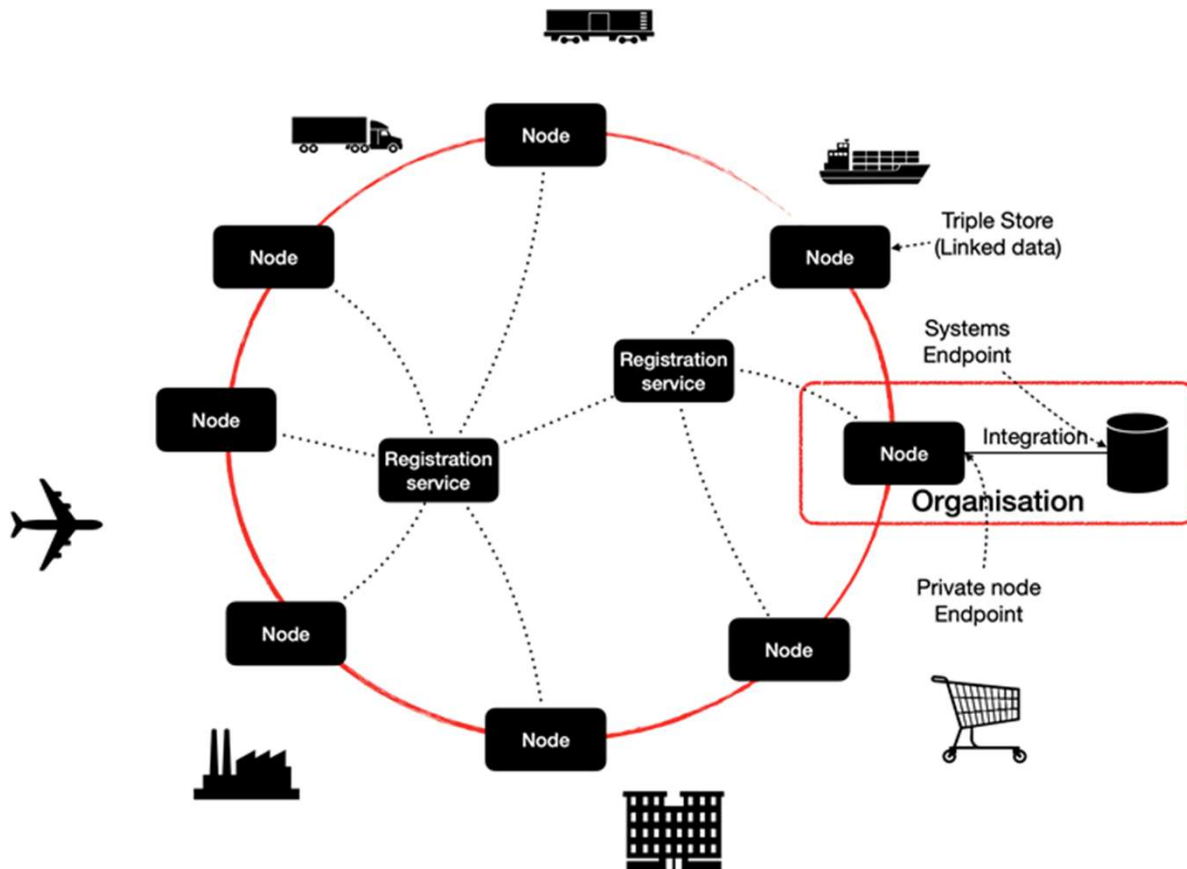


An aerial, high-angle photograph of a port at night. The scene is illuminated by various lights, creating a vibrant palette of colors. In the foreground and middle ground, there are dense stacks of shipping containers in shades of red, blue, green, and white. Several large gantry cranes are visible, their structures silhouetted against the dark sky. The water of the port is visible in the upper left corner. The overall atmosphere is one of industrial activity and modern infrastructure.

TNO innovation
for life

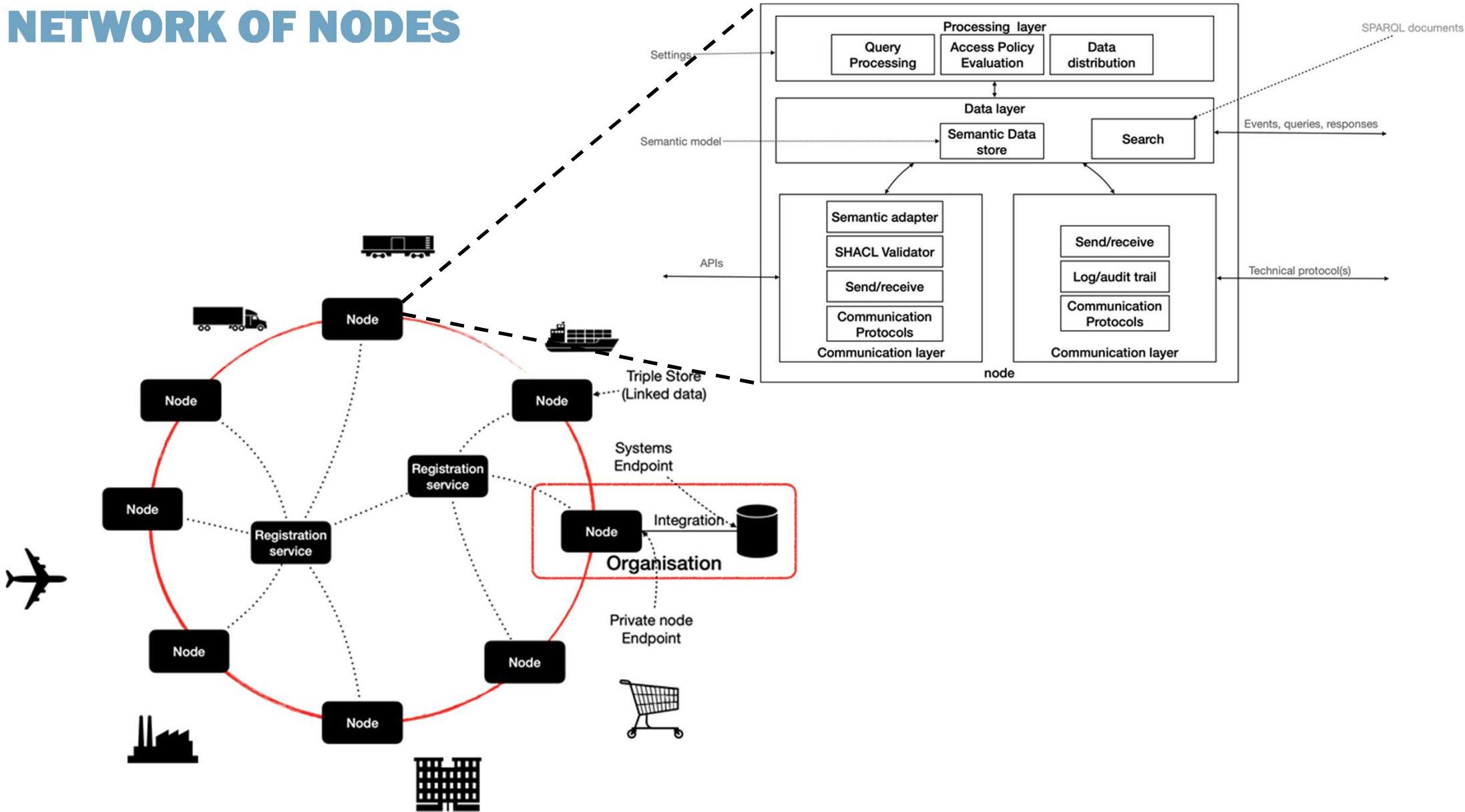
BDI PROTOTYPE DEMO (NOV 2022)

BASIS DATA INFRASTRUCTURE



- › Same language:
 - › Data model
 - › Digital Twins
 - › Event based (e.g. departure, arrival, ...)
- › Data at the source

NETWORK OF NODES



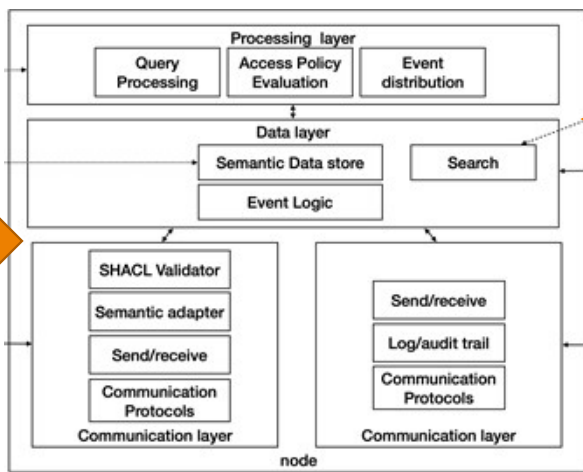
1STE PROTOTYPE (DOUANE-TRADELENS CASE)

