTemplate = {
  ...defaultConfig,
  ...twinTemplate,
};
const twin = await DigitalTwin.create(runtime, configWithTemplate);
const template = await twin.exportAsTemplate();

console.log(template);
// {
//   "description": { ... },
//   "plugins": {
//     "plugin1": {
//       "description": {
//         ...
//       },
//       "template": {
//         ...
//       }
//     },
//     "pluginX": {
//       ...
//     }
```

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```
//   }
// }
```

5.8.26 getContractAddress

```
digitalTwin.getContractAddress();
```

Get contract address of underlying DigitalTwin.

Returns

`Promise` returns `string`: contract address

Example

```
const digitalTwin = new DigitalTwin(options, config);
console.log(await digitalTwin.getContractAddress());
// Output:
// 0x000000000000000000000000000000001d327171
```

5.8.27 Additional Components

5.8.28 Public Properties

defaultDescription (static)

Default description used when no specific description is given to *.create*.

```
console.dir(DigitalTwin.defaultDescription);
// Output:
// {
//   name: 'Digital Identity',
//   description: 'Digital Identity Contract',
//   author: '',
//   version: '0.1.0',
//   dbcpVersion: 2
// }
```

5.8.29 Enums

DigitalTwinEntryType

possible entry types for entries in index

1. `AccountId`
2. `Container`
3. `FileHash`
4. `GenericContract`
5. `Hash`
6. `DigitalTwin`

5.8.30 Interfaces

DigitalTwinConfig

config for digital twin

1. `accountId` - `string`: account id of user, that interacts with digital twin
2. `containerConfig` - `ContainerConfig`: address of a `DigitalTwin` instance, can be ENS or contract address
3. `address` - `string` (optional): address of an `DigitalTwin` instance, can be ENS or contract address
4. `description` - `string` (optional): description has to be passed to `.create` to apply it to to contract
5. `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer digital twin factory

DigitalTwinIndexEntry

container for digital twin entry values

1. `entryType` - `DigitalTwinEntryType` (optional): type of entry in index
2. `raw` - `any` (optional): raw value (`bytes32` hash)
3. `value` - `any` (optional): decrypted/loaded value

DigitalTwinVerificationEntry

data for verifications for digital twins

1. `topic` - `string`: name of the verification (full path)
2. `descriptionDomain` - `string` (optional): domain of the verification, this is a subdomain under 'verifications.evan', so passing 'example' will link verifications
3. `disableSubVerifications` - `boolean` (optional): if true, verifications created under this path are invalid, defaults to `false`
4. `expirationDate` - `number` (optional): expiration date, for the verification, defaults to *0* (does not expire)
5. `verificationValue` - `any` (optional): json object which will be stored in the verification

5.9 Container

Class Name	Container
Extends	Logger
Source	container.ts
Examples	container.spec.ts

TL;DR: usage examples and a data flow can be found *here*.

The `Container` is an API layer over *DataContract* and combines its functionalities into a more use case oriented straight forward interface.

To reduce complexity the most common usage patterns from *DataContract* have been set as fixed in the `Container` implementation. Therefore the `Container` follows these principles:

- data is always encrypted
- each entry gets an own key for encryption
- each entry get an own role for granting write permissions
- an identity always is created for the container
- adding verifications adds the verification topic to the contract description to allow listing of all verifications of this container
- a property called `type` is added to the `Container` at creation type and marks its template type

---

5.9.1 constructor

```
new Container(options, config);
```

Create new `Container` instance. This will not create a smart contract contract but is used to load existing containers. To create a new contract, use the static *create* function.

Parameters

1. **`options` - `ContainerOptions`: runtime for new container**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `dataContract` - `DataContract`: `DataContract` instance
    - `description` - `Description`: `Description` instance
    - `executor` - `Executor`: `Executor` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
    - `sharing` - `Sharing`: `Sharing` instance
    - `verifications` - `Verifications`: `Verifications` instance
    - `web3` - `Web3`: `Web3` instance

- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

2. **`config` - `DigitalTwinconfIg`: config for new container**
   - `accountId` - `string`: identity or account of user, that interacts with container
   - `address` - `string`: address of a `DataContract` instance, can be ENS or contract address

Returns

`Container` instance

Example

```
const container = new Container(
  runtime,
  {
    accountId: '0x0000000000000000000000000000000000000000',
    address: 'samplecontainer.somewhere.evan',
  },
);
```

5.9.2 = Creating Containers =

5.9.3 create

```
Container.create(runtime, config);
```

Creates a new digital container contract on the blockchain.

Note, that this function is static. It is used on the `Container` class object and returns a `Container` class instance.

The options argument has the same structure as the options object that is passed to the constructor as it is used for the new `Container` instance. The `config` argument requires a proper value for the property `description`.

Parameters

1. **`options` - `ContainerOptions`: runtime for new container**
   - `contractLoader` - `ContractLoader`: `ContractLoader` instance
   - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
   - `dataContract` - `DataContract`: `DataContract` instance
   - `description` - `Description`: `Description` instance
   - `executor` - `Executor`: `Executor` instance
   - `nameResolver` - `NameResolver`: `NameResolver` instance

- `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
- `sharing` - `Sharing`: `Sharing` instance
- `verifications` - `Verifications`: `Verifications` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

2. **`config` - `DigitalTwinconfIg`: config for new container**
   - `accountId` - `string`: identity or account of user, that interacts with container
   - `address` - `string`: ENS address used for container
   - `description` - `string`: description has to be passed to `.create` to apply it to to contract
   - `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer container factory
   - `plugin` - `string|ContainerPlugin` (optional): plugin to be used in `.create`, can be string with name or a `ContainerPlugin`

Returns

`Promise` returns `Container`: new instance bound to new `DataContract`

Example

```
const container = await Container.create(options, config);
console.log(await container.getContractAddress());
// Output:
// 0x0000000000000000000000000000000000001234
```

5.9.4 clone

```
Container.clone(options, config, source[, copyValues]);
```

Clone `Container` instance into plugin and creates new `Container` with it.

Cloning containers:

- is done with identity or account from `config.accountId`, which will be owner of the new contract
- copies all fields from source container to new container (including roles, that have permissions on them)
- copies values for entry-fields (no lists) to new container, if `copyValues` is set
- does not copy role membership
  - `config.accountId` is the owner of the new contract and also a member of the contract (role 0 and 1)

  - other roles receive permissions on fields, but do not get members added to them
- does not copy sharings
  - a new sharing with new keys is generated for this container
  - only the owner of the container receives keys shared to it for this container
- does not copy verifications
- does not copy the description
  - `config.description` is used for the cloned contract
  - fields are dynamically added to the description when generating the clone

Parameters

1. **`options` - `ContainerOptions`: runtime for new container**
   - `contractLoader` - `ContractLoader`: `ContractLoader` instance
   - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
   - `dataContract` - `DataContract`: `DataContract` instance
   - `description` - `Description`: `Description` instance
   - `executor` - `Executor`: `Executor` instance
   - `nameResolver` - `NameResolver`: `NameResolver` instance
   - `rightsAndRoles` - `RightsAndRoles`: `RightsAndRoles` instance
   - `sharing` - `Sharing`: `Sharing` instance
   - `verifications` - `Verifications`: `Verifications` instance
   - `web3` - `Web3`: `Web3` instance
   - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
   - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
   - `logLog` - `LogLogInterface` (optional): container for collecting log messages
   - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
2. **`config` - `DigitalTwinconfIg`: config for new container**
   - `accountId` - `string`: identity or account of user, that interacts with container
   - `address` - `string`: ENS address used for container
   - `description` - `string`: description has to be passed to `.create` to apply it to to contract
   - `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer container factory
   - `plugin` - `string|ContainerPlugin` (optional): plugin to be used in `.create`, can be string with name or a `ContainerPlugin`
3. `source` - `Container`: container to clone
4. `copyValues` - `boolean`: copy entry values from source contract to new contract

Returns

`Promise` returns `Container`: new instance bound to new `DataContract` and a copy of `source`

Example

```
const container = await Container.create(options, config);
console.log(await container.getContractAddress());
// Output:
// 0x0000000000000000000000000000000000001234

const clone = await Container.clone(options, config, container);
console.log(await container.getContractAddress());
// Output:
// 0x0000000000000000000000000000000000005678
```

5.9.5 deleteContainerPlugin

```
container.deleteContainerPlugin(profile);
```

Remove a container plugin from a users profile.

Parameters

1. `Profile` - `Profile`: profile instance
2. `name` - `string`: plugin name

Returns

`Promise` returns `void`

Example

```
await Container.deleteContainerPlugin(profile, 'awesomeplugin');
```

5.9.6 getContainerPlugin

```
container.getContainerPlugin(profile, name);
```

Get one container plugin for a users profile by name.

Parameters

1. `Profile` - `Profile`: profile instance
2. `name` - `string`: plugin name

Returns

`Promise` returns `ContainerPlugin`

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const plugin = await Container.getContainerPlugin(profile, 'awesomeplugin');

// create container with accountId1
const container = await Container.create(options, {
  ...config,
  accountId: accountId1,
  description: plugin.description,
  plugin: plugin,
});
```

5.9.7 getContainerPlugins

```
container.getContainerPlugins(profile);
```

Get all container plugins for a users profile

Parameters

1. `Profile` - `Profile`: profile instance
2. `loadContracts` - boolean (default = true): run loadBcContract directly for all saved entries (if false, unresolved ipld tree will be returned as value)

Returns

`Promise` returns `Array<ContainerPlugin>`

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const plugins = await Container.getContainerPlugins(profile);

// create container with accountId1
const container = await Container.create(options, {
  ...config,
```

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```
  accountId: accountId1,
  description: plugins['awesomeplugin'].description,
  plugin: plugins['awesomeplugin'],
});
```

5.9.8 saveContainerPlugin

```
container.saveContainerPlugin(profile, name, plugin);
```

Persists a plugin including an dbcp description to the users profile.

Parameters

1. `Profile` - `Profile`: profile instance
2. `name` - `string`: plugin name
3. `plugin` - `ContainerPlugin`: container plugin object
4. `beforeName` - `strinf`: remove previous plugin instance when it was renamed

Returns

`Promise` returns `void`

Example

```
const plugins = await Container.saveContainerPlugin(
  profile,
  'awesomeplugin',
  { ... }
);
```

5.9.9 toPlugin

```
container.toPlugin([getValues]);
```

Export current container state as plugin. If `getValues` is `true`, exports entry values as well.

This plugin can be passed to *create* and used to create new containers.

Parameters

1. `getValues` - `boolean`: export entry values or not (list entries are always excluded)

Returns

`Promise` returns `ContainerPlugin`: plugin build from current container

Example

```
const sampleValue = 123;
await container.setEntry('numberField', sampleValue);

console.dir(await container.toPlugin(true));
```

5.9.10 = Entries =

5.9.11 setEntry

```
container.setEntry(entryName, value);
```

Set a value for an entry.

Parameters

1. `entryName` - `string`: name of an entry in the container
2. `value` - `any`: value to set

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleValue = 123;
await container.setEntry('numberField', sampleValue);
console.log(await container.getEntry('numberField'));
// Output:
// 123
```

5.9.12 getEntry

```
container.getEntry(entryName);
```

Return entry from contract.

Parameters

1. `entryName` - `string`: entry name

Returns

`Promise` returns `any`: entry value

Example

Entries can be retrieved with:

```
const sampleValue = 123;
await container.setEntry('numberField', sampleValue);
console.log(await container.getEntry('numberField'));
// Output:
// 123
```

5.9.13 removeEntries

```
container.removeEntries(entries);
```

Remove multiple entries from the container, including data keys and sharings. Can also pass a single property instead of an array. Retrieves dynamically all sharings for the passed entries and runs *unshareProperties* for them.

Parameters

1. `entries` - `string` / `string[]`: name / list of entries, that should be removed

Returns

`Promise` returns `void`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const accountId2 = '0x0000000000000000000000000000000000000002';

// open container with accountId1
const container = new Container(options, { ...config, accountId: accountId1 });

// assuming, that entry 'myField' has been shared with accountId2
// remove the whole property from the container
await container.removeEntries(['myField']);

// fetch value with accountId2 and with accountId1
const accountId2Container = new Container(options, { ...config, accountId: accountId2␣
↪});
```

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```
let value;
try {
  value = await accountId2Container.getEntry('myField');
  console.log(value);
} catch (ex) {
  console.error('could not get entry');
}

// also the owner cannot get this entry anymore
try {
  value = await container.getEntry('myField');
  console.log(value);
} catch (ex) {
  console.error('could not get entry');
}
// Output:
// could not get entry
```

5.9.14 = List Entries =

5.9.15 addListEntries

```
container.addListEntries(listName, values);
```

Add list entries to a list list property.

List entries can be added in bulk, so the value argument is an array with values. This array can be arbitrarily large **up to a certain degree**. Values are inserted on the blockchain side and adding very large arrays this way may take more gas during the contract transaction, than may fit into a single transaction. If this is the case, values can be added in chunks (multiple transactions).

Parameters

1. `listName` - `string`: name of the list in the container
2. `values` - `any[]`: values to add

Returns

`Promise` returns `void`: resolved when done

Example

```
const listName = 'exampleList';
console.log(await container.getListEntryCount(listName));
// Output:
// 0

const sampleValue = {
```

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```
  foo: 'sample',
  bar: 123,
};
await container.addListEntries(listName, [sampleValue]);
console.log(await container.getListEntryCount(listName));
// Output:
// 1

console.dir(await container.getListEntries(listName));
// Output:
// [{
//   foo: 'sample',
//   bar: 123,
// }]
```

5.9.16 getListEntryCount

```
container.getListEntryCount(listName);
```

Return number of entries in the list. Does not try to actually fetch and decrypt values, but just returns the count.

Parameters

1. `listName` - `string`: name of a list in the container

Returns

`Promise` returns `number`: list entry count

Example

```
const listName = 'exampleList';
console.log(await container.getListEntryCount(listName));
// Output:
// 0

const sampleValue = {
  foo: 'sample',
  bar: 123,
};
await container.addListEntries(listName, [sampleValue]);
console.log(await container.getListEntryCount(listName));
// Output:
// 1

console.dir(await container.getListEntries(listName));
// Output:
// [{
//   foo: 'sample',
```

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```
//   bar: 123,
// }]
```

5.9.17 getListEntries

```
container.getListEntries(listName, count, offset, reverse);
```

Return list entries from contract. Note, that in the current implementation, this function retrieves the entries one at a time and may take a longer time when querying large lists, so be aware of that, when you retrieve lists with many entries. Keep in mind if only the listName is passed it will not retrieve the entire list instead only the first 10 elements in the list.

Parameters

1. `listName` - `string`: name of the list in the container
2. `count` - `number` (optional): number of elements to retrieve, defaults to `10`
3. `offset` - `number` (optional): skip this many items when retrieving, defaults to `0`
4. `reverse` - `boolean` (optional): retrieve items in reverse order, defaults to `false`

Returns

`Promise` returns `any[]`: list entries

Example

```
const listName = 'exampleList';
console.log(await container.getListEntryCount(listName));
// Output:
// 0

const sampleValue = [ 'Hello', 'welcome', 'to', 'evan', 'network' ];
await container.addListEntries(listName, [sampleValue]);
console.log(await container.getListEntryCount(listName));
// Output:
// 5

console.dir(await container.getListEntries(listName));
// Output:
// [ 'Hello', 'welcome', 'to', 'evan', 'network' ]

console.log(await container.getListEntries(listName, 2));
//Output:
// [ 'Hello', 'welcome' ]

console.log(await container.getListEntries(listName, 10, 2));
//Output
// [ 'to', 'evan', 'network' ]
```

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```
console.log(await container.getListEntries('testList', 10, 0, true));
//Output:
// [ 'network', 'evan', 'to', 'welcome', 'Hello' ]
```

5.9.18 getListEntry

```
container.getListEntry(listName, index);
```

Return a single list entry from contract.

Parameters

1. `listName` - `string`: name of the list in the container
2. `index` - `number`: list entry id to retrieve

Returns

`Promise` returns `any`: list entry

Example

```
const listName = 'exampleList';
console.log(await container.getListEntryCount(listName));
// Output:
// 0

const sampleValue = {
  foo: 'sample',
  bar: 123,
};
await container.addListEntries(listName, [sampleValue]);
const count = await container.getListEntryCount(listName);
console.log(count);
// Output:
// 1

console.dir(await container.getListEntry(listName, count - 1));
// Output:
// {
//   foo: 'sample',
//   bar: 123,
// }
```

5.9.19 = Store multiple properties =

5.9.20 storeData

```
container.storeData(data);
```

Store data to a container. This allows to

- – store data into already existing entries and/or list entries
- – implicitely create new entries and/or list entries (the same logic for deciding on their type is applied as in *setEntry/addListEntries* is applied here)
- – in case of entries, their value is overwritten
- – in case of list entries, given values are added to the list

Parameters

1. `data` - `object`: object with keys, that are names of lists or entries and values, that are the values to store to them

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleValue = 123;
await container.storeData({
  'numberField': sampleValue,
});
console.log(await container.getEntry('numberField'));
// Output:
// 123
```

5.9.21 = Share Container Data =

5.9.22 shareProperties

```
container.shareProperties(shareConfigs);
```

Share entry/list to another user; this handles role permissions, role memberships.

Share configurations are given per user, that receives gets data shared with. The properties have the following meaning

- `accountId`:
  - – identity or account, that gets properties shared
  - – this user will be invited to the contract as a consumer (role 1)
- `read`:

  - list of properties, that are shared read-only
  - for each property here, a key sharing for the user will be added if not already done so
  - this field will always be expanded by the field `type`, which is read only accessible for every member by default, even if `read` is omitted
  - if not already done so, a hash key sharing will be added for given user
- `readWrite`:
  - properties listed here will be threaded the same way as those in the field `read`
  - additionally the following applies:
    * if not already done so, a role, that has `Set` permissions will be added for this field
    * given `accountId` will be added to the group responsible for this field
    * aforementioned roles roles start at role 64, the first 64 roles are system reserved for smart contract custom logic or in-detail role configurations
    * possible roles can go up to 255, so it is possible to add up to 192 properties to a container
- `removeListEntries`:
  - properties listed here will be threaded the same way as those in the field `read`
  - additionally the following applies:
    * if not already done so, a role, that has `Remove` permissions will be added for this field
    * given `accountId` will be added to the group responsible for this field
    * aforementioned roles roles start at role 64, the first 64 roles are system reserved for smart contract custom logic or in-detail role configurations
    * possible roles can go up to 255, so it is possible to add up to 192 properties to a container

Parameters

1. `shareConfigs` - `ContainerShareConfig[]`: list of share configs

Returns

`Promise` returns `void`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const accountId2 = '0x0000000000000000000000000000000000000002';

// create container with accountId1
const container = await Container.create(options, { ...config, accountId: accountId1 }
↪);
await container.setEntry('myField', 123);
console.log(await container.getEntry('myField'));
// Output:
// 123
```

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```
// share field from accountId1 to accountId2
await container.shareProperties([{
  accountId: accountId2,
  read: ['myField'],
}]);

// fetch value with accountId2
const accountId2Container = new Container(options, { ...config, accountId: accountId2
↪});
console.log(await accountId2Container.getEntry('myField'));
// Output:
// 123
```

5.9.23 unshareProperties

```
container.unshareProperties(unshareConfigs);
```

Remove keys and/or permissions for a user; this also handles role permissions, role memberships.

Please note: To prevent 'dead' and inaccessible container entries, the API will throw an error by trying to unshare properties for an owner of a container. If you are sure and really want remove the owner from a property, you need to set the 'force' attribute of the *ContainerUnshareConfig* for the owner to true. If you want to remove a property for all invited users, please use the *removeEntries* function.

Parameters

1. `unshareConfigs` - *ContainerUnshareConfig*: list of identity/account-field setups to remove permissions/keys for

Returns

`Promise` returns `void`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const accountId2 = '0x0000000000000000000000000000000000000002';

// open container with accountId1
const container = new Container(options, { ...config, accountId: accountId1 });

// assuming, that entry 'myField' has been shared with accountId2
// unshare field from accountId1 to accountId2
await container.unshareProperties([{
  accountId: accountId2,
  read: ['myField'],
}]);

// fetch value with accountId2
```

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```
const accountId2Container = new Container(options, { ...config, accountId: accountId2␣
↪});
let value;
try {
  value = await accountId2Container.getEntry('myField');
  console.log(value);
} catch (ex) {
  console.error('could not get entry');
}
// Output:
// could not get entry
```

5.9.24 getContainerShareConfigForAccount

```
container.getContainerShareConfigForAccount(accountId);
```

Check permissions for given identity or account and return them as ContainerShareConfig object.

Parameters

1. `accountId` - `string`: account to check permissions for

Returns

`Promise` returns `ContainerShareConfig`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const accountId2 = '0x0000000000000000000000000000000000000002';

// create container with accountId1
const container = await Container.create(options, { ...config, accountId: accountId1 }
↪);
await container.setEntry('myField', 123);
console.log(await container.getEntry('myField'));
// Output:
// 123

// share field from accountId1 to accountId2
await container.shareProperties([{
  accountId: accountId2,
  read: ['myField'],
}]);

// fetch value with accountId2
const accountId2Container = new Container(options, { ...config, accountId: accountId2␣
↪});
console.log(await accountId2Container.getEntry('myField'));
```

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```
// Output:
// 123

const shareConfig = await container.getContainerShareConfigForAccount(accountId2);
console.dir(shareConfig);
// Output:
// {
//   accountId: '0x0000000000000000000000000000000000000002',
//   read: ['myField']
// }
```

5.9.25 getContainerShareConfigs

```
container.getContainerShareConfigs();
```

Check permissions for given identity or account and return them as ContainerShareConfig object.

Returns

`Promise` returns `ContainerShareConfig[]`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';  // account in␣
↪runtime
const accountId2 = '0x0000000000000000000000000000000000000002';  // account to invite

const container = await Container.create(runtime, defaultConfig);
const randomString1 = Math.floor(Math.random() * 1e12).toString(36);
await container.setEntry('testField1', randomString1);
const randomString2 = Math.floor(Math.random() * 1e12).toString(36);
await container.setEntry('testField2', randomString2);

await container.shareProperties([
  { accountId: accountId2, readWrite: ['testField1'], read: ['testField2'] },
]);

console.dir(await container.getContainerShareConfigs());
// Output:
// [ { accountId: '0x0000000000000000000000000000000000000001',
//   readWrite: [ 'testField1', 'testField2' ] },
// { accountId: '0x0000000000000000000000000000000000000002',
//   read: [ 'testField2' ],
//   readWrite: [ 'testField1' ] } ]
```

5.9.26 setContainerShareConfigs

```
container.setContainerShareConfigs(newConfigs, originalConfigs);
```

Takes a full share configuration for an identity or account (or a list of them), share newly added properties and unshare removed properties from the container. Also accepts a list or instance of the original sharing configurations so that duplicated loading can be avoided.

Parameters

1. `newConfigs` - *ContainerShareConfig* / *ContainerShareConfig* []: sharing configurations that should be persisted
2. `originalConfigs` - *ContainerShareConfig* / *ContainerShareConfig* [] (optional): pass original share configurations to check differences; better performance if provided, automatically fetched if omitted

Returns

`Promise` returns `void`: resolved when done

Example

```
const accountId1 = '0x0000000000000000000000000000000000000001';
const accountId2 = '0x0000000000000000000000000000000000000002';

// open container with accountId1
const container = new Container(options, { ...config, accountId: accountId1 });

await container.shareProperties([{
  accountId: '0x0000000000000000000000000000000000000002',
  read: [ 'testField', ],
  readWrite: [ 'testField2', ]
}]);

console.dir(await container.getContainerShareConfigForAccount(accountId2))
// {
//   accountId: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//   read: [ 'testField' ],
//   readWrite: [ 'testField2' ]
// }

shareConfig.readWrite = [ 'testField3' ];
await container.setContainerShareConfigs(shareConfig);

console.dir(await container.getContainerShareConfigForAccount(accountId2))
// {
//   accountId: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//   read: [ 'testField' ],
//   readWrite: [ 'testField3' ]
// }
```

5.9.27 = Verifying Containers =

5.9.28 addVerifications

```
container.addVerifications(verifications);
```

Add verifications to this container; this will also add verifications to contract description.

If the calling account is the owner of the identity of the container

- the description will is automatically updated with tags for verifications
- verifications issued with this function will be accepted automatically

See interface `ContainerVerificationEntry` for input data format.

Parameters

1. `verifications` - `ContainerVerificationEntry[]`: list of verifications to add

Returns

`Promise` returns `void`: resolved when done

Example

```
await container.addVerifications([{ topic: 'exampleVerification' }]);
```

5.9.29 getOwner

```
container.getOwner();
```

Gets the owner identity or account for the container.

Returns

`Promise` returns `string`: owner identity or account

Example

```
const isOwner = (await container.getOwner()) === runtime.activeAccount;
```

5.9.30 getVerifications

```
container.getVerifications();
```

Gets verifications from description and fetches list of verifications for each of them.

See `Verifications` documentation for details on output data format.

Returns

`Promise` returns `any`: list of verification lists from `Verifications`, `getVerifications`

Example

```
await container.addVerifications([{ topic: 'exampleVerification' }]);
const verifications = await container.getVerifications());
```

5.9.31 = Working with Container Descriptions =

5.9.32 getDescription

```
container.getDescription();
```

Get description from container contract.

Returns

`Promise` returns `any`: public part of the description

Example

```
const description = await container.getDescription();
console.dir(description);
// Output:
// { name: 'test container',
//   description: 'container from test run',
//   author: 'evan GmbH',
//   version: '0.1.0',
//   dbcpVersion: 2,
//   identity:
//    '0x70c969a64e880fc904110ce9ab72ba5f95f706a252ac085ae0525bd7a284337c',
//   dataSchema: { type: { type: 'string', '$id': 'type_schema' } } }
```

5.9.33 setDescription

```
container.setDescription(description);
```

Write given description to containers DBCP.

Parameters

1. `description` - `any`: description (public part)

Returns

`Promise` returns `void`: resolved when done

Example

```
// get current description
const description = await container.getDescription();
console.dir(description);
// Output:
// { name: 'test container',
//   description: 'container from test run',
//   author: 'evan GmbH',
//   version: '0.1.0',
//   dbcpVersion: 2,
//   identity:
//    '0x70c969a64e880fc904110ce9ab72ba5f95f706a252ac085ae0525bd7a284337c',
//   dataSchema: { type: { type: 'string', '$id': 'type_schema' } } }

// update description
description.version = '0.1.1';
await container.setDescription(description);

// fetch again
console.dir(await container.getDescription());
// Output:
// { name: 'test container',
//   description: 'container from test run',
//   author: 'evan GmbH',
//   version: '0.1.1',
//   dbcpVersion: 2,
//   identity:
//    '0x70c969a64e880fc904110ce9ab72ba5f95f706a252ac085ae0525bd7a284337c',
//   dataSchema: { type: { type: 'string', '$id': 'type_schema' } } }
```

5.9.34 = Utilities =

5.9.35 getContractAddress

```
container.getContractAddress();
```

Get contract address of underlying `DataContract`.

Returns

`Promise` returns `string`: address of the `DataContract`

Example

```
const container = await Container.create(options, config);
console.log(await container.getContractAddress());
// Output:
// 0x0000000000000000000000000000000000001234
```

5.9.36 ensureProperty

```
container.ensureProperty(propertyName, dataSchema[, propertyType]);
```

Ensure that container supports given property.

Returns

`Promise` returns `void`: resolved when done

Example

