The Semantic Interoperability Framework

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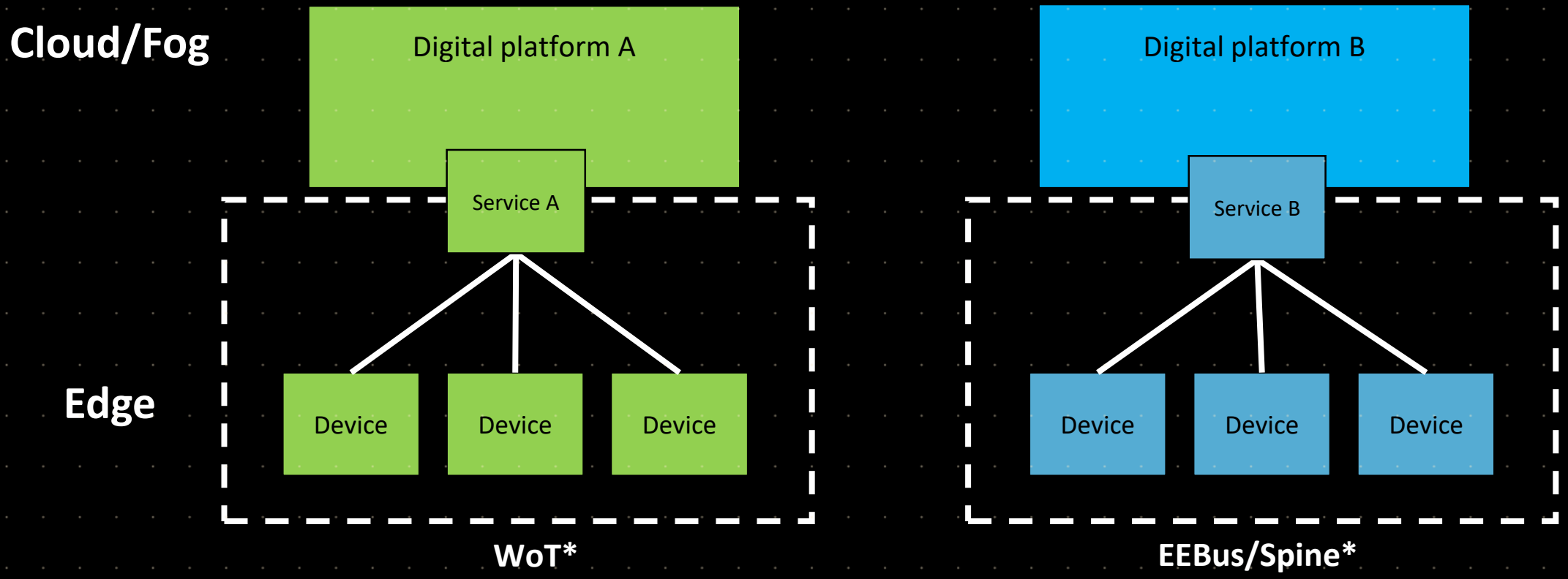
Sustainable Places, Brussels

22.09.2022.

