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Canis Major

Notarization of digital twin data exchanges using blockchain

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Open APIs for Open Minds

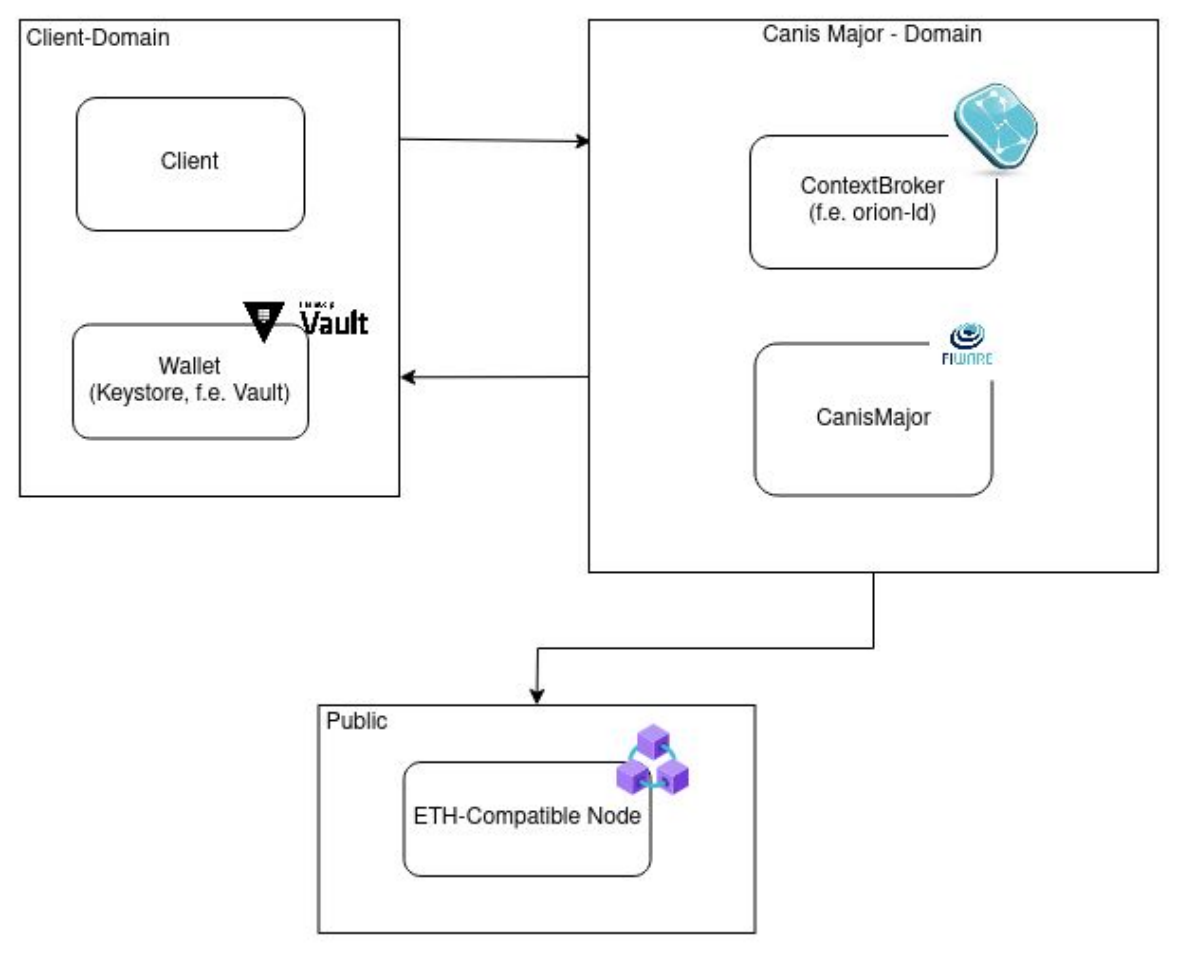
Canis Major

- What it is:
  - an adaptor for notarizing NGSI-LD interactions on Blockchain
  - interface to query notarized transactions for entities
- What it is not:
  - a general connector to Blockchain
  - a storage component for NGSI-LD entities on the Blockchain

Features

- notarization on ETH-compatible blockchains
- notarization for a sub-set of the NGSI-LD API:
  - single entity creation (POST /ngsi-ld/v1/entities/)
  - batch creation (POST /ngsi-ld/v1/entityOperations/upsert)
  - attribute level updates (POST /ngsi-ld/v1/entities/{entityId}/attrs)
  - entity retrieval (GET /ngsi-ld/v1/entities/{entityId})
  - querying (GET /ngsi-ld/v1/entities/)
- storage of the transaction history off-chain in the ContextBroker
- dedicated query-api for transaction data by entities