FIRST STEP

- › PoC: event based communication with data at the source using het same data model
- › two node - one event implementation

Data Holder

Data User

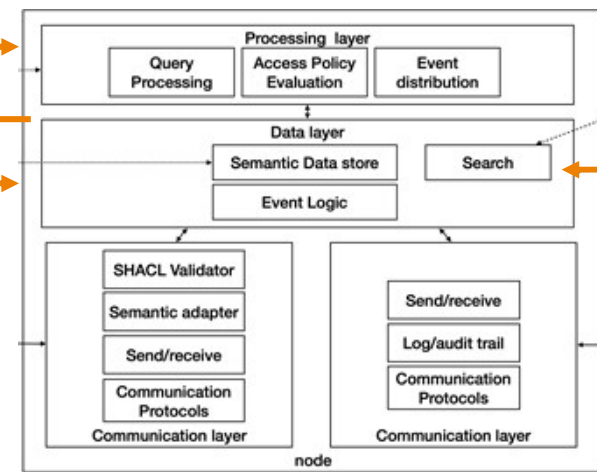


BDI node

Event

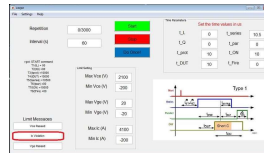
SPARQL Query

Linked Data



BDI node

GUI



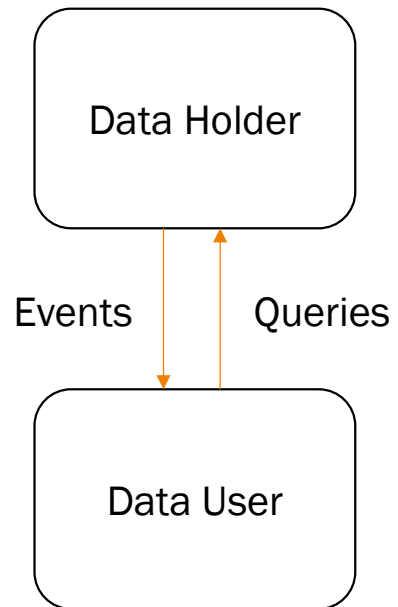
› BDI PROTOTYPE SCOPE

V0.1

- › Implement a proof-of-concept for a Basic Data-sharing Infrastructure (BDI)
 - › Event based **semantic** data-sharing between **two** BDI nodes
 - › **Querying** data at the **source** using **SPARQL** queries
- › By creating a working prototype
 - › Demonstrate that it is **technically possible** to implement
 - › Reference implementation
- › Using Tradelens and Douane as an example use-case
 - › We **subscribe** to Tradelens events like: “*Actual Loaded On Vessel*” using a **WebHook**
 - › Data is queried **by Douane** using a **SPARQL** query

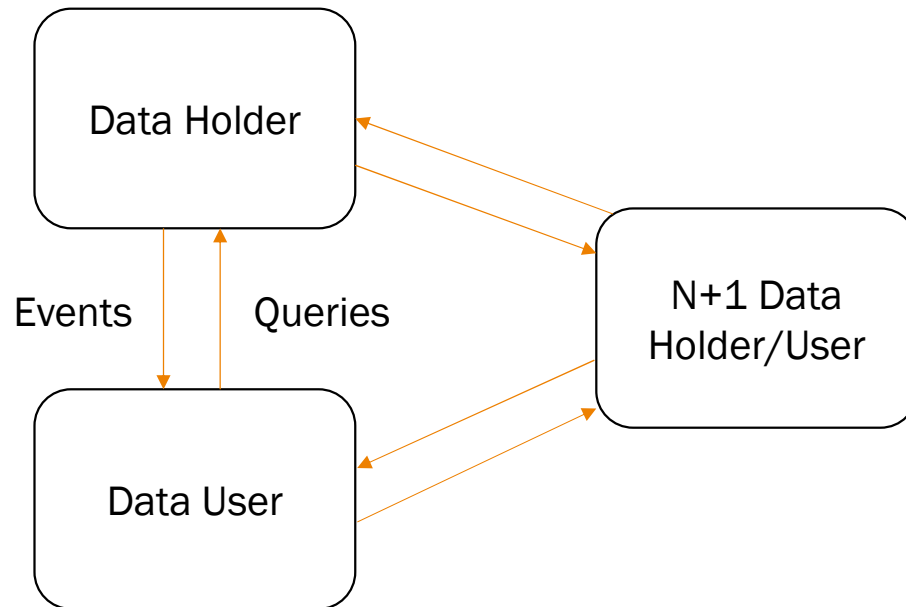
DATA HOLDER & DATA USER

VO.1: TWO BDI NODES

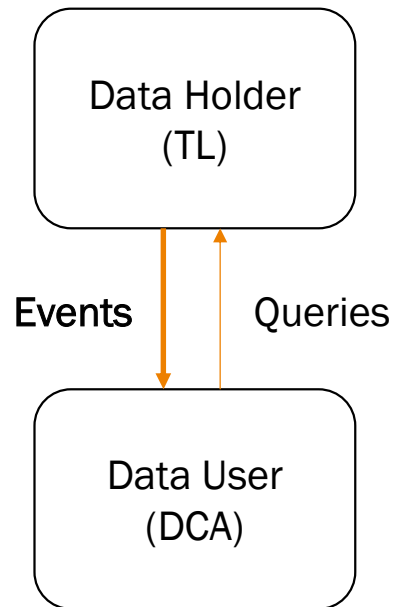


DATA HOLDER & DATA USER

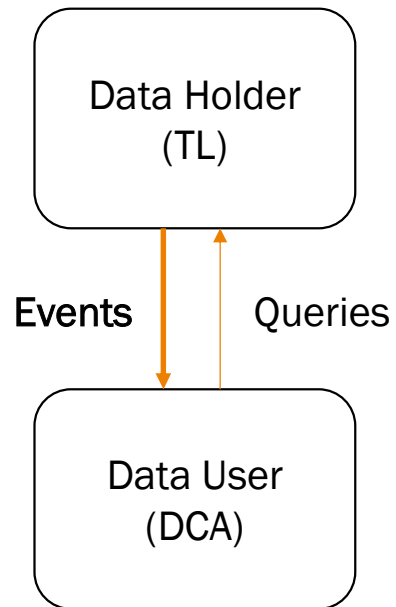
N+1 BDI NODES



DATA HOLDER & DATA USER TRADELENS & DCA



DATA HOLDER & DATA USER TRADELENS & DCA



Events (RDF in turtle)

```
@prefix data: <https://ontology.tno.nl/logistics/federated/tradelens#> .
```

```
....
```

```
data:DigitalTwin-c2cb84ce-87e9-4465-bb03-79e34c4d54fe a owl:NamedIndividual, dt:Container .
```

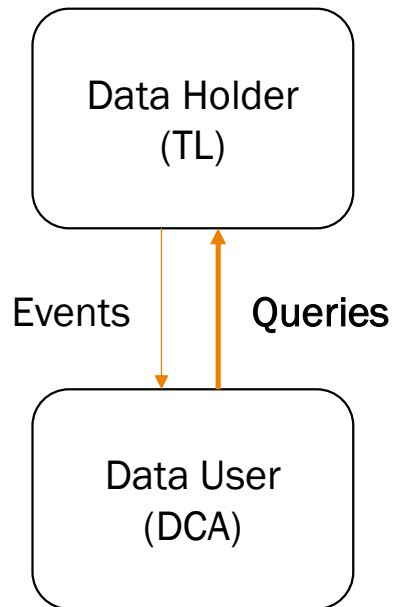
```
data:DigitalTwin-d2cbf432-6dff-4f55-ad0a-63fccdaf5c69 a owl:NamedIndividual, dt:TransportMeans .
```

```
data:PhysicalInfrastructure-AEJEA a owl:NamedIndividual, pi:Location .
```

```
data:event-746dd77c-2b71-4b05-b928-7fcd7663e8df a owl:NamedIndividual, event:Event,  
event:LoadEvent;
```

```
....
```

DATA HOLDER & DATA USER TRADELENS & DCA



Events (RDF in turtle)

```
@prefix data: <https://ontology.tno.nl/logistics/federated/tradelens#> .
```

....

```
data:DigitalTwin-c2cb84ce-87e9-4465-bb03-79e34c4d54fe a owl:NamedIndividual, dt:Container .
```

```
data:DigitalTwin-d2cbf432-6dff-4f55-ad0a-63fccdaf5c69 a owl:NamedIndividual, dt:TransportMeans .
```

```
data:PhysicalInfrastructure-AEJEA a owl:NamedIndividual, pi:Location .
```

```
data:event-746dd77c-2b71-4b05-b928-7fcd7663e8df a owl:NamedIndividual, event:Event,  
event:LoadEvent;
```

....