```
await container.ensureProperty('testField', Container.defaultSchemas.stringEntry);
```

5.9.37 Additional Components

5.9.38 Interfaces

ContainerConfig

config properties, specific to *Container* instances

1. `accountId` - `string`: identity or account of user, that interacts with container
2. `address` - `string` (optional): address of a `DataContract` instance, can be ENS or contract address
3. `description` - `string` (optional): description has to be passed to `.create` to apply it to to contract
4. `factoryAddress` - `string` (optional): factory address can be passed to `.create` for customer container factory
5. `plugin` - `string|ContainerPlugin` (optional): plugin to be used in `.create`, can be string with name or a `ContainerPlugin`

ContainerFile

description and content of a single file, usually used in arrays (add/get/set operations)

1. `name` - `string`: filename, e.g. `animal-animal-photography-cat-96938.jpg`
2. `fileType` - `string`: mime type of the file, e.g. `image/jpeg`
3. `file` - `Buffer`: file data as Buffer

ContainerShareConfig

config for sharing multiple fields to one account (read and/or readWrite access)

1. `accountId` - `string`: identity or account, that gets properties shared
2. `read` - `string[]` (optional): list of properties, that are shared read-only
3. `readWrite` - `string[]` (optional): list of properties, that are shared readable and writable

ContainerUnshareConfig

config for unsharing multiple fields from one account (write and/or readWrite access)

1. `accountId` - `string`: identity or account, that gets properties unshared
2. `readWrite` - `string[]` (optional): list of properties, that are unshared (read and write permissions)
3. `removeListEntries` - `string[]` (optional): list of properties, that are losing the rights to remove list-entries
4. `write` - `string[]` (optional): list of properties, for which write permissions should be removed
5. `force` - `boolean` (optional): Without force flag, removal of the owner will throw an error. By setting to true, force will even remove the owner. **Important: By removing the owner from a property, the encryptions keys get lost and cannot be recovered. As the result of this, the data isn't readable anymore and must be overwritten by creating new encryption keys to encrypt future content.**

ContainerPlugin

base definition of a container instance, covers properties setup and permissions

1. `description` - `any`: type of the template (equals name of the template)
2. `template` - `ContainerTemplate`: template for container instances, covers properties setup and permissions

ContainerTemplate

template for container instances, covers properties setup and permissions

1. `type` - `string`: type of the template (equals name of the template)
2. `properties` - `{ [id: string]: ContainerTemplateProperty; }` (optional): list of properties included in this template, key is field name, value is property setup

ContainerTemplateProperty

config for sharing multiple fields to one identity or account (read and/or readWrite access)

1. `dataSchema` - `any`: Ajv data schema for field
2. `permissions` - `{ [id: number]: string[] }`: permissions for this template, key is role id, value is array with 'set' and/or 'remove'
3. `type` - `string`: type of property (entry/list)
4. `value` - `any` (optional): value of property

ContainerVerificationEntry

data for verifications for containers

1. `topic` - `string`: verification path
2. `descriptionDomain` - `string` (optional): domain, where the description of this verification is stored
3. `disableSubverifications` - `boolean` (optional): if set, verification created in a sub-path are invalid by default, defaults to `false`
4. `expirationDate` - `number` (optional): expiration date, verifications do not expire if omitted, defaults to `0`
5. `verificationValue` - `string` (optional): reference to additional verification details

---

5.9.39 Public Properties

defaultDescription (static)

Default description used when no specific description is given to *.create*.

defaultSchemas (static)

Predefined simple schemas, contains basic schemas for files, number, object, string entries and their list variants.

defaultTemplate (static)

Default template used when no specific description is given to *.create*. Default template is `metadata`.

profileTemplatesKey (static)

Key that is used in user profile to store templates, default is `templates.datacontainer.digitaltwin.evan`

templates (static)

Predefined templates for containers, currently only contains the `metadata` template.

This section includes modules, that deal with smart contract interactions, which includes:

- contract helper libraries, e.g. for
  - `BaseContract`
  - `DataContract`
  - `ServiceContract`
- permission management
- sharing keys for contracts

CHAPTER 6

DFS (Distributed File System)

6.1 DFS Interface

Interface Name	DfsInterface
Source	dfs-interface.ts

The DfsInterface is used to add or get files from the distributed file system. It is the only class, that has to be used before having access to a runtime, when using the *createDefaultRuntime*.

Internally the modules use the DfsInterface to access data as well. As the actual implementation of the file access may vary, an instance of the interface has to be created beforehand and passed to the *createDefaultRuntime* function. An implementation called Ipfs, that relies on the IPFS framework is included as in the package.

6.1.1 add

```
dfs.add(name, data);
```

add content to dfs file content is converted to Buffer (in NodeJS) or an equivalent "polyfill" (in browsers)

Parameters

1. `name` - `string`: name of the added file
2. `data` - `buffer`: data (as buffer) of the added file

Returns

`string`: hash of the data.

Example

```
const fileHash = await runtime.dfs.add(
  'about-maika-1.txt',
  Buffer.from('we have a cat called "Maika"', 'utf-8'),
);
console.log(fileHash);
// Output:
// 0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70
```

6.1.2 addMultiple

```
dfs.addMultiple(files);
```

Multiple files can be added at once. This way of adding should be preferred for performance reasons, when adding files, as requests are combined.

Parameters

1. `files` - `FileToAdd[]`: array with files to add

Returns

`Promise` resolves to `string[]`: hash array of the data.

Example

```
const fileHashes = await runtime.dfs.addMultiple([{
    path: 'about-maika-1.txt',
    content: Buffer.from('we have a cat called "Maika"', 'utf-8'),
  }, {
    path: 'about-maika-2.txt',
    content: Buffer.from('she can be grumpy from time to time"', 'utf-8'),
  }
]);
console.dir(fileHashes);
// Output:
// [ '0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70',
//   '0x6b85c8b24b59b12a630141143c05bbf40a8adc56a8753af4aa41ebacf108b2e7' ]
```

6.1.3 get

```
dfs.get(hash, returnBuffer);
```

get data from dfs by hash

Parameters

1. `hash` - `string`: hash (or bytes32 encoded) of the data
2. `returnBuffer` - `bool`: should the function return the plain buffer, defaults to `false`

Returns

`Promise` resolves to `string | buffer`: data as text or buffer.

Example

```
const fileBuffer = await runtime.dfs.get(
↪'0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70');
console.log(fileBuffer.toString('utf-8'));
// Output:
// we have a cat called "Maika"
```

6.1.4 remove

```
dfs.remove(hash);
```

removes data by hash reference

Parameters

1. `hash` - `string`: hash (or bytes32 encoded) of the data

Returns

`Promise` resolves to `void`: resolved when done

Example

```
const fileBuffer = await runtime.dfs.remove(
↪'0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70');
```

6.1.5 = Additional Components =

6.1.6 Interfaces

FileToAdd

1. `path` - `string`: name of the added file
2. `content` - `buffer`: data (as buffer) of the added file

6.2 IPFS

Class Name	Ipfs
Implements	DfsInterface
Extends	Logger
Source	ipfs.ts
Examples	ipfs.spec.ts

This is DfsInterface implementation, that relies on the IPFS framework.

6.2.1 constructor

```
new Ipfs(options);
```

Creates a new IPFS instance.

Parameters

1. **`options` - `IpfsOptions`: options for IPFS constructor.**
    - `remoteNode` - `any`: ipfs-api instance to remote server
    - `cache` - `DfsCacheInterface` (optional): `DfsCacheInterface` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Ipfs` instance

Example

```
const ipfs = new Ipfs({
    remoteNode,
    cache
  });
```

6.2.2 ipfsHashToBytes32

```
dfs.ipfsHashToBytes32(hash);
```

convert IPFS hash to bytes 32 see https://www.reddit.com/r/ethdev/comments/6lbmhy/a_practical_guide_to_cheap_ipfs_hash_storage_in

Parameters

1. `hash` - `string`: IPFS hash

Returns

`string`: bytes32 string.

Example

```
runtime.dfs.ipfsHashToBytes32('QmWmyoMoctfbAaiEs2G46gpeUmhqFRDW6KWo64y5r581Vz')
// returns 0x7D5A99F603F231D53A4F39D1521F98D2E8BB279CF29BEBFD0687DC98458E7F89
```

6.2.3 bytes32ToIpfsHash

```
dfs.bytes32ToIpfsHash(str);
```

convert bytes32 to IPFS hash see https://www.reddit.com/r/ethdev/comments/6lbmhy/a_practical_guide_to_cheap_ipfs_hash_storage_in

Parameters

1. `str` - `string`: bytes32 string

Returns

`string`: IPFS Hash.

Example

```
runtime.dfs.ipfsHashToBytes32(
↪'0x7D5A99F603F231D53A4F39D1521F98D2E8BB279CF29BEBFD0687DC98458E7F8')
// returns QmWmyoMoctfbAaiEs2G46gpeUmhqFRDW6KWo64y5r581Vz
```

6.2.4 add

```
dfs.add(name, data);
```

add content to ipfs file content is converted to Buffer (in NodeJS) or an equivalent “polyfill” (in browsers)

Parameters

1. `name` - `string`: name of the added file
2. `data` - `buffer`: data (as buffer) of the added file

Returns

`string`: ipfs hash of the data.

Example

```
const fileHash = await runtime.dfs.add(
  'about-maika-1.txt',
  Buffer.from('we have a cat called "Maika"', 'utf-8'),
);
console.log(fileHash);
// Output:
// 0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70
```

6.2.5 addMultiple

```
dfs.addMultiple(files);
```

Multiple files can be added at once. This way of adding should be preferred for performance reasons, when adding files, as requests are combined.

Parameters

1. `files` - `FileToAdd[]`: array with files to add

Returns

`Promise` resolves to `string[]`: ipfs hash array of the data.

Example

```
const fileHashes = await runtime.dfs.addMultiple([{
    path: 'about-maika-1.txt',
    content: Buffer.from('we have a cat called "Maika"', 'utf-8'),
  }, {
    path: 'about-maika-2.txt',
    content: Buffer.from('she can be grumpy from time to time"', 'utf-8'),
  }
]);
console.dir(fileHashes);
// Output:
// [ '0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70',
//   '0x6b85c8b24b59b12a630141143c05bbf40a8adc56a8753af4aa41ebacf108b2e7' ]
```

6.2.6 pinFileHash

```
dfs.pinFileHash(hash);
```

pins file hashes on ipfs cluster

Parameters

1. `hash` - `string`: filehash of the pinned item

Returns

`Promise` resolves to `void`: resolved when done.

Example

```
const fileBuffer = await runtime.dfs.pinFileHash(
↪'QmWmyoMoctfbAaiEs2G46gpeUmhqFRDW6KWo64y5r581Vz');
```

6.2.7 remove

```
dfs.remove(hash);
```

unpins file hashes on ipfs cluster

Parameters

1. `hash` - `string`: filehash of the pinned item

Returns

`Promise` resolves to `void`: resolved when done.

Example

```
await runtime.dfs.remove('QmWmyoMoctfbAaiEs2G46gpeUmhqFRDW6KWo64y5r581Vz');
```

6.2.8 unPinFileHash

```
dfs.unPinFileHash(hash);
```

unpins file hashes on ipfs cluster

Parameters

1. `hash` - `string`: filehash of the pinned item

Returns

`Promise` resolves to `void`: resolved when done.

Example

```
await runtime.dfs.unPinFileHash('QmWmyoMoctfbAaiEs2G46gpeUmhqFRDW6KWo64y5r581Vz');
```

6.2.9 get

```
dfs.get(hash, returnBuffer);
```

get data from ipfs by ipfs hash

Parameters

1. `hash` - `string`: ipfs hash (or bytes32 encoded) of the data
2. `returnBuffer` - `bool`: if true the method will return a raw buffer holding the data (default false)

Returns

`Promise` resolves to `string | buffer`: data as text or buffer.

Example

```
const fileBuffer = await runtime.dfs.get(
↪'0x695adc2137f1f069ff697aa287d0eae486521925a23482f180b3ae4e6dbf8d70');
console.log(fileBuffer.toString('utf-8'));
// Output:
// we have a cat called "Maika"
```

6.2.10 = Additional Components =

6.2.11 Interfaces

FileToAdd

1. `path` - `string`: name of the added file
2. `content` - `buffer`: data (as buffer) of the added file

6.3 IPLD

Class Name	Ipld
Extends	Logger
Source	ipld.ts
Examples	ipld.spec.ts

IPLD is a way to store data as trees. The used implementation relies on js-ipld-graph-builder for iterating over tree nodes and setting new subtrees, but uses a few modifications to the standard: - nodes are not stored as IPFS DAGs, but stored as play JSON IPFS files - nodes, that are encrypted, contain the property *cryptoInfo* for decryption (see Encryption)

6.3.1 constructor

```
new IPLD(options);
```

Creates a new Ipld instance.

Requires

Parameters

1. **`options` - `IpldOptions`: The options used for calling**
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `defaultCryptoAlgo` - `string`: default encryption algorithm
    - `ipfs` - `Ipfs`: `Ipfs` instance
    - `keyProvider` - `KeyProviderInterface`: `KeyProviderInterface` instance
    - `originator` - `string`: originator of tree (default encryption context)
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`IpldOptions` instance

Example

```
const ipld = new IPLD(options);
```

6.3.2 store

```
ipld.store(toSet);
```

Store tree, if tree contains merklefied links, stores tree with multiple linked subtrees. Hashes returned from this function represent the the final tree, that can be stored as bytes32 hashes in smart contracts, etc.

Parameters

1. `toSet` - `any`: tree to store

Returns

`Promise` returns `string`: hash reference to a tree with with merklefied links

Example

```
const sampleObject = {
  personalInfo: {
    firstName: 'eris',
  },
};
const stored = await ipld.store(Object.assign({}, sampleObject));
console.log(stored);
// Output:
// 0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d
```

When storing nested trees created with _ipld_set_, subtrees at junction points are stored as separate trees, then converted to serialized buffers, which are automatically deserialized and cast back when calling *ipld_getLinkedGraph*.

```
console.log(JSON.stringify(extended, null, 2));
const extendedstored = await ipld.store(Object.assign({}, extended));
// Output:
// "0xc74f6946aacbbd1418ddd7dec83a5bcd3710b384de767d529e624f9f08cbf9b4"
const loaded = await ipld.getLinkedGraph(extendedstored, '');
console.log(JSON.stringify(Ipld.purgeCryptoInfo(loaded), null, 2));
// Output:
//
//  "personalInfo": {
//    "firstName": "eris"
//  },
//  "dapps": {
//    "/": {
//      "type": "Buffer",
//      "data": [ 18, 32, 246, 21, 166, 135, 236, 212, 70, 130, 94, 47, 81, 135, 153,␣
↪154, 201, 69, 109, 249, 97, 84, 252, 56, 214, 195, 149, 133, 116, 253, 19, 87, 217,␣
↪66 ]
//    }
//  }
//
```

6.3.3 getLinkedGraph

```
ipld.getLinkedGraph(graphReference[, path]);
```

Get a path from a tree; resolve subtrees only if required (depends on requested path).

Parameters

1. `graphReference` - `string | Buffer | any`: hash/buffer to look up or a graph object
2. `path` - `string` (optional): path in the tree, defaults to `''`

Returns

`Promise` returns `any`: linked graph

Example

To retrieve data from IPLD trees, use the *bytes32* hash from storing the data:

```
const stored = '0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d';
const loaded = await ipld.getLinkedGraph(stored, '');
console.dir(Ipld.purgeCryptoInfo(loaded));
// Output:
// { personalInfo: { firstName: 'eris' } }
```

For info about the `Ipld.purgeCryptoInfo` part see Encryption.

The second argument is the path inside the tree. Passing '' means "retrieve data from root level". To get more specifc data, provide a path:

```
const stored = '0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d';
const loaded = await ipld.getLinkedGraph(stored, 'personalInfo');
console.dir(Ipld.purgeCryptoInfo(loaded));
// Output:
// { firstName: 'eris' }
```

```
const stored = '0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d';
const loaded = await ipld.getLinkedGraph(stored, 'personalInfo/firstName');
console.dir(Ipld.purgeCryptoInfo(loaded));
// Output:
// 'eris'
```

6.3.4 getResolvedGraph

```
ipld.getResolvedGraph(graphReference[, path, depth]);
```

Get a path from a tree; resolve links in paths up to depth (default is 10).

This function is for **debugging and analysis purposes only**, it tries to resolve the entire graph, which would be too much requests in most scenarios. If resolving graphs, prefer using *ipld_getLinkedGraph*, with specific queries into the tree, that limit the resolve requests.

Parameters

1. `graphReference` - `string | Buffer | any`: hash/buffer to look up or a graph object
2. `path` - `string` (optional): path in the tree, defaults to `''`
3. `depth` - `number` (optional): resolve up do this many levels of depth, defaults to `10`

Returns

`Promise` returns `any`: resolved graph

Example

```
const treeHash = '0xc74f6946aacbbd1418ddd7dec83a5bcd3710b384de767d529e624f9f08cbf9b4';
console.dir(await ipld.getResolvedGraph(treeHash, ''));
// Output:
// { personalInfo: { firstName: 'eris' },
// dapps: { '/': { contracts: [Array], cryptoInfo: [Object] } },
// cryptoInfo:
//   { originator: '0xd7c759941fa3962e4833707f2f44f8cb11b471916fb6f9f0facb03119628234e
↪',
//     keyLength: 256,
//     algorithm: 'aes-256-cbc' } }
```

Compared to *ipld_getLinkedGraph*:

```
const treeHash = '0xc74f6946aacbbd1418ddd7dec83a5bcd3710b384de767d529e624f9f08cbf9b4';
console.dir(await ipld.getLinkGraph(treeHash, ''));
// Output:
// { personalInfo: { firstName: 'eris' },
// dapps:
//   { '/':
//      Buffer [18, 32, 246, 21, 166, 135, 236, 212, 70, 130, 94, 47, 81, 135, 153,␣
↪154, 201, 69, 109, 249, 97, 84, 252,  56, 214, 195, 149, 133, 116, 253, 19, 87, 217,
↪ 66] },
// cryptoInfo:
//   { originator: '0xd7c759941fa3962e4833707f2f44f8cb11b471916fb6f9f0facb03119628234e
↪',
//     keyLength: 256,
//     algorithm: 'aes-256-cbc' } }
```

6.3.5 set

```
ipld.set(tree, path, subtree[, plainObject, cryptoInfo]);
```

Set a value to a tree node; inserts new element as a linked subtree by default.

What's pretty useful about IPLD graphs is, that not only plain JSON trees can be stored, but that those trees can be linked to other graphs, which makes it possible to build very powerful tree structures, that consist of multiple separate trees, that can be used on their own or in a tree, that combines all of those. The resulting hash is again `bytes32` hash and this can be stored in smart contracts like any other IPFS hash.

This function adds the given subtree under a path in the existing tree. Different subtrees can be added by using this function multiple times. The final tree can then be stored to IPFS with *ipld_store*.

Parameters

1. `tree` - `any`: tree to extend
2. `path` - `string`: path of inserted element
3. `subtree` - `any`: element that will be added
4. `plainObject` - `boolean` (optional): do not link values as new subtree, defaults to `false`
5. `cryptoInfo` - `CryptoInfo` (optional): crypto info for encrypting subtree

Returns

`Promise` returns `any`: tree with merklefied links

Example

```
const sampleObject = {
  personalInfo: {
    firstName: 'eris',
  },
};
const sub = {
  contracts: ['0x01', '0x02', '0x03']
};
const extended = await ipld.set(
  sampleObject,               // extend this graph
  'dapps',                    // attach the subgraph under the path "dapps"
  sub,                        // attach this graph as a subgraph
);
console.log(JSON.stringify(extended, null, 2));
// Output:
// {
//   "personalInfo": {
//     "firstName": "eris"
//   },
//   "dapps": {
//     "/": {
//       "contracts": [
//         "0x01",
//         "0x02",
//         "0x03"
//       ]
//     }
//   }
// }
```

6.3.6 remove

```
ipld.remove(tree, path);
```

Delete a value from a tree node.

Parameters

1. `tree` - `any`: tree to extend
2. `string` - `string`: path of inserted element

Returns

`Promise` returns `any`: tree with merklefied links

Example

```
const treeHash = '0xc74f6946aacbbd1418ddd7dec83a5bcd3710b384de767d529e624f9f08cbf9b4';
const loaded = await ipld.getLinkedGraph(treeHash, '');
console.log(loaded);
// Output:
// { personalInfo: { firstName: 'eris' },
//   dapps:
//    { '/': <Buffer 12 20 f6 15 a6 87 ec d4 46 82 5e 2f 51 87 99 9a c9 45 6d f9 61␣
↪54 fc 38 d6 c3 95 85 74 fd 13 57 d9 42> },
//   cryptoInfo:
//    { originator:
↪'0xd7c759941fa3962e4833707f2f44f8cb11b471916fb6f9f0facb03119628234e',
//      keyLength: 256,
//      algorithm: 'aes-256-cbc' } }

const updated = await ipld.remove(loaded, 'dapps');
console.log(updated);
// Output:
// { personalInfo: { firstName: 'eris' },
//   cryptoInfo:
//    { originator:
↪'0xd7c759941fa3962e4833707f2f44f8cb11b471916fb6f9f0facb03119628234e',
//      keyLength: 256,
//      algorithm: 'aes-256-cbc' } }
```

6.3.7 purgeCryptoInfo

```
Ipld.purgeCryptoInfo(toPurge);
```

(static class function)

Remove all cryptoInfos from tree.

Some example here use `Ipld.purgeCryptoInfo` to cleanup the objects before logging them. This is done, because IPLD graphs are encrypted by default, which has a few impact on the data stored:

- The root node of a tree is "encrypted" with the encryption algorithm "unencrypted", resulting in the root node having its data stored as a Buffer. This is done to keep the root node in the same format as the other nodes, as:
- Nodes in the Tree are encrypted. This encryption is specified in the constructor as *defaultCryptoAlgo*.
- All nodes are en- or decrypted with the same identity or account or "originator". The originator, that is used, is specified in the constructor as "originator". This means, that the IPLD instance is identity or account bound and a new instance has to be created if another identity or account should be used.

Parameters

1. `toPurge` - `any`: The options used for calling

Returns

`void`

Example

To show the difference, without purging:

```
const stored = '0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d';
const loaded = await ipld.getLinkedGraph(stored, '');
console.dir(loaded);
// Output:
// { personalInfo: { firstName: 'eris' },
//   cryptoInfo:
//    { originator:
↪'0xd7c759941fa3962e4833707f2f44f8cb11b471916fb6f9f0facb03119628234e',
//      keyLength: 256,
//      algorithm: 'aes-256-cbc' } }
//
```

With purging:

```
const stored = '0x12f6526dbe223eddd6c6a0fb7df118c87c56d34bf0c845b54bdca2fec0f3017d';
const loaded = await ipld.getLinkedGraph(stored, '');
console.dir(Ipld.purgeCryptoInfo(loaded));
// Output:
// { personalInfo: { firstName: 'eris' } }
```

The DFS section handles modules, that deal with managing data in distributed file system, like the DFS interface, its implementation for IPFS and the IPLD graph builder, that works on top of the IPFS impementation.

CHAPTER 7

Encryption

7.1 Encryption Wrapper

Class Name	EncryptionWrapper
Extends	Logger
Source	encryption-wrapper.ts
Examples	encryption-wrapper.spec.ts

Encryption processes othen deal with the following questions:

- Where to get a key from?
- Do I need to generate a new key? How can I store this?
- How to fetch a matching crypto?
- How to encrypt data?

`EncryptionWrapper` handles these topcis and offers a fast way to work with encryption.

7.1.1 constructor

```
new EncryptionWrapper(options);
```

Create new `EncryptionWrapper` instance.

Parameters

1. **`options` - `DigitalTwinOptions`: runtime-like object with required modules**
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance

- `nameResolver` - `NameResolver`: `NameResolver` instance
- `profile` - `Profile`: `Profile` instance
- `sharing` - `Sharing`: `Sharing` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog` factory

Returns

`EncryptionWrapper` instance

Example

```
const encryptionWrapper = new EncryptionWrapper(runtime);
```

7.1.2 = CryptoInfos =

7.1.3 getCryptoInfo

```
encryptionWrapper.getCryptoInfo(keyContext, keyType, cryptorType[, artifacts])
```

`CryptoInfo` s are descriptors for encrypted documents. They are stored alongside the encrypted data and provide a hint about the context of the data and how to decrypt them. In the `EncryptionWrapper` they are also used as an option parameter for the `encrypt` function.

Parameters

1. `keyContext` - `any`: used to identify key, can be any string (but must not have colons)
2. `keyType` - `EncryptionWrapperKeyType`: defines where keys are stored
3. `cryptorType` - `EncryptionWrapperCryptorType`: cryptor to use
4. `artifacts` - `any`: (optional) additional information for encryption may be required, depends on `keyType`, see section below for details

artifacts

Depending on `keyType` different properties are required. `artifacts` can be omitted, if used `keyType` is not listed below.

- `EncryptionWrapperKeyType.Sharing`:
  - `sharingContractId` - `string`: contract address of `Shared` or `MultiShared` contract

- `sharingId` - `string` (optional): id in a `MultiShared` contract and only used for them, defaults to `null`

Returns

`Promise` returns `CryptoInfo`: crypto info built out of input arguments

Example

```
const keyContext = 'my key 15';
const cryptoInfo = await encryptionWrapper.getCryptoInfo(
  keyContext,
  EncryptionWrapperKeyType.Profile,
  EncryptionWrapperCryptorType.Content,
);
console.dir(cryptoInfo);
// Output:
// { algorithm: 'aes-256-cbc',
// block: 198543,
// originator: 'profile:my key 15' }
```

7.1.4 = Key Handling =

7.1.5 generateKey

```
encryptionWrapper.generateKey(cryptoInfo);
```

Generates a new encryption key. Crypto algorithm in `cryptoInfo` is used to decide on which `Cryptor` to pick for this.

Parameters

1. `cryptoInfo` - `CryptoInfo`: details for encryption, can be created with *getCryptoInfo*

Returns

`Promise` returns `any`: key to encrypt/decrypt data

Example

```
const key = await encryptionWrapper.generateKey(cryptoInfo);
console.dir(key);
// Output:
// 'd387d41011a2f04f18930e982ad30c537d29bc12588164cb978d0f70a5d11b3f'
```

7.1.6 storeKey

```
encryptionWrapper.storeKey(cryptoInf[, artifacts]);
```

Store key in respective storage location, depending on given cryptoInfo, additional information may be required, which can be given via `artifacts`.

Parameters

1. `cryptoInfo` - `CryptoInfo`: details for encryption, can be created with *getCryptoInfo*
2. `key` - `any`: key to store
3. `artifacts` - `any`: (optional) additional information for encryption may be required, depends on `cryptoInfo.originator`, see section below for details

artifacts

Depending on `cryptoInfo.originator` different properties are required. `artifacts` can be omitted, if used `cryptoInfo.originator` schema is not listed below. Note, that `cryptoInfo.originator` schema depends on with which `EncryptionWrapperKeyType` *getCryptoInfo* was called.

- **`sharing:.*:`**
  - `accountId` - `string`: accountId, that is used to share keys from, executes the internal transaction
  - `receiver` - `string` (optional): accountId, that receives the key, defaults to `accountId`

Returns

`Promise` returns `void`: resolved when done

Example

```
const key = await encryptionWrapper.generateKey(cryptoInfo);
await encryptionWrapper.storeKey(cryptoInfo, key);
```

7.1.7 getKey

