



# CHALLENGES OF PUBLISHING IOT DATA

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umec



EDIT

DE VLAAMSE  
VEERKRACHT

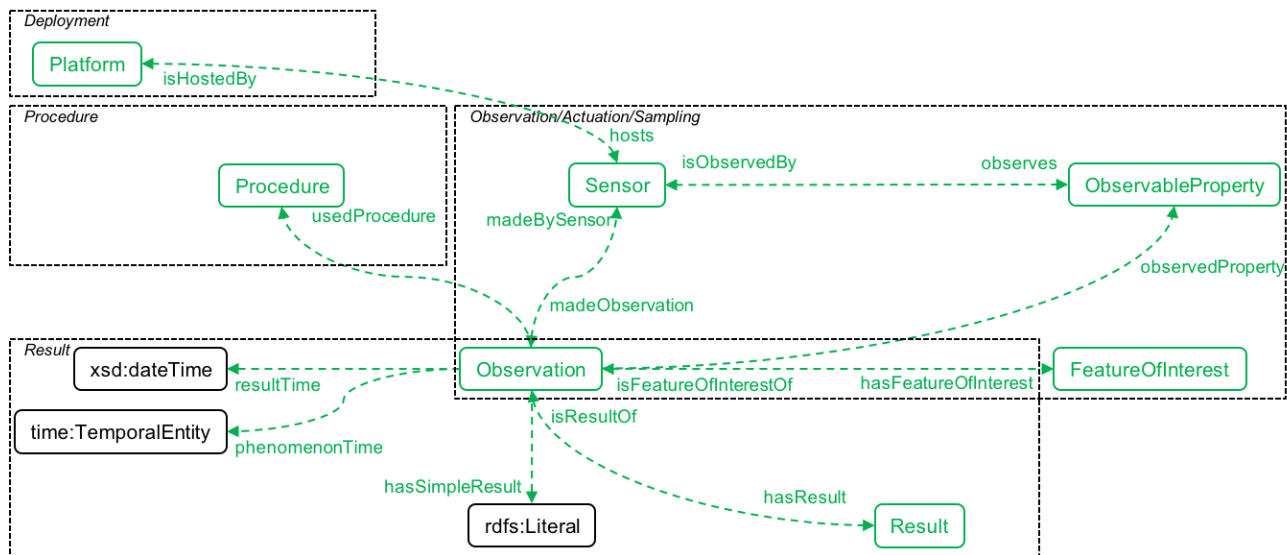


Gefinancierd door  
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# SAVING MEASUREMENTS

## SSN AND SOSA

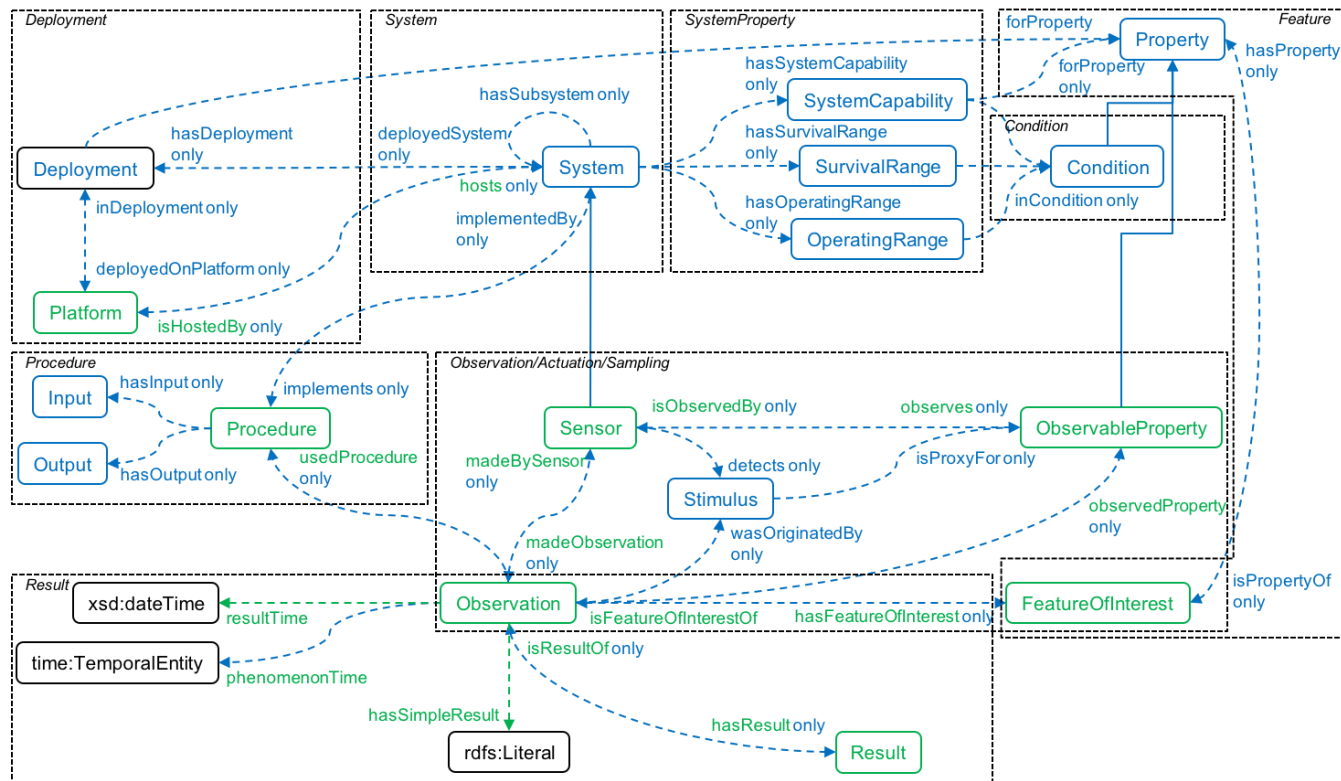
- SOSA: Sensors, Observations, Actuation, Sampling (observation perspective)