Queries (SPARQL)

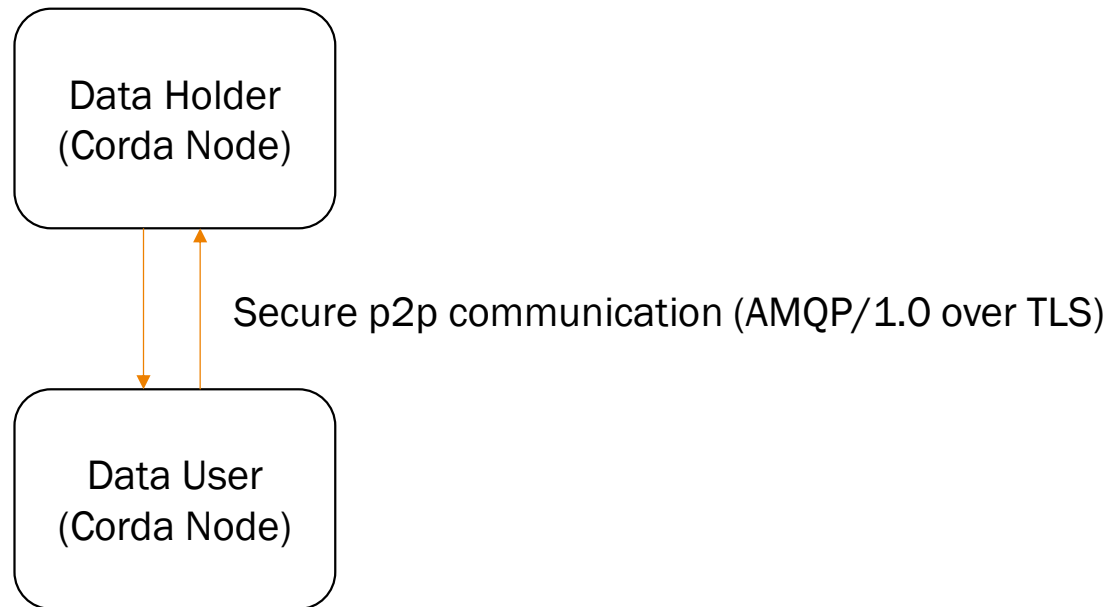
```
PREFIX data: <https://ontology.tno.nl/logistics/federated/tradelens#>
```

```
SELECT * WHERE {
```

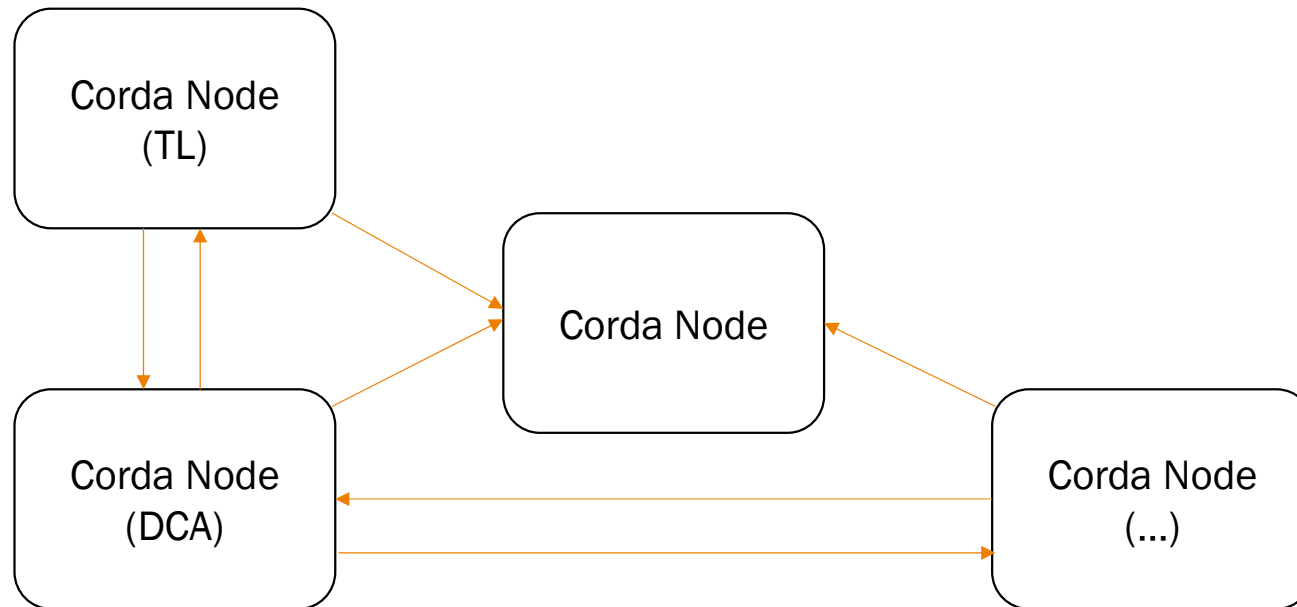
```
  data:DigitalTwin-c2cb84ce-87e9-4465-bb03-79e34c4d54fe ?p ?o .
```

```
}
```