```
encryptionWrapper.getKey(cryptoInf[, artifacts]);
```

Get key for given `cryptoInfo`. Can when storing keys in custom storage locations.

Parameters

1. `cryptoInfo` - `CryptoInfo`: details for encryption, can be created with *getCryptoInfo*
2. `artifacts` - `any`: (optional) additional information for encryption may be required, depends on `cryptoInfo.originator`, see section below for details

artifacts

Depending on `cryptoInfo.originator` different properties are required. `artifacts` can be omitted, if used `cryptoInfo.originator` schema is not listed below. Note, that `cryptoInfo.originator` schema depends on with which `EncryptionWrapperKeyType` *getCryptoInfo* was called.

- `sharing:.*`:
  - `accountId - string`: accountId, that accesses data, is used to get shared keys with
  - `propertyName - string` (optional): property, that is decrypted, defaults to `'*'`
- `custom:.*`:
  - `key - string`: accountId, that accesses data, is used to get shared keys with

Returns

`Promise` returns `void`: resolved when done

Example

```
const keyContext = 'my key 15';
const cryptoInfo = await encryptionWrapper.getCryptoInfo(
  keyContext,
  EncryptionWrapperKeyType.Profile,
  EncryptionWrapperCryptorType.Content,
);
console.dir(await encryptionWrapper.getKey(cryptoInfo));
// Output:
// '08bca9594ebaa7812f030f299fa30b51c5a7c3e7b2b66cd0a18c5cf46314aab7'
```

7.1.8 = Encryption =

7.1.9 encrypt

```
encryptionHandler.encrypt(toEncrypt, cryptoInfo[, artifacts]);
```

Encrypt given object, depending on given `cryptoInfo`, additional information may be required, which can be given via `artifacts`

Parameters

1. `toEncrypt - any`: object to encrypt
2. `cryptoInfo - CryptoInfo`: details for encryption, can be created with `getCryptoInfos`
3. `artifacts - any`: (optional) additional information for encryption may be required, depends on `cryptoInfo.originator`, see section below for details

artifacts

Depending on `cryptoInfo.originator` different properties are required. `artifacts` can be omitted, if used `cryptoInfo.originator` schema is not listed below. Note, that `cryptoInfo.originator` schema depends on with which `EncryptionWrapperKeyType` *getCryptoInfo* was called.

- `sharing:.*`:
  - `accountId - string`: accountId, that accesses data, is used to get shared keys with
  - `propertyName - string` (optional): property, that is encrypted, defaults to `'*'`
- `custom:.*`:
  - `key - string`: accountId, that accesses data, is used to get shared keys with

Returns

`Promise` returns `Envelope`: envelope with encrypted data

Example

```
const sampleData = {
  foo: TestUtils.getRandomBytes32(),
  bar: Math.random(),
};
const keyContext = 'my key 15';
const cryptoInfo = await encryptionWrapper.getCryptoInfo(
  keyContext,
  EncryptionWrapperKeyType.Profile,
  EncryptionWrapperCryptorType.Content,
);
const encrypted = await encryptionWrapper.encrypt(sampleData, cryptoInfo);
// Output:
// { private:
//
↪'ec6a2e0401e6270c50a88db31d0a22b677516162925a87bb7ec11a80613275817b883e75ee4bc8f82fe681d3462cf8ad4
↪',
//   cryptoInfo:
//    { algorithm: 'aes-256-cbc',
//      block: 198573,
//      originator:
//       'profile:0xb1c492ee6085679497c73008100c3b3136a75a8519c2a0016fec686a05f1c7f0'␣
↪} }
```

7.1.10 decrypt

```
encryptionHandler.decrypt(toDecrypt[, artifacts]);
```

Decrypt given `Envelope`.

Parameters

1. `toDecrypt` - `any`: encrypted envelop
2. `artifacts` - `any`: (optional) additional information for decrypting

artifacts

Depending on `cryptoInfo.originator` different properties are required. `artifacts` can be omitted, if used `cryptoInfo.originator` schema is not listed below. Note, that `cryptoInfo.originator` schema depends on with which `EncryptionWrapperKeyType` *getCryptoInfo* was called.

- `sharing:.*`:
  - `accountId` - `string`: accountId, that accesses data, is used to get shared keys with
  - `propertyName` - `string` (optional): property, that is decrypted, defaults to `'*'`
- **`custom:.*`:**
  - `key` - `string`: accountId, that accesses data, is used to get shared keys with

Returns

`Promise` returns `Envelope`: envelope with encrypted data

Example

```
const sampleData = {
  foo: TestUtils.getRandomBytes32(),
  bar: Math.random(),
};
const keyContext = 'my key 15';
const cryptoInfo = await encryptionWrapper.getCryptoInfo(
  keyContext,
  EncryptionWrapperKeyType.Profile,
  EncryptionWrapperCryptorType.Content,
);
const encrypted = await encryptionWrapper.encrypt(sampleData, cryptoInfo);
const decrypted = await encryptionWrapper.decrypt(encrypted);
console.dir(decrypt);
// Output:
// { foo:
//  '0x746dccef8a185d9e34a2778af51e8ee7e513e4035f7a5e2c2d122904a21f32e6',
// bar: 0.618861426409717 }
```

7.1.11 Additional Components

7.1.12 Enums

DigitalTwinEntryType

- `Content`: content encryption is used for generic data (strings, in memory objects)

- `File`: file encryption is used for binary file data
- `Unencrypted`: unencrypted data encryption can be used to embed unencrypted data in encryption containers

EncryptionWrapperKeyType

- `Custom`: custom key handling means that the key is handled elsewhere and has to be given to profile
- `Profile`: key is stored in profile, usually in property "encryptionKeys"
- `Sharing`: key is stored in Shared or MultiShared contract

7.2 Key Provider

Class Name	KeyProvider
Implements	KeyProviderInterface
Extends	Logger
Source	key-provider.ts

The KeyProvider returns given decryption/encryption keys for a given CryptoInfo. They use a given evan.network profile to retrieve the needed keys to encrypt/decrypt the envelope

---

7.2.1 constructor

```
new KeyProvider(options);
```

Creates a new KeyProvider instance.

Parameters

1. **`options` - `KeyProviderOptions`: options for KeyProvider constructor.**
    - `keys` - `any` (optional): object with key mappings of accounts
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`KeyProvider` instance

Example

```
const keyProvider = new KeyProvider({
    keys: {
      '0x123': 'abcdeF9043'
    }
  });
```

7.2.2 init

```
keyProvider.init(_profile);
```

initialize a new KeyProvider with a given evan.network Profile

Parameters

1. `_profile` - `Profile`: initialized evan.network profile

Example

```
runtime.keyProvider.init(runtime.profile);
```

7.2.3 getKey

```
keyProvider.getKey(info);
```

get a encryption/decryption key for a specific CryptoInfo from the associated AccountStore or the loaded evan.network profile

Parameters

1. `cryptoAlgo` - `string`: crypto algorithm

Returns

Promise resolves to `string`: the found key for the cryptoinfo.

Example

```
const cryptoInfo = {
  "public": {
    "name": "envelope example"
  },
  "private": "...",
  "cryptoInfo": {
```

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```
    "algorithm": "unencrypted",
    "keyLength": 256,
    "originator": "0x0000000000000000000000000000000000000001,
↪0x0000000000000000000000000000000000000002",
    "block": 123
  }
};
const key = runtime.keyProvider.getKey(info);
```

7.3 Crypto Provider

Class Name	CryptoProvider
Extends	CryptoProvider
Source	crypto-provider.ts

The CryptoProvider is a container for supported *Cryptors* and is able to determine, which *Cryptor* to use for encryption / decryption.

7.3.1 constructor

```
new CryptoProvider(cryptors);
```

Creates a new CryptoProvider instance.

Parameters

1. `cryptors` - `any`: object with available `Cryptors`.

Returns

`CryptoProvider` instance

Example

```
const serviceContract = new CryptoProvider({
    cryptors: {
      aes: new Aes(),
      unencrypted: new Unencrypted()
    }
  });
```

7.3.2 getCryptorByCryptoAlgo

```
cryptoProvider.getCryptorByCryptoAlgo(cryptoAlgo);
```

get a Cryptor matching the crypto algorithm

Parameters

1. `cryptoAlgo` - `string`: crypto algorithm

Returns

`Cryptor`: matching cryptor.

Example

```
const cryptor = runtime.cryptoProvider.getCryptorByCryptoAlgo('aes');
```

7.3.3 getCryptorByCryptoInfo

```
cryptoProvider.getCryptorByCryptoInfo(info);
```

get a Cryptor matching the provided CryptoInfo

Parameters

1. `info` - `CryptoInfo`: details about en-/decryption

Returns

`Cryptor`: matching cryptor.

Example

```
const cryptoInfo = {
  "public": {
    "name": "envelope example"
  },
  "private": "...",
  "cryptoInfo": {
    "algorithm": "unencrypted",
    "keyLength": 256,
    "originator": "0x0000000000000000000000000000000000000001,
↪0x0000000000000000000000000000000000000002",
    "block": 123
  }
```

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```
};
const cryptor = runtime.cryptoProvider.getCryptorByCryptoInfo(cryptoInfo);
```

7.3.4 = Additional Components =

7.3.5 Interfaces

Cryptor

1. `options` - `any`: options which will passed to the cryptor to work (like key for encryption)
2. `generateKey` - `function`: generates a random key for encryption/decryption
3. `getCryptoInfo` - `function`: returns a empty CryptoInfo object for the current Cryptor
4. `encrypt` - `function`: function to encrypt a given message
5. `decrypt` - `function`: function to decrypt a given message

Envelope

1. `algorithm` - `string`: algorithm used for encryption
2. `block` - `number` (optional): block number for which related item is encrypted
3. `cryptorVersion` - `number` (optional): version of the cryptor used. describes the implementation applied during decryption and not the algorithm version.
4. `originator` - `string` (optional): context for encryption, this can be
   - a context known to all parties (e.g. key exchange)
   - a key exchanged between two accounts (e.g. bmails)
   - a key from a sharings info from a contract (e.g. DataContract)

   defaults to 0
5. `keyLength` - `number` (optional): length of the key used in encryption

CryptoInfo

1. `public` - `any` (optional): unencrypted part of the data; will stay as is during encryption
2. `private` - `any` (optional): encrypted part of the data. If encrypting, this part will be encrypted, depending on the encryption. If already encrypted, this will be the encrypted value
3. `cryptoInfo` - `CryptoInfo`: describes used encryption

7.4 Cryptor - AES CBC

Class Name	Aes
Implements	Cryptor
Extends	Logger
Source	aes.ts
Examples	aes.spec.ts

The AES cryptor encodes and decodes content with aes-cbc.

7.4.1 constructor

```
new Aes(options);
```

Creates a new Aes instance.

Parameters

1. **`options` - `AesOptions`: options for Aes constructor.**
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Aes` instance

Example

```
const aes = new Aes();
```

7.4.2 getCryptoInfo

```
cryptor.getCryptoInfo(originator);
```

create new crypto info for this cryptor

Parameters

1. `originator` - `string`: originator or context of the encryption

Returns

`CryptoInfo`: details about encryption for originator with this cryptor.

Example

```
const cryptor = new Aes();
const cryptoInfo = cryptor.getCryptoInfo('0x123');
```

7.4.3 generateKey

```
cryptor.generateKey();
```

generate key for cryptor/decryption

Returns

Promise resolves to `string`: key used for encryption.

Example

```
const cryptor = new Aes();
const cryptoInfo = cryptor.generateKey();
```

7.4.4 encrypt

```
cryptor.encrypt(message, options);
```

'encrypt' a message (serializes message)

Parameters

1. `message` - `string`: message which should be encrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `string`: encrypted message.

Example

```
const cryptor = new Aes();
const cryptoInfo = cryptor.encrypt('Hello World', { key: '0x12345' });
```

7.4.5 decrypt

```
cryptor.decrypt(message, options);
```

'decrypt' a message (deserializes message)

Parameters

1. `message` - `Buffer`: message which should be decrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `any`: decrypted message.

Example

```
const cryptor = new Aes();
const cryptoInfo = cryptor.decrypt('afeweq41f1e61e3f', { key: '0x12345' });
```

7.5 Cryptor - AES ECB

Class Name	AesEcb
Implements	Cryptor
Extends	Logger
Source	aes-ecb.ts
Examples	aes-ecb.spec.ts

The AES ECB cryptor encodes and decodes content with aes-ecb.

7.5.1 constructor

```
new AesEcb(options);
```

Creates a new AesEcb instance.

Parameters

1. **`options` - `AesEcbOptions`: options for AesEcb constructor.**
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`AesEcb` instance

Example

```
const aesEcb = new AesEcb();
```

7.5.2 getCryptoInfo

```
cryptor.getCryptoInfo(originator);
```

create new crypto info for this cryptor

Parameters

1. `originator` - `string`: originator or context of the encryption

Returns

`CryptoInfo`: details about encryption for originator with this cryptor.

Example

```
const cryptor = new AesEcb();
const cryptoInfo = cryptor.getCryptoInfo('0x123');
```

7.5.3 generateKey

```
cryptor.generateKey();
```

generate key for cryptor/decryption

Returns

Promise resolves to `string`: key used for encryption.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.generateKey();
```

7.5.4 encrypt

```
cryptor.encrypt(message, options);
```

'encrypt' a message (serializes message)

Parameters

1. `message` - `string`: message which should be encrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `string`: encrypted message.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.encrypt('Hello World', { key: '0x12345' });
```

7.5.5 decrypt

```
cryptor.decrypt(message, options);
```

'decrypt' a message (deserializes message)

Parameters

1. `message` - `Buffer`: message which should be decrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `any`: decrypted message.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.decrypt('afeweq41f1e61e3f', { key: '0x12345' });
```

7.6 Cryptor - AES Blob

Class Name	AesBlob
Implements	Cryptor
Extends	Logger
Source	aes-blob.ts
Examples	aes-blob.spec.ts

The AES Blob cryptor encodes and decodes content with aes-cbc.

7.6.1 constructor

```
new AesBlob(options);
```

Creates a new AesBlob instance.

Parameters

1. **`options` - `AesBlobOptions`: options for AesBlob constructor.**
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`AesBlob` instance

Example

```
const aesBlob = new AesBlob({
    dfs
  });
```

7.6.2 getCryptoInfo

```
cryptor.getCryptoInfo(originator);
```

create new crypto info for this cryptor

Parameters

1. `originator` - `string`: originator or context of the encryption

Returns

`CryptoInfo`: details about encryption for originator with this cryptor.

Example

```
const cryptor = new AesBlob();
const cryptoInfo = cryptor.getCryptoInfo('0x123');
```

7.6.3 generateKey

```
cryptor.generateKey();
```

generate key for cryptor/decryption

Returns

Promise resolves to `string`: key used for encryption.

Example

```
const cryptor = new AesBlob();
const cryptoInfo = cryptor.generateKey();
```

7.6.4 encrypt

```
cryptor.encrypt(message, options);
```

'encrypt' a message (serializes message)

Parameters

1. `message` - `string`: message which should be encrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `string`: encrypted message.

Example

```
const cryptor = new AesBlob();
const cryptoInfo = cryptor.encrypt('Hello World', { key: '0x12345' });
```

7.6.5 decrypt

```
cryptor.decrypt(message, options);
```

'decrypt' a message (deserializes message)

Parameters

1. `message` - `Buffer`: message which should be decrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `any`: decrypted message.

Example

```
const cryptor = new AesBlob();
const cryptoInfo = cryptor.decrypt('afeweq41f1e61e3f', { key: '0x12345' });
```

7.7 Cryptor - Unencrypted

Class Name	Unencrypted
Implements	Cryptor
Extends	Logger
Source	unencrypted.ts

The Unencrypted cryptor encodes and decodes content "unencrypted" this means no encryption is applied to the content. So simply the content is public, only HEX encoded.

7.7.1 constructor

```
new Unencrypted(options);
```

Creates a new Unencrypted instance.

Parameters

1. **`options` - `UnencryptedOptions`: options for Unencrypted constructor.**
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Unencrypted` instance

Example

```
const unencrypted = new Unencrypted();
```

7.7.2 getCryptoInfo

```
cryptor.getCryptoInfo(originator);
```

create new crypto info for this cryptor

Parameters

1. `originator` - `string`: originator or context of the encryption

Returns

`CryptoInfo`: details about encryption for originator with this cryptor.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.getCryptoInfo('0x123');
```

7.7.3 generateKey

```
cryptor.generateKey();
```

generate key for cryptor/decryption

Returns

Promise resolves to `string`: key used for encryption.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.generateKey();
```

7.7.4 encrypt

```
cryptor.encrypt(message, options);
```

'encrypt' a message (serializes message)

Parameters

1. `message` - `string`: message which should be encrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `string`: encrypted message.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.encrypt('Hello World', { key: '0x12345' });
```

7.7.5 decrypt

```
cryptor.decrypt(message, options);
```

'decrypt' a message (deserializes message)

Parameters

1. `message` - `Buffer`: message which should be decrypted
2. **`options` - `any`: cryptor options**
    - `key` - `string`: key used for encryption

Returns

Promise resolves to `any`: decrypted message.

Example

```
const cryptor = new Unencrypted();
const cryptoInfo = cryptor.decrypt('afeweq41f1e61e3f', { key: '0x12345' });
```

To allow extended data security, contents added to DFS can be encrypted before storing them and decrypted before reading them. To allow this encryption support has been added to the library.

Data is encrypted and stored in so called "Envelopes", which act as container for the data itself and contain enough information for the API to determine which key to use for decryption and where to retrieve the key from. If you were wondering why the *descriptions* had the property *public*, this is the right section for you.

```
{
  "public": {
    "name": "envelope example"
  },
  "private": "...",
  "cryptoInfo": {
    "algorithm": "unencrypted",
    "keyLength": 256,
    "originator": "0x0000000000000000000000000000000000000001,
↪0x0000000000000000000000000000000000000002",
    "block": 123
  }
}
```

The “public” section contains data, that is visible without any knowledge of the encryption key. The “private” section can only be decrypted if the user that tries to read the data has access to the encryption key. The *cryptoInfo* part is used to determine which decryption algorithm to use and where to look for it.

When decrypted, the *private* section takes precedence over the *public* section. This can lead to the private section overwriting sections of the *public* part. For example a public title may be replace with a “true” title (only visible for a group of people) from the private section.

CHAPTER 8

Profile

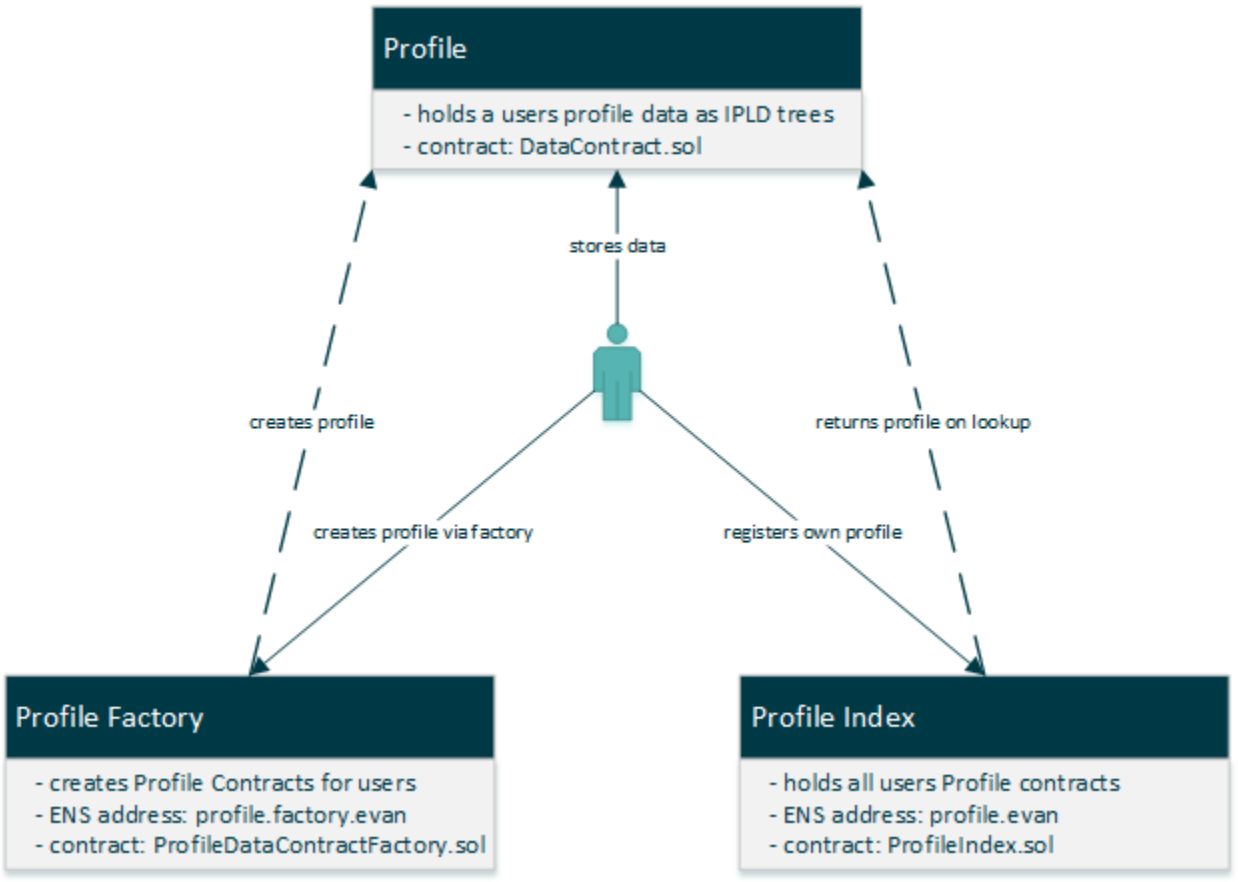
8.1 Profile

Class Name	Profile
Extends	Logger
Source	profile.ts
Examples	profile.spec.ts

A users profile is its personal storage for - contacts - encryption keys exchanged with contacts - an own public key for exchanging keys with new contacts - bookmarked ĐAPPs - created contracts

This data is stored as an IPLD Graphs per type and stored in a users profile contract. These graphs are independant from each other and have to be saved separately.

This contract is a DataContract and can be created via the factory at *profile.factory.evan* and looked up at the global profile index *profile.evan*. The creation process and landmap looks like this:



8.1.1 Basic Usage

```
// the bookmark we want to store
const sampleDesc = {
  title: 'sampleTest',
  description: 'desc',
  img: 'img',
  primaryColor: '#FFFFFF',
};

// create new profile, set private key and keyexchange partial key
await profile.createProfile(keyExchange.getDiffieHellmanKeys());

// add a bookmark
await profile.addDappBookmark('sample1.test', sampleDesc);

// store tree to contract
await profile.storeForAccount(profile.treeLabels.bookmarkedDapps);
```

8.1.2 constructor

```
new Profile(options);
```

Creates a new Profile instance.

Parameters

1. **`options` - `ProfileOptions`: options for Profile constructor**
    - `accountId` - `string`: account, that is the profile owner
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `dataContract` - `DataContract`: `DataContract` instance
    - `executor` - `Executor`: `Executor` instance
    - `ipld` - `Ipld`: `Ipld` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `defaultCryptoAlgo` - `string` (optional): crypto algorith name from `CryptoProvider`, defaults to `aes`
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
    - `trees` - `object` (optional): precached profile data, defaults to `{}`

Returns

`Profile` instance

Example

```
const profile = new Profile({
  accountId: accounts[0],
  contractLoader,
  dataContract,
  executor,
  ipld,
  nameResolver,
});
```

8.1.3 createProfile

```
profile.createProfile(keys)
```

Create new profile, store it to profile index initialize addressBook and publicKey.

Parameters

1. **`keys` - `any`: diffie hell man keys for account, created by `KeyExchange`**
    - `privateKey` - `Buffer`: private key for key exchange
    - `publicKey` - `Buffer`: combination of shared secret and own private key

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.createProfile(keyExchange.getDiffieHellmanKeys());
```

8.1.4 checkCorrectProfileData

```
profile.checkCorrectProfileData();
```

Check if profile data is correct, according to a specific profile type. Throws, when the data is invalid.

Parameters

1. `data` - `object`: profile data (accountDetails, registration, contact, ...) (see setProfileProperties for example values)
2. `type` - `string`: profileType (user, company, device)

Returns

`Promise` returns `void`: true if a contract was registered, false if not

Example

```
console.log(await Profile.checkCorrectProfileData({
  "accountDetails": {
    "accountName": "Test",
    "profileType": "company"
  },
  "registration": {
    "company": "Company Name",
    "court": "register court1",
    "register": "hrb",
    "registerNumber": "Registration Number",
    "salesTaxID": "tax id"
  },
  "contact": {
    "country": "DE",
```

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```
    "city": "City",
    "postalCode": "12345",
    "streetAndNumber": "street",
    "website": "https://evan.network"
  }
}, 'company'));
// Output:
// true
```

8.1.5 exists

```
profile.exists();
```

Check if a profile has been stored for current account.

Parameters

1. `options` - `object`: The options used for calling

Returns

`Promise` returns `void`: true if a contract was registered, false if not

Example

```
console.log(await profile.exists());
// Output:
// true
```

8.1.6 getContactKnownState

```
profile.getContactKnownState(accountId);
```

Check, known state for given account.

Parameters

1. `accountId` - `string`: account id of a contact

Returns

`Promise` returns `void`: true if known account

Example

```
  console.log(await profile.getContactKnownState(accountId));
// Output:
// true
```

8.1.7 getProfileProperty

```
profile.getProfileProperty(property);
```

Return the saved profile information according to the specified profile type. No type directly uses "user" type.

Parameters

1. `property` - `string`: Restrict properties that should be loaded.

Returns

`Promise` returns `void`: true if known account

Example

```
  console.log(await profile.getProfileProperty('accountDetails'));
// Output:
// {
//     "accountName": "Test",
//     "profileType": "company"
// }
```

8.1.8 setContactKnownState

```
profile.setContactKnownState(contactAddress, contactKnown);
```

Store given state for this account.

Parameters

1. `contactAddress` - `string`: contact identity or account
2. `contactKnown` - `boolean`: true if known, false if not

Returns

`Promise` returns `void`: resolved when done

Example

```
// mark contact1 as a known contact
profile.setContactKnownState(contact1, true);
```

8.1.9 setProfileProperties

```
profile.setProfileProperties(payload);
```

Takes a set of profile properties and saves them into the profile DataContainer. Throws errors, if not the correct properties are applied for the specified account type.

Parameters

1. `payload` - `any`: Object that should saved. Each entry will be saved as seperated entry.

Returns

`Promise` returns `void`: resolved when done

Example

```
// mark accountId as a known contact
profile.setProfileProperties({
  "accountDetails": {
    "accountName": "Test",
    "profileType": "company"
  },
  "registration": {
    "company": "Company Name",
    "court": "register court1",
    "register": "hrb",
    "registerNumber": "Registration Number",
    "salesTaxID": "tax id"
  },
  "contact": {
    "country": "DE",
    "city": "Cirty",
    "postalCode": "12345",
    "streetAndNumber": "street",
    "website": "https://evan.network"
  }
});
```

8.1.10 loadForAccount

```
profile.loadForAccount([tree]);
```

Load profile for given account from global profile contract, if a tree is given, load that tree from ipld as well.

Parameters

1. `tree` - `string` (optional): tree to load ('bookmarkedDapps', 'contracts', ...), profile.treeLabels properties can be passed as arguments

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.loadForAccount(profile.treeLabels.contracts);
```

8.1.11 storeForAccount

```
profile.storeForAccount(tree);
```

Stores profile tree or given hash to global profile contract.