# SAVING MEASUREMENTS

## SSN AND SOSA

- SSN: Semantic Sensor Network (observation perspective)



Semantic Sensor Network Ontology (w3.org)

## EXAMPLE

### IPHONE BAROMETER

```
# The barometric readings from a Bosch Sensortec BMP282 sensor in an Apple iPhone 7  
# observed on June 6 2017 using only the SOSA core for modelling.
```

```
<earthAtmosphere> rdf:type sosa:FeatureOfInterest ;  
  rdfs:label "Atmosphere of Earth"@en .
```

```
# An iPhone 7 as the Platform that hosts several sensors,  
# among others the Bosch Sensortec BMP282 atmospheric pressure sensor.
```

```
<iphone7/35-207306-844818-0> a sosa:Platform ;  
  rdfs:label "iPhone 7 - IMEI 35-207306-844818-0"@en ;  
  rdfs:comment "iPhone 7 - IMEI 35-207306-844818-0 - John Doe"@en ;  
  sosa:hosts <sensor/35-207306-844818-0/BMP282> .
```

```
<sensor/35-207306-844818-0/BMP282> rdf:type sosa:Sensor ;  
  rdfs:label "Bosch Sensortec BMP282"@en ;  
  sosa:observes <sensor/35-207306-844818-0/BMP282/atmosphericPressure> .
```

# EXAMPLES

## IPHONE BAROMETER OBSERVATION

# An observation made by the BMP282 atmospheric pressure sensor.

```
<Observation/346344> rdf:type sosa:Observation ;  
  sosa:observedProperty <sensor/35-207306-844818-0/BMP282/atmosphericPressure> ;  
  sosa:hasFeatureOfInterest <earthAtmosphere> ;  
  sosa:madeBySensor <sensor/35-207306-844818-0/BMP282> ;  
  sosa:hasSimpleResult "1021.45 hPa"^^cdt:ucum ;  
  sosa:resultTime "2017-06-06T12:36:12Z"^^xsd:dateTime .
```

# Another observation made a second later by the BMP282 atmospheric pressure sensor  
# using the QUDT Ontology for the Units of Measurement  
# and the Time Ontology for the instant.

```
<Observation/346345> rdf:type sosa:Observation ;  
  sosa:observedProperty <sensor/35-207306-844818-0/BMP282/atmosphericPressure> ;  
  sosa:hasFeatureOfInterest <earthAtmosphere> ;  
  sosa:madeBySensor <sensor/35-207306-844818-0/BMP282> ;  
  sosa:hasResult [  
    rdf:type qudt-1-1:QuantityValue ;  
    qudt-1-1:numericValue "101936"^^xsd:double ;  
    qudt-1-1:unit qudt-unit-1-1:Pascal ] ;  
  sosa:resultTime [  
    rdf:type time:Instant ;  
    time:inXSDDateTimeStamp "2017-06-06T12:36:13+00:00"^^xsd:dateTimeStamp ] .
```