Overview


Client-Domain
Client
Wallet
(Keystore, f.e. Vault)
Vault
Canis Major - Domain
ContextBroker
(f.e. orion-ld)
CanisMajor
Public
ETH-Compatible Node

Storage

- in order to reduce costs and data leakage, only hashes stored on the Blockchain
- transaction-receipts stored in the broker
  - SmartDatamodel for distributed ledger -> https://github.com/smart-data-models/dataModel.DistributedLedgerTech
  - reference to the original entity
  - allows query by entity
  - change history of an entity can be reproduced and validated through temporal
- Original entity stays untouched

TransactionReceipt Entity


```
{
        "@context": "https://uri.etsi.org/ngsi-ld/v1/ngsi-ld-core-context.jsonld",
        "id": "urn:ngsi-ld:dlttxreceipt:0x3371009d971c0cb2712032d283077e3dff025ce13f8f79bb4f347cfb84e44218",
        "type": "https://smartdatamodels.org/dataModel.DistributedLedgerTech/DLTtxReceipt",
        "https://smartdatamodels.org/dataModel.DistributedLedgerTech/refEntity": {
                "type": "Relationship",
                "object": "urn:ngsi-ld:Packet:packet-1"
        },
        "https://smartdatamodels.org/dataModel.DistributedLedgerTech/TxReceipts": {
                "type": "Property",
                "value": {
                        "blockHash": "0xdc3e80407fa9d3b12268eef903024781dc282a9b92a408a2802921c8d14b84d7",
                        "blockNumber": 4,
                        "blockNumberRaw": "0x4",
                        "cumulativeGasUsed": 23866,
                        "cumulativeGasUsedRaw": "0x5d3a",
                        "from": "0xa508dd875f10c33c52a8abb20e16fc68e981f186", <- address of the signee
                        "gasUsed": 23866,
                        "gasUsedRaw": "0x5d3a",
                        ….
                        "status": "0x1",
                        "statusOK": true,
                        "to": "0x476059cd57800db8eb88f67c2aa38a6fcf8251e0",
                        "transactionHash": "0x3371009d971c0cb2712032d283077e3dff025ce13f8f79bb4f347cfb84e44218",
                        "transactionIndex": 0,
                        "transactionIndexRaw": "0x0"
                }
        }
}
```