Context



interconnect

* Used as examples. Partners in consortium use these frameworks/protocols

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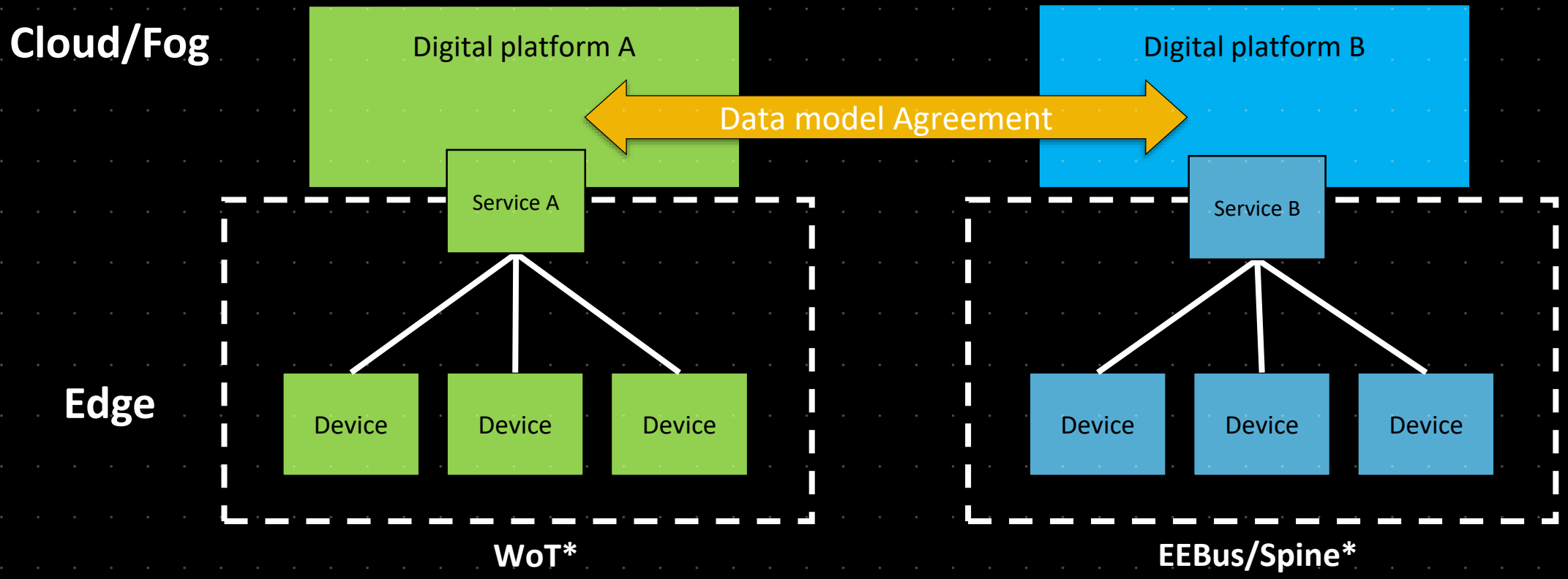

Interoperability based on the agreement to use a specific data model.