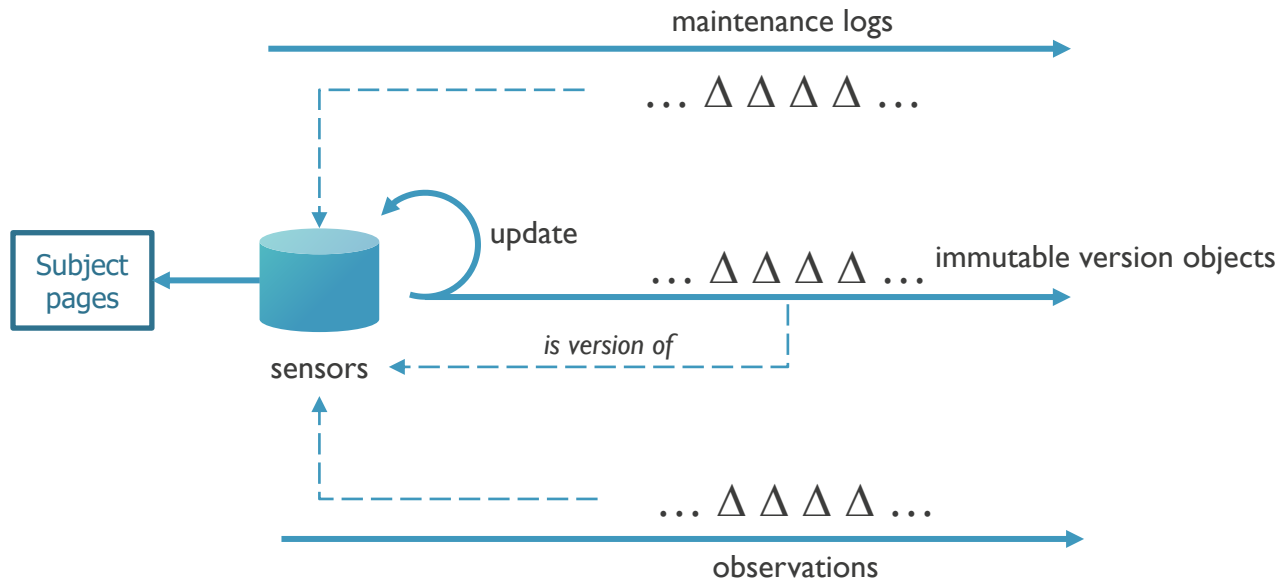
# CONTEXT MATTERS

## Making measurements useful

- Observations may show sudden changes in atmospheric pressure
- What is going on ...
  - Did the weather change?
  - Did the sensor move?
- Keeping track of context is important
  - Sensor properties may change
  - External factors may influence the sensor behavior (maintenance, replacement)
  - ...
- But ... these are also just timeseries!

# CHALLENGES OF IOT

## CONTEXT VERSUS MEASUREMENTS



# CHALLENGES OF IOT

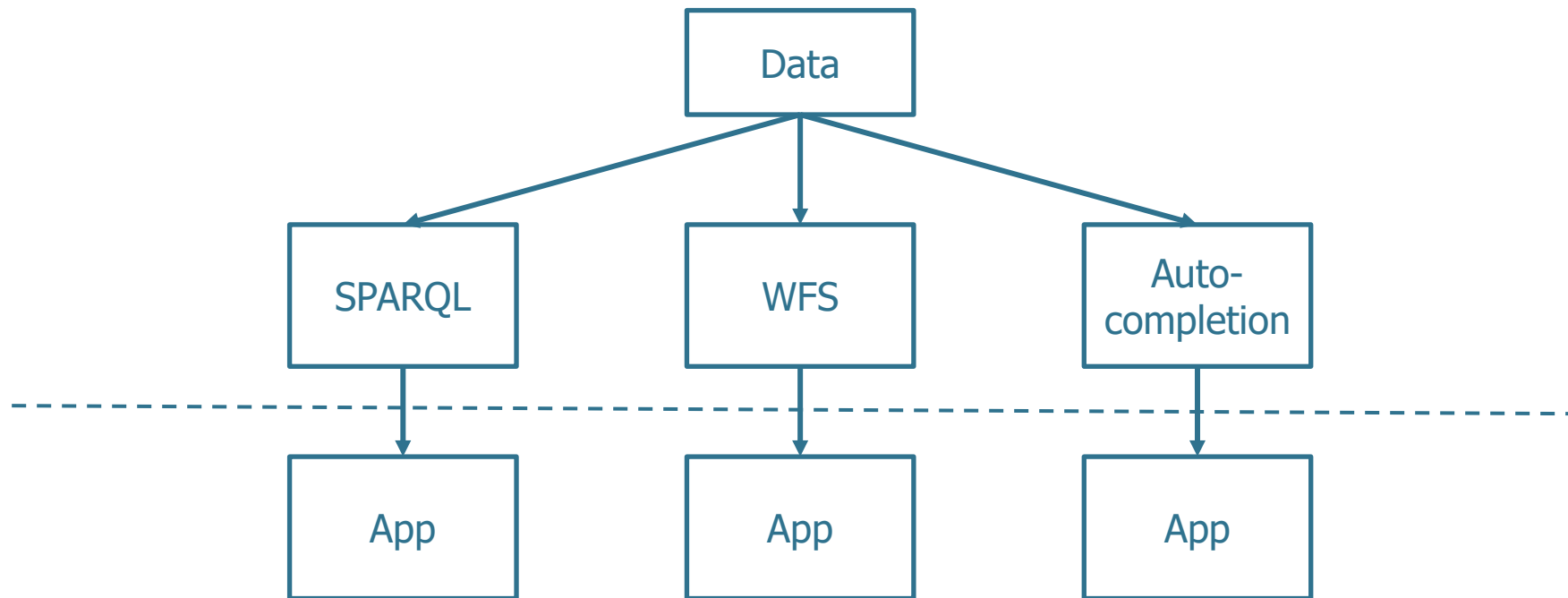
## DATA STORAGE AND PUBLISHING

- Storing IoT timeseries, plenty of options
  - MySQL database
  - Influx DB
  - ...
- Publishing IoT timeseries
  - Interface?
  - Scalability?
  - Retention?
  - ...