› COMMUNICATION BETWEEN BDI NODES CORDA NETWORK

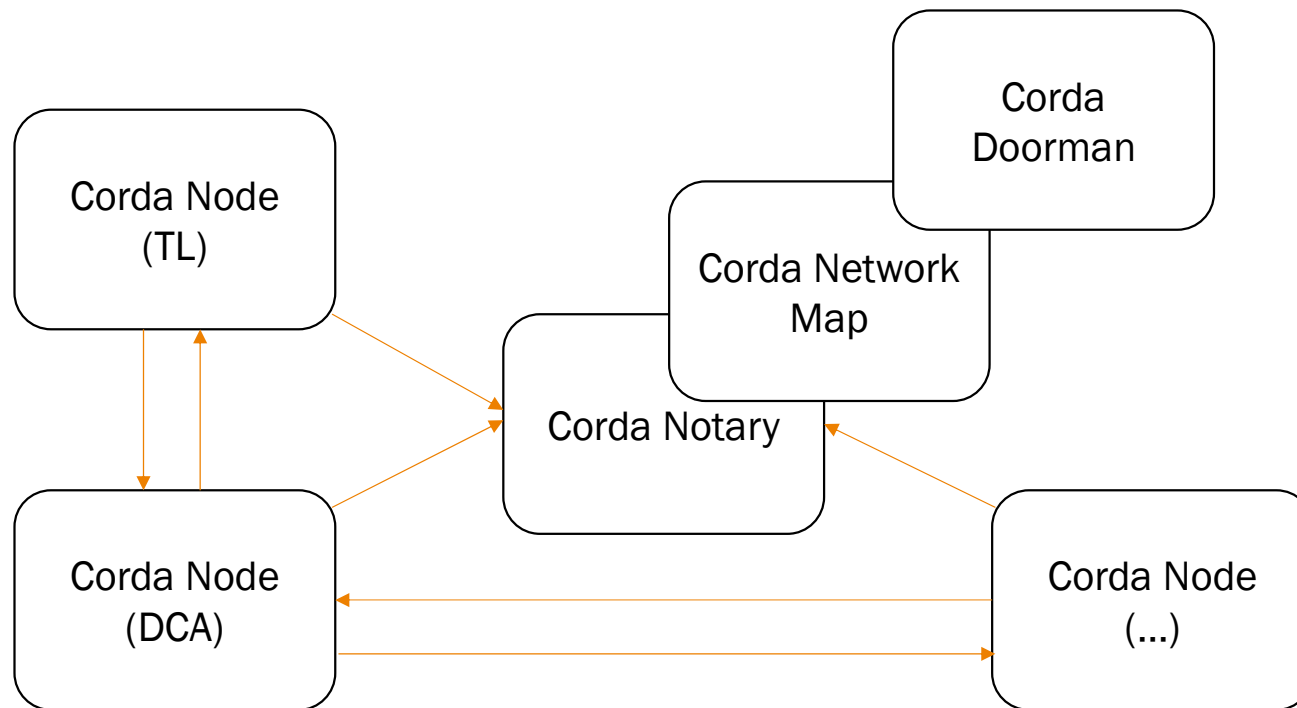


› **CORDA NETWORK (EXTENSIBLE)**
N+1 BDI NODES = N+1 CORDA NODES



› **CORDA NETWORK**

LEDGER, DISCOVERABILITY, PERMISSIONING



SEMANTIC ADAPTER

FROM NON-SEMANTIC TO SEMANTIC DATA

Events (RDF in turtle)

```
@prefix data: <https://ontology.tno.nl/logistics/federated/tradelens#> .
```

```
....
```

```
data:DigitalTwin-c2cb84ce-87e9-4465-bb03-79e34c4d54fe a owl:NamedIndividual, dt:Container .
```

```
data:DigitalTwin-d2cbf432-6dff-4f55-ad0a-63fccdaf5c69 a owl:NamedIndividual, dt:TransportMeans .
```

```
data:PhysicalInfrastructure-AEJEA a owl:NamedIndividual, pi:Location .
```

```
data:event-746dd77c-2b71-4b05-b928-7fcd7663e8df a owl:NamedIndividual, event:Event,  
event:LoadEvent;
```

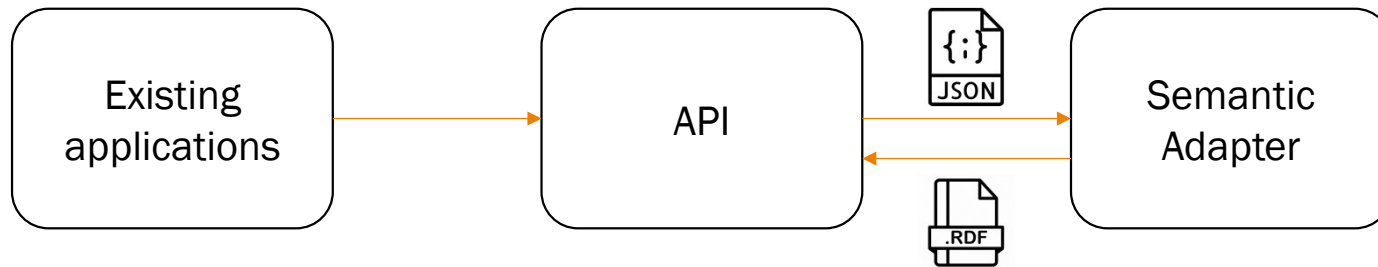
```
....
```

Events from Tradelens are in JSON format

```
{  
  "eventType": "actualLoadedOnVessel",  
  "eventName": "Actual loaded on vessel",  
  "consignmentId": "9c0a54d9-b152-4019-8994-283353ffdaaa",  
  "transportEquipmentId": "c2cb84ce-87e9-4465-bb03-79e34c4d54fe",  
  "billOfLadingNumber": "BL429905",  
  "eventSubmissionTime8601": "2022-09-23T12:35:01.307Z",  
  ....  
}
```