interconnect

* Used as examples. Partners in consortium use these frameworks/protocols

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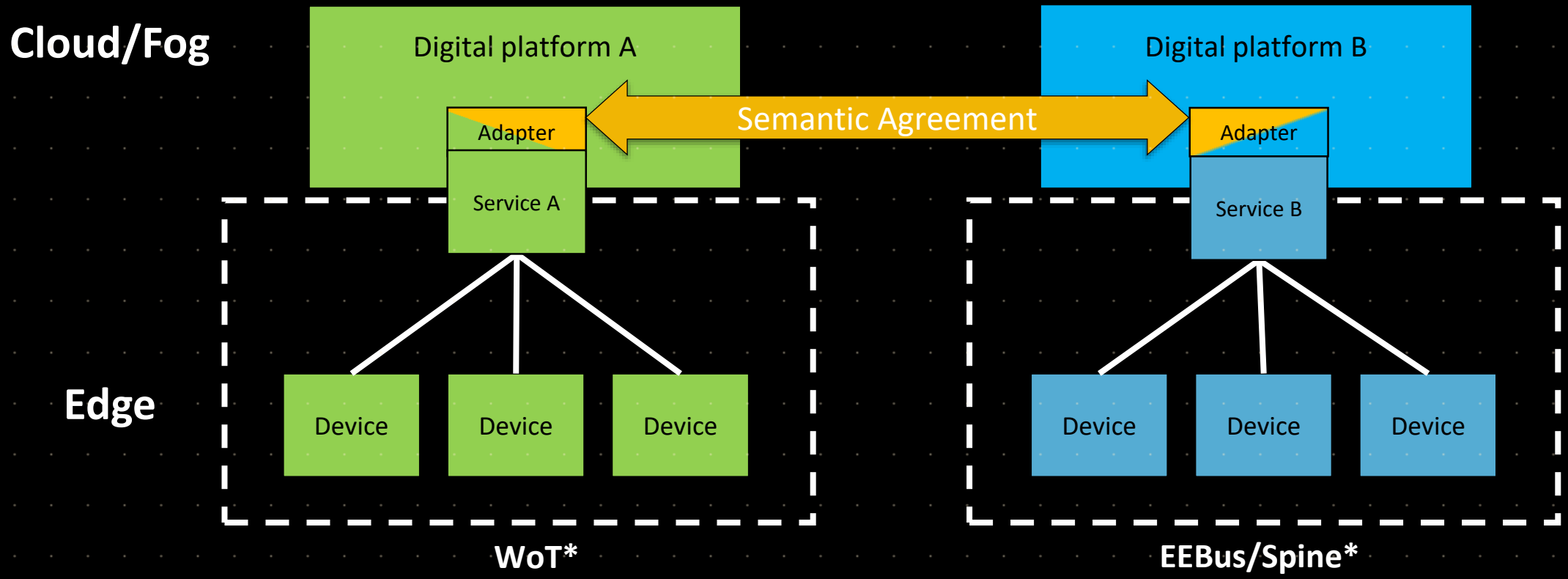
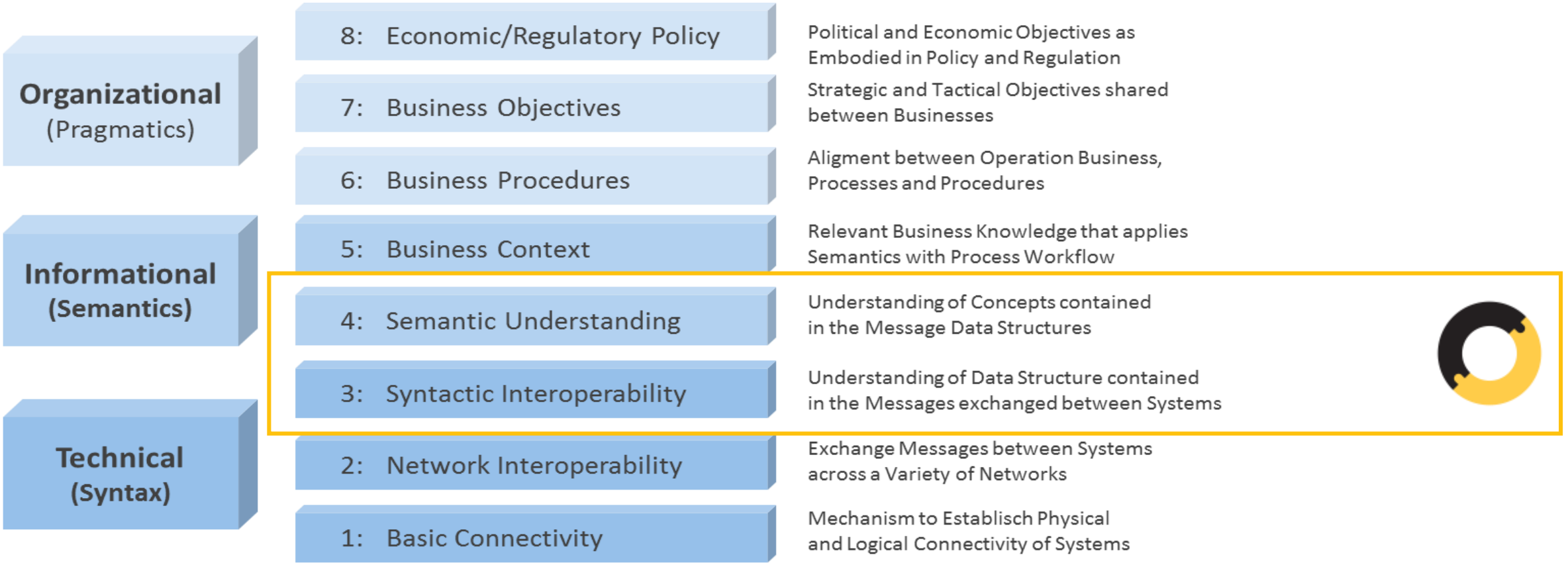


Interoperability based on the agreement to use a specific <u>domain</u>.

interconnect

* Used as examples. Partners in consortium use these frameworks/protocols

The levels of interoperability



source GWAC - GridWise Architecture Council

The role of ontologies

- Ontologies can be used to define the common data knowledge representations for different stakeholders to interoperate
- InterConnect uses SAREF suite of ontologies as pillar for deploying semantic interoperability on a large scale
- Not all concepts needed by the pilots were present in SAREF and its extensions. Interconnect developed new ontology modules based on
  - 112 Use Cases*
  - 66 Services from 21 InterConnect partners, based on 166 APIs, for a total of 864 parameters to be "SAREFized" **