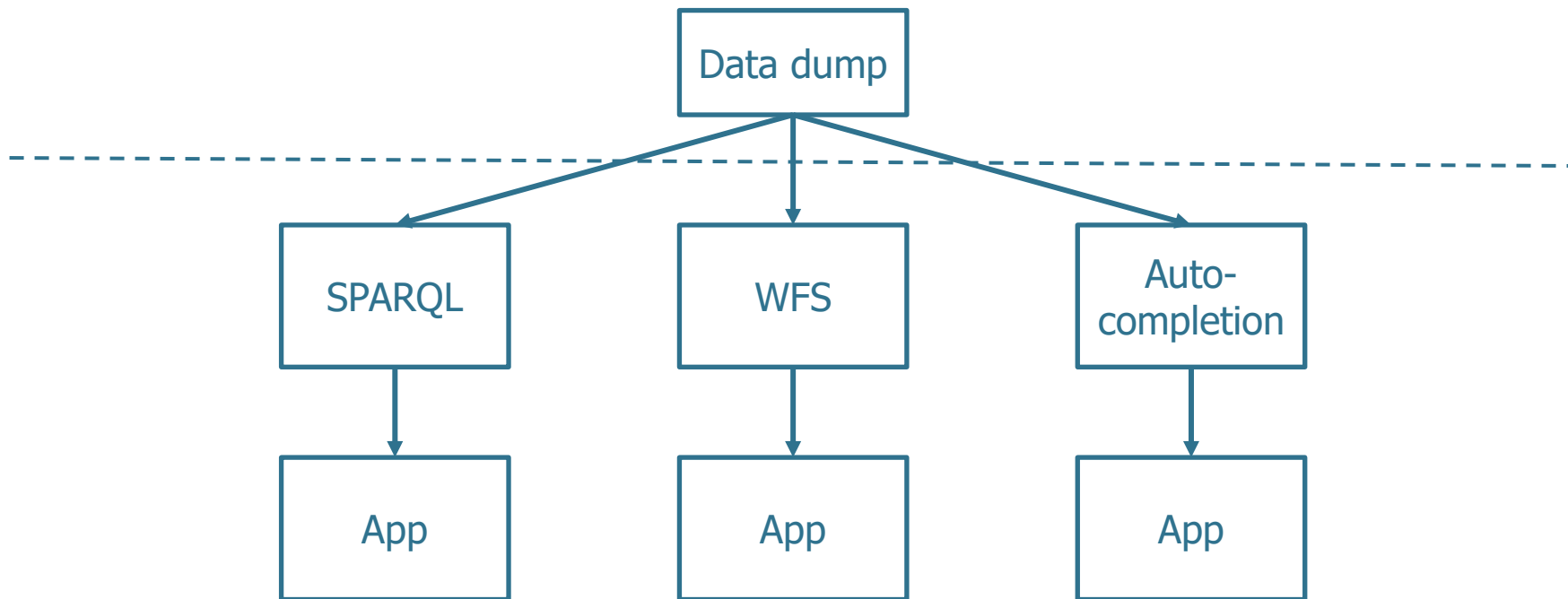
# CHALLENGES OF IOT

## MAINTENANCE & SCALABILITY HELL



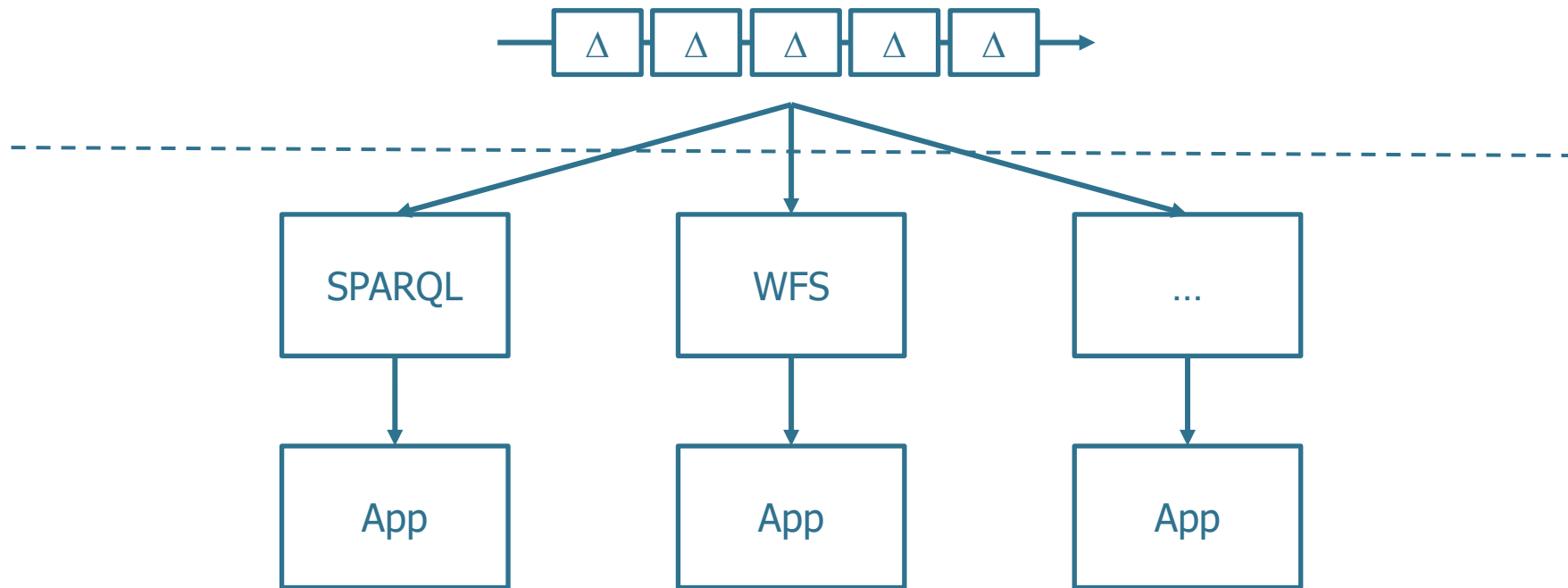
# CHALLENGES OF IOT

## REPLICATION HELL



# LINKED DATA EVENT STREAMS

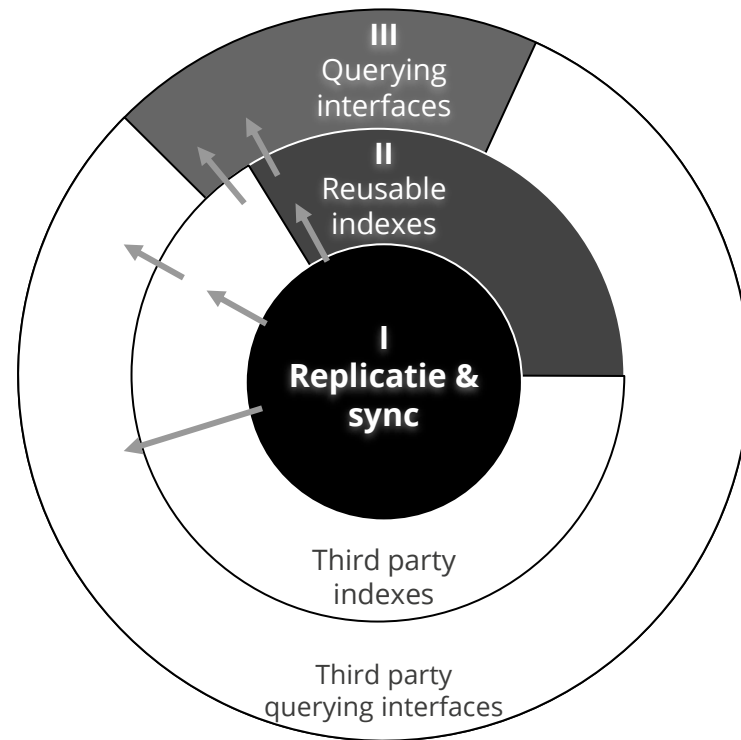
## STAYING IN SYNC



# LINKED DATA EVENT STREAMS

## PRIORITIES OF PUBLISHING DATA

- Data publishers focus on efficient scalable publishing, allowing consumers to stay in sync
- Consumers can replicate and stay in sync efficiently via fragment-based syncing
- Alternative fragmenting by publishers or intermediaries supports other use cases (e.g., time-based, geo-based, ...)
- Indexes can be combined/queried for use in apps without burdening the publisher
- Retention at publisher side is advertised



# EXAMPLE: ADDRESS REGISTRY

[HTTPS://SMARTDATA.DEV-VLAANDEREN.BE/BASE/](https://smartdata.dev-vlaanderen.be/base/)

- LDES published at the source
  - Communities
  - Street names
- Third party indexes on name (substring fragmentation/index)
- Metadata catalog makes fragmentation discoverable
- Client queries all fragments

[Autocomplete demo \(treecg.github.io\)](https://treecg.github.io)

TREE | Autocomplete over TREE structured fragmentations

Choose TREE fragmentation to query over:

☐ Municipalities of Flemish Address Registry

☐ Streets of Flemish Address Registry

© the Linked Data Fragments collaborators. [Contact us.](#)