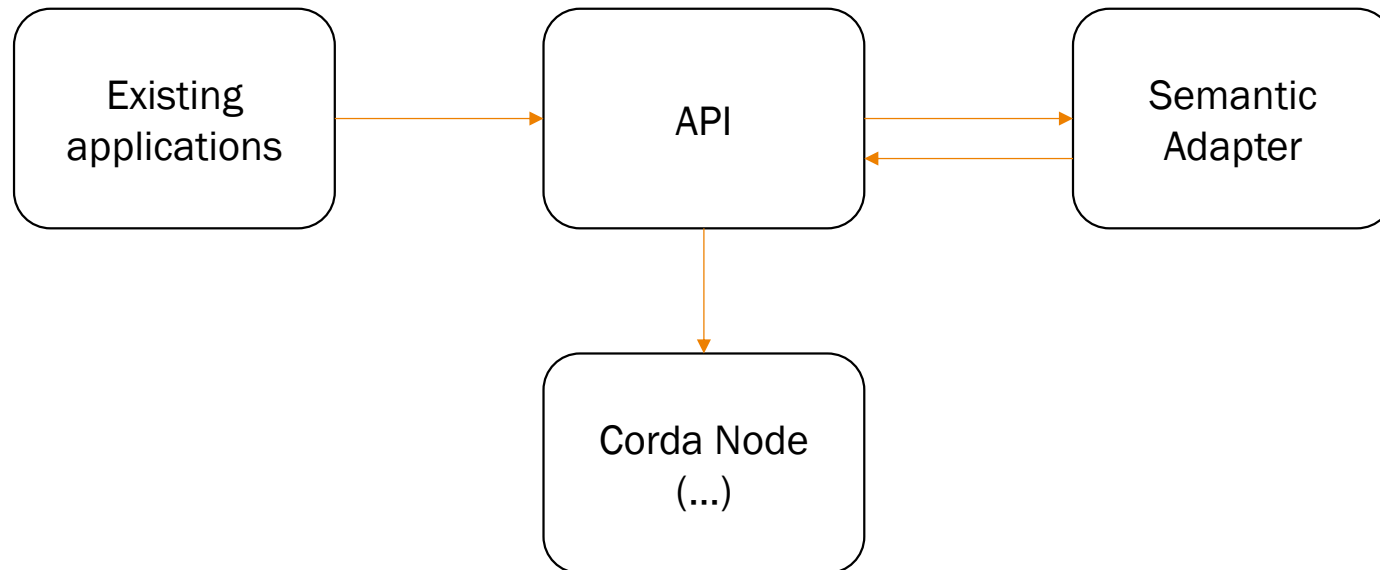
SEMANTIC ADAPTER

MAPPER BETWEEN NON-SEMANTIC AND SEMANTIC WORLD

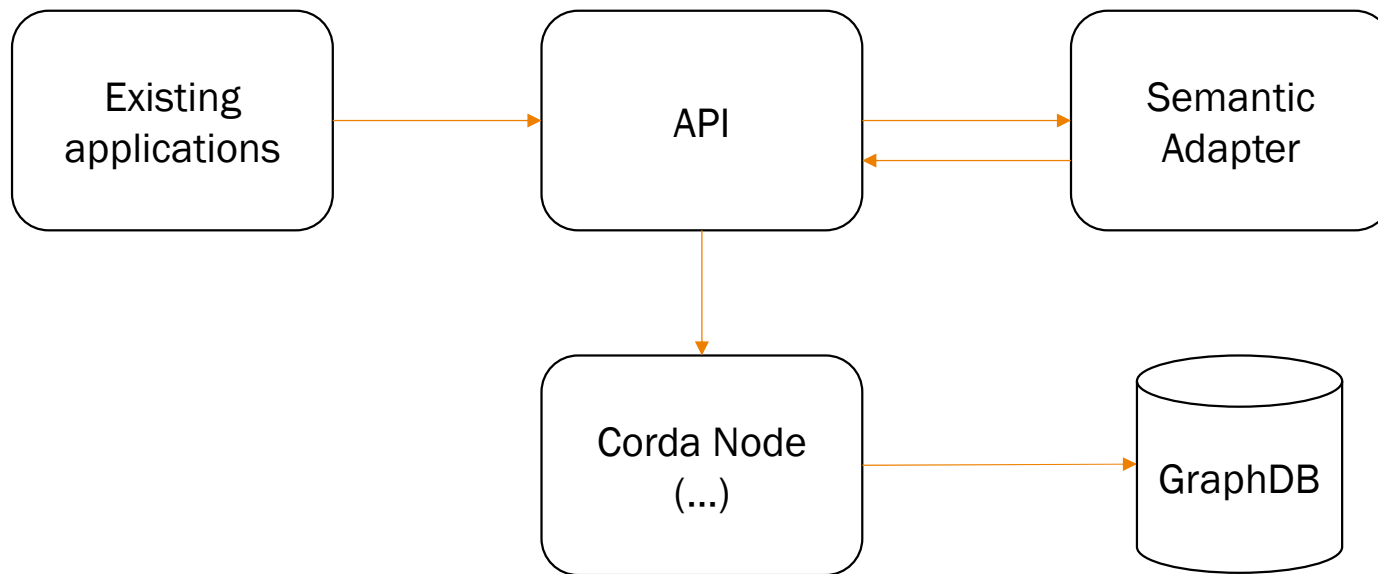


> API

BRIDGES THE NON-BDI AND BDI WORLD

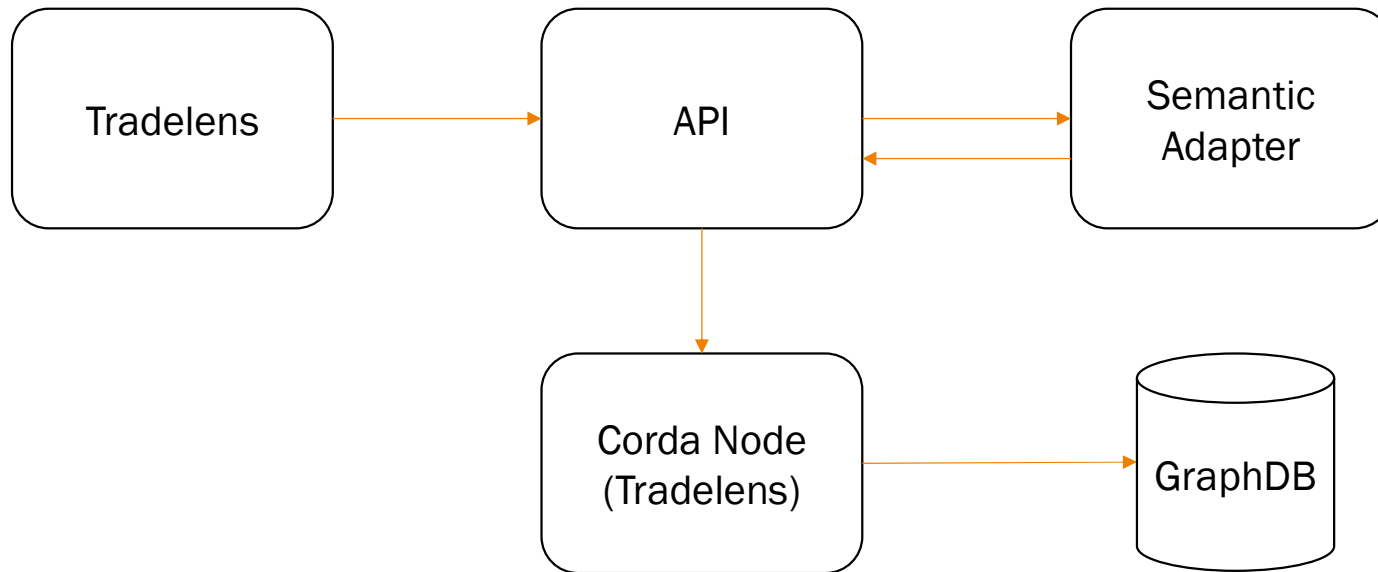


› STORING EVENTS GRAPHDB

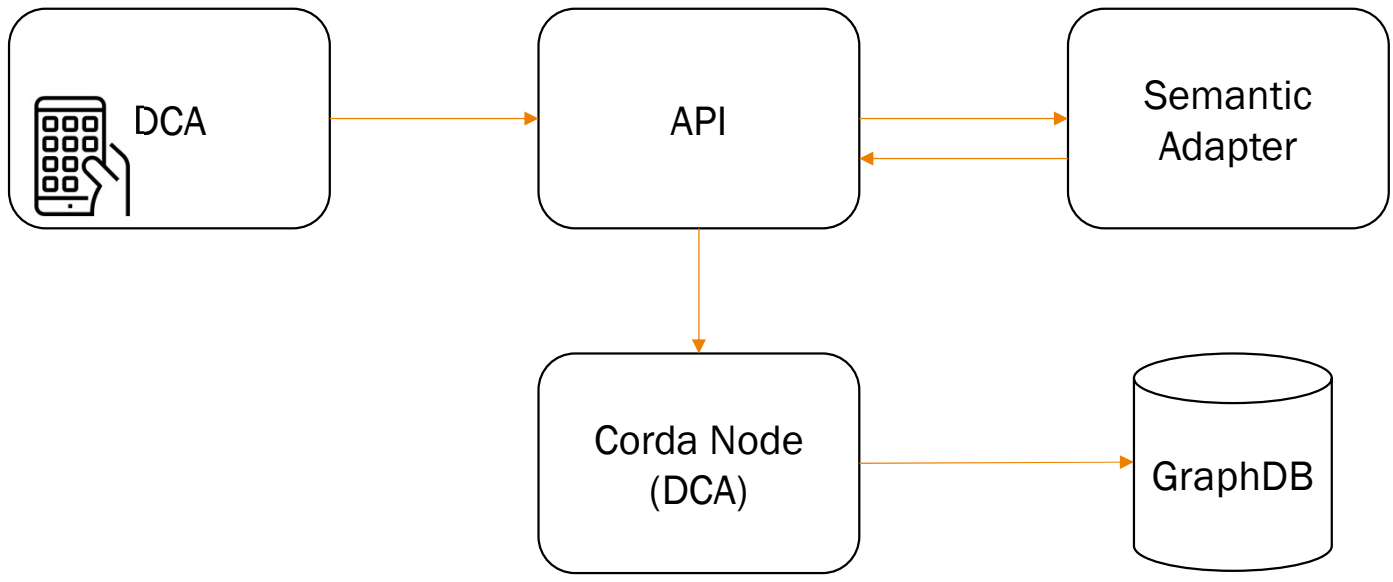


TRADELENS

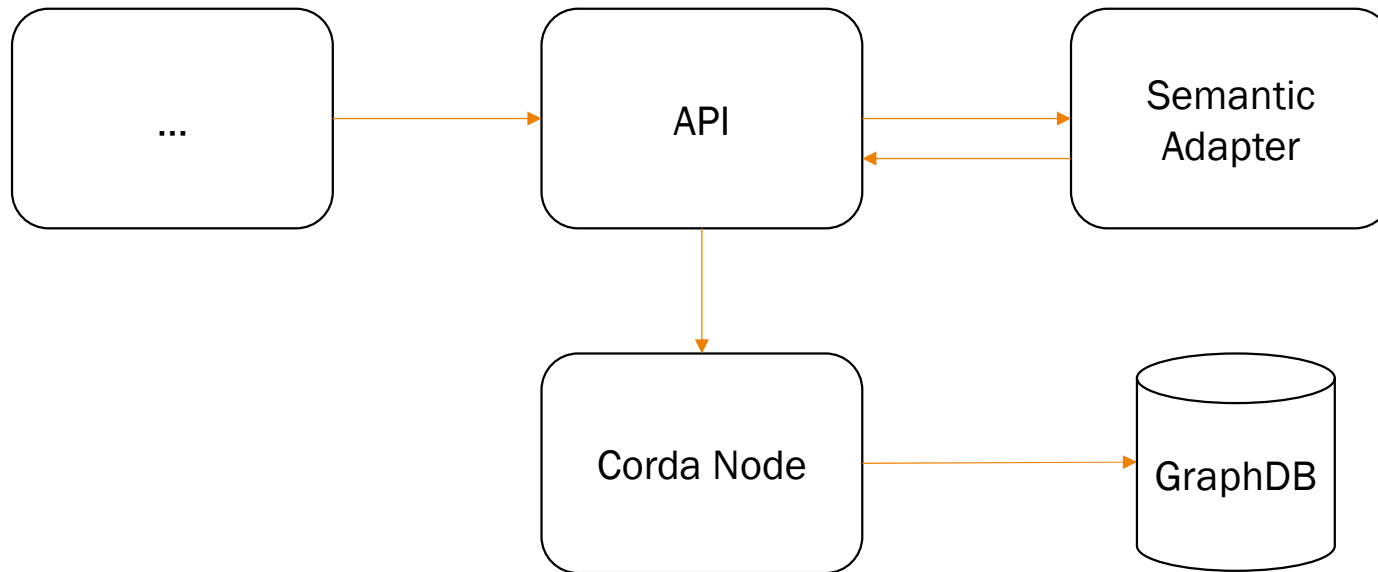
BDI



› DUTCH CUSTOMS AUTHORITY BDI



› ANY
BDI



› **PROTOTYPE V0.1**

COMPONENTS

- › Corda 4.x network
- › Corda workflows written in Kotlin
- › REST API using Spring Boot and Kotlin
- › Semantic Adapter written in Python
- › Running on JVM technology
- › GraphDB 10
- › Runs on Docker and Kubernetes