Query API

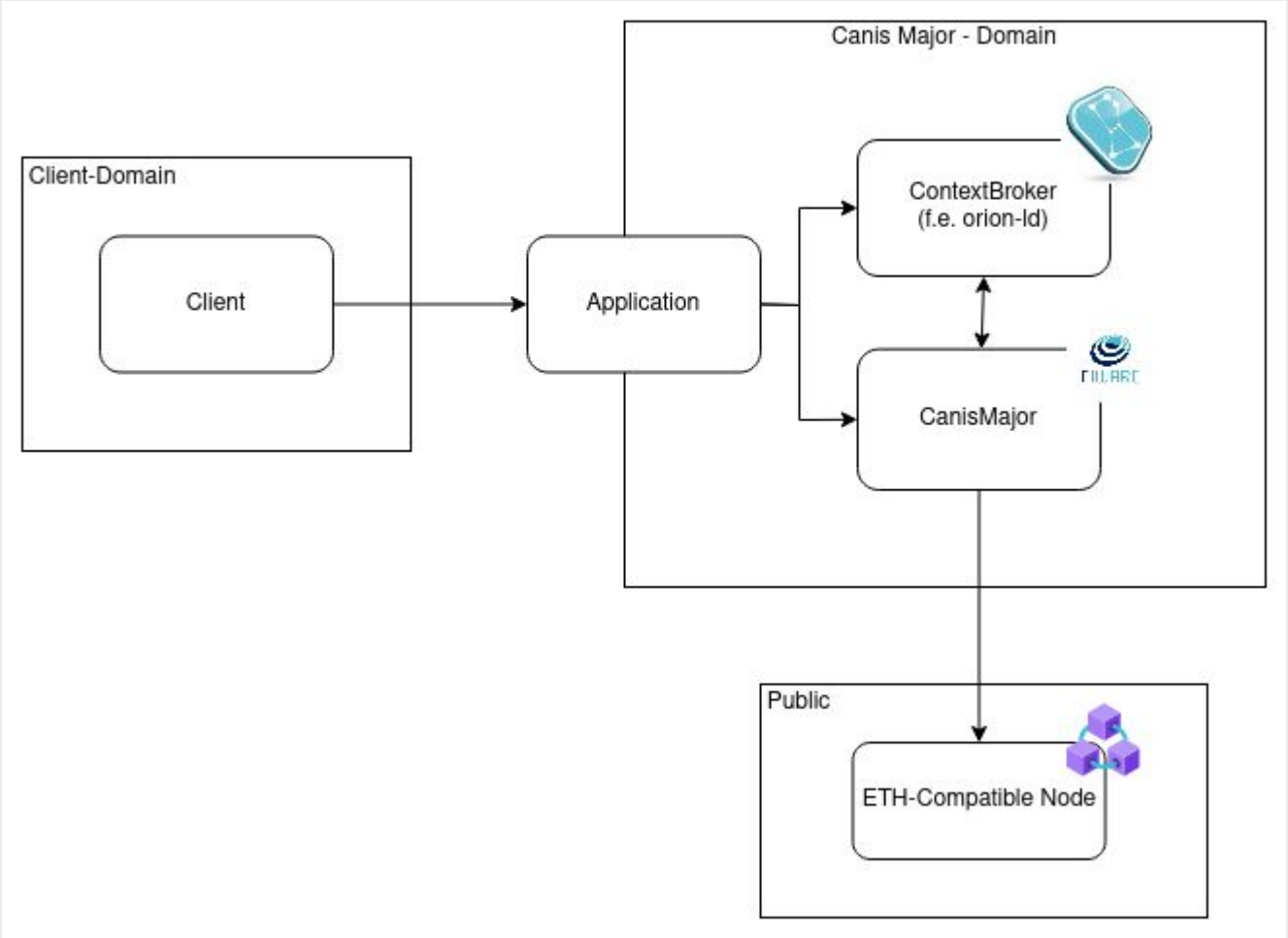
- Canis Major provides two convenience APIs:
  - get all entities with transactions
  - get all transactions for an entity

```
{
	"records": [
		{
		"entityId" : "urn:ngsi-ld:packet:1",
		"txDetails": [
			{
				"transactionHash": "0x3371009d971c0cb2712032d283077e3dff025ce13f8f79bb4f347cfb84e44218",
				"from": "0xa508dd875f10c33c52a8abb20e16fc68e981f186",
				…
			},
			{ another transaction }
		]},
		{
			another entity
		}
	],
	<pagination information>
}
```

Key Management

- every Transaction has to be signed
- 2 modes supported:
  - signed by the requestor
    - more responsibility for the requestor
    - slower
    - no trust in central entity required
  - signed by a “default”-account
    - transparent to the requestor
    - faster
    - trust in the central entity(runnig Canis Major) required, no real benefit from Blockchain integration