# Vlaamse Smart Data Space

## Why?

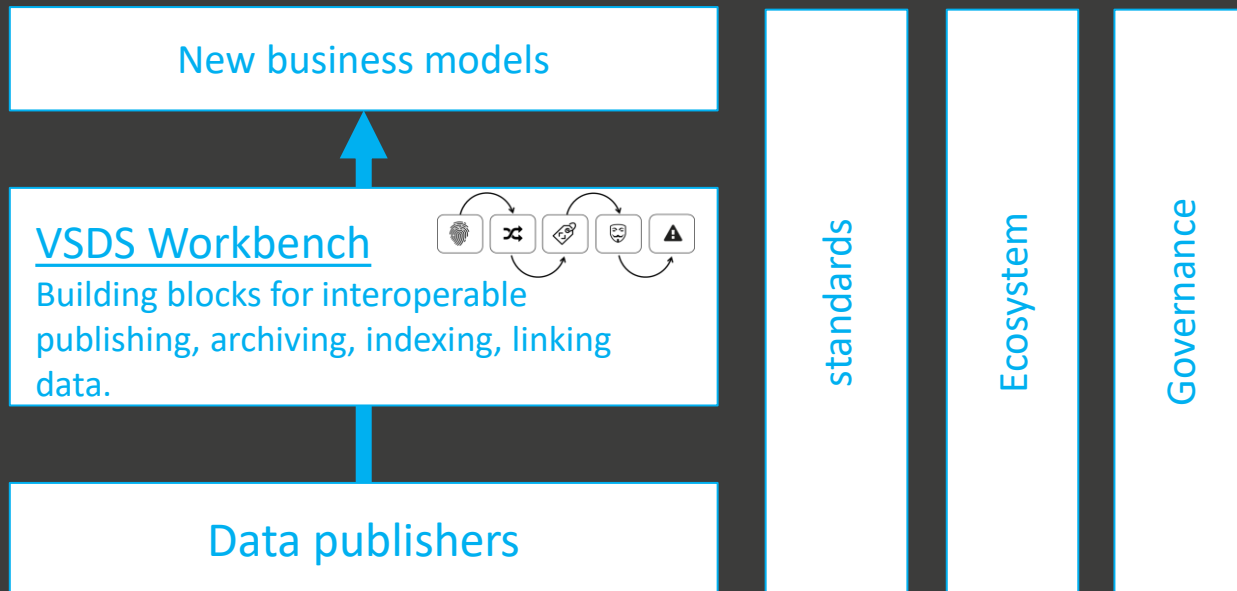
Data gets stuck in silos. Different kinds of lock-ins hamper innovation and business value:

- *Vendor lock-in,*
- *Project lock-in,*
- *Domein lock-in,*
- *Technische lock-in.*