Parameters

1. `tree` - `string`: tree to store ('bookmarkedDapps', 'contracts', ...)
2. `ipldHash` - `string` (optional): store this hash instead of the current tree for the profile's identity or account

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.storeForAccount(profile.treeLabels.contracts);
```

8.1.12 loadFromIpld

```
profile.loadFromIpld(tree, ipldIpfsHash);
```

Load profile from ipfs via ipld dag via ipfs file hash.

Parameters

1. `tree` - `string`: tree to load ('bookmarkedDapps', 'contracts', ...)
2. `ipldIpfsHash` - `string`: ipfs file hash that points to a file with ipld a hash

Returns

`Promise` returns `Profile`: this profile

Example

```
await profile.loadFromIpld(profile.treeLabels.contracts, ipldIpfsHash);
```

8.1.13 storeToIpld

```
profile.storeToIpld(tree);
```

Store profile in ipfs as an ipfs file that points to a ipld dag.

Parameters

1. `tree` - `string`: tree to store ('bookmarkedDapps', 'contracts', ...)

Returns

`Promise` returns `string`: hash of the ipfs file

Example

```
const storedHash = await profile.storeToIpld(profile.treeLabels.contracts);
```

8.1.14 = addressBook =

8.1.15 addContactKey

```
profile.addContactKey(address, context, key);
```

Add a key for a contact to bookmarks.

Parameters

1. `address` - `string`: account key of the contact
2. `context` - `string`: store key for this context, can be a contract, bc, etc.
3. `key` - `string`: communication key to store

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.addContactKey(accounts[0], 'context a', 'key 0x01_a');
```

8.1.16 addProfileKey

```
profile.addProfileKey(address, key, value);
```

Add a profile value to an account.

Parameters

1. `address` - `string`: account key of the contact
2. `key` - `string`: store key for the account like alias, etc.
3. `value` - `string`: value of the profile key

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.addProfileKey(accounts[0], 'email', 'sample@example.org');
await profile.addProfileKey(accounts[0], 'alias', 'Sample Example');
```

8.1.17 setIdentityAccess

```
profile.setIdentityAccess(address, key);
```

Add identity key to address book, so a *getRuntimeForIdentity* can be used without specifying the encryptionKey in the keyConfig.

Parameters

1. `address` - `string`: identity address
2. `key` - `string`: identity datakey

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.setIdentityAccess(identities[0], 'key 0x01_b');
```

8.1.18 removeIdentityAccess

```
profile.removeIdentityAccess(address);
```

Remove identity key from address book

Parameters

1. `address` - `string`: identity address to be removed

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.removeIdentityAccess(identities[0]);
```

8.1.19 getIdentityAccessList

```
profile.getIdentityAccessList();
```

Function description

Gets a list of identities, where the profile identity has access to, from address book. Keep in mind address book needs to be loaded beforehand using the loadForAccount API. The result will be an object containing identity addresses mapped to their encryption keys and sha3 addresses mapped to their identity address. Those identity addresses which have an alias will also return the alias.

Parameters

(none)

Returns

`any`: identity list from address loaded book

Example

```
// load address book
await profile.loadForAccount(profile.treeLabels.addressBook);
// identities[0] does not have an alias, adding identity to address book
await profile.setIdentityAccess(identities[0], 'key 0x01_a');
// identities[1] has an alias, adding identity to address book
await profile.setIdentityAccess(identities[1], 'key 0x01_b');
// get list of identities
await profile.getIdentityAccessList();

Output:
{
'sha3(identities[1])': { identityAccess: 'key 0x01_b', alias: 'test account' },
'sha3(identities[0])': { identityAccess: 'key 0x01_a' },
'identities[1]': { identityAccess: 'key 0x01_b', alias: 'test account' }
}
```

8.1.20 getAddressBookAddress

```
profile.getAddressBookAddress(address);
```

Function description

Parameters

1. `address` - `string`: contact address

Returns

`Promise` returns `any`: bookmark info

Example

```
await profile.getAddressBookAddress(accounts[0]);
```

8.1.21 getAddressBook

```
profile.getAddressBook();
```

Get the whole addressBook.

Parameters

(none)

Returns

`any`: entire address book

Example

```
await profile.getAddressBook();
```

8.1.22 getContactKey

```
profile.getContactKey(address, context);
```

Get a communication key for a contact from bookmarks.

Parameters

1. `address` - `string`: account key of the contact
2. `context` - `string`: store key for this context, can be a contract, bc, etc.

Returns

`Promise` returns `void`: matching key

Example

```
await profile.getContactKey(accounts[0], 'exampleContext');
```

8.1.23 getProfileKey

```
profile.getProfileKey(address, key);
```

Get a key from an address in the address book.

Parameters

1. `address` - `string`: address to look up
2. `key` - `string`: type of key to get

Returns

`Promise` returns `any`: key

Example

```
const alias = await profile.getProfileKey(accountId, 'alias');
```

8.1.24 removeContact

```
profile.removeContact(address);
```

Remove a contact from bookmarkedDapps.

Parameters

1. `address` - `string`: identity or account of the contact

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.removeContact(address);
```

8.1.25 = bookmarkedDapps =

8.1.26 addDappBookmark

```
profile.addDappBookmark(address, description);
```

Add a bookmark for a dapp.

Parameters

1. `address` - `string`: ENS name or contract address (if no ENS name is set)
2. `description` - `DappBookmark`: description for bookmark

Returns

`Promise` returns `void`: resolved when done

Example

```
const bookmark = {
  "name": "taskboard",
  "description": "Create todos and manage updates.",
  "i18n": {
    "description": {
      "de": "Erstelle Aufgaben und überwache Änderungen",
      "en": "Create todos and manage updates"
    },
    "name": {
      "de": "Task Board",
      "en": "Task Board"
    }
  },
  "imgSquare": "...",
  "standalone": true,
  "primaryColor": "#e87e23",
  "secondaryColor": "#fffaf5",
};
await profile.addDappBookmark('sampletaskboard.evan', bookmark);
```

8.1.27 getDappBookmark

```
profile.getDappBookmark(address);
```

Get a bookmark for a given address if any.

Parameters

1. `address` - `string`: ENS name or contract address (if no ENS name is set)

Returns

`Promise` returns `any`: bookmark info

Example

```
await profile.getDappBookmark('sample1.evan');
```

8.1.28 getBookmarkDefinition

```
profile.getBookmarkDefinition();
```

Get all bookmarks for profile.

Parameters

(none)

Returns

`Promise` returns `any`: all bookmarks for profile

Example

```
await profile.getBookmarkDefinitions();
```

8.1.29 removeDappBookmark

```
profile.removeDappBookmark(address);
```

Remove a dapp bookmark from the bookmarkedDapps.

Parameters

1. `address` - `string`: address of the bookmark to remove

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.removeDappBookmark(address);
```

8.1.30 setDappBookmarks

```
profile.setDappBookmarks(bookmarks);
```

Set bookmarks with given value.

Parameters

1. `bookmarks` - `any`: The options used for calling

Returns

`Promise` returns `void`: resolved when done

Example

```
const bookmarks = await profile.getBookmarkDefinitions();
// update bookmarks
// ...
await profile.setDappBookmarks(bookmarks);
```

8.1.31 = contracts =

8.1.32 addContract

```
profile.addContract(address, data);
```

Add a contract to the current profile.

Parameters

1. `address` - `string`: contract address
2. `data` - `any`: bookmark metadata

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.addContract('0x...', contractDescription);
```

8.1.33 getContracts

```
profile.getContracts();
```

Get all contracts for the current profile.

Parameters

(none)

Returns

`Promise` returns `any`: contracts info

Example

```
await profile.getContracts();
```

8.1.34 getContract

```
profile.getContract(address);
```

Get a specific contract entry for a given address.

Parameters

1. `address` - `string`: contact address

Returns

`Promise` returns `any`: bookmark info

Example

```
await profile.getContract('testbc.evan');
```

8.1.35 addBcContract

```
profile.addBcContract(bc, address, data)
```

Add a contract (task contract etc.) to a business center scope of the current profile

Parameters

1. `bc` - `string`: business center ens address or contract address
2. `address` - `string`: contact address
3. `data` - `any`: bookmark metadata

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.addBcContract('testbc.evan', '0x...', contractDescription);
```

8.1.36 getBcContract

```
profile.getBcContract(bc, address);
```

Get a specific contract entry for a given address.

Parameters

1. `bcc` - `string`: business center ens address or contract address
2. `address` - `string`: contact address

Returns

`Promise` returns `any`: bookmark info

Example

```
await profile.getBcContract('testbc.evan', '0x...');
```

8.1.37 getBcContracts

```
profile.getBcContracts(bc, address);
```

Get all contracts grouped under a business center.

Parameters

1. `bcc` - `string`: business center ens address or contract address

Returns

`Promise` returns `any`: bookmark info

Example

```
await profile.getBcContracts('testbc.evan');
```

8.1.38 removeContract

```
profile.removeBcContract(address, data);
```

removes a contract (task contract etc.) from a business center scope of the current profile

Parameters

1. `bc` - `string`: business center ens address or contract address
2. `address` - `any`: contact address

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.removeBcContract('testbc.evan', '0x');
```

8.1.39 = publicKey =

8.1.40 addPublicKey

```
profile.addPublicKey(key);
```

Add a key for a contact to bookmarks.

Parameters

1. `key` - `string`: public Diffie Hellman key part to store

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.addPublicKey('...');
```

8.1.41 getPublicKey

```
profile.getPublicKey();
```

Get public key of profiles.

Parameters

(none)

Returns

`Promise` returns `any`: public key

Example

```
const key = await profile.getPublicKey();
```

8.1.42 loadActiveVerifications

```
profile.loadActiveVerifications();
```

Load all verificationss that should be displayed for this profile within the ui.

Parameters

(none)

Returns

`Promise` returns `string[]`: array of topics of verificationss that should be displayed (e.g. ['/company/tuev', '/test/1234'])

Example

```
const topics = await bcc.profile.loadActiveVerifications();
```

8.1.43 setActiveVerifications

```
profile.setActiveVerifications(bookmarks);
```

Save an array of active verificationss to the profile.

Parameters

1. `bookmarks` - `string[]`: bookmarks to set

Returns

`Promise` returns `void`: resolved when saving is done

Example

```
await bcc.profile.setActiveVerifications([ '/company/tuev', '/test/1234' ]);
```

8.1.44 setPlugins

```
profile.setPlugins(plugins);
```

Save set of plugins to profile.

Parameters

1. `plugins` - `any`: entire collections of plugins to store in profile

Returns

`Promise` returns `void`: resolved when done

Example

```
await profile.setPlugins({ customMetadata: {} });
```

8.1.45 getPlugins

```
profile.getPlugins();
```

Get entire set of plugins from profile.

Returns

`Promise` returns `any`: all plugins from profile

Example

```
const plugins = await profile.getPlugins();
```

8.2 Business Center Profile

Class Name	BusinessCenterProfile
Extends	Logger
Source	business-center-profile.ts
Examples	business-center-profile.spec.ts

The `BusinessCenterProfile` module allows to create profiles in a business center.

These profiles are like business cards for specific contexts and can be used to share data like contact data or certificates under this business centers context.

8.2.1 Basic Usage

```
// update/set contact card locally
await profile.setContactCard(JSON.parse(JSON.stringify(sampleProfile)));

// store to business center
await profile.storeForBusinessCenter(businessCenterDomain, accounts[0]);

// load from business center
await profile.loadForBusinessCenter(businessCenterDomain, accounts[0]);
const loadedProfile = await profile.getContactCard();
```

8.2.2 constructor

```
new BusinessCenterProfile(options);
```

Creates a new BusinessCenterProfile instance.

Parameters

1. **`options` - `BusinessCenterProfileOptions`: options for BusinessCenterProfile constructor.**
    - `bcAddress` - `string`: ENS address (domain name) of the business center, the module instance is scoped to
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `defaultCryptoAlgo` - `string`: crypto algorith name from `CryptoProvider`
    - `ipld` - `Ipld`: `Ipld` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `ipldData` - `any` (optional): preloaded profile data
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`BusinessCenterProfile` instance

Example

```
const businessCenterProfile = new BusinessCenterProfile({
  ipld,
  nameResolver,
  defaultCryptoAlgo: 'aes',
  bcAddress: businessCenterDomain,
  cryptoProvider,
});;
```

8.2.3 setContactCard

```
businessCenterProfile.setContactCard();
```

Set contact card on current profile.

Parameters

1. `contactCard` - `any`: contact card to store

Returns

`Promise` returns `any`: updated tree

Example

```
const updated = await businessCenterProfile.setContactCard(contactCard);
```

8.2.4 getContactCard

```
businessCenterProfile.getContactCard();
```

Get contact card from.

Parameters

(none)

Returns

`Promise` returns `any`: contact card

Example

```
const loadedProfile = await businessCenterProfile.getContactCard();
```

8.2.5 storeForBusinessCenter

```
businessCenterProfile.storeForBusinessCenter(businessCenterDomain, identity);
```

Stores profile to business centers profile store.

Parameters

1. `businessCenerDomain` - `string`: ENS domain name of a business center
2. `executorAddress` - `string`: Identity or account making the transaction

Returns

`Promise` returns `void`: resolved when done

Example

```
await businessCenterProfile.setContactCard(contactCard);
await businessCenterProfile.storeForBusinessCenter(businessCenterDomain,␣
↪identities[0]);
```

8.2.6 loadForBusinessCenter

```
businessCenterProfile.loadForBusinessCenter(businessCenterDomain, identity);
```

Function description

Parameters

1. `businessCenerDomain` - `string`: ENS domain name of a business center
2. `executorAddress` - `string`: identity or account making the transaction

Returns

`Promise` returns `void`: resolved when done

Example

```
await newProfilebusinessCenterProfile.loadForBusinessCenter(businessCenterDomain,␣
↪identities[0]);
const contactCard = await businessCenterProfile.getContactCard();
```

8.2.7 storeToIpld

```
businessCenterProfile.storeToIpld();
```

Store profile in ipfs as an ipfs file that points to a ipld dag.

Parameters

(none)

Returns

`Promise` returns `string`: hash of the ipfs file

Example

```
await businessCenterProfile.storeToIpld();
```

8.2.8 loadFromIpld

```
businessCenterProfile.loadFromIpld(tree, ipldIpfsHash);
```

Load profile from ipfs via ipld dag via ipfs file hash.

Parameters

1. `ipldIpfsHash` - `string`: ipfs file hash that points to a file with ipld a hash

Returns

`Promise` returns `BusinessCenterProfile`: this profile

Example

```
businessCenterProfile.loadFromIpld(ipldIpfsHash);
```

8.2.9 getMyBusinessCenterContracts

```
businessCenterProfile.getMyBusinessCenterContracts(domain, contractType, subject);
```

Gets all registered contracts for a specific contract type on a businesscenter

Parameters

1. `businessCenterDomain` - `string`: The business center domain
2. `contractType` - `string`: The contract type
3. `subject` - `string`: Subject to get the contracts for

Returns

`Promise` returns `any`: Array with all registered bc contracts

Example

```
businessCenterProfile.loadFromIpld(ipldIpfsHash);
```

8.3 Onboarding

Class Name	Onboarding
Extends	Logger
Source	onboarding.ts
Examples	onboarding.spec.ts

The onboarding process is used to enable users to invite other users, where no blockchain account id is known. It allows to send an email to such contacts, that contains a link. This link points to a evan.network ĐApp, that allows accept the invitation by either creating a new account or by accepting it with an existing account.

It uses the Key Exchange module described in the last section for its underlying key exchange process but moves the process of creating a new communication key to the invited user.

To get in contact with a user via email, a smart agent is used. This smart agent has to be added as a contact and a regular key exchange with the smart agent is performed. The agent accepts the invitation automatically and the inviting user sends a bmail (blockchain mail) with the contact details of the user, that should be invited, and an amount of welcome EVEs to the smart agent.

The onboarding smart creates a session on his end and sends an email to the invited user, that includes the session token, with which the invited user can claim the welcome EVEs.

The invited user now creates or confirms an account and start the key exchange process on his or her end. The rest of the flow is as described in Key Exchange.

To start the process at from the inviting users side, make sure that this user has exchanged keys with the onboarding smart agent.

8.3.1 constructor

```
new Onboarding(options);
```

Creates a new Onboarding instance.

Parameters

1. **`options` - `OnboardingOptions`: options for Onboarding constructor**
    - `executor` - `Executor`: `Executor` instance
    - `mailbox` - `Mailbox`: `Mailbox` instance
    - `smartAgentId` - `string`: account id of onboarding smart agent
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Onboarding` instance

Example

```
const onboarding = new Onboarding({
  mailbox,
  smartAgentId: config.smartAgents.onboarding.accountId,
  executor,
});
```

8.3.2 sendInvitation

```
onboarding.sendInvitation(invitation, weiToSend);
```

Send invitation to another user via smart agent that sends a mail.

Parameters

1. `invitation` - `invitation`: mail that will be sent to invited person
2. `weiToSend` - `string`: amount of ETC to transfert to new member, can be created with web3.utils.toWei(10, 'ether') [web3 >=1.0] / web.toWei(10, 'ether') [web3 < 1.0]

Returns

`Promise` returns `void`: resolved when done

Example

```
await onboarding.sendInvitation({
  fromAlias: 'example inviter',
  to: 'example invitee <example.invitee@evan.network>',
  lang: 'en',
  subject: 'evan.network Onboarding Invitation',
  body: 'I\'d like to welcome you on board.',
}, web3.utils.toWei('1'));
```

8.3.3 createMnemonic

```
Onboarding.createMnemonic();
```

(static class function)

Generates a new random Mnemonic

Returns

`string`

Example

To show the difference, without purging:

```
const mnemnonic = Onboarding.createMnemnonic();
console.log(mnemnoic);
// prints out a random 12 word mnemnonic
```

8.3.4 createNewProfile

```
Onboarding.createNewProfile(mnemnonic, password, profileProperties);
```

(static class function)

Creates a new full blown profile on a given evan network (testcore/core) and returns the mnemonic, password and a configuration for the runtime initalization

Parameters

1. `mnemnonic` - `string`: 12 word mnemnonic as string
2. `password` - `string`: password of the new created profile
3. `profileProperties` - `any`: Properties for the profile to be created

Returns

`Promise` returns `any`: object with the mnemonic, password and the config object for the runtime

Example

```
const originRuntime = await TestUtils.getRuntime(accounts[0]);
const mnemonic = Onboarding.createMnemonic();
await Onboarding.createNewProfile(originRuntime, mnemonicNew, 'Test1234', {
    accountDetails: {
        profileType: 'company',
        accountName: 'test account'
    }});
```

8.4 Key Exchange

Class Name	KeyExchange
Extends	Logger
Source	keyExchange.ts
Examples	keyExchange.spec.ts

The `KeyExchange` module is used to exchange communication keys between two parties, assuming that both have created a profile and have a public facing partial Diffie Hellman key part (the combination of their own secret and the shared secret). The key exchange consists of three steps:

1. create a new communication key, that will be used by both parties for en- and decryption and store it on the initiators side
2. look up the other parties partial Diffie Hellman key part and combine it with the own private key to create the exchange key
3. use the exchange key to encrypt the communication key and send it via bmail (blockchain mail) to other party

---

8.4.1 Basic Usage

Starting the Key Exchange Process

This example retrieves public facing partial Diffie Hellman key part from a second party and sends an invitation mail to it:

```
// identity, that initiates the invitation
const identity1 = '0x0000000000000000000000000000000000000001';
// identity, that will receive the invitation
const identity2 = '0x0000000000000000000000000000000000000002';
// profile from user, that initiates key exchange
const profile1 = {};
await profile1.loadForAccount();
// profile from user, that is going to receive the invitation
const profile2 = {};
```

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```
await profile2.loadForAccount();
// key exchange instance for identity1
const keyExchange1 = {};
// key exchange instance for identity2
const keyExchange2 = {};

const foreignPubkey = await profile2.getPublicKey();
const commKey = await keyExchange1.generateCommKey();
await keyExchange1.sendInvite(identity2, foreignPubkey, commKey, {
  fromAlias: 'Bob',           // initiating user states, that his name is 'Bob'
});
await profile1.addContactKey(identity2, 'commKey', commKey);
await profile1.storeForAccount(profile1.treeLabels.addressBook);
```

Finishing the Key Exchange Process

Let's assume that the communication key from the last example has been successfully sent to the other party and continue at there end from here. To keep the roles from the last example, the variables profile1, profile2 will belong to the same identites:

```
const encryptedCommKey = '...';       // key sent by identity1
const profile1 = await profile1.getPublicKey();
const commSecret = keyExchange2.computeSecretKey(profile1);
const commKey = await keyExchange2.decryptCommKey(encryptedCommKey, commSecret.
↪toString('hex'));
```

8.4.2 constructor

```
new KeyExchange(options);
```

Creates a new KeyExchange instance.

Parameters

1. **`options` - `KeyExchangeOptions`: options for KeyExchange constructor.**
    - `account` - `string`: address of identity or account, that will perform actions
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `defaultCryptoAlgo` - `string`: default encryption algorithm
    - `keyProvider` - `KeyProviderInterface`: `KeyProviderInterface` instance
    - `mailbox` - `Mailbox`: `Mailbox` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

- `privateKey` - `object` (optional): private key for key exchange, if `privateKey` or `publicKey` is omitted, new keys are generated
- `publicKey` - `object` (optional): public key for key exchange, if `privateKey` or `publicKey` is omitted, new keys are generated

Returns

`KeyExchange` instance

Example

```
const keyExchange = new KeyExchange({
  mailbox,
  cryptoProvider,
  defaultCryptoAlgo: 'aes',
  account: identities[0],
  keyProvider,
});
```

8.4.3 computeSecretKey

```
keyExchange.computeSecretKey(partialKey);
```

Combines given partial key from another profile with own private key.

Parameters

1. `partialKey` - `string`: The options used for calling

Returns

`string` combined exchange key

Example

```
// encrypted communication key sent from identity 1 to identity 2
const encryptedKey = '...'
// (profile 1 belongs to identity 1, keyExchange 2 to identity 2)
const publicKeyProfile1 = await profile1.getPublicKey();
const commSecret = keyExchange2.computeSecretKey(publicKeyProfile1);
commKey = await keyExchange2.decryptCommKey(encryptedKey, commSecret.toString('hex'));
```

8.4.4 decryptCommKey

```
keyExchange.decryptCommKey(encryptedCommKey, exchangeKey);
```

Decrypts a given communication key with an exchange key.

Parameters

1. `encryptedCommKey` - `string`: encrypted communications key received from another identity or account
2. `exchangeKey` - `string`: Diffie Hellman exchange key from computeSecretKey

Returns

`Promise` returns `Buffer`: commKey as a buffer

Example

```
// encrypted communication key sent from identity 1 to identity 2
const encryptedKey = '...'
// (profile 1 belongs to identity 1, keyExchange 2 to identity 2)
const publicKeyProfile1 = await profile1.getPublicKey();
const commSecret = keyExchange2.computeSecretKey(publicKeyProfile1);
commKey = await keyExchange2.decryptCommKey(encryptedKey, commSecret.toString('hex'));
```

8.4.5 getDiffieHellmanKeys

```
keyExchange.getDiffieHellmanKeys();
```

Returns the public and private key from the diffieHellman.

Parameters

(void)

Returns

`Promise` returns `any`: object with public and private keys

Example

```
console.dir(await keyExchange.getDiffieHellmanKeys());
// Output:
// {
//   private: '...',
//   public: '...',
// }
```

8.4.6 generateCommKey

```
keyExchange.generateCommKey();
```

Generates a new communication key end returns the hex string.

Parameters

(none)

Returns

`Promise` returns `string`: comm key as string

Example

```
console.dir(await keyExchange.generateCommKey());
// Output:
// '1c967697c192235680efbb24b980981b4778c8058b5e0864f1471fc1d941499d'
```

8.4.7 getExchangeMail

```
keyExchange.getExchangeMail(from, mailContent[, encryptionCommKey]);
```

Creates a bmail for exchanging comm keys.

Parameters

1. `from` - `string`: sender identity or account
2. `mailContent` - `any`: bmail metadata
3. `encryptedCommKey` - `string` (optional): comm key, that should be exchanged

Returns

`Promise` returns `Mail`: mail for key exchange

Example

```
const commKey = '1c967697c192235680efbb24b980981b4778c8058b5e0864f1471fc1d941499d';
const mail = keyExchange.getExchangeMail(
  '0x0000000000000000000000000000000000000001',
  { fromAlias: 'user 1', fromMail: 'user1@example.com', title:'sample', body:'sample',
↪ }
);
console.log(mail);
```

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```
// Output:
// { content:
//    { from: '0x0000000000000000000000000000000000000001',
//      fromAlias: 'user 1',
//      fromMail: 'user1@example.com',
//      title: 'sample',
//      body: 'sample',
//      attachments: [ [Object] ] } }
```

8.4.8 sendInvite

```
keyExchange.sendInvite(receiver, receiverPublicKey, commKey, mailContent);
```

Sends a mailbox mail to the target with the partial key for the key exchange.

Parameters

1. `string` - `receiver`: receiver of the invitation
2. `string` - `receiverPublicKey`: public key of the receiver
3. `string` - `commKey`: communication key between sender and receiver
4. `any` - `mailContent`: mail to send

Returns

`Promise` returns `void`: resolved when done

Example

```
const foreignPubkey = await profile2.getPublicKey();
const commKey = await keyExchange1.generateCommKey();
await keyExchange1.sendInvite(identities[1], foreignPubkey, commKey, { fromAlias: 'Bob
↪', });
await profile.addContactKey(identities[1], 'commKey', commKey);
await profile.storeForAccount(profile.treeLabels.addressBook);
```

8.4.9 setPublicKey

```
keyExchange.setPublicKey(publicKey, privateKey);
```

Set the private and public key on the current diffieHellman object.

Parameters

1. `publicKey` - `string`: public Diffie Hellman key
2. `privateKey` - `string`: private Diffie Hellman key

Returns

(no return value)

Example

```
keyExchange.setPublicKey('...', '...');
```

8.5 Mailbox

Class Name	Mailbox
Extends	Logger
Source	mailbox.ts
Examples	mailbox.spec.ts

The Mailbox module is used for sending and retrieving bmails (blockchain mails) to other even.network members. Sending regular bmails between to parties requires them to have completed a Key Exchange before being able to send encrypted messages. When exchanging the keys, bmails are encrypted with a commonly known key, that is only valid is this case and the underlying messages, that contain the actual keys are encrypted with Diffie Hellman keys, to ensure, that keys are exchanged in a safe manner (see Key Exchange for details).

The mailbox is a smart contract, that holds

- `bytes32` hashes, that are the encrypted contents of the mails
- basic metadata about the mails, like
  - recipient of a mail
  - sender of a mail
  - amount of EVEs, that belongs to the bmail
- if the mail is an answer to another mail, the reference to the original mail

---

8.5.1 constructor

```
new Mailbox(options);
```

Creates a new Mailbox instance.

Instances created with the constructor are **not usable** right from the start. They require the *init()* function to be called, before they are ready to use.

Parameters

1. **`options` - `MailboxOptions`: options for Mailbox constructor.**
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `cryptoProvider` - `CryptoProvider`: `CryptoProvider` instance
    - `defaultCryptoAlgo` - `string`: crypto algorith name from `CryptoProvider`
    - `ipfs` - `Ipfs`: `Ipfs` instance
    - `keyProvider` - `KeyProviderInterface`: `KeyProviderInterface` instance
    - `mailboxOwner` - `string`: account, that will be used, when working with the mailbox
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `executor` - `Executor` (optional): `Executor` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

Returns

`Mailbox` instance

Example

```
const mailbox = new Mailbox({
  mailboxOwner,
  nameResolver,
  ipfs,
  contractLoader,
  cryptoProvider,
  keyProvider,
  defaultCryptoAlgo: 'aes',
});
await mailbox.init();
```

8.5.2 init

```
mailbox.init();
```

Initialize mailbox module.

This function needs to be called, before the mailbox module can be used.

Parameters

(none)

Returns

`Promise` returns `void`: resolved when done

Example

```
const mailbox = new Mailbox({
  mailboxOwner,
  nameResolver,
  ipfs,
  contractLoader,
  cryptoProvider,
  keyProvider,
  defaultCryptoAlgo: 'aes',
});
await mailbox.init();
```

8.5.3 sendMail

```
mailbox.sendMail(mail, from, to[, value, context]);
```

Sends a mail to given target.

Parameters

1. `mail` - `Mail`: a mail to send
2. `from` - `string`: sender identity or account
3. `to` - `string`: receiver identity or account
4. `value` - `string` (optional): amount of EVEs to send with mail in Wei, can be created with `web3[.utils].toWei(...)`, defaults to `0`
5. `context` - `string` (optional): encryption context for bmail, if a special context should be used (e.g. `keyExchange`)

Returns

`Promise` returns `void`: resolved when done

Example

```
// account, that sends the mail
const account1 = '0x0000000000000000000000000000000000000001';
// account, that receives the mail
const account2 = '0x0000000000000000000000000000000000000002';
// mailbox of the sender
const mailbox1 = {};
// mailbox of the receiver
```

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```
const mailbox2 = {};

const bmail = {
  content: {
    from: account1,
    to,
    title: 'Example bmail',
    body: 'This is a little example to demonstrate sending a bmail.',
    attachments: [ ]
  }
};
await mailbox1.sendMail(bmail, account1, account2);
```

8.5.4 sendAnswer

```
mailbox.sendAnswer(mail, from, to[, value, context]);
```

Send answer to a mail.