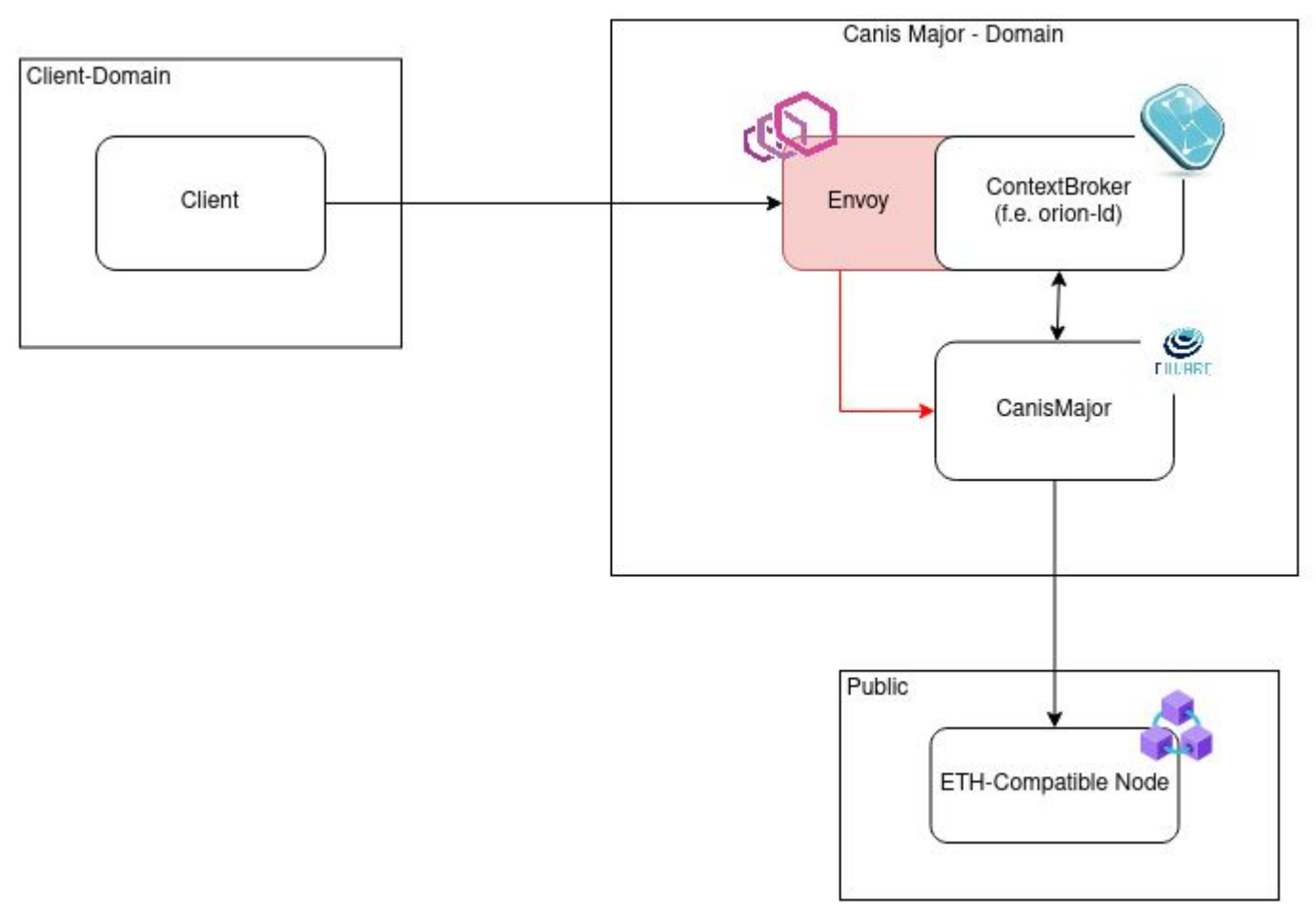
Demo - Simple


Canis Major - Domain
Client-Domain
Client
Application
ContextBroker
(f.e. orion-ld)
CanisMajor
Public
ETH-Compatible Node

Demo - Simple Scenario

- every transaction is signed with the default-account
- the Application has to take care of sending the request to:
  - the broker
  - Canis Major
- Application has to take care of transactionallity between Context Broker and Canis Major updates
- transaction history cannot show “who”

Demo - Proxy Integration



Demo - Proxy Integration

- every transaction is signed with the default-account
- client communicates directly with the Context Broker
- Front-Proxy(envoy) intercepts all incoming requests
- Front-Proxy is responsible for
  - handling communication with Canis Major
  - forwarding the requests to the Context Broker
- transparent to the client

Demo - Proxy Integration

- 2 modes supported:
  - strict:
    - Context Broker request is delayed until Canis Major confirms notarization
    - slows down the request, due to the sequential request
    - guarantees that every change is notarized
  - best-effort:
    - Canis Major and Context Broker request performed in parallel
    - faster, due to parallelism
    - no guarantee that every request is notarized
      - client get informed, needs to handle potential failed notarization itself