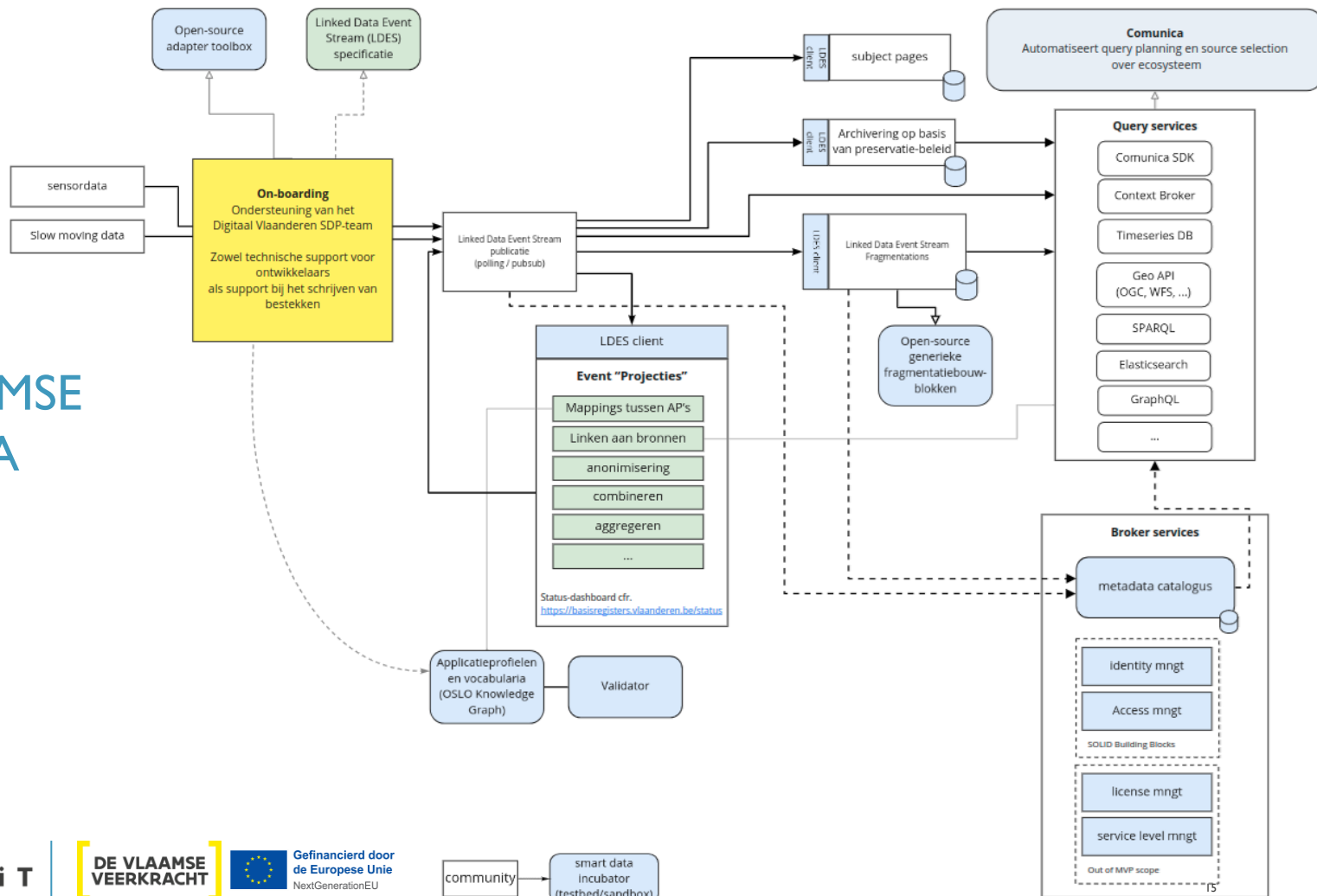
Key: **interoperability**

## Leveraging smart data for sustainable growth of the Flemish data economy

### 4 Pillars



# VSDS: VLAAMSE SMART DATA SPACE



# ‘BUT WAIT, WHAT’S A DATA SPACE REALLY ABOUT?

## BUILDING BLOCKS AND AGREEMENTS

Data spaces are communities that agree on converging to using shared agreements in the form of

- Meta-data publishing
- Data transfer protocols & service standards
- Schemas and semantics
- Data licensing
- Authentication and access control
- Persistent identifier strategy

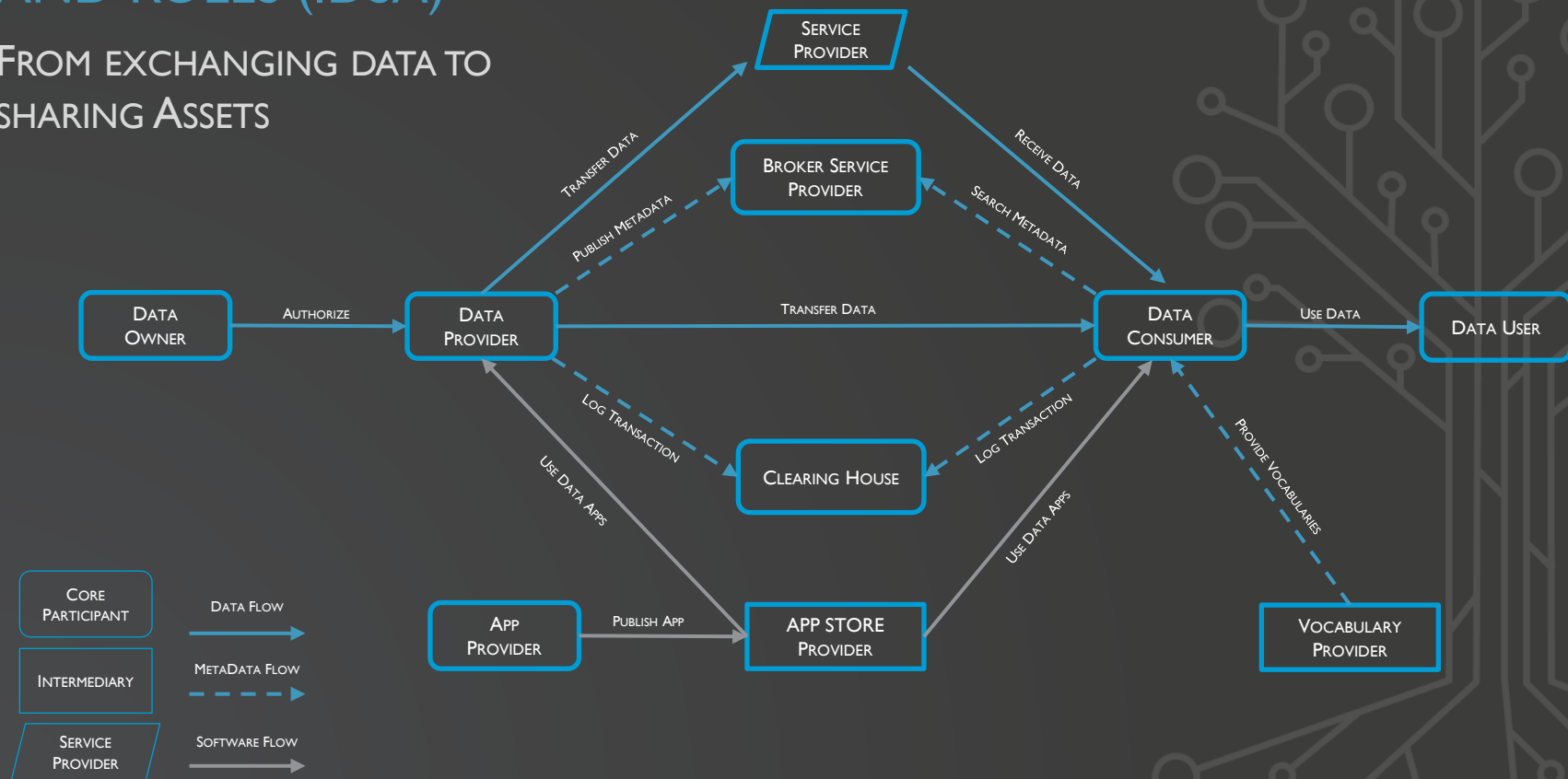
In addition to agreements, a data space may offer

- Data publishing & processing components
- Run-time environment(s) for running the components
- Community support & tools for data onboarding, software contributions, service development, ...