› USE-CASE: TRADELENS EVENT DEMO



CORDA NETWORK NODES RUNNING

```
soudmaijer — bash -c — java < bash -c cd "/Users/soudmaijer/workspace/tno/platform-corda/build/nodes/Notary_Notary" ; "/Library/Java/JavaVirtu...
bash
bash
bash
Last login: Thu Nov  3 11:39:48 on ttys004
bash -c 'cd "/Users/soudmaijer/workspace/tno/platform-corda/build/nodes/Notary_Notary" ; "/Library/Java/JavaVirtualMachines/adoptopenjdk-8.jdk/Co
ntents/Home/jre/bin/java" "-Dcapsule.jvm.args=-agentlib:jwp=transport=dt_socket,server=y,suspend=n,address=5007 -javaagent:drivers/jolokia-jvm-1
.6.0-agent.jar=port=7007,logHandlerClass=net.corda.node.JolokiaSlf4jAdapter" "-Dname=Notary_Notary" "-jar" "/Users/soudmaijer/workspace/tno/platf
orm-corda/build/nodes/Notary_Notary/corda.jar" && exit'
+ ~ bash -c 'cd "/Users/soudmaijer/workspace/tno/platform-corda/build/nodes/Notary_Notary" ; "/Library/Java/JavaVirtualMachines/adoptopenjdk-8.j
dk/Contents/Home/jre/bin/java" "-Dcapsule.jvm.args=-agentlib:jwp=transport=dt_socket,server=y,suspend=n,address=5007 -javaagent:drivers/jolokia-
jvm-1.6.0-agent.jar=port=7007,logHandlerClass=net.corda.node.JolokiaSlf4jAdapter" "-Dname=Notary_Notary" "-jar" "/Users/soudmaijer/workspace/tno/
platform-corda/build/nodes/Notary_Notary/corda.jar" && exit'
Listening for transport dt_socket at address: 5007

 Kind of like a regular database but
with emojis, colours and ascii art. 🤖

--- Corda Open Source 4.5.8 (9c7f493) -----

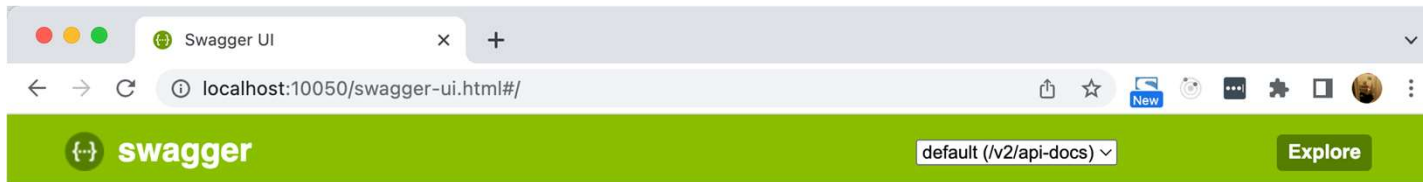
Jolokia: Agent started with URL http://127.0.0.1:7007/jolokia/
⚠️ ATTENTION: This node is running in development mode! 🚧 This is not safe for production deployment.
Advertised P2P messaging addresses : localhost:10002
RPC connection address : localhost:10003
RPC admin connection address : localhost:10043
Loaded 2 CorDapp(s) : Contract CorDapp: Template Contracts version 4 by vendor Corda Open Source with licence Apache License,
Version 2.0, Workflow CorDapp: Template Flows version 4 by vendor Corda Open Source with licence Apache License, Version 2.0
Node for "Notary" started up and registered in 23.03 sec
Running P2PMessaging loop

Welcome to the Corda interactive shell.
You can see the available commands by typing 'help'.

Thu Nov 03 11:40:18 CET 2022>>> █
```

API

SWAGGER UI



Api Documentation

Api Documentation

[Apache 2.0](#)

Access token validation : Authorization Controller

Show/Hide | List Operations | Expand Operations

Corda details : Node Controller

Show/Hide | List Operations | Expand Operations

Data pull endpoints : Data Pull Controller

Show/Hide | List Operations | Expand Operations

Event details : Event Controller

Show/Hide | List Operations | Expand Operations

[BASE URL: / , API VERSION: 1.0]

platform-corda – newUnprocessedTradelensEvent.http [platform-corda]

platform-corda http bdi-api newUnprocessedTradelensEvent.http

newUnprocessedTradelensEvent.http

Run with: dev-tradelens

```
1 # POST a Tradelens 'Actual loaded on vessel' event (simulates the TL webhook)
2 POST {{api_url}}/events/newUnprocessed/{{destination}}
3 Authorization: Bearer doitanyway
4 Content-Type: application/json
5 Accept: application/json
6
7 [
8   {
9     "eventType": "actualLoadedOnVessel",
10    "eventName": "Actual loaded on vessel",
11    "consignmentId": "9c0a54d9-b152-4019-8994-283353ffdaaa",
12    "transportEquipmentId": "c2cb84ce-87e9-4465-bb03-79e34c4d54fe",
13    "billOfLadingNumber": "BL429905",
14    "eventSubmissionTime8601": "2022-09-23T12:35:01.307Z",
15    "eventOccurrenceTime8601": "2022-10-01T11:35:01.302Z",
```

Services

- Spring Boot
 - Running
 - Server TradeLens API :10050/
 - Server Douane API :10051/
- Docker
 - Docker-compose: platform-corda
 - graphdb
 - graphdb
 - semanticadapter
 - semanticadapter
 - platform-corda_default
 - Containers
 - Images

Console Actuator

Git Run Debug Endpoints Profiler Build Dependencies TODO Snyk Problems Spring Terminal GitLive Services

Gradle sync finished in 2 s 112 ms (52 minutes ago)

6:1 CRLF UTF-8 4 spaces master

00:00,00

TRADELENS: NEW EVENT DEMO

```
newUnprocessedTradelensEvent.http x
+ [🔍] [🔄] [🗑️] [📄] [▶️] Run with: dev ▾
1 # incoming tradelens event that would be submitted via a webhook
2 ▶️ POST http://localhost:10050/events/newUnprocessed/{{destination}}
3   Authorization: Bearer doitanyway
4   Content-Type: application/json
5   Accept: application/json
6
7 [
8   {
9     "eventPublishTime": 1663936501514,
10    "eventSubmissionTime": 1663936501307,
11    "eventSubmissionTime8601": "2022-09-23T12:35:01.307Z",
12    "eventName": "Actual loaded on vessel"
13  }
14 ]

```

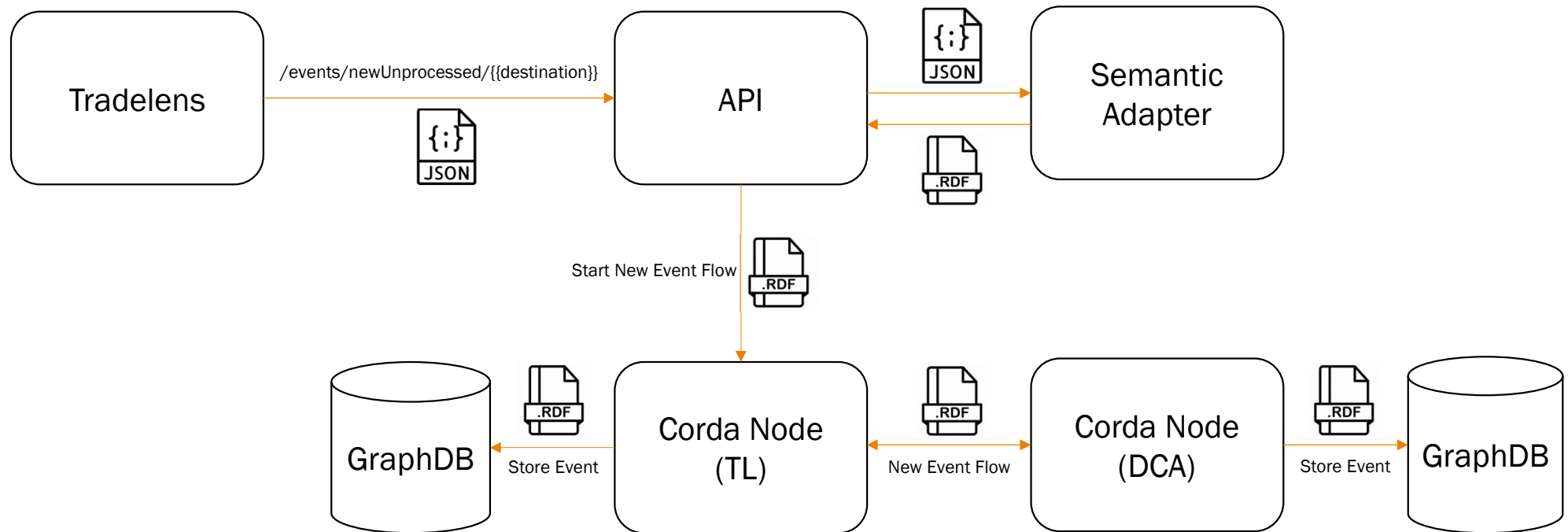
http://localhost:10050/events/newUnprocessed/BE