Parameters

1. `mail` - `Mail`: a mail to send, `mail.parentId` must be set to mailId of mail, that is answered
2. `from` - `string`: account id to send mail from
3. `to` - `string`: account id to send mail to
4. `value` - `string` (optional): amount of EVEs to send with mail in Wei, can be created with `web3[.utils].toWei(...)`, defaults to `0`
5. `context` - `string` (optional): encryption context for bmail, if a special context should be used (e.g. `keyExchange`)

Returns

`Promise` returns `void`: resolved when done

Example

```
// account, that sends the answer
const account1 = '0x0000000000000000000000000000000000000001';
// account, that receives the answer
const account2 = '0x0000000000000000000000000000000000000002';
// mailbox of the sender
const mailbox1 = {};
// mailbox of the receiver
const mailbox2 = {};

const bmail = {
  content: {
```

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```
    from: account1,
    to,
    title: 'Example bmail',
    body: 'This is a little example to demonstrate sending a bmail.',
    attachments: [ ]
  },
  parentId: '0x0000000000000000000000000000000000000000000000000000000000000012',
};
await mailbox1.sendAnswer(bmail, account1, account2);
```

8.5.5 getMails

```
mailbox.getMails([count, offset, type]);
```

Gets the last n mails, resolved contents.

Parameters

1. `count` - `number` (optional): retrieve up to this many answers (for paging), defaults to `10`
2. `offset` - `number` (optional): skip this many answers (for paging), defaults to `0`
3. `type` - `string` (optional): retrieve sent or received mails, defaults to `'Received'`

Returns

`Promise` returns `any`: resolved mails

Example

```
const received = await mailbox2.getMails();
console.dir(JSON.stringify(received[0], null, 2));
// Output:
// {
//   "mails": {
//     "0x000000000000000000000000000000000000000e": {
//       "content": {
//         "from": "0x0000000000000000000000000000000000000001",
//         "to": "0x0000000000000000000000000000000000000002",
//         "title": "Example bmail",
//         "body": "This is a little example to demonstrate sending a bmail.",
//         "attachments": [ ],
//         "sent": 1527083983148
//       },
//       "cryptoInfo": {
//         "originator":
↪"0x549704d235e1fe5cd7326a1eb0c44c1e0a5434799ba6ff2370c2955730b66e2b",
//         "keyLength": 256,
//         "algorithm": "aes-256-cbc"
//       }
```

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```
//     }
//   },
//   "totalResultCount": 9
// }
```

Results can be paged with passing arguments for page size and offsetto the `getMails` function:

```
const received = await mailbox2.getMails(3, 0);
console.dir(JSON.stringify(received[0], null, 2));
// Output:
// { mails:
//    { '0x000000000000000000000000000000000000000e': { content: [Object],␣
↪cryptoInfo: [Object] },
//      '0x000000000000000000000000000000000000000d': { content: [Object],␣
↪cryptoInfo: [Object] },
//      '0x000000000000000000000000000000000000000c': { content: [Object],␣
↪cryptoInfo: [Object] } },
//   totalResultCount: 9 }
```

To get bmails *sent* by an account, use (the example account hasn't sent any bmail yet):

```
const received = await mailbox2.getMails(3, 0, 'Sent');
console.dir(JSON.stringify(received[0], null, 2));
// Output:
// { mails: {}, totalResultCount: 0 }
```

8.5.6 getMail

```
mailbox.getMail(mail);
```

Gets one single mail directly.

Parameters

1. `mail` - `string`: mail to resolve (mailId or hash)

Returns

`Promise` returns `void`: resolved when done

Example

```
const mailId = '0x0000000000000000000000000000000000000000000000000000000000000012';
const bmail = await mailbox.getMail(mailId);
```

8.5.7 getAnswersForMail

```
mailbox.getAnswersForMail(mailId[, count, offset]);
```

Gets answer tree for mail, traverses subanswers as well.

Parameters

1. `mailId` - `string`: mail to resolve
2. `count` - `number` (optional): retrieve up to this many answers, defaults to `5`
3. `offset` - `number` (optional): skip this many answers, defaults to `0`

Returns

`Promise` returns `any`: answer tree for mail

Example

```
const mailId = '0x0000000000000000000000000000000000000000000000000000000000000012';
const answers = await mailbox.getAnswersForMail(mailId);
```

8.5.8 getBalanceFromMail

```
mailbox.getBalanceFromMail(mailId);
```

Returns amount of EVE deposited for a mail.

Bmails can contain EVEs for the recipient as well. Because retrieving bmails is a reading operation, funds send with a bmail have to be retrieved separately.

Parameters

1. `mailId` - `string`: mail to resolve

Returns

`Promise` returns `string`: balance of the mail in Wei, can be converted with web3[.utils].fromWei(...)

Example

```
const bmail = {
  content: {
    from: account1,
    to,
    title: 'Example bmail',
```

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```
    body: 'This is a little example to demonstrate sending a bmail.',
    attachments: [ ]
  }
};
await mailbox1.sendMail(bmail, account1, account2, web3.utils.toWei('0.1', 'Ether'));
const received = await mailbox2.getMails(1, 0);
const mailBalance = await mailbox2.getBalanceFromMail(Object.keys(received)[0]);
console.log(mailBalance);
// Output:
// 100000000000000000
```

8.5.9 withdrawFromMail

```
mailbox.withdrawFromMail(mailId, recipient);
```

Funds from bmails can be claimed with the account, that received the bmail. Funds are transferred to a specified account, which can be the claiming account or another account of choice.

Parameters

1. `mailId` - `string`: mail to resolve
2. `recipient` - `string`: account, that receives the EVEs

Returns

`Promise` returns `void`: resolved when done

Example

```
const received = await mailbox2.getMails(1, 0);
const mailBalance = await mailbox2.getBalanceFromMail(Object.keys(received)[0]);
console.log(mailBalance);
// Output:
// 100000000000000000
await mailbox2.withdrawFromMail(received)[0], accounts2);
const mailBalance = await mailbox2.getBalanceFromMail(Object.keys(received)[0]);
console.log(mailBalance);
// Output:
// 0
```

8.6 Verifications

Class Name	Verifications
Extends	Logger
Source	verifications.ts
Tests	verifications.spec.ts

The `Verifications` module allows to

- issue verifications about oneself or about other parties
- confirm or delete verifications about oneself

Verifications have a pattern similar to file paths, a verification for an account called "foo" being an employee of a company called "bar" may look like this:

`/company/bar/employee`

Under this "path" a set of values can be found. These value describe the verification, the subject of the verification and optional its response to it. Basically an `issuer` creates a `verification` about a `subject` The values are:

- `verification (name)` full path to a verification, for example `/company/bar/employee/foo`, settable by the `subject` of the parent verification `/company/bar/employee`
- `subject` an account, a verification has been issued for, can be a group/wallet or an externally owned account being the `subject` of a `verification` basically means to be the owner of the verification and allows to create subverifications below the own verification path
- `issuer` an account (group/wallet or externally owned) that creates a verification, to be able to issue a verification, the `issuer` has to be the `subject` of the parent verification `/company/bar/employee`
- `data` The hash of the verification data, sitting in another location, a bit-mask, call data, or actual data based on the verification scheme.
- `uri` The location of the verification, this can be HTTP links, swarm hashes, IPFS hashes, and such.
- `status` this represents a `verifications` status, values are `uint8` range from 0 to 255, the currently used values are: - 0: Issued - 1: Confirmed
- `signature` Signature which is the proof that the verification issuer issued a verification of topic for this identity. It MUST be a signed message of the following structure: keccak256(address identityHolder_address, uint256 _ topic, bytes data)
- `creationDate` creationDate of the verification
- `id` id of the current verification
- `valid` check if the verification has a valid signature

For a explanation on how to use verification API, possible flows and meaning of the results have a look at the *verifications usage example*.

8.6.1 constructor

```
new Verifications(options);
```

Creates a new Verifications instance.

Note, that the option properties `registry` and `resolver` are optional but should be provided in most cases. As the module allows to create an own ENS structure, that includes an own ENS registry and an own default resolver for it, setting them beforehand is optional.

Parameters

1. **`options` - `VerificationsOptions`: options for Verifications constructor.**

- `accountStore` - `AccountStore`: `AccountStore` instance
- `config` - `any`: config object with `NameResolver` config
- `contractLoader` - `ContractLoader`: `ContractLoader` instance
- `description` - `Description`: `Description` instance
- `dfs` - `DfsInterface`: `DfsInterface` instance
- `executor` - `Executor`: `Executor` instance
- `nameResolver` - `NameResolver`: `NameResolver` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
- `registry` - `string` (optional): contract address of the identity storage registry
- `storage` - `string` (optional): contract address of the identity storage registry

Returns

`Verifications` instance

Example

```
const verifications = new Verifications({
  accountStore,
  config,
  contractLoader,
  description,
  dfs,
  executor,
  nameResolver,
  storage: '0x0000000000000000000000000000000000000001',
});
```

8.6.2 updateConfig

```
verifications.updateConfig([options[, config]]);
```

Merge given partial options and config into current options and config.

This function is mainly used to decouple the creation process of required libraries by setting them at a later point of time.

Parameters

1. `options` - `Partial<VerificationsOptions>` (optional): updates for options
2. `config` - `Partial<VerificationsConfig>` (optional): updates for config

Returns

`Promise` returns `void`: resolved when done

Example

```
// create initial instance of `Verifications`, that is missing `Vc` and `Did`␣
↪instances
const verifications = new Verifications({
  accountStore,
  config,
  contractLoader,
  description,
  dfs,
  executor,
  nameResolver,
  storage: '0x0000000000000000000000000000000000000001',
});

// required libraries and config values are are created by other logic
const { activeIdentity, did, vc, underlyingAccount } = await someHelper();

// now update setup
verifications.updateConfig({ did, vc }, { activeIdentity, underlyingAccount });
```

8.6.3 = Issuers =

8.6.4 createIdentity

```
verifications.createIdentity(identity[, contractId, updateDescription]);
```

Creates a new identity for account or contract and registers them on the storage. Returned identity is either a 20B contract address (for account identities) or a 32B identity hash contract identities.

Parameters

1. `creator` - `string`: identity or account that runs transaction, receiver of identity when omitting the other arguments
2. `contractId` - `string`: (optional) contract address to create the identity for, creates account identity for `creator` if omitted
3. `updateDescription` - `boolean` (optional): update description of contract, defaults to `true`

Returns

`Promise` returns `void`: resolved when done

Example

```
const identity = await verifications.createIdentity(accounts[0]);
console.log(identity);
// Output:
// 0x1fE5F7235f1989621135466Ff8882287C63A5bae
```

8.6.5 identityAvailable

```
verifications.identityAvailable(subject);
```

Checks if a account has already an identity contract.

Parameters

1. `subject` - `string`: target subject to check

Returns

`Promise` returns `boolean`: true if identity exists, otherwise false

Example

```
console.log(await verifications.identityAvailable(accounts[0]);
// Output:
// false

await  await verifications.createIdentity(accounts[0]);

console.log(await verifications.identityAvailable(accounts[0]);
// Output:
// true
```

8.6.6 getOwnerAddressForIdentity

```
verifications.getOwnerAddressForIdentity(identityAddress);
```

Gets an identity's owner's address. This can be either an identity or account address.

Parameters

1. `identityAddress` - `string`: The identity address to look up the owner for. Works with both 20 bytes and 32 bytes addresses.

Returns

`Promise` returns `string`: address of the owning account

Example

```
const ownerAddress = await verifications.getOwnerAddressForIdentity(
↪'0x16a2e6af9cf78ddf6a170f38fceacca6bfdcd68b');
console.log(`The owner is ${ownerAddress}`);
// The owner is 0x001de828935e8c7e4cb56fe610495cae63fb2612
```

8.6.7 getIdentityForAccount

```
verifications.getIdentityForAccount(subject);
```

Gets the identity contract for a given account id or contract.

Parameters

1. `subject` - `string`: target subject to get identity for

Returns

`Promise` returns `any`: identity contract instance

Example

```
const identityContract = await verifications.getIdentityForAccount(accounts[0]);
```

8.6.8 setVerification

```
verifications.setVerification(issuer, subject, topic, expirationDate,␣
↪verificationValue, descriptionDomain, disableSubVerifications);
```

Sets or creates a verification; this requires the issuer to have permissions for the parent verification (if verification name seen as a path, the parent 'folder').

The "verificationValue" field can also be set to a custom JSON object with any data. For example DID, VC's, documents or any other custom value you want to attach to the verification.

Parameters

1. `issuer` - `string`: issuer of the verification
2. `subject` - `string`: subject of the verification and the owner of the verification node
3. `topic` - `string`: name of the verification (full path)
4. `expirationDate` - `number` (optional): expiration date, for the verification, defaults to `0` (does not expire)
5. `verificationValue` - `any` (optional): json object which will be stored in the verification
6. `descriptionDomain` - `string` (optional): domain of the verification, this is a subdomain under 'verifications.evan', so passing 'example' will link verifications description to 'example.verifications.evan', unset if omitted
7. `disableSubVerifications` - `boolean` (optional): invalidate all verifications that gets issued as children of this verification (warning will include the disableSubVerifications warning)
8. `isIdentity` - `boolean` (optional): boolean value if the subject is already a identity address (default false)
9. `uri` - `string` (optional): adds a specific URI to the verification

Returns

`Promise` returns `string`: id of new verification

Example

```
// accounts[0] issues verification '/company' for accounts[1]
const firstVerification = await verifications.setVerification(accounts[0],␣
↪accounts[1], '/company');

// accounts[0] issues verification '/companyData' for accounts[1] with additional␣
↪data attached
const secondVerification = await verifications.setVerification(accounts[0],␣
↪accounts[1], '/companyData', 0, {
  additionalDocument: <binary buffer>
  vcDid: {
    "@context": [
      "https://www.w3.org/2018/credentials/v1",
      "https://www.w3.org/2018/credentials/examples/v1"
    ],
    "id": "http://example.edu/credentials/3732",
    "type": ["VerifiableCredential", "UniversityDegreeCredential"],
    "credentialSubject": {
      "id": "did:example:ebfeb1f712ebc6f1c276e12ec21",
      "degree": {
        "type": "BachelorDegree",
        "name": "Bachelor of Science and Arts"
      }
    },
    "proof": {  }
  }
});

// accounts[0] issues verification '/company' for accounts[1], sets an expiration date
// and links to description domain 'sample'
```

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```
const thirdVerification = await verifications.setVerification(
  accounts[0], accounts[1], '/company', expirationDate, verificationValue, 'example');
```

8.6.9 setVerificationAndVc

```
verifications.setVerificationAndVc(issuer, subject, topic, expirationDate,␣
↪verificationValue, descriptionDomain, disableSubVerifications, isIdentity, uri);
```

Sets or creates a verification along with a verifiable credential. Creating a verification requires the issuer to have permissions for the parent verification (the parent directory, if the verification name is seen as a path).

The *verificationValue* property can also be a custom JSON object with any data. It is treated just like in the *setVerification* function, except that this function also adds it to the VC document.

Parameters

1. `issuer` - `string`: issuer of the verification
2. `subject` - `string`: subject of the verification and the owner of the verification node
3. `topic` - `string`: name of the verification (full path)
4. `expirationDate` - `number` (optional): expiration date, for the verification, defaults to `0` (does not expire)
5. `verificationValue` - `any` (optional): json object which will be stored in the verification
6. `descriptionDomain` - `string` (optional): domain of the verification, this is a subdomain under 'verifications.evan', so passing 'example' will link verifications description to 'example.verifications.evan', unset if omitted
7. `disableSubVerifications` - `boolean` (optional): invalidate all verifications that gets issued as children of this verification (warning will include the disableSubVerifications warning)
8. `isIdentity` - `boolean` (optional): boolean value if the subject is already a identity address (default false)
9. `uri` - `string` (optional): adds a specific URI to the verification

Returns

`Promise` returns `string`: verificationId and vcId

Example

```
// accounts[0] issues verification '/company' for accounts[1]
const verification = verifications.setVerificationAndVc(accounts[0], accounts[1], '/
↪company');
console.log(verification);
/* Output:
{
  vcId:

↪'vc:evan:testcore:0x9becd31c7e5b6a1fe8ee9e76f1af56bcf84b6718548dbdfd1412f935b515ebe0
↪',
```

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```
  verificationId:
    '0x5373812c3cba3fdee77730a45e7bd05cf52a5f2195abf1f623a9b22d94cea939'
}
*/
```

8.6.10 getVerifications

```
verifications.getVerifications(subject, topic, isIdentity]);
```

Gets verification information for a verification name from a given account; results has the following properties: creationBlock, creationDate, data, description, expirationDate, id, issuer, name, signature, status, subject, topic, uri, valid.

Parameters

1. `subject` - `string`: subject of the verifications
2. `topic` - `string`: name (/path) of a verification
3. `isIdentity` - `string` (optional): indicates if the subject is already an identity

Returns

`Promise` returns `any[]`: verification info array,

Verifications have the following properties:

1. `creationBlock` - `string`: block number at which verification was issued
2. `creationDate` - `string`: UNIX timestamp (in seconds), at which verification was issued
3. `data` - `string`: 32Bytes hash of data stored in DFS
4. `description` - `any`: DBCP description
5. `disableSubVerifications` - `boolean`: `true` if this verification does not allow verifications at subtopics
6. `expirationDate` - `string`: `string`: UNIX timestamp (in seconds), null if verification does not expire
7. `expired` - `boolean`: ticket expiration state
8. `id` - `string`: 32Bytes id of verification
9. `issuer` - `string`: account address of issuers identity contract
10. `name` - `string`: topic of verification
11. `rejectReason` - `any`: object with information from subject about rejection
12. `signature` - `string`: arbitrary length hex string with signature of verification data, signed by issuer
13. `status` - `number`: 0 (Issued) || 1 (Confirmed) || 2 (Rejected)
14. `subject` - `string`: accountId of subject
15. `topic` - `string`: keccak256 hash of the topic name, converted to uint256
16. `uri` - `string`: link to ipfs file of data

17. `valid` - `boolean`: `true` if issuer has been correctly confirmed as the signer of `signature` and if `signature` is related to `subject`, `topic` and `data`

Example

```
const verificationId = await verifications.setVerification(
  accounts[0], accounts[1], '/example1');
console.log(verificationId);
// Output:
// 0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270

const issued = await verifications.getVerifications(accounts[1], '/example1');
console.dir(issued);
// Output:
// [ {
//   creationBlock: '186865',
//   creationDate: '1558599441',
//   data: '0x0000000000000000000000000000000000000000000000000000000000000000',
//   description: null,
//   disableSubVerifications: false,
//   expirationDate: null,
//   expired: false,
//   id: '0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270',
//   issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//   name: '/example1',
//   rejectReason: undefined,
//   signature:
↪'0x6a2b41714c1faac09a5ec06024c8931ad6e3aa902c502e3d1bc5d5c4577288c04e9be136c149b569e0456dfec9d50a2
↪',
//   status: 0,
//   subject: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//   topic:
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548',
//   uri: '',
//   valid: true
// } ]
```

8.6.11 getNestedVerifications

```
getNestedVerifications(subject, topic, isIdentity);
```

Get all the verifications for a specific subject, including all nested verifications for a deep integrity check.

Parameters

1. `subject` - `string`: subject to load the verifications for.
2. `topic` - `string`: topic to load the verifications for.
3. `isIdentity` - `boolean`: optional indicates if the subject is already a identity

Returns

`Promise` returns `Array<any>`: all the verifications with the following properties.

Example

```
const nestedVerifications = await getNestedVerifications('0x123...', '/test')

// will return
[
  {
    // creator of the verification
    issuer: '0x1813587e095cDdfd174DdB595372Cb738AA2753A',
    // topic of the verification
    name: '/company/b-s-s/employee/swo',
    // -1: Not issued => no verification was issued
    // 0: Issued => status = 0, warning.length > 0
    // 1: Confirmed => issued by both, self issued state is 2, values match
    status: 2,
    // verification for account id / contract id
    subject: subject,
    // ???
    value: '',
    // ???
    uri: '',
    // ???
    signature: ''
    // icon for cards display
    icon: 'icon to display',
    // if the verification was rejected, a reject reason could be applied
    rejectReason: '' || { },
    // subjec type
    subjectType: 'account' || 'contract',
    // if it's a contract, it can be an contract
    owner: 'account' || 'contract',: 'account' || 'contract',
    // warnings
    [
      // parent verification does not allow subverifications
      'disableSubVerifications',
      // verification has expired
      'expired',
      // signature does not match requirements, this could be because it hasn't been␣
↪signed by
      // correct account or underlying checksum does not match
      // ``subject``, ``topic`` and ``data``
      'invalid',
      // verification has been issued, but not accepted or rejected by subject
      'issued',
      // verification has not been issued
      'missing',
      // given subject has no identity
      'noIdentity',
      // verification path has a trusted root verification topic, but this␣
↪verification is not
      // signed by a trusted instance
      'notEnsRootOwner',
```

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```
      // parent verification is missing in path
      'parentMissing',
      // verification path cannot be traced back to a trusted root verification
      'parentUntrusted',
      // verification has been issued and then rejected by subject
      'rejected',
      // verification issuer is the same account as the subject
      'selfIssued',
    ],
    parents: [ ... ],
    parentComputed: [ ... ]
  }
]
```

8.6.12 getNestedVerificationsV2

```
getNestedVerificationsV2(subject, topic[, isIdentity, queryOptions]);
```

Get verifications and their parent paths for a specific subject, then format it to updated result format.