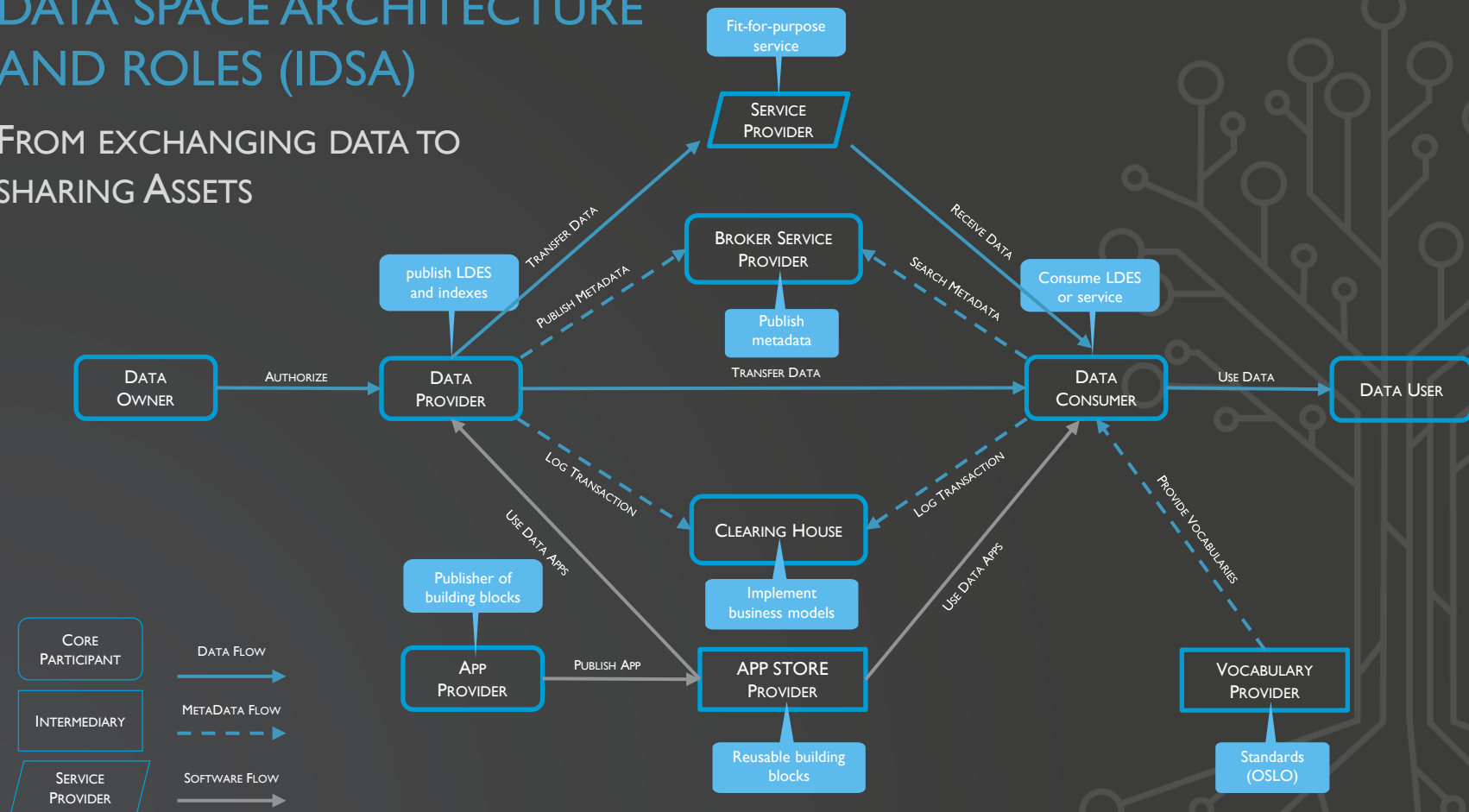
# DATA SPACE ARCHITECTURE AND ROLES (IDSA)

FROM EXCHANGING DATA TO SHARING ASSETS



# DATA SPACE ARCHITECTURE AND ROLES (IDSA)

## FROM EXCHANGING DATA TO SHARING ASSETS



# MORE INFORMATION

## POINTER AND REFERENCES

- Vlaamse Sensor Data Space: [Vlaamse Sensor Data Space | Vlaanderen.be](#)
- Linked Data Event Streams
  - Specification: [SEMICeu/LinkedDataEventStreams:The Linked Data Event Streams specification \(github.com\)](#)
  - Online course: <https://academy.europa.eu/courses/publishing-data-with-linked-data-event-streams-why-and-how>
  - In-depth article: [Publishing Linked Data Event Streams \(thepieterdc.github.io\)](#)
- Semantic Sensor Ontology: [Semantic Sensor Network Ontology \(w3.org\)](#)
- Imec smart city whitepaper: [Download white paper on Smart City and Smart Architecture | imec City of Things](#)



embracing a better life

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