HTTP/1.1 201
Content-Type: application/json;charset=UTF-8
Content-Length: 51
Date: Thu, 03 Nov 2022 12:47:29 GMT

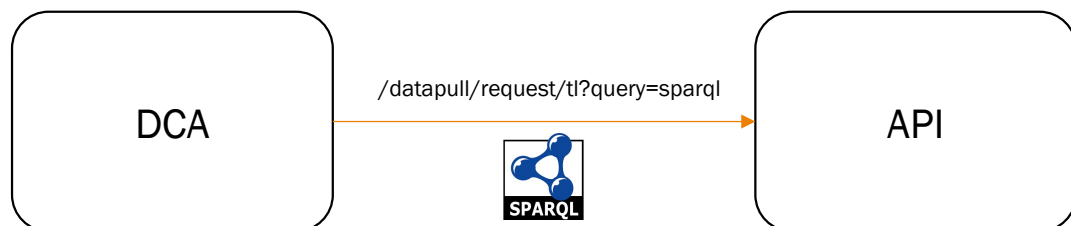
Event created: 12f828d8-329c-4578-8d87-ac62e2b8b7b4
Response file saved.
> [2022-11-03T134729.201.json](#)

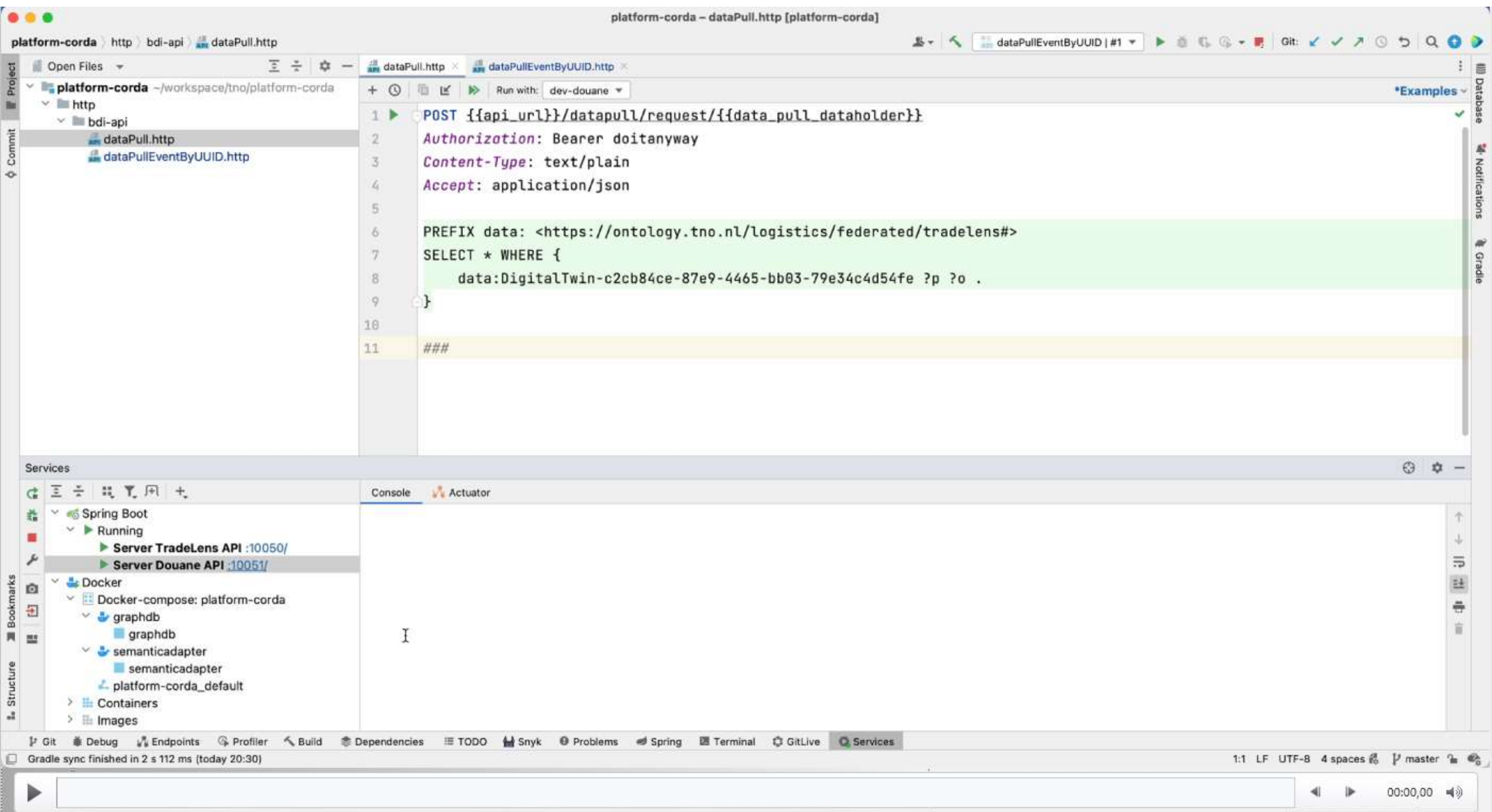
Response code: 201; Time: 12768ms (12 s 768 ms); Content Length: 51 bytes (51 B)