Parameters

1. `subject` - `string`: subject (account/contract or identity)
2. `topic` - `string`: topic (verification name) to check
3. `isIdentity` - `boolean`: true if subject is identity
4. `queryOptions` - `VerificationsQueryOptions`: options for query and status computation

Returns

`Promise` returns `VerificationsResultV2`: verification result object with status, verification data and tree

Example

```
const validationOptions: VerificationsValidationOptions = {
  disableSubVerifications: VerificationsStatusV2.Red,
  expired:                 VerificationsStatusV2.Red,
  invalid:                 VerificationsStatusV2.Red,
  issued:                  VerificationsStatusV2.Yellow,
  missing:                 VerificationsStatusV2.Red,
  noIdentity:              VerificationsStatusV2.Red,
  notEnsRootOwner:         VerificationsStatusV2.Yellow,
  parentMissing:           VerificationsStatusV2.Yellow,
  parentUntrusted:         VerificationsStatusV2.Yellow,
  rejected:                VerificationsStatusV2.Red,
  selfIssued:              VerificationsStatusV2.Yellow,
};
const queryOptions: VerificationsQueryOptions = {
```

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```
  validationOptions: validationOptions,
};
const nestedVerificationsV2 = await verifications.getNestedVerificationsV2(
  accounts[1], '/example1', false, queryOptions);
console.dir(nestedVerificationsV2);
// Output:
// { verifications:
//    [ { details:
//         { creationDate: 1561722858000,
//           ensAddress:
//            '4d2027082fdec4ee253363756eccb1b5492f61fb6329f25d8a7976d7909c10ac.
↪example1.verifications.evan',
//           id:
//            '0x855a3c10b9cd6d42da5fd5e9b61e0f98a5af79b1acbfee57a9e4f3c9721f9c5d',
//           issuer: '0x5035aEe29ea566F3296cdD97C29baB2b88C17c25',
//           issuerIdentity: '0xD2860FeC7A198A646f9fD1207B59aD42f00c3189',
//           subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757',
//           subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           subjectType: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           topic: '/example1',
//           status: 'green' },
//        raw:
//         { creationBlock: '224038',
//           creationDate: '1561722858',
//           data:
//            '0x0000000000000000000000000000000000000000000000000000000000000000',
//           disableSubVerifications: false,
//           signature:
//
↪'0x941f316d77f5c1dc8b38000ecbb60304554ee2fb36453487ef7822ce6d8c7ce5267bb62396cfb08191028099de2e28d
↪',
//           status: 1,
//           topic:
//
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548' },
//        statusFlags: [] } ],
//   levelComputed:
//    { subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//      subjectType: 'account',
//      topic: '/example1',
//      subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757' },
//   status: 'green' }
```

8.6.13 computeVerifications

```
bcService.computeVerifications(topic, verifications);
```

Takes an array of verifications and combines all the states for one quick view.

Parameters

1. `topic` - `string`: topic of all the verifications

2. `verifications` - `Array<any>`: all verifications of a specific topic

Returns

`any`: computed verification including latest creationDate, displayName

Example

```
// load all sub verifications
verification.parents = await verifications.getNestedVerifications(verification.
↪issuerAccount, verification.parent || '/', false);

// use all the parents and create a viewable computed tree
const computed = verifications.computeVerifications(verification.topic, verification.
↪parents)

// returns =>
//   const computed:any = {
//     verifications: verifications,
//     creationDate: null,
//     displayName: topic.split('/').pop() || 'evan',
//     loading: verifications.filter(verification => verification.loading).length > 0,
//     name: topic,
//     status: -1,
//     subjects: [ ],
//     warnings: [ ],
//   }
```

8.6.14 getComputedVerification

```
getComputedVerification(subject, topic, isIdentity);
```

Loads a list of verifications for a topic and a subject and combines to a single view for a simple verification status check, by combining `getNestedVerifications` with `computeVerifications`.

Parameters

1. `subject` - `string`: subject to load the verifications for.
2. `topic` - `string`: topic to load the verifications for.
3. `isIdentity` - `boolean`: optional indicates if the subject is already a identity

Returns

`any`: computed verification including latest creationDate, displayName

Example

```
// use all the parents and create a viewable computed tree
const computed = verifications.getComputedVerification(subject, topic)

// returns =>
//   const computed:any = {
//     verifications: verifications,
//     creationDate: null,
//     displayName: topic.split('/').pop() || 'evan',
//     loading: verifications.filter(verification => verification.loading).length > 0,
//     name: topic,
//     status: -1,
//     subjects: [ ],
//     warnings: [ ],
//   }
```

8.6.15 validateVerification

```
verifications.validateVerification(subject, verificationId, isIdentity]);
```

validates a given verificationId in case of integrity

Parameters

1. `subject` - `string`: subject of the verifications
2. `verificationId` - `string`: The verification identifier
3. `isIdentity` - `boolean` (optional): indicates if the subject is already an identity, defaults to `false`

Returns

`Promise` returns `boolean`: resolves with true if the verification is valid, otherwise false

Example

```
console.dir(await verifications.validateVerification(
  accounts[1]),
  '0x0000000000000000000000000000000000000000000000000000000000000000',
);
// Output:
true
```

8.6.16 deleteVerification

```
verifications.deleteVerification(accountId, subject, verificationId[, isIdentity]);
```

Delete a verification. This requires the **accountId** to have permissions for the parent verification (if verification name seen as a path, the parent 'folder'). Subjects of a verification may only delete it, if they are the issuer as well. If not, they can only react to it by confirming or rejecting the verification.

Parameters

1. `deletor` - `string`: identity or account deleting the verification
2. `subject` - `string`: the subject of the verification
3. `verificationId` - `string`: id of a verification to delete
4. `isIdentity` - `bool` (optional): `true` if given `subject` is an identity, defaults to `false`

Returns

`Promise` returns `void`: resolved when done

Example

```
const verificationId = await verifications.setVerification(accounts[0], accounts[1],
↪'/company');
await verifications.deleteVerification(accounts[0], accounts[1], verificationId);
```

8.6.17 = Subjects =

8.6.18 confirmVerification

```
verifications.confirmVerification(identity, subject, verificationId[, isIdentity]);
```

Confirms a verification; this can be done, if a verification has been issued for a subject and the subject wants to confirm it.

Parameters

1. `confirmer` - `string`: identity or account to confirm the verification
2. `subject` - `string`: verification subject
3. `verificationId` - `string`: id of a verification to confirm
4. `isIdentity` - `bool` (optional): `true` if given `subject` is an identity, defaults to `false`

Returns

`Promise` returns `void`: resolved when done

Example

```
const newVerification = await verifications.setVerification(identites[0],␣
↪identites[1], '/company');
await verifications.confirmVerification(identites[0], identites[1], newVerification);
```

8.6.19 rejectVerification

```
verifications.rejectVerification(rejector, subject, verificationId[, rejectReason,␣
↪isIdentity]);
```

Reject a Verification. This verification will be marked as rejected but not deleted. This is important for tracking reasons. You can also optionally add a reject reason as JSON object to track additional informations about the rejection. Issuer and Subject can reject a special verification.

Parameters

1. `rejector` - `string`: identity or account rejecting the verification
2. `subject` - `string`: the subject of the verification
3. `verificationId` - `string`: id of a verification to delete
4. `rejectReason` - `object` (optional): JSON Object of the rejection reason
5. `isIdentity` - `bool` (optional): `true` if given `subject` is an identity, defaults to `false`

Returns

`Promise` returns `void`: resolved when done

Example

```
const verificationId = await verifications.setVerification(identities[0],␣
↪identities[1], '/company');
await verifications.rejectVerification(identities[0], identities[1], verificationId,
↪{ rejected: "because not valid anymore"});
```

8.6.20 = Delegated Verifications =

8.6.21 signSetVerificationTransaction

```
verifications.signSetVerificationTransaction(issuer, subject, topic[, expirationDate,␣
↪verificationValue, descriptionDomain, disableSubVerifications, isIdentity,␣
↪executionNonce]);
```

Signs a verification (offchain) and returns data, that can be used to submit it later on. Return value can be passed to `executeVerification`.

Note that, when creating multiple signed verification transactions, the `nonce` argument **has to be specified and incremented between calls**, as the nonce is included in transaction data and restricts the order of transactions, that can be made.

Parameters

1. `issuer` - `string`: issuer of the verification
2. `subject` - `string`: subject of the verification and the owner of the verification node
3. `topic` - `string`: name of the verification (full path)
4. `expirationDate` - `number` (optional): expiration date, for the verification, defaults to `0` (does not expire)
5. `verificationValue` - `any` (optional): json object which will be stored in the verification
6. `descriptionDomain` - `string` (optional): domain of the verification, this is a subdomain under 'verifications.evan', so passing 'example' will link verifications description to 'example.verifications.evan', unset if omitted
7. `disableSubVerifications` - `boolean` (optional): invalidate all verifications that gets issued as children of this verification (warning will include the disableSubVerifications warning)
8. `isIdentity` - `boolean` (optional): true if given subject is identity, defaults to `false`
9. `executionNonce` - `number` (optional): current execution nonce of issuer identity contract, defaults to `-1` (fetch dynamically)
10. `uri` - `string` (optional): adds a specific URI to the verification

Returns

`Promise` returns `VerificationsDelegationInfo`: data for submitting delegated verifications

Example

```
// accounts[0] wants to issue a verification for accounts[1] via delegation
const txInfo = await verifications.signSetVerificationTransaction(
  accounts[0], accounts[1], '/company');
```

8.6.22 executeVerification

```
verifications.executeVerification(executorAddress, txInfo);
```

Executes a pre-signed verification transaction with given account. This account will be the origin of the transaction and not of the verification. Second argument is generated with `signSetVerificationTransaction`.

Parameters

1. `executorAddress` - `string`: identity or account, that submits the transaction
2. `txInfo` - `VerificationsDelegationInfo`: information with verification tx data

Returns

`Promise` returns `string`: id of new verification

Example

```
// accounts[0] wants to issue a verification for accounts[1] via delegation
const txInfo = await verifications.signSetVerificationTransaction(
  accounts[0], accounts[1], '/company');

// accounts[2] submits transaction, that actually issues verification
const verificationId = await verifications.executeVerification(accounts[2], txInfo);
```

8.6.23 getExecutionNonce

```
verifications.getExecutionNonce(issuer[, isIdentity]);
```

Gets current execution nonce for an identity or an accounts identity.

Nonce is returned as `string`. When using nonces for preparing multiple transactions, small nonces can just be parsed to a number and then incremented as needed. Consider using BigNumber or similar modules to deal with large numbers if required.

Parameters

1. `issuer` - `string`: identity or account to get execution nonce for
2. `isIdentity` - `boolean` (optional): true if given issuer is an identity, defaults to `false`

Returns

`Promise` returns `string`: execution nonce

Example

```
// nonce in this example is relatively small, so we can just parse it and use it as a␣
↪number
// consider using BigNumber or similar to deal with larger numbers if required
let nonce = JSON.parse(await verifications.getExecutionNonce(accounts[0]));
const txInfos = await Promise.all(['/example1', '/example2', '/example3'].map(
  topic => verifications.signSetVerificationTransaction(
    accounts[0], accounts[1], topic, 0, null, null, false, false, nonce++)
));
```

8.6.24 = Delegated Transactions =

8.6.25 signTransaction

```
verifications.signTransaction(contract, functionName, options[, ...args]);
```

Signs a transaction from an identity (offchain) and returns data, that can be used to submit it later on. Return value can be passed to `executeTransaction`.

Note that, when creating multiple signed transactions, the `nonce` argument **has to be specified and incremented between calls**, as the nonce is included in transaction data and restricts the order of transactions, that can be made.

Parameters

1. `contract` - `any`: target contract of transcation or `null` if just sending funds
2. `functionName` - `string`: function for transaction or `null` if just sending funds
3. `options` - `any`: options for transaction, supports from, to, nonce, input, value
4. `args` - `any[]` (optional): arguments for function transaction

Returns

`Promise` returns `VerificationsDelegationInfo`: prepared transaction for `executeTransaction`

Example

```
// create test contract
const testContract = await executor.createContract(
  'TestContract', ['old data'], { from: accounts[0], gas: 500000 });
let data = await executor.executeContractCall(testContract, 'data');

// on account[0]s side
const txInfo = await verifications.signTransaction(
  testContract,
  'setData',
  { from: accounts[0] },
  'new data',
);

// on account[2]s side
await verifications.executeTransaction(accounts[2], txInfo);

// now check
data = await executor.executeContractCall(testContract, 'data');
```

8.6.26 executeTransaction

```
verifications.executeTransaction(executorAddress, txInfo);
```

Executes a pre-signed transaction from `signTransaction` of an identity. This can be and usually is a transaction, that has been prepared by the identity owner and is now submitted to the chain and executed by another account.

Parameters

1. `executorAddress` - `string`: identity or account, that sends transaction to the blockchain and pays for it
2. `txInfo` - `VerificationsDelegationInfo`: details about the transaction
3. `partialOptions` - `any` (optional): data for handling event triggered by this transaction

Returns

`Promise` returns `any`: result of transaction (if received from event)

Example

```
// create test contract
const testContract = await executor.createContract(
  'TestContract', ['old data'], { from: identities[0], gas: 500000 });
let data = await executor.executeContractCall(testContract, 'data');

// on identities[0]s side
const txInfo = await verifications.signTransaction(
  testContract,
  'setData',
  { from: identities[0] },
  'new data',
);

// on identities[2]s side
await verifications.executeTransaction(identities[2], txInfo);

// now check
data = await executor.executeContractCall(testContract, 'data');
```

8.6.27 executeAndHandleEventResult

```
verifications.executeAndHandleEventResult(accountId, data);
```

Run given data (serialized contract transaction (tx)) with given user's identity.

Parameters

1. `accountId` - `string`: account with whose identity the given tx is executed
2. `data` - `string`: serialized function data
3. `eventInfo` - `any` (optional) object with properties: 'eventName' and 'contract' (web3 contract instance, that triggers event)
4. `getEventResults` - `Function` (optional) function with arguments event and eventArgs, that returns result of *executeAndHandleEventResult* call
5. `sourceIdentity` - `string` (optional) identity to execute given tx with. If omitted, account's identity is used

6. `value` - `number` (optional) amount of EVEs to send. Defaults to 0
7. `to` - `string` (optional) target address. Defaults to verifications registry.
8. `signedTransactionInfo`- `string` (optional) transaction signature if this execution call should be a delegated call.

Returns

`Promise` returns `any`: if `eventInfo` and `getEventResults`, result of `getEventResults`, otherwise void

Example

```
const description = await myTwin.getDescription();
const newTwinOwner = '0x0123456789012345678901234567890123456789';
const verificationRegistry = this.options.verifications.contracts.registry;
await this.options.verifications.executeAndHandleEventResult(
  this.config.accountId,
  verificationRegistry.methods.transferIdentity(
    description.identity,
    newTwinOwner,
  ).encodeABI(),
);
```

8.6.28 = Descriptions =

8.6.29 setVerificationDescription

```
verifications.setVerificationDescription(identity, topic, domain, description);
```

Set description for a verification under a domain owned by given account. This sets the description at the ENS endpoint for a verification.

Notice, that this will **not** insert a description at the verification itself. Consider it as setting a global registry with the description for your verifications and not as a label attached to a single verification.

So a setting a description for the verification `/some/verification` the subdomain `example` registers this at the ENS path *${sha3('/some/verification')}example.verifications.evan*‘.

When this description has been set, it can be used when setting verifications, e.g. with

```
verifications.setVerification(accounts[0], accounts[1], '/some/verification',␣
↪expirationDate, verificationValue, 'example');
```

A description can be setup even after verifications have been issued. So it is recommended to use the verification domain when setting up verifications, even if the description isn't required at the moment, when verifications are set up.

Parameters

1. `identityOrAccount` - `string`: identity or account, that performs the description update

2. `topic` - `string`: name of the verification (full path) to set description
3. `domain` - `string`: domain of the verification, this is a subdomain under 'verifications.evan', so passing 'example' will link verifications description to 'example.verifications.evan'
4. `description` - `string`: DBCP description of the verification; can be an Envelope but only public properties are used

Returns

`Promise` returns `void`: resolved when done

Example

```
const sampleVerificationsDomain = 'sample';
  const sampleVerificationTopic = '/company';
  const sampleDescription = {
    name: 'sample verification',
    description: 'I\'m a sample verification',
    author: 'evan.network',
    version: '1.0.0',
    dbcpVersion: 1,
  };
await verifications.setVerificationDescription(accounts[0], sampleVerificationTopic,␣
↪sampleVerificationsDomain, sampleDescription);
await verifications.setVerification(accounts[0], accounts[1], sampleVerificationTopic,
↪ null, null, sampleVerificationsDomain);
const verificationsForAccount = await verifications.getVerifications(accounts[1],␣
↪sampleVerificationTopic);
const last = verificationsForAccount.length - 1;
console.dir(verificationsForAccount[last].description);
// Output:
// {
//   name: 'sample verification',
//   description: 'I\'m a sample verification',
//   author: 'evan.network',
//   version: '1.0.0',
//   dbcpVersion: 1,
// }
```

8.6.30 getVerificationEnsAddress

```
verifications.getVerificationEnsAddress(topic);
```

Map the topic of a verification to it's default ens domain.

Parameters

1. `topic` - `string`: verification topic

Returns

`string`: The verification ens address

Example

```
const ensAddress = verifications.getVerificationEnsAddress('/evan/test');
// will return test.verifications.evan
```

8.6.31 ensureVerificationDescription

```
verifications.ensureVerificationDescription(verification);
```

Gets and sets the default description for a verification if it does not exists.

Parameters

1. `verification` - `any`: verification topic

Example

```
verifications.ensureVerificationDescription(verification);
```

8.6.32 = Utilities =

8.6.33 createStructure

```
verifications.createStructure(accountId);
```

Create a new verifications structure; this includes a userregistry and the associated libraries. This isn't required for creating a module instance, its is solely used for creating new structures on the blockchain.

Parameters

1. `accountId` - `string`: account, that execute the transaction and owner of the new registry

Returns

`Promise` returns `any`: object with property 'storage', that is a web3js contract instance

Example

```
const verificationsStructure = await verifications.createStructure(accountId);
console.log(verificationsStructure.storage.options.address);
// Output:
// 0x000000000000000000000000000000000000000a
```

8.6.34 deleteFromVerificationCache

```
verifications.deleteFromVerificationCache(subject, topic);
```

Delete a single entry from the verification cache object using subject and topic

Parameters

1. `subject` - `string`: the subject that should be removed
2. `topic` - `string`: the topic that should be removed

Example

```
verifications.deleteFromVerificationCache(accounts[1], '/some/verification');
```

8.6.35 trimToStatusTree

```
verifications.trimToStatusTree(result);
```

Trim `VerificationsResultV2` result down to statusFlags and status values for analysis purposes and debugging.

Parameters

1. `inputResult` - `VerificationsResultV2`: result to trim down

Returns

`Promise` returns `any`: trimmed down tree

Example

```
const validationOptions: VerificationsValidationOptions = {
  disableSubVerifications: VerificationsStatusV2.Red,
  expired:                 VerificationsStatusV2.Red,
  invalid:                 VerificationsStatusV2.Red,
  issued:                  VerificationsStatusV2.Yellow,
  missing:                 VerificationsStatusV2.Red,
  noIdentity:              VerificationsStatusV2.Red,
  notEnsRootOwner:         VerificationsStatusV2.Yellow,
  parentMissing:           VerificationsStatusV2.Yellow,
  parentUntrusted:         VerificationsStatusV2.Yellow,
```

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```
  rejected:                VerificationsStatusV2.Red,
  selfIssued:              VerificationsStatusV2.Yellow,
};
const queryOptions: VerificationsQueryOptions = {
  validationOptions: validationOptions,
};
const nestedVerificationsV2 = await verifications.getNestedVerificationsV2(
  accounts[1], '/example1', false, queryOptions);
console.dir(nestedVerificationsV2);
// Output:
// { verifications:
//    [ { details:
//         { creationDate: 1561722858000,
//           ensAddress:
//            '4d2027082fdec4ee253363756eccb1b5492f61fb6329f25d8a7976d7909c10ac.
↪example1.verifications.evan',
//           id:
//            '0x855a3c10b9cd6d42da5fd5e9b61e0f98a5af79b1acbfee57a9e4f3c9721f9c5d',
//           issuer: '0x5035aEe29ea566F3296cdD97C29baB2b88C17c25',
//           issuerIdentity: '0xD2860FeC7A198A646f9fD1207B59aD42f00c3189',
//           subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757',
//           subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           subjectType: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           topic: '/example1',
//           status: 'green' },
//        raw:
//         { creationBlock: '224038',
//           creationDate: '1561722858',
//           data:
//            '0x0000000000000000000000000000000000000000000000000000000000000000',
//           disableSubVerifications: false,
//           signature:
//
↪'0x941f316d77f5c1dc8b38000ecbb60304554ee2fb36453487ef7822ce6d8c7ce5267bb62396cfb08191028099de2e28d
↪',
//           status: 1,
//           topic:
//
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548' },
//        statusFlags: [] } ],
//   levelComputed:
//    { subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//      subjectType: 'account',
//      topic: '/example1',
//      subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757' },
//   status: 'green' }

const trimmed = verifications.trimToStatusTree(nestedVerificationsV2);
console.dir(trimmed);
// Output:
// { status: 'green',
//   verifications:
//    [ { details: { status: 'green', topic: '/example1' },
//        statusFlags: [] } ] }
```

8.6.36 Enums

VerificationsStatus

verification status from blockchain

1. `Issued`: issued by a non-issuer parent verification holder, self issued state is 0
2. `Confirmed`: issued by a non-issuer parent verification holder, self issued state is 0
3. `Rejected`: verification rejected status

VerificationsStatusFlagsV2

status annotations about verification, depending on defined `VerificationsQueryOptions`, this may lead to the verification to be invalid or less trustworthy

1. `disableSubVerifications`: parent verification does not allow subverifications
2. `expired`: verification has expired
3. `invalid`: signature does not match requirements, this could be because it hasn't been signed by correct account or underlying checksum does not match subject, topic and data
4. `issued`: verification has been issued, but not accepted or rejected by subject
5. `missing`: verification has not been issued
6. `noIdentity`: given subject has no identity
7. `notEnsRootOwner`: verification path has a trusted root verification topic, but this verification is not signed by a trusted instance
8. `parentMissing`: parent verification is missing in path
9. `parentUntrusted`: verification path cannot be traced back to a trusted root verification
10. `rejected`: verification has been issued and then rejected by subject
11. `selfIssued`: verification issuer is the same account as the subject

VerificationsStatusV2

represents the status of a requested verification topic after applying rules in `VerificationsQueryOptions`

1. `Green`: verification is valid according to `VerificationsQueryOptions`
2. `Yellow`: verification may be valid but more checks may be required more for trusting it, see status flags for details
3. `Red`: verification is invalid, see status flags for details

---

8.6.37 Interfaces

VerificationsDelegationInfo

information for submitting a delegated transaction, created with `signSetVerificationTransaction` consumed by `executeVerification`

1. `sourceIdentity` - `string`: address of identity contract, that issues verification
2. `value` - `number`: value to transfer, usually 0
3. `input` - `string`: abi encoded input for transaction
4. `signedTransactionInfo` - `string`: signed data from transaction
5. `nonce` - ‘‘string‘‘(optional): source identity contract execution nonce for this transaction
6. `targetIdentity - string``(optional): address of identity contract, that receives verification, either this or ``to` has to be given
7. `to` - `string` (optional): address of target of transaction, either this or *targetIdentity* has to be given

VerificationsQueryOptions

options for `getNestedVerificationsV2`, define how to calculate status of verification

1. `statusComputer` - `VerificationsStatusComputer` (optional): function for setting verification with custom logic
2. `validationOptions` - `VerificationsValidationOptions` (optional): specification of how to handle status flags of each single verification

VerificationsResultV2

result of a verification query

1. `status` - `VerificationsStatusV2`: overall status of verification
2. `verifications` - `VerificationsVerificationEntry[]`: (optional): list of verifications on same topic and subject
3. **`levelComputed` (optional): consolidated information about verification**
    - `subjectIdentity` - `string`: identity contract address or hash of subject
    - `subjectType` - `string`: type of subject (account/contract)
    - `topic` - `string`: topic (name) of verification
    - `expirationDate` - `number` (optional): timestamp, when verification will expire, js timestamp
    - `parents` - `VerificationsResultV2` (optional): verifications of parent path, issued for all issuers of verifications on this level
    - `subject - number` (optional): subject accountId/contractId (if query was issued with `isIdentity` set to `false`)

VerificationsVerificationEntry

a single verification; usually used in `VerificationsResultV2`

1. **`details`: details about verification**
    - `creationDate` - `number`: js timestamp of verification creation
    - `ensAddress` - `string`: ens address of description for this verification
    - `id` - `string`: id in verification holder / verifications registry
    - `issuer` - `string`: account id of verification issuer

- `issuerIdentity` - `string`: issuers identity contract id
- `subjectIdentity` - `string`: identity (contract or identity hash) of subject
- `subjectType` - `string`: type of subject (account/contract)
- `topic` - `string`: topic of identity (name)
- `data` - `any` (optional): 32B data hash string of identity
- `description` - `any` (optional): only if actually set
- `expirationDate` - `number` (optional): expiration date of verification (js timestamp)
- `rejectReason` - `string` (optional): if applicable, reason for verification rejection
- `status` - `VerificationsStatusV2` (optional): status of verification, is optional during result computation and required when done
- `subject` - `string` (optional): subject accountId/contractId (if query was issued with `isIdentity` set to `false`)

2. **`raw` (optional): raw data about verification from contract**
    - `creationBlock` - `string`: block in which verification was issued
    - `creationDate` - `string`: unix timestamp is s when verification was issued
    - `data` - `string`: 32B data hash string of identity, bytes32 zero if unset
    - `disableSubVerifications` - `boolean`: true if subverification are not allowed
    - `signature` - `string`: signature over verification data
    - `status` - `number`: status of verification, (issued, accepted, rejected, etc.)
    - `topic` - `string`: uint string of verification name (topic), is uint representation of sha3 of name
3. `statusFlags` - `string[]` (optional): all found flags, those may not have impact on status, depends on `VerificationsStatusFlagsV2`

VerificationsVerificationEntryStatusComputer

Computes status for a single verification. verification, partialResult.

Parameters

1. `verification` - `Partial<VerificationsVerificationEntry>`: current verification result (without status)
2. `partialResult` - `Partial<VerificationsResultV2>`: options for verifications query

Returns

`Promise` returns `VerificationsStatusV2`: status for this verification

VerificationsStatusComputer

Computes status from overall verifications result. This function is applied after each verification has received an own computed status.

Parameters

1. `partialResult` - `Partial<VerificationsResultV2>`: current verification result (without status)
2. `queryOptions` - `VerificationsQueryOptions`: options for verifications query
3. `currentStatus` - `VerificationsStatusV2`: current status of verification

Returns

`Promise` returns `Promise<VerificationsStatusV2>`: updated status, will be used at verification status

VerificationsValidationOptions

Options for verification status computation. Keys are string representations of `VerificationsStatusFlagsV2`, values can be `VerificationsStatusV2` or functions. If value is `VerificationsStatusV2`, then finding given status flag sets verification value to given `VerificationsStatusV2` (if not already at a higher trust level). If value is function, pass verification to this function and set verification status to return value (if not already at a higher trust level).

1. `[id: string]` - `VerificationsStatusV2 | VerificationsVerificationEntryStatusComputer`: each key is a status flag and usually an enum value from `VerificationsStatusFlagsV2`, though it is possible to use custom status flags

8.7 Verifications Examples

This sections aims to help getting started with the verifications service. Herein are shown a few examples on

- how to set verifications
- how to get verifications
- how to handle verifications for externally owned accounts and contracts
- how to check verifications for validity

Verifications can be issued with the *Verification API*. Their smart contract implementation follow the principles outlined in ERC-725 and ERC-735.

8.7.1 About the Code Examples

Many code examples are taken from the verification tests. You can a look at those for more examples or to have a look at in which context the test are run in.

Code examples on this page use an initialized module called `verifications`, which is an instance of the verification module *Verification API*. When using a *runtime* this module is available as `runtime.verifications`.

Many code examples here use variable naming from the tests. So there are a few assumptions about variables used here:

- `accounts` is an array with addresses of externally owned accounts, of which private keys are known to the runtime/executor/signer instance to make transaction with them
- `accounts[0]` usually takes the role of issuing verifications

- `accounts[1]` is usually an account that responds to actions from `accounts[0]`
- `accounts[2]` is usually an account, that has no direct relation to the former two accounts
- `contractId` refers to the address of a contract, that is owned by `accounts[0]`, this contract usually has a DBCP description

---

8.7.2 Different Types of Identities

Okay, this page is about verifications, so why does the first heading talk about some kind of identities? The answer for this is pretty simple simple: Verifications are issued by identities.

So what exactly is an identity? An identity is an instance, that is able to issue and hold verifications (therefore the technical name VerificationHolder.

Technically speaking, identities are like Wallet Contracts, that have a certificate store attached to them. Identities can be traced back to an externally owned account, that owns this wallet contract and vice versa the matching identity (wallet) contract can be looked up for any given externally owned account, if this account has created and registered an identity contract.

Because of their wallet-like behavior, identity contracts require a calling instance, for example an externally owned account or another wallet to call them for managing their verifications. For example to issue a verification for another identity, a user makes a transaction against its own identity contract, which itself makes a transaction to create a verification in the other identity.

This works pretty well and comes with useful features like preparing "outgoing" transactions to be made from ones own identity, that can be paid by another party, but has some implications when applied as "smart contract identities" instead of "account identities". These smart contracts would need to be owner of their own identities and working with verifications would require the contracts to have functions for issuing, rejecting, etc. verification or offer wallet like functionalities themselves, which would make it often pretty hard to introduce verifications in an existing smart contract infrastructure and it would often have an impact on these contracts costs as these extra functionalities have to be added to the contract.

To allow for a more easy integration, contract identities have been added as a 32 Bytes identities or pseudonyms, which can be created with a registry contract. These 32 Bytes identities are IDs in a central registry, that offers basically the same functionalities as the single identity contracts. Identities at the registry are owned by the account, that created them (ownership can be transfered) and ownership over such an identity grants the permission to make transactions for it the same way as for the own account identity.

So let's get to the code examples.

Account Identities

Note that the creation example can be omitted when using an account creating during the visual onboarding flow, as this includes creating an identity.

If you want to check if your account already has an identity, you can try to get its identity contracts address with *identityAvailable*:

```
if (await verifications.identityAvailable(accounts[0])) {
  console.log(`account "${accounts[0]}" has an identity`);
} else {
  console.log(`account "${accounts[0]}" does not have an identity`);
}
```

Account identities can be created straight forward by calling *createIdentity* and passing the account to it, an identity should be created for.

```
const identity = await verifications.createIdentity(accounts[0]);
console.log(identity);
// Output:
// 0x1fE5F7235f1989621135466Ff8882287C63A5bae
```

This returns the 40Bytes contract address of the accounts identity contract.

The given account now has an identity attached to it, which is a requirement for interacting with the rest of the *verifications API* and only has to be done once per externally owned account.

Contract Identities / Pseudonym Identities

Contract identities are created "on behalf of" a contract. An externally owned account, often the owner of the contract, usually does the following:

- creating an identity for the contract
- linking contract and identity
- providing the information of which identity belongs to a contract to other parties

Creating a contract identity registers a new contract identity at the registry, this identity is then owned by the executing accountId.