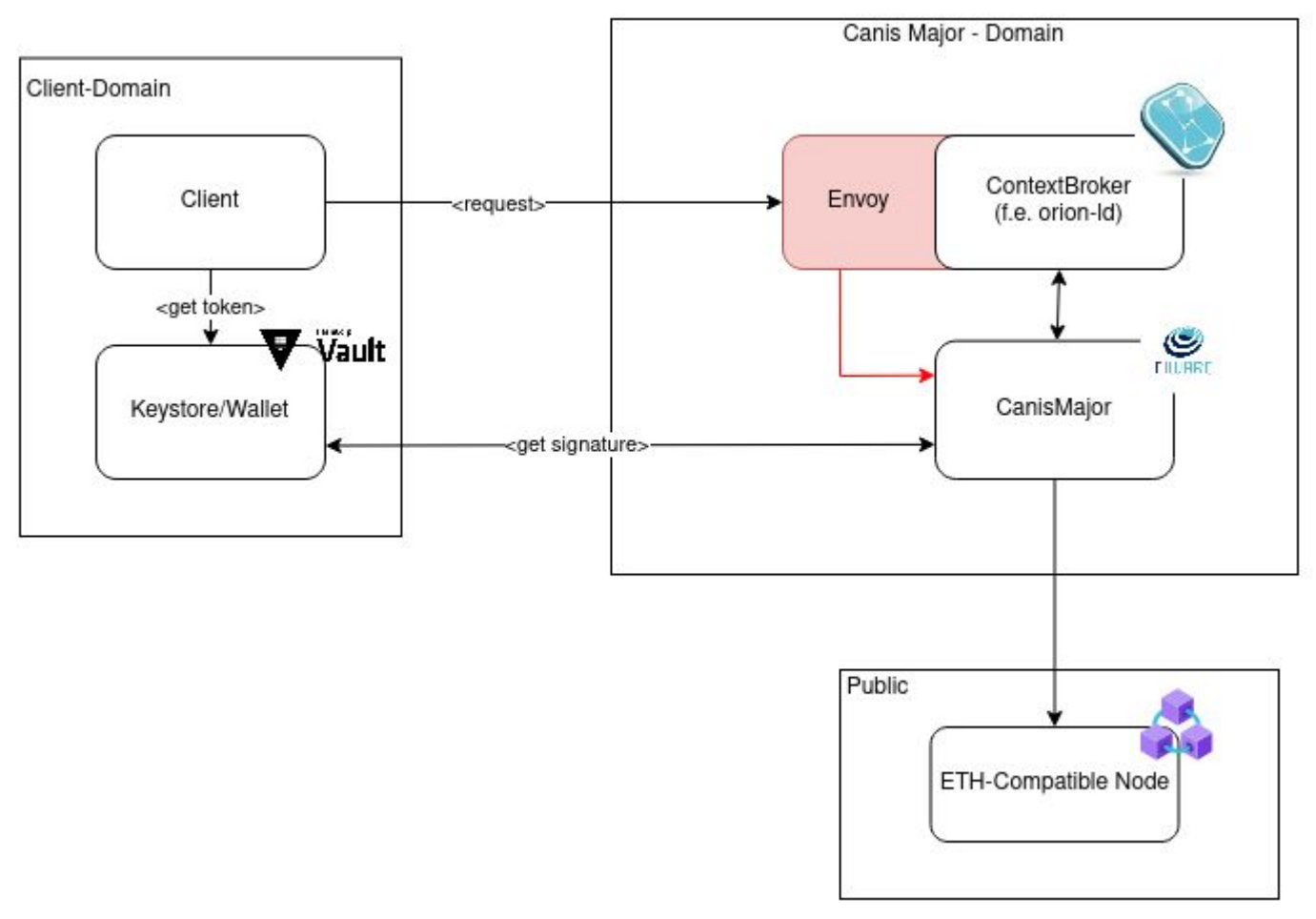
Front-Proxy integration

- Transparent integration of Canis Major into the request chain
- reduces influence on architecture impact for other components

Envoy as Front-Proxy:

- Stable and well maintained OpenSource-Project(CNCF graduated)
- support for proxy-wasm
  - well defined and documented plugin-mechanism
  - potential reuse in other proxies, API-Gateways
- integration with service meshes
  - OSSM and Istio are both Envoy based

Demo - Requestor Signature



Demo - Requestor Signature

- every transaction is signed with the key of the requestor
- 3 additional headers used to provide the wallet-callback:
  - Wallet-Type - currently only “Vault” supported
  - Wallet-Token
  - Wallet-Address
- Canis Major uses the provided information to request a signature for the transaction from the client wallet
  - private key does never leave the client
  - every transaction can be directly verified to the requestor

Demo - Requestor Signature

- Benefits:
  - every change can be connected to the responsible client
  - no single participant to trust, potentially able to add “fake-notarizations”
- Drawback:
  - Client has to provide a compliant endpoint
  - slower than the default-account option, due to the additional call

When to use?

- notarization beyond traditional access-logs is required
- immutability of the transaction history is required
- no single trusted entity exists
- the performance impact can be accepted
  - carefully decide what transactions need to be notarized

- Canis Major on github: https://github.com/FIWARE/CanisMajor
- Demo deployments:
  - https://github.com/FIWARE-Ops/fiware-gitops/tree/master/aws/fiware/canis-major
  - https://github.com/FIWARE-Ops/fiware-gitops/tree/master/aws/token

The slides: https://github.com/wistefan/presentations

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