USE-CASE: TRADELENS EVENT INTERNAL WORKING



› USE-CASE: DCA QUERY (DATA PULL) DEMO





USE-CASE: DCA QUERY (DATA PULL) DEMO

```
dataPull.http x
+ [refresh] [copy] [paste] [run] Run with: dev
1 POST http://localhost:10051/datapull/request/{{dataholder}}
2   Authorization: Bearer doitanyway
3   Content-Type: text/plain
4   Accept: application/json
5
6   PREFIX data: <https://ontology.tno.nl/Logistics/federated/tradeLens#>
7   SELECT * WHERE {
8     data:DigitalTwin-c2cb84ce-87e9-4465-bb03-79e34c4d54fe ?p ?o .
9 }
10
11 ###

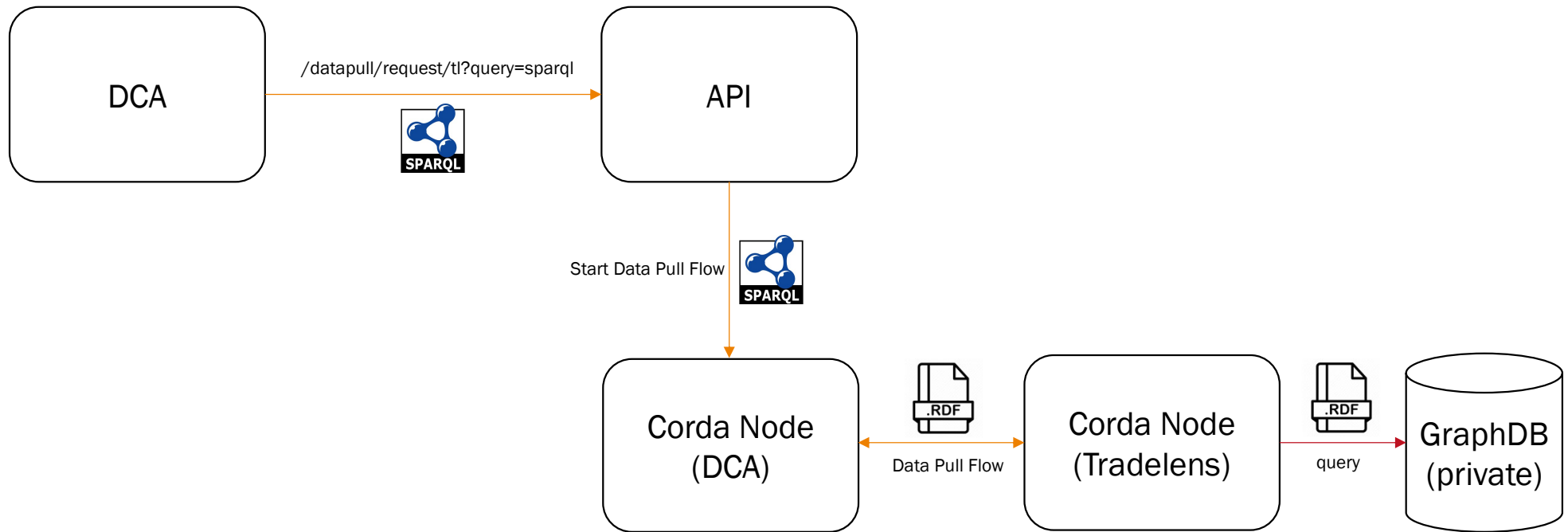
http://localhost:10051/datapull/request/Netherlands

HTTP/1.1 202
Content-Type: application/json;charset=UTF-8
Content-Length: 55
Date: Thu, 03 Nov 2022 13:37:35 GMT

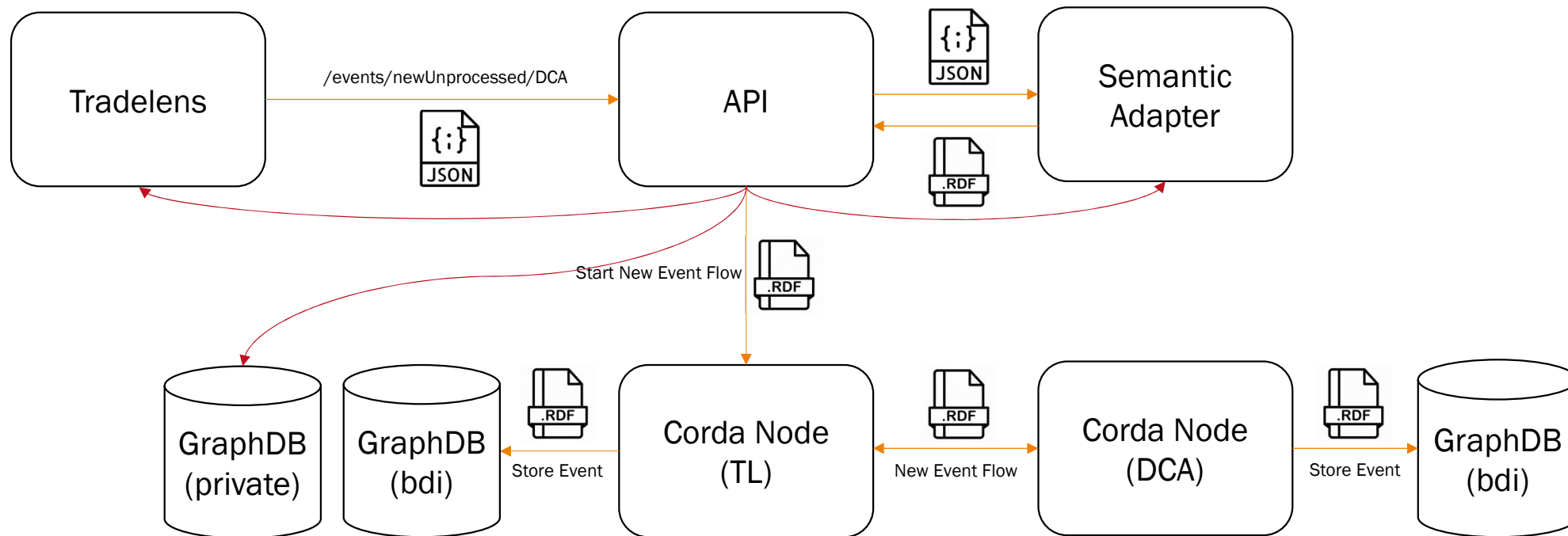
State with result: 13351127-79a3-4ab1-b395-9d7eb0a3278f
Response file saved.
> 2022-11-03T143735.202.json

Response code: 202; Time: 6687ms (6 s 687 ms); Content length: 55 bytes (55 B)
```

› USE-CASE: DCA QUERY (DATA PULL) INTERNAL WORKING



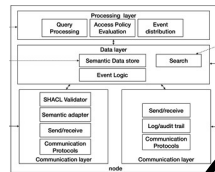
USE-CASE: TRADELENS EVENT STORING EXTRA SEMANTIC DATA



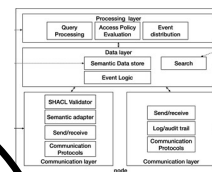
2ND PROTOTYPE (MULTIPLE EVERYTHING) NEXT STEPS

- › PoC: multiple nodes, multiple events, multiple queries
 - › Distribution algorithm(s)

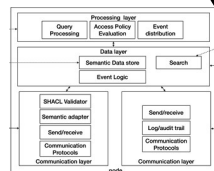
Data Holder/User



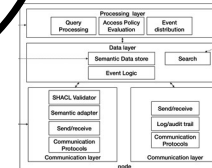
Data Holder/User



Data Holder/User



Data Holder/User

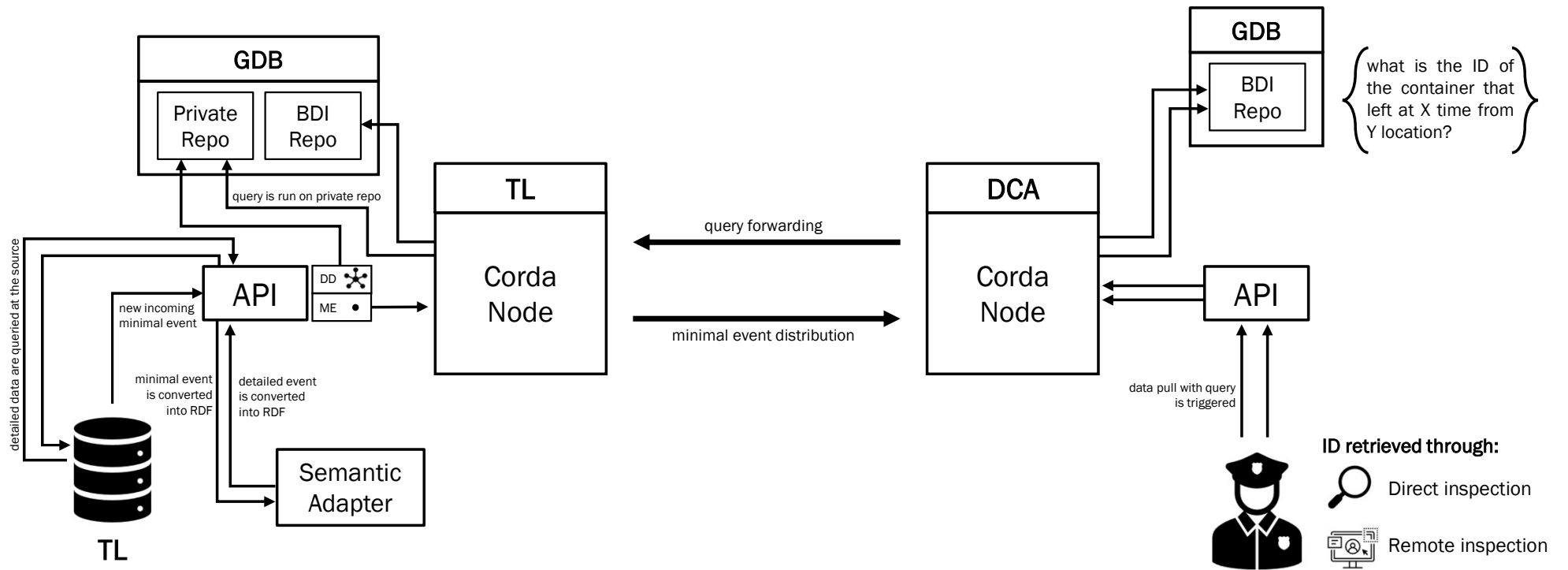


› AFTER V0.2

- › Event based access control
- › Technology independent: Corda, IDSA, Peppol, Kafka, ...
- › Data at the source implementation: SPARQL, Triple store, API's, ...
- › ...

› **QUESTIONS?**
THANK YOU FOR LISTENING

FROM EVENT-SHARING TO EVENT-QUERYING



FROM EVENT-SHARING TO EVENT-QUERYING