Linking is done by registering the contract address as the receiver of the identity, this is done at the registry as well.

When third parties want to check verifications of a contract, they need a way to get the identity for a contract. This can be done by adding an extra function to the contract, by setting up a lookup mechanism, etc. DBCP is a description language used throughout evan.network, which provides a way to add meta information to smart contracts. The contract identity is usually added to this DBCP description of a contract.

The aforementioned three steps are covered by the *createIdentity* function, which can be called with:

```
const contractIdentity = await verifications.createIdentity(accounts[0], contractId);
console.log(idencontractIdentitytity);
// Output:
// 0x4732281e708aadbae13f0bf4dd616de86df3d3edb3ead21604a354101de45316
```

When using contracts without descriptions or when handling the relation between contracts and an identity elsewhere, the process of updating the description can be omitted. For this set the `updateDescription` argument to `false`:

```
const contractIdentity = await verifications.createIdentity(accounts[0], contractId,␣
↪false);
console.log(idencontractIdentitytity);
// Output:
// 0x4732281e708aadbae13f0bf4dd616de86df3d3edb3ead21604a354101de45316
```

Pseudonyms can be handled the same way. Just set the flag to link given identity to false:

```
const contractIdentity = await verifications.createIdentity(accounts[0], null, false,␣
↪false);
console.log(idencontractIdentitytity);
// Output:
// 0x4732281e708aadbae13f0bf4dd616de86df3d3edb3ead21604a354101de45316
```

This returns an identity, that is owned by `accountId` and can be used to issue verifications for.

8.7.3 Issue verifications

Verifications are statements, issued by an account called `issuer`, towards target, called `subject`. This basically means something like "The person `issuer` says, a statement applies to `subject`". The subject may or may not react to it by confirming or rejecting it. Technically speaking, the `issuer` identity issues the verification with the statement to `subject`'s identity and the `subjects`'s identity may react to it.

Issue verifications for an account

```
const verificationId = await verifications.setVerification(
  accounts[0], accounts[1], '/example1');
console.log(verificationId);
// Output:
// 0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270

const issued = await verifications.getVerifications(accounts[1], '/example1');
console.dir(issued);
// Output:
// [ {
//   creationBlock: '186865',
//   creationDate: '1558599441',
//   data: '0x0000000000000000000000000000000000000000000000000000000000000000',
//   description: null,
//   disableSubVerifications: false,
//   expirationDate: null,
//   expired: false,
//   id: '0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270',
//   issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//   name: '/example1',
//   rejectReason: undefined,
//   signature:
↪'0x6a2b41714c1faac09a5ec06024c8931ad6e3aa902c502e3d1bc5d5c4577288c04e9be136c149b569e0456dfec9d50a2
↪',
//   status: 0,
//   subject: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//   topic:
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548',
//   uri: '',
//   valid: true
// } ]
```

Have a look at *getVerifications* or the section on *this page* for the meaning of the returned values, for how to find out, if the returned verification is trustworthy, have a look at *Validating Verifications*.

Issue verifications for a contract with a description

```
const verificationId = await verifications.setVerification(
  accounts[0], contractId, '/example2');
console.log(verificationId);
// Output:
// 0x2bc6d5fdb937f6808252b837437220d8e16b92a974367f224260d028413e7c6e
```

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```
const issued = await verifications.getVerifications(contractId, '/example2');
console.dir(issued);
// [ {
//   creationBlock: '187823',
//   creationDate: '1558621998',
//   data: '0x0000000000000000000000000000000000000000000000000000000000000000',
//   description: null,
//   disableSubVerifications: false,
//   expirationDate: null,
//   expired: false,
//   id: '0x2bc6d5fdb937f6808252b837437220d8e16b92a974367f224260d028413e7c6e',
//   issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//   name: '/example2',
//   rejectReason: undefined,
//   signature:
↪'0x0f4f19a369645a0ec2795bd2836fad0857ef82169c7e5800d7a06fb162583c9c14a731f4e942cf30d67fb10a551d906
↪',
//   status: 0,
//   subject: '0x005C5FF57D4d6Bf105Bf3bF16ffCd8Ac143B3Ef0',
//   topic:
↪'107276559880603231420598591656057035604273757486333915273364042567965107775848',
//   uri: '',
//   valid: true
// } ]
```

Have a look at *getVerifications* or the section on *this page* for the meaning of the returned values, for how to find out, if the returned verification trustworthy, have a look at *Validating Verifications*.

Note that for contracts with descriptions the contractId can be given to `setVerification` and `getVerifications`. The contract identity is fetched from the contract description automatically.

Issue verifications for a contract without using a description

```
// assume, we have created an identity for our contract and stored this identity as␣
↪the variable ``contractIdentity``
const verificationId = await verifications.setVerification(
  accounts[0], contractIdentity, '/example3', 0, null, null, false, true));
console.log(verificationId);
// Output:
// 0x2bc6d5fdb937f6808252b837437220d8e16b92a974367f224260d028413e7c6e

const issued = await verifications.getVerifications(contractIdentity, '/example3',␣
↪true);
console.dir(issued);
// [ {
//   creationBlock: '187823',
//   creationDate: '1558621998',
//   data: '0x0000000000000000000000000000000000000000000000000000000000000000',
//   description: null,
//   disableSubVerifications: false,
//   expirationDate: null,
//   expired: false,
//   id: '0x2bc6d5fdb937f6808252b837437220d8e16b92a974367f224260d028413e7c6e',
//   issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
```

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```
//   name: '/example2',
//   rejectReason: undefined,
//   signature:
↪'0x0f4f19a369645a0ec2795bd2836fad0857ef82169c7e5800d7a06fb162583c9c14a731f4e942cf30d67fb10a551d906
↪',
//   status: 0,
//   subject: '0x005C5FF57D4d6Bf105Bf3bF16ffCd8Ac143B3Ef0',
//   topic:
↪'107276559880603231420598591656057035604273757486333915273364042567965107775848',
//   uri: '',
//   valid: true
// } ]
```

In case you're wondering: `contractIdentity` is the same identity as returned in our Contract Identities / Pseudonym Identities example.

Have a look at *getVerifications* for the meaning of the returned values, for how to find out, if the returned verification trustworthy, have a look at *Validating Verifications*.

Note that for contracts without descriptions `contractIdentity` is given and the last argument (`isIdentity`) is set to true. The functions `setVerification` and `getVerifications` support passing a contract identity to them as well and they also have the argument `isIdentity`, which is set to true, when passing contract identities to them.

Delegated verification issuing

The transaction that issues a verification can be done by an account, that is neither `issuer` nor `subject`. This means, that it is possible to let another account pay transaction costs but issuing the verification itself is done from the original identity.

For example: Alice wants to issue a verification to Bob, but should not pay for the transaction costs. Alice can now prepare the transaction to be done from her identity contract towards Bobs identity contract and send the prepared transaction data to Clarice. Clarice then can submit this data to Alice's identity contract, which will issue the verification.

```
const [ alice, bob, clarice ] = accounts;

// on Alice's side
const txInfo = await verifications.signSetVerificationTransaction(alice, bob, '/
↪example');

// on Clarice's side
const verificationId = await verifications.executeVerification(clarice, txInfo);
```

Note that transactions prepared with `signSetVerificationTransaction` can only be executed once and only with the arguments of the original data. To prevent multiple repetitions of the transaction, a nonce at the issuers identity contract is used. This nonce is retrieved from the identity contract automatically when calling `signSetVerificationTransaction`, but when preparing multiple transactions and not submitting them immediately, the nonce would stay the same. Therefore the nonce has to be increased by hand when preparing multiple transactions from the same identity contract.

Nonces determine the order in which prepared transactions can be performed from issuers identity contract, so execute prepared transactions in order of their nonces.

```
const [ alice, bob, clarice ] = accounts;

// on Alice's side
// nonce in this example is relatively small, so we can just parse it and use it as a␣
↪number
// consider using BigNumber or similar to deal with larger numbers if required
let nonce = JSON.parse(await verifications.getExecutionNonce(alice));
const txInfos = await Promise.all(['/example1', '/example2', '/example3'].map(
  topic => verifications.signSetVerificationTransaction(
    alice, bob, topic, 0, null, null, false, false, nonce++)
));

// on Clarice's side
const verificationIds = [];
for (let txInfo of txInfos) {
  verificationIds.push(await verifications.executeVerification(clarice, txInfo));
}
```

8.7.4 Validating Verifications

Verifications can be retrieved with two different functions:

- *getVerifications*: simple "fetch all" verifications for a topic, returns all verifications and detailed validity checks have to be made by hand
- *getNestedVerification*: return verifications with default checks and inspects parent verifications as well, used for verifications, that should be traced back to a trusted root verifier

getVerifications

The example for *getVerifications* is the same we used when creating a verification for and account:

```
const verificationId = await verifications.setVerification(
  accounts[0], accounts[1], '/example1');
console.log(verificationId);
// Output:
// 0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270

const issued = await verifications.getVerifications(accounts[1], '/example1');
console.dir(issued);
// Output:
// [ {
//   creationBlock: '186865',
//   creationDate: '1558599441',
//   data: '0x0000000000000000000000000000000000000000000000000000000000000000',
//   description: null,
//   disableSubVerifications: false,
//   expirationDate: null,
//   expired: false,
//   id: '0xb4843ed5177433312dd2c7c4f8065ce84f37bf96c04db2775c16c9455ad96270',
//   issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//   name: '/example1',
//   rejectReason: undefined,
```

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```
//   signature:
↪'0x6a2b41714c1faac09a5ec06024c8931ad6e3aa902c502e3d1bc5d5c4577288c04e9be136c149b569e0456dfec9d50a2
↪',
//   status: 0,
//   subject: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//   topic:
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548',
//   uri: '',
//   valid: true
// } ]
```

As stated above, only basic validations have been made on the data of the verifications, so conclusions have to be drawn by based on the data returned here. For a full list of explanations to the properties have a look at the *API documentation*, but the ones you will be most probably using the most are:

- `status` and `rejectReason`:
  - `status` - `number`:
  - 0 (Issued) || 1 (Confirmed) || 2 (Rejected)
  - reflects how the subject responded (1|2) to the verification or if no response has been made (0)
  - `rejectReason` - `any`: object with information from subject about rejection
- `valid` - `boolean`:
  - `true` if issuer has been correctly confirmed as the signer of `signature`
  - also checks if provided `signature` has been correctly built as checksum over `subject`, `topic` and `data`
- `expired` and `expirationDate`:
  - `expired` - `boolean`: ticket expiration state
  - `expirationDate` - `string`: UNIX timestamp (in seconds), null if verification does not expire
- `issuer` - `string`:
  - account address of issuers identity contract, can be used to check if the issuer is an account, that you trust
- `data` and `uri`:
  - `data` - `string`: 32Bytes hash of data stored in DFS
  - `uri` - `string`: link to ipfs file of data
  - these two properties point to data, that has been attached to your verification (attaching data is optional)
  - the data referred here is the data provided as `verificationValue` in *setVerification*
  - data content handling, especially encryption and key management has be be handled in custom logic and is not covered in here

A sample, on how these properties can be used to determine the trustworthiness of a verification can be found at hem workshop project.

getNestedVerifications

For this section we take the last example and issue two subverifications. We add `/example1/example1_child` as the direct child of it and `/example1/example1_child/example1_grandchild` as a subverification below the first this child.

```
const verificationId = await verifications.setVerification(
  accounts[0], accounts[0], '/example4');
const verificationId = await verifications.setVerification(
  accounts[0], accounts[0], '/example4/child');
const verificationId = await verifications.setVerification(
  accounts[0], accounts[0], '/example4/child/grandchild');

const issued = await verifications.getNestedVerifications(accounts[0], '/example1/
↪example1_child/example1_grandchild');
console.dir(issued);
// Output:
// [ {
//     name: '/example4/child/grandchild',
//     parent: '/example4/child',
//     warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
//     id: '0x1adef760f5a8d153aeeeda7a6e4f8c950fa93b0cb5d3218c6a9389cd05f5f7f6',
//     issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//     status: 0,
//     subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//     subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//     subjectType: 'account',
//     issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//     parents:
//      [ {
//          name: '/example4/child',
//          parent: '/example4',
//          warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
//          id: '0x28e1df758883bb3d4d5e7e0fa978ff673bc749ade0a3d78ad952a30d0a0e2a01',
//          issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//          status: 0,
//          subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//          subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//          subjectType: 'account',
//          issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//          parents:
//           [ {
//               name: '/example4',
//               parent: '',
//               warnings: [ 'issued' ],
//               id:
↪'0x18fb0ef05d96cba2a57c6de6d8cfd031e16367f6484f20797a39d25a3e76e20a',
//               issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//               status: 0,
//               subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//               subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
//               subjectType: 'account',
//               issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
//               parents: [],
//           } ],
//     } ],
// } ]
```

The output above has been heavily trimmed down to show differences between both functions and highlight parent to child relations and warnings. To view full output have a look at the *full output*.

To create a simple chain of verifications, we have used the following structure: - `accounts[0]` creates a verification for itself, called `/example4` - then creates a subverification under called `/example4/child` for itself under this - then creates another subverification (under the first subverification) called `/example4/child/grandchild` for

itself

The call `verifications.getNestedVerifications(accounts[0], '/example1/example1_child/example1_grandchild')` now inspects what verifications and possible relations to parent verifications exits and it finds the following possible issues:

- `/example4/child/grandchild`: `warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ]`
  - `issued` means, that is is only issued and not confirmed, we can see its status is `0`, so yes, it is unconfirmed (and if we look above, we actually didn't confirm the verification)
  - `selfIssued`, yes, `issuer` equals `subjectIndentity`, therefore `selfIssued` and thinking back, we did issue this verification to ourself
  - `parentUntrusted`, this means that the parent verification hasn't been accepted, its status is `0`, so yes, only issued and not confirmed
- following the parent verifications, we find basically the same on the next level
  - `/example4/child`: `warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ]`
  - the same reasons and explanations apply here, so let's continue to the last on in the verification path
- `/example4`: `warnings: [ 'issued' ]`
  - `issued`: yep, status is `0` therefore it is only issued and not confirmed
  - no `parentUntrusted`? as this verification is a root verification, there is not parent
  - no `selfIssued`?
    - the path is `/example4`, which makes this verification a root verification
    - root verifications can be issued by any party without being flagged as `selfIssued`, to allow building own verification chains
    - to narrow this down to a limited set of trusts, there are basically two solutions:
      - own checks can be made, e.g. check if the issuer of the root verification is a well known and trusted account
      - use `/evan` derived verification paths, the root verification `/evan` is only trusted, if it is issued by a trusted root issuer, get in contact with us via info@evan.team for details on how to obtain a subverification like `/evan/myOwnTrustedVerification`, that can be used for building widely accepted verification paths

getNestedVerificationsV2

The output from the last example has some aspects, where it could perform better:

- the output is a bit lengthy and looks unstructured, some of the information here may not be useful in most situations and relies on predefined defaults (e.g. a default description, that isn't actually set is returned if no description is defined, which may lead to the opinion, that a description has been set)
- it is quite hard to determine with a simple query and not further processing to determine if a valid verification is present or not
- documentation about properties returned in verification is a bit sparse in some points

An updated version of the `getNestedVerifications` has been added as `getNestedVerificationsV2`. This version will replace the current one soon, but is available for now under the V2 name. This version is under

development and may undergo further changes but the basic behavior will not change and it will replace the regular one at some point of time.

A usage example:

```
const validationOptions: VerificationsValidationOptions = {
  disableSubVerifications: VerificationsStatusV2.Red,
  expired:                 VerificationsStatusV2.Red,
  invalid:                 VerificationsStatusV2.Red,
  issued:                  VerificationsStatusV2.Yellow,
  missing:                 VerificationsStatusV2.Red,
  noIdentity:              VerificationsStatusV2.Red,
  notEnsRootOwner:         VerificationsStatusV2.Yellow,
  parentMissing:           VerificationsStatusV2.Yellow,
  parentUntrusted:         VerificationsStatusV2.Yellow,
  rejected:                VerificationsStatusV2.Red,
  selfIssued:              VerificationsStatusV2.Yellow,
};
const queryOptions: VerificationsQueryOptions = {
  validationOptions: validationOptions,
};
const nestedVerificationsV2 = await verifications.getNestedVerificationsV2(
  accounts[1], '/example1', false, queryOptions);
console.dir(nestedVerificationsV2);
// Output:
// { verifications:
//    [ { details:
//         { creationDate: 1561722858000,
//           ensAddress:
//            '4d2027082fdec4ee253363756eccb1b5492f61fb6329f25d8a7976d7909c10ac.
↪example1.verifications.evan',
//           id:
//            '0x855a3c10b9cd6d42da5fd5e9b61e0f98a5af79b1acbfee57a9e4f3c9721f9c5d',
//           issuer: '0x5035aEe29ea566F3296cdD97C29baB2b88C17c25',
//           issuerIdentity: '0xD2860FeC7A198A646f9fD1207B59aD42f00c3189',
//           subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757',
//           subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           subjectType: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//           topic: '/example1',
//           status: 'green' },
//        raw:
//         { creationBlock: '224038',
//           creationDate: '1561722858',
//           data:
//            '0x0000000000000000000000000000000000000000000000000000000000000000',
//           disableSubVerifications: false,
//           signature:
//
↪'0x941f316d77f5c1dc8b38000ecbb60304554ee2fb36453487ef7822ce6d8c7ce5267bb62396cfb08191028099de2e28d
↪',
//           status: 1,
//           topic:
//
↪'34884897835812838038558016063403566909277437558805531399344559176587016933548' },
//        statusFlags: [] } ],
//   levelComputed:
//    { subjectIdentity: '0x9F870954c615E4457660D22BE0F38FE0200b1Ed9',
//      subjectType: 'account',
```

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```
//      topic: '/example1',
//      subject: '0x9aE6533e7a2C732863C0aF792D5EA358518cd757' },
//   status: 'green' }
```

The variable `validationOptions` from the example is a set of rules for about how to interpret the `statusFlags` from the `verifications`. The last example no flags, but possible issues are tracked as status flags and are evaluated by given rules. The rules are explained in the respective interface and mostly match the warnings explained in the section below.

8.7.5 Warnings in Verifications

getNestedVerification returns a set of different warnings, that can be used to decide if a certification is valid or not. Those warnings are stored in the `.warnings` property, warnings, that can be returned are:

- `disableSubVerifications`: parent verification does not allow subverifications
- `expired`: verification has expired
- `invalid`: signature does not match requirements, this could be because it hasn't been signed by correct account or underlying checksum does not match `subject`, `topic` and `data`
- `issued`: verification has been issued, but not accepted or rejected by subject
- `missing`: verification has not been issued
- `noIdentity`: given subject has no identity
- `notEnsRootOwner`: verification path has a trusted root verification topic, but this verification is not signed by a trusted instance
- `parentMissing`: parent verification is missing in path
- `parentUntrusted`: verification path cannot be traced back to a trusted root verification
- `rejected`: verification has been issued and then rejected by subject
- `selfIssued`: verification issuer is the same account as the subject

---

8.7.6 Data in Verifications

Unencrypted Data in Verifications

Additional data can be given when creating a verification. For this pass an object, that can be serialized to JSON as the `verificationValue` argument to `setVerification`. As this argument is placed after the `expirationDate` argument, we set this argument as well.

```
const verificationId = await verifications.setVerification(
  accounts[0], accounts[1], '/example1', 0, { foo: 'bar' });
console.log(verificationId);
// Output:
// 0x5ea689a7ed1d56d948dc8223dcd60866746bc7bea47617c19b63df75d63c9194

const issued = await verifications.getVerifications(accounts[1], '/example1');
```

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```
console.dir(issued);
// Output:
// [ { creationBlock: '198673',
//     creationDate: '1559913567',
//     data:
//      '0xc710c57357d3862f351c00ff77a5ef90bb4491851f11c3e8ea010c16745c468e',
//     description: null,
//     disableSubVerifications: false,
//     expirationDate: null,
//     expired: false,
//     id:
//      '0x5ea689a7ed1d56d948dc8223dcd60866746bc7bea47617c19b63df75d63c9194',
//     issuer: '0x6d2b20d6bf2B848D64dFE0B386636CDbFC521d4f',
//     name: '/example1',
//     rejectReason: undefined,
//     signature:
//
↪'0xf7ce3cc2f50ef62783ef293f8f45814b3ae868e614042cc05154853d00a694c176f8bdd94700736a137f92ff9a87639
↪',
//     status: 0,
//     subject: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//     topic:
//      '34884897835812838038558016063403566909277437558805531399344559176587016933548
↪',
//     uri:
//      'https://ipfs.test.evan.network/ipfs/
↪Qmbjig3cZbUUufWqCEFzyCppqdnmQj3RoDjJWomnqYGy1f',
//     valid: true } ]

const data = JSON.parse(await dfs.get(issued[0].data));
console.dir(data);
// Output:
// { foo: 'bar' }
```

Encrypted Data in Verifications

Data added to the verification can be encrypted as well. Encryption is done outside of the verification service and has to be done before settin a verification and after getting the verification.

As key handling, storage and encryption itself is handled outside of the verification service, there are different ways for doing this. The suggested way to do this though, is using the *EncryptionWrapper*. See the example below and its documentation for how it can be used.

```
const unencrypted = {foo: 'bar'};
const cryptoInfo = await encryptionWrapper.getCryptoInfo('test',␣
↪EncryptionWrapperKeyType.Custom);
const key = await encryptionWrapper.generateKey(cryptoInfo);
const encrypted = await encryptionWrapper.encrypt(unencrypted, cryptoInfo, { key });

const verificationId = await verifications.setVerification(
  accounts[0], accounts[1], '/example1', 0, encrypted);
console.log(verificationId);
// Output:
// 0xdaa700acd52af1690c394445cc7908d01bef9a6c0c209dd4590cf869aa801586
```

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```
const issued = await verifications.getVerifications(accounts[1], '/example1');
console.dir(issued);
// Output:
// [ { creationBlock: '198706',
//     creationDate: '1559915070',
//     data:
//      '0xb2eca508b635094d642950d3715783d744eac6771ff665303196040c6778cbc3',
//     description: null,
//     disableSubVerifications: false,
//     expirationDate: null,
//     expired: false,
//     id:
//      '0xdaa700acd52af1690c394445cc7908d01bef9a6c0c209dd4590cf869aa801586',
//     issuer: '0x6d2b20d6bf2B848D64dFE0B386636CDbFC521d4f',
//     name: '/example1',
//     rejectReason: undefined,
//     signature:
//
↪'0x8ce1f239b254f2a4453e704cf5bd50f1aef215c5843408dc94ba3d128bba75d346a0b7945dd49f78b16cfd312ba51f6
↪',
//     status: 0,
//     subject: '0x0030C5e7394585400B1FB193DdbCb45a37Ab916E',
//     topic:
//      '34884897835812838038558016063403566909277437558805531399344559176587016933548
↪',
//     uri:
//      'https://ipfs.test.evan.network/ipfs/
↪QmaP6Zyz2Mw4uBX1veuxQJSnvZnG3MLFxLGrPxbc2Y4pnn',
//     valid: true } ]

const retrieved = JSON.parse(await dfs.get(issued[0].data));
console.dir(retrieved);
// Output:
// { private:
//    '017b0c07256180a69457f5c9a4e52431424532f698deaf401b754414bb070649',
//   cryptoInfo:
//    { algorithm: 'aes-256-cbc',
//      block: 198705,
//      originator: 'custom:test' } }

const decrypted = await encryptionWrapper.decrypt(retrieved, { key });
console.dir(decrypt);
// Output:
// { foo: 'bar' }
```

8.8 Verifications Examples - Full Output

This page shows the full output from the first nested verification example on *verification-usage-examples*.

```
[ { creationBlock: '188119',
    creationDate: 1558697814000,
    data:
     '0x0000000000000000000000000000000000000000000000000000000000000000',
```

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```
    description:
     { author: '0x0000000000000000000000000000000000000000',
       dbcpVersion: 1,
       description: '/example4/child/grandchild',
       name: '/example4/child/grandchild',
       version: '1.0.0',
       i18n: { name: { en: 'grandchild' } } },
    disableSubVerifications: false,
    expirationDate: null,
    expired: false,
    id:
     '0x1adef760f5a8d153aeeeda7a6e4f8c950fa93b0cb5d3218c6a9389cd05f5f7f6',
    issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
    name: '/example4/child/grandchild',
    rejectReason: undefined,
    signature:

↪'0x80e79018b417d750e5ed74f6180d7d5481e797e16835a829a0df860c57617a167ce9d678f73916937d777cb84d9e2605
↪',
    status: 0,
    subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
    topic:
     '31822021085297058095741669606963155991988970574619507474279247743587091547 5',
    uri: '',
    valid: true,
    displayName: 'grandchild',
    parent: '/example4/child',
    warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
    subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
    subjectType: 'account',
    issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
    ensAddress:
     '00b41b33a2396efb6fd434bc67d84b47a32eee9a9a275ee6384f5c32f2b12b93.example4.
↪verifications.evan',
    topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
    parents:
     [ { creationBlock: '188118',
         creationDate: 1558697805000,
         data:
          '0x0000000000000000000000000000000000000000000000000000000000000000',
         description:
          { author: '0x0000000000000000000000000000000000000000',
            dbcpVersion: 1,
            description: '/example4/child',
            name: '/example4/child',
            version: '1.0.0',
            i18n: { name: { en: 'child' } } },
         disableSubVerifications: false,
         expirationDate: null,
         expired: false,
         id:
          '0x28e1df758883bb3d4d5e7e0fa978ff673bc749ade0a3d78ad952a30d0a0e2a01',
         issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
         name: '/example4/child',
         rejectReason: undefined,
         signature:

↪'0x568770823b2b541c24deddfa403f82f883ac73cbdaae99d3b4a112bb36ec391d374d624115e2f94fe2072f180b0aa946
↪',
```

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```
        status: 0,
        subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
        topic:

↪'77917584097763165263567038986179239309321992426417843471841530443014147675245',
        uri: '',
        valid: true,
        displayName: 'child',
        parent: '/example4',
        warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
        subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
        subjectType: 'account',
        issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
        ensAddress:
         'ac43ca2dd23f1c08f2c2c6b22dcf233346588a5043ab7c4380656a2f7ac0146d.example4.
↪verifications.evan',
        topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
        parents:
         [ { creationBlock: '188117',
             creationDate: 1558697790000,
             data:
              '0x0000000000000000000000000000000000000000000000000000000000000000',
             description:
              { author: '0x0000000000000000000000000000000000000000',
                dbcpVersion: 1,
                description: '/example4',
                name: '/example4',
                version: '1.0.0',
                i18n: { name: { en: 'example4' } } },
             disableSubVerifications: false,
             expirationDate: null,
             expired: false,
             id:
              '0x18fb0ef05d96cba2a57c6de6d8cfd031e16367f6484f20797a39d25a3e76e20a',
             issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
             name: '/example4',
             rejectReason: undefined,
             signature:

↪'0x081dec25292eeea7a969ec662a85b4160b8090227afff998c71d14d49f669e192569b4b76d5adbf4e7f9883bc560fdb5
↪',
             status: 0,
             subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
             topic:

↪'66865638538889962651480090943794875041354346360740147141539983678449951391661',
             uri: '',
             valid: true,
             displayName: 'example4',
             parent: '',
             warnings: [ 'issued' ],
             subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
             subjectType: 'account',
             issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
             ensAddress:
              '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
```

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```
            topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
            parents: [],
            levelComputed:
             { creationDate: 1558697790000,
               disableSubVerifications: false,
               displayName: 'example4',
               loading: false,
               name: '/example4',
               status: 0,
               subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
               verifications: [Circular],
               warnings: [ 'issued' ],
               description:
                { author: '0x0000000000000000000000000000000000000000',
                  dbcpVersion: 1,
                  description: '/example4',
                  name: '/example4',
                  version: '1.0.0',
                  i18n: { name: { en: 'example4' } } },
               ensAddress:
                '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
               topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
               expirationDate: null } } ],
        parentComputed:
         { creationDate: 1558697790000,
           disableSubVerifications: false,
           displayName: 'example4',
           loading: false,
           name: '/example4',
           status: 0,
           subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
           verifications:
            [ { creationBlock: '188117',
                creationDate: 1558697790000,
                data:
                 '0x0000000000000000000000000000000000000000000000000000000000000000
↪',
                description:
                 { author: '0x0000000000000000000000000000000000000000',
                   dbcpVersion: 1,
                   description: '/example4',
                   name: '/example4',
                   version: '1.0.0',
                   i18n: { name: { en: 'example4' } } },
                disableSubVerifications: false,
                expirationDate: null,
                expired: false,
                id:
                 '0x18fb0ef05d96cba2a57c6de6d8cfd031e16367f6484f20797a39d25a3e76e20a
↪',
                issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                name: '/example4',
                rejectReason: undefined,
                signature:

↪'0x081dec25292eeea7a969ec662a85b4160b8090227afff998c71d14d49f669e192569b4b76d5adbf4e7f9883bc560fdb5
↪',
```

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```
                status: 0,
                subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
                topic:

↪'6686563853888996265148009094379487504135434636074014714153998367844995139166 1',
                uri: '',
                valid: true,
                displayName: 'example4',
                parent: '',
                warnings: [ 'issued' ],
                subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                subjectType: 'account',
                issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
                ensAddress:
                 '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
                topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                parents: [],
                levelComputed:
                 { creationDate: 1558697790000,
                   disableSubVerifications: false,
                   displayName: 'example4',
                   loading: false,
                   name: '/example4',
                   status: 0,
                   subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
                   verifications: [Circular],
                   warnings: [ 'issued' ],
                   description:
                    { author: '0x0000000000000000000000000000000000000000',
                      dbcpVersion: 1,
                      description: '/example4',
                      name: '/example4',
                      version: '1.0.0',
                      i18n: { name: { en: 'example4' } } },
                   ensAddress:

↪'93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.example4.
↪verifications.evan',
                   topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                   expirationDate: null } } ],
            warnings: [ 'issued' ],
            description:
             { author: '0x0000000000000000000000000000000000000000',
               dbcpVersion: 1,
               description: '/example4',
               name: '/example4',
               version: '1.0.0',
               i18n: { name: { en: 'example4' } } },
            ensAddress:
             '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
            topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
            expirationDate: null },
         levelComputed:
          { creationDate: 1558697805000,
            disableSubVerifications: false,
```

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```
            displayName: 'child',
            loading: false,
            name: '/example4/child',
            status: 0,
            subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
            verifications: [Circular],
            warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
            description:
             { author: '0x0000000000000000000000000000000000000000',
               dbcpVersion: 1,
               description: '/example4/child',
               name: '/example4/child',
               version: '1.0.0',
               i18n: { name: { en: 'child' } } },
            ensAddress:
             'ac43ca2dd23f1c08f2c2c6b22dcf233346588a5043ab7c4380656a2f7ac0146d.
↪example4.verifications.evan',
            topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
            expirationDate: null } } ],
   parentComputed:
    { creationDate: 1558697805000,
      disableSubVerifications: false,
      displayName: 'child',
      loading: false,
      name: '/example4/child',
      status: 0,
      subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
      verifications:
       [ { creationBlock: '188118',
           creationDate: 1558697805000,
           data:
            '0x0000000000000000000000000000000000000000000000000000000000000000',
           description:
            { author: '0x0000000000000000000000000000000000000000',
              dbcpVersion: 1,
              description: '/example4/child',
              name: '/example4/child',
              version: '1.0.0',
              i18n: { name: { en: 'child' } } },
           disableSubVerifications: false,
           expirationDate: null,
           expired: false,
           id:
            '0x28e1df758883bb3d4d5e7e0fa978ff673bc749ade0a3d78ad952a30d0a0e2a01',
           issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
           name: '/example4/child',
           rejectReason: undefined,
           signature:

↪'0x568770823b2b541c24deddfa403f82f883ac73cbdaae99d3b4a112bb36ec391d374c824f15e279474f072f180b0aa94
↪',
           status: 0,
           subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
           topic:

↪'77917584097763165263567038986179239309321992426417843471841530443014147675245',
           uri: '',
```

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```
            valid: true,
            displayName: 'child',
            parent: '/example4',
            warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
            subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
            subjectType: 'account',
            issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
            ensAddress:
             'ac43ca2dd23f1c08f2c2c6b22dcf233346588a5043ab7c4380656a2f7ac0146d.
↪example4.verifications.evan',
            topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
            parents:
             [ { creationBlock: '188117',
                 creationDate: 1558697790000,
                 data:
                  '0x00000000000000000000000000000000000000000000000000000000000000000000000000000
↪',
                 description:
                  { author: '0x0000000000000000000000000000000000000000',
                    dbcpVersion: 1,
                    description: '/example4',
                    name: '/example4',
                    version: '1.0.0',
                    i18n: { name: { en: 'example4' } } },
                 disableSubVerifications: false,
                 expirationDate: null,
                 expired: false,
                 id:
                  '0x18fb0ef05d96cba2a57c6de6d8cfd031e16367f6484f20797a39d25a3e76e20a
↪',
                 issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                 name: '/example4',
                 rejectReason: undefined,
                 signature:

↪'0x081dec25292eeea7a969ec662a85b4160b8090227afff998c71d14d49f669e192569b4b76d5adbf4e7f9883bc560fdb5
↪',
                 status: 0,
                 subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
                 topic:

↪'668656385388899626514800909437948750413543463607401471415399836784499513916 61',
                 uri: '',
                 valid: true,
                 displayName: 'example4',
                 parent: '',
                 warnings: [ 'issued' ],
                 subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                 subjectType: 'account',
                 issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
                 ensAddress:
                  '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
                 topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                 parents: [],
                 levelComputed:
                  { creationDate: 1558697790000,
```

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```
                    disableSubVerifications: false,
                    displayName: 'example4',
                    loading: false,
                    name: '/example4',
                    status: 0,
                    subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
                    verifications: [Circular],
                    warnings: [ 'issued' ],
                    description:
                     { author: '0x0000000000000000000000000000000000000000',
                       dbcpVersion: 1,
                       description: '/example4',
                       name: '/example4',
                       version: '1.0.0',
                       i18n: { name: { en: 'example4' } } },
                    ensAddress:

↪'93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.example4.
↪verifications.evan',
                    topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                    expirationDate: null } } ],
            parentComputed:
             { creationDate: 1558697790000,
               disableSubVerifications: false,
               displayName: 'example4',
               loading: false,
               name: '/example4',
               status: 0,
               subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
               verifications:
                [ { creationBlock: '188117',
                    creationDate: 1558697790000,
                    data:

↪'0x0000000000000000000000000000000000000000000000000000000000000000',
                    description:
                     { author: '0x0000000000000000000000000000000000000000',
                       dbcpVersion: 1,
                       description: '/example4',
                       name: '/example4',
                       version: '1.0.0',
                       i18n: { name: { en: 'example4' } } },
                    disableSubVerifications: false,
                    expirationDate: null,
                    expired: false,
                    id:

↪'0x18fb0ef05d96cba2a57c6de6d8cfd031e16367f6484f20797a39d25a3e76e20a',
                    issuer: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                    name: '/example4',
                    rejectReason: undefined,
                    signature:

↪'0x081dec25292eeea7a969ec662a85b4160b8090227afff998c71d14d49f669e192569b4b76d5adbf4e7f9883bc560fdb5
↪',
                    status: 0,
                    subject: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
```

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```
                    topic:
↪'66865638538889962651480090943794875041354346360740147141539983678449951391661',
                    uri: '',
                    valid: true,
                    displayName: 'example4',
                    parent: '',
                    warnings: [ 'issued' ],
                    subjectIdentity: '0xe560eF0954A2d61D6006E8547EC769fAc322bbCE',
                    subjectType: 'account',
                    issuerAccount: '0x001De828935e8c7e4cb56Fe610495cAe63fb2612',
                    ensAddress:
↪'93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.example4.
↪verifications.evan',
                    topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                    parents: [],
                    levelComputed:
                     { creationDate: 1558697790000,
                       disableSubVerifications: false,
                       displayName: 'example4',
                       loading: false,
                       name: '/example4',
                       status: 0,
                       subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
                       verifications: [Circular],
                       warnings: [ 'issued' ],
                       description:
                        { author: '0x0000000000000000000000000000000000000000',
                          dbcpVersion: 1,
                          description: '/example4',
                          name: '/example4',
                          version: '1.0.0',
                          i18n: { name: { en: 'example4' } } },
                       ensAddress:
↪'93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.example4.
↪verifications.evan',
                       topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
                       expirationDate: null } } ],
               warnings: [ 'issued' ],
               description:
                { author: '0x0000000000000000000000000000000000000000',
                  dbcpVersion: 1,
                  description: '/example4',
                  name: '/example4',
                  version: '1.0.0',
                  i18n: { name: { en: 'example4' } } },
               ensAddress:
                '93d49c39618452a1dcf4a52f91c7d50634851b5082233671e10070a3c73b3fad.
↪example4.verifications.evan',
               topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
               expirationDate: null },
            levelComputed:
             { creationDate: 1558697805000,
               disableSubVerifications: false,
               displayName: 'child',
```

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```
              loading: false,
              name: '/example4/child',
              status: 0,
              subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
              verifications: [Circular],
              warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
              description:
               { author: '0x0000000000000000000000000000000000000000',
                 dbcpVersion: 1,
                 description: '/example4/child',
                 name: '/example4/child',
                 version: '1.0.0',
                 i18n: { name: { en: 'child' } } },
              ensAddress:
               'ac43ca2dd23f1c08f2c2c6b22dcf233346588a5043ab7c4380656a2f7ac0146d.
↪example4.verifications.evan',
              topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
              expirationDate: null } } ],
      warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
      description:
       { author: '0x0000000000000000000000000000000000000000',
         dbcpVersion: 1,
         description: '/example4/child',
         name: '/example4/child',
         version: '1.0.0',
         i18n: { name: { en: 'child' } } },
      ensAddress:
       'ac43ca2dd23f1c08f2c2c6b22dcf233346588a5043ab7c4380656a2f7ac0146d.example4.
↪verifications.evan',
      topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
      expirationDate: null },
   levelComputed:
    { creationDate: 1558697814000,
      disableSubVerifications: false,
      displayName: 'grandchild',
      loading: false,
      name: '/example4/child/grandchild',
      status: 0,
      subjects: [ '0x001De828935e8c7e4cb56Fe610495cAe63fb2612' ],
      verifications: [Circular],
      warnings: [ 'issued', 'selfIssued', 'parentUntrusted' ],
      description:
       { author: '0x0000000000000000000000000000000000000000',
         dbcpVersion: 1,
         description: '/example4/child/grandchild',
         name: '/example4/child/grandchild',
         version: '1.0.0',
         i18n: { name: { en: 'grandchild' } } },
      ensAddress:
       '00b41b33a2396efb6fd434bc67d84b47a32eee9a9a275ee6384f5c32f2b12b93.example4.
↪verifications.evan',
      topLevelEnsOwner: '0x0000000000000000000000000000000000000000',
      expirationDate: null } } ]
```

8.9 DID

Class Name	Did
Extends	Logger
Source	did.ts
Tests	did.spec.ts

The *Did* module allows to interact with DIDs on evan.network. As development of identity and DID handling on evan.network is an ongoing process, this document describes the current interoperability of DIDs on evan.network and can be seen as a work-in-progress state of the current implementation.

8.9.1 constructor

```
new Did(options);
```

Creates a new *Did* instance.

Parameters

1. **`options` - `DidOptions`: options for Did constructor.**
    - `accountStore` - `AccountStore`: `AccountStore` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance
    - `dfs` - `DfsInterface`: `DfsInterface` instance
    - `executor` - `Executor`: `Executor` instance
    - `nameResolver` - `NameResolver`: `NameResolver` instance
    - `signerIdentity` - `SignerIdentity`: `SignerIdentity` instance
    - `web3` - `Web3`: `Web3` instance
    - `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
    - `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
    - `logLog` - `LogLogInterface` (optional): container for collecting log messages
    - `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`
2. **`config` - `DidConfig` (optional): description, defaults to `123`**
    - `registryAddress` - `string` (optional): contract address or ENS name for *DidRegistry*

Returns

`Did` instance

Example

```
const did = new Did({
  contractLoader,
  dfs,
  executor,
  nameResolver,
  signerIdentity,
  web3,
});
```

8.9.2 = Working with DID documents =

8.9.3 deactivateDidDocument

```
did.deactivateDidDocument(didToDeactivate);
```

Unlinks the current DID document from the given DID

Parameters

1. `did` - `string`: DID to unlink the DID document from

Returns

`Promise` returns `void`: Resolves when done

Example

```
const twinIdentity = '0x1234512345123451234512345123451234512345';
const twinDid = await runtime.did.convertIdentityToDid(twinIdentity);
await runtime.did.deactivateDidDocument(twinDid);
```

8.9.4 didIsDeactivated

```
did.didIsDeactivated(didToCheck);
```

Gets the deactivation status of a DID.

Parameters

1. `did` - `string`: DID to check

Returns

`Promise` returns `boolean`: True if the DID has been deactivated

Example

```
const twinIdentity = '0x12345123451234512345123451234512345';
const twinDid = await runtime.did.convertIdentityToDid(twinIdentity);
await runtime.did.deactivateDidDocument(twinDid);
console.log(await runtime.did.didIsDeactivated(twinDid));
// Output: true
```

8.9.5 getDidDocument

```
did.getDidDocument(myDid);
```

Get DID document for given DID. If the DID has a proof property, *getDidDocument* will attempt to validate the proof and throw an error if the proof is invalid.

Parameters

1. `did` - `string`: DID to fetch DID document for.

Returns

`Promise` returns `DidDocument`: A DID document. For deactivated DIDs it returns a default DID document containing no authentication material.

Example

```
const identity = await runtime.verifications.getIdentityForAccount(accountsId, true);
const did = await runtime.did.convertIdentityToDid(identity);
const document = await runtime.did.getDidDocumentTemplate();
await runtime.did.setDidDocument(did, document);
const retrieved = await runtime.did.getDidDocument(did);
```

8.9.6 getService

```
did.getService(myDid);
```

Get the services from a DID document.

Parameters

1. `did` - `string`: DID to fetch DID service for.

Returns

`Promise` returns `DidServiceEntry[]`: Array of services.

Example

```
const document = await runtime.did.getDidDocumentTemplate();
const identity = await runtime.verifications.getIdentityForAccount(account, true);
const did = await runtime.did.convertIdentityToDid(identity);
await runtime.did.setDidDocument(did, document);
const service = {
  id: `${did}#randomService`,
  type: `randomService-${random}`,
  serviceEndpoint: `https://openid.example.com/${random}`,
};
await runtime.did.setService(did, service);
const retrieved = await runtime.did.getService(did);
```

8.9.7 setDidDocument

```
did.setDidDocument(myDid, document);
```

Store given DID document for given DID. If the document misses the property *created*, it will automatically be appended. The *updated* property will be updated accordingly. A proof over the DID document will be generated automatically and appended to the document.

Parameters

1. `did` - `string`: DID to store DID document for
2. `document` - `DidDocument`: DID document to store, `getDidDocumentTemplate` can be used as a starting point for DID documents

Returns

`Promise` returns `void`: resolved when done

Example

```
const identity = await runtime.verifications.getIdentityForAccount(accountsId, true);
const did = await runtime.did.convertIdentityToDid(identity);
const document = await runtime.did.getDidDocumentTemplate();
await runtime.did.setDidDocument(did, document);
```

8.9.8 setService

```
did.setService(myDid, service);
```

Sets service in DID document. Overrides old services, so make sure to include current service if you only want to add a service.

Parameters

1. `did` - `string`: DID name to set service for
2. `service` - `DidServiceEntry[] | DidServiceEntry`: service or array of services to set

Returns

`Promise` returns `void`: resolved when done

Example

```
const document = await runtime.did.getDidDocumentTemplate();
const identity = await runtime.verifications.getIdentityForAccount(account, true);
const did = await runtime.did.convertIdentityToDid(identity);
await runtime.did.setDidDocument(did, document);
const service = {
  id: `${did}#randomService`,
  type: `randomService-${random}`,
  serviceEndpoint: `https://openid.example.com/${random}`,
};
await runtime.did.setService(did, service);
```

8.9.9 = utilities =

8.9.10 convertDidToIdentity

```
did.convertDidToIdentity(didToConvert);
```

Converts given DID to a evan.network identity.

Parameters

1. `did` - `string`: a DID like "did:evan:testcore:0x0000000000000000000000000000000000001234"

Returns

`Promise` returns `string`: evan.network identity like "0x0000000000000000000000000000000000001234"

Example

```
const did = 'did:evan:testcore:0x0000000000000000000000000000000000001234';
const identity = await did.convertDidToIdentity(did);
console.log(identity);
// Output:
// 0x0000000000000000000000000000000000001234
```

8.9.11 convertIdentityToDid

```
did.convertIdentityToDid(identityToConvert);
```

Converts given evan.network identity hash to DID.

Parameters

1. `identity` - `string`: evan.network identity like "0x0000000000000000000000000000000000001234"

Returns

`Promise` returns `string`: a DID like "did:evan:testcore:0x0000000000000000000000000000000000001234"

Example

```
const identity = '0x0000000000000000000000000000000000001234';
const did = await did.convertIdentityToDid(identity);
console.log(did);
// Output:
// did:evan:testcore:0x0000000000000000000000000000000000001234
```

8.9.12 getDidDocumentTemplate

```
did.getDidDocumentTemplate();
```

Gets a DID document for currently configured identity. Notice, that this document may a complete DID document for currently configured active identity, a part of it or not matching it at all. You can use the result of this function to build a new DID document but should extend it or an existing DID document, if your details derive from default format.

All three arguments are optional. When they are used, all of them have to be given and the result then describes a contracts DID document. If all of them are omitted the result describes an accounts DID document.

Parameters

1. `did` - `string` (optional): contract DID
2. `controllerDid` - `string` (optional): controller of contracts identity (DID)
3. `authenticationKey` - `string` (optional): authentication key used for contract

Returns

`Promise` returns `DidDocumentTemplate`: template for DID document

Example

```
const document = await runtime.did.getDidDocumentTemplate();
console.log(JSON.stringify(document, null, 2));
// Output:
// {
//   "@context": "https://w3id.org/did/v1",
//   "id": "did:evan:testcore:0x126E901F6F408f5E260d95c62E7c73D9B60fd734",
//   "publicKey": [
//     {
//       "id": "did:evan:testcore:0x126E901F6F408f5E260d95c62E7c73D9B60fd734#key-1",
//       "type": "Secp256k1VerificationKey2018",
//       "controller": "did:evan:testcore:0x126E901F6F408f5E260d95c62E7c73D9B60fd734",
//       "ethereumAddress": "0x126E901F6F408f5E260d95c62E7c73D9B60fd734"
//     }
//   ],
//   "authentication": [
//     "did:evan:testcore:0x126E901F6F408f5E260d95c62E7c73D9B60fd734#key-1"
//   ]
// }
```

8.10 VC

Class Name	Vc
Extends	Logger
Source	vc.ts
Tests	vc.spec.ts

The *Vc* module allows to create, store, retrieve and revoke VCs on evan.network. As development of identities, and DID and VC handling on evan.network is an ongoing process, this document describes the current interoperability of VCs on evan.network and can be seen as a work-in-progress state of the current implementation.

8.10.1 constructor

```
new Vc(options, did);
```

Creates a new *Vc* instance.

Parameters

1. **`options` - `VcOptions`: options for Vc constructor.**
    - `accountStore` - `AccountStore`: `AccountStore` instance
    - `contractLoader` - `ContractLoader`: `ContractLoader` instance

- `dfs` - `DfsInterface`: `DfsInterface` instance
- `did` - `Did`: `Did` instance for resolving and validating
- `executor` - `Executor`: `Executor` instance
- `nameResolver` - `NameResolver`: `NameResolver` instance
- `signerIdentity` - `SignerIdentity`: `SignerIdentity` instance
- `verifications` - `Verifications`: `Verifications` instance
- `web3` - `Web3`: `Web3` instance
- `log` - `Function` (optional): function to use for logging: `(message, level) => {...}`
- `logLevel` - `LogLevel` (optional): messages with this level will be logged with `log`
- `logLog` - `LogLogInterface` (optional): container for collecting log messages
- `logLogLevel` - `LogLevel` (optional): messages with this level will be pushed to `logLog`

2. **`config` - `VcConfig`: custom configuration for Vc constructor.**
   - `credentialStatusEndpoint` - `string`: URL of the credential status endpoint

Returns

`Vc` instance

Example

```
const vc = new Vc(
  {
    accountStore,
    contractLoader,
    dfs,
    did,
    executor,
    nameResolver,
    signerIdentity,
    verifications,
    web3,
  },
  { credentialStatusEndpoint },
);
```

8.10.2 = Working with VC documents =

8.10.3 createId

Claim a new ID in the VC registry which can be used later to store a VC **on-chain**.

```
vc.createId();
```

Returns

`Promise` returns `string`: A new ID string

Example

```
const newRegisteredId = await runtime.vc.createId();
const myVcDocument = {
  // Data here,
  id: newRegisteredId
};
await runtime.vc.storeVc(myVcDocument);
```

8.10.4 createVc

Create a signed **off-chain** VC document

```
vc.createVc(vcData);
```

Parameters

1. `vcData` - *DocumentTemplate*: Collection of mandatory and optional VC properties to store in the VC document

Returns

`Promise` returns `VcDocument`: The final VC document

Example

```
const minimalVcData = {
    id: 'randomCustomId',
    issuer: {
      did: 'someDid',
    },
    credentialSubject: {
      did: 'someOtherDid',
    },
    validFrom: new Date(Date.now()).toISOString()
};
const offchainVc = await runtime.vc.createVc(minimalVcData);
```

8.10.5 getVc

Get VC document for given VC ID.

```
vc.getVc(vcId, encryptionInfo);
```

Parameters

1. `vcId` - `string`: ID to fetch VC document for. Can be either a full VC URI (starting with `vc:evan:`) or just the VC ID (starting with `0x`)
2. `encryptionInfo` - *EncryptionInfo*: (optional): Information required for decryption

Returns

`Promise` returns `VcDocument`: A VC document

Example

```
const storedVcDoc = await vc.getVc(
↪'0x2a838a6961be98f6a182f375bb9158848ee9760ca97a379939ccdf03fc442a23');
const otherStoredVcDoc = await vc.getVc(
↪'vc:evan:testcore:0x2a838a6961be98f6a182f375bb9158848ee9760ca97a379939ccdf03fc442a23
↪');

// using encryption
encryptionInfo = { key: vcKey };
const EncryptedVcDoc = await vc.getVc(
↪'vc:evan:testcore:0x5f7514378963d3a1211a3b015c51dd9fbd1e52d66a2fbb411fcdf80fdfd7bbd4
↪', encryptionInfo);
```

8.10.6 storeVc

```
vc.storeVc(vcData, encryptionInfo);
```

Create a new VC that holds the given data and **store it on the chain**. Whether a new ID should be registered with the VC registry or the given ID in the document should be used depends of if `vcData.id` is set. If set, the method calls `createId()` to generate a new ID.

Parameters

1. `vcData` - *DocumentTemplate*: Collection of mandatory and optional VC properties to store in the VC document
2. `encryptionInfo` - *EncryptionInfo*: (optional): Information required for encryption

Returns

`Promise` returns `VcDocument`: Returns the VC document as stored on the chain.

Example

```
const minimalVcData = {
    issuer: {
      did: 'someDid',
    },
    credentialSubject: {
      did: 'someOtherDid',
    },
    validFrom: new Date(Date.now()).toISOString()
};
const createdVcDoc = await runtime.vc.storeVc(minimalVcData);
const permanentVcAddress = createdVcDoc.id;
```

```
const myRegisteredId = await runtime.vc.createId();
const minimalVcData = {
    issuer: {
      did: 'someDid',
    },
    credentialSubject: {
      did: 'someOtherDid'
    },
    validFrom: new Date(Date.now()).toISOString()
};
minimalVcData.id = myRegisteredId;
const createdVcDoc = await runtime.vc.storeVc(minimalVcData);
const permanentVcAddress = createdVcDoc.id;
```

8.10.7 revokeVc

```
vc.revokeVc(vcId);
```

Sets a revoke status flag for the VC.

Parameters

1. `vcId` - `string`: ID for VC document to be revoked.

Returns

`Promise` returns `void`: resolved when done

Example

```
const storedVcDoc = await vc.getVc(permanentVcAddress);
const vcId = storedVcDoc.id;

const revokeProcessed = await vc.revokeVc(vcId);
```

8.10.8 getRevokeVcStatus

```
vc.getRevokeVcStatus(vcId);
```

Gets the revoke status flag for the VC.

Parameters

1. `vcId - string`: ID for VC document whose status needs to be retrieved.

Returns

`Promise` returns `bool`: true for revoked, false for not revoked

Example

```
const storedVcDoc = await vc.getVc(permanentVcAddress);
const vcId = storedVcDoc.id;

const vcRevokeStatus = await vc.getRevokeVcStatus(vcId);
```

8.10.9 Additional Components

8.10.10 Interfaces

EncryptionInfo

configuration settings required for the encryption and decryption

1. `key-string`: the encryption key required for encrypting and decrypting the VC

DocumentTemplate

Template for the VC document containing the relevant data

1. `id-string`: the id of the VC
2. `type-string`: set of unordered URIs
3. `issuer-` *VcIssuer*: VC issuer details
4. `validFrom-string`: date from which the VC is valid
5. `validUntil-string` (optional): date until which the VC is valid
6. `credentialSubject-` *VcCredentialSubject*: subject details of VC
7. `credentialStatus-` *VcCredentialStatus* (optional): details regarding the status of VC
8. `proof-` *VcProof* (optional): proof of the respective VC

VcIssuer

Template for the VC Issuer containing the relevant data

1. `id-string`: the id of the issuer
2. `name-string` (optional): name of the issuer

VcCredentialSubject

Template for the VC credential subject containing the relevant data

1. `id-string`: the id of the subject
2. `data-VcCredentialSubjectPayload` (optional): data payload for subject
3. `description-string` (optional): description about subject
4. `uri-string` (optional): uri of subject

VcCredentialStatus

Template for the VC credential status containing the status data

1. `id-string`: the id of the VC
2. `type-string`: VC status type

VcProof

proof for VC, contains JWS and metadata

1. `type-string`: VC status type
2. `created-string`: date when the proof was created
3. `proofPurpose-string`: purpose of the proof
4. `verificationmethod-string`: method used for verification
5. `jws-string`: JSON Web Signature

Profiles are personal data for accounts. They can be shared with other accounts or used for storing own data. This section contains modules for maintaining profile and interacting with profiles from other accounts.

Two types of profiles are supported:

- personal profiles, that hold users data like contacts, bookmarks, encryption keys
- business center profiles, that are like contact cards and hold data intended for other participants