*Described in D1.1 (“Services and Use Cases for Smart Buildings and Grids”) at https://interconnectproject.eu/resources

**Described in D3.1 and D3.2, yet to be published

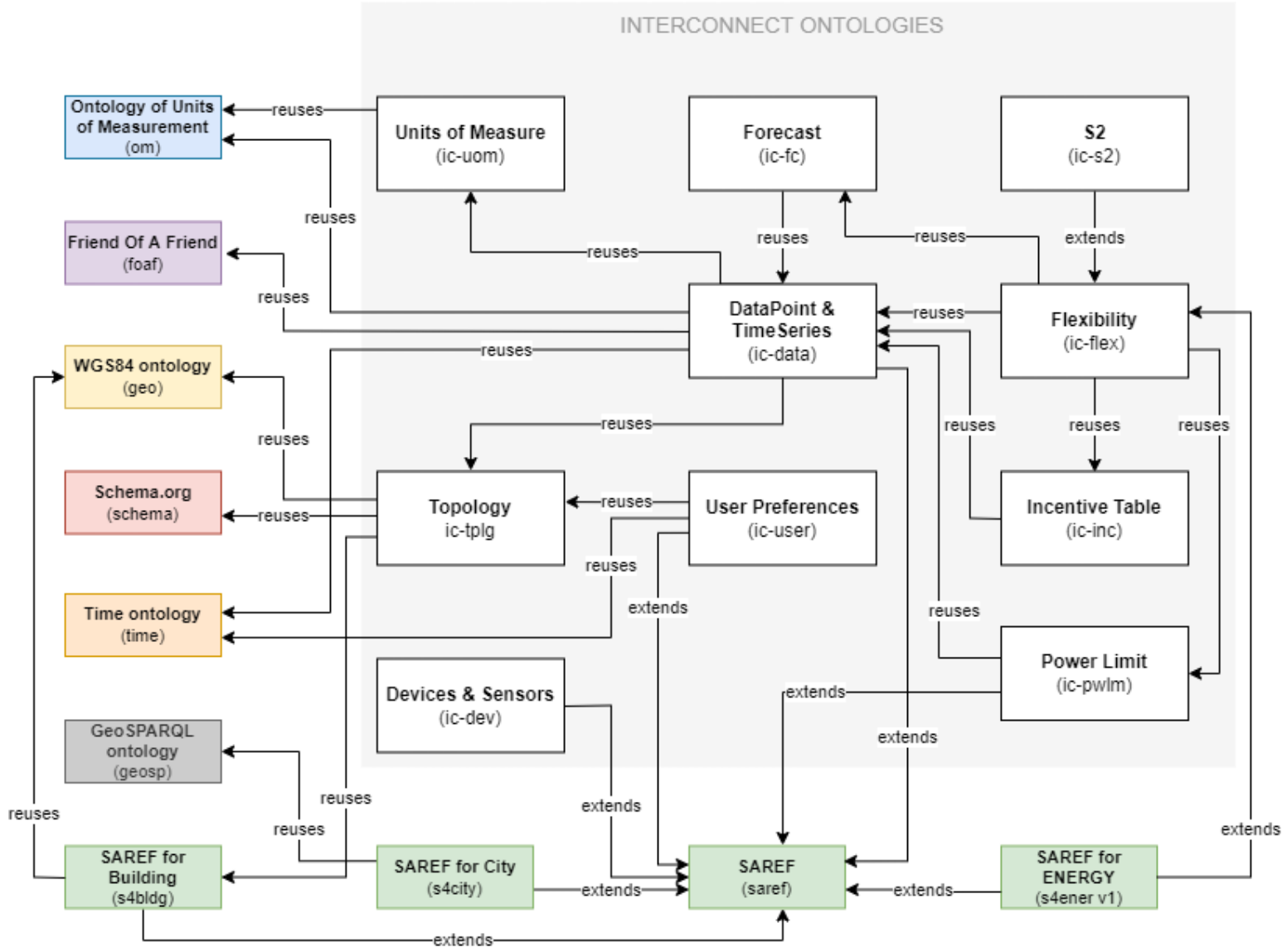
SAREF: Smart Applications REFerence ontology

- The ETSI SAREF ontology and its extensions for Energy, Building, City and Water are a solid example of mature, standardized and sustainable ontologies that can be used as basis to enable cross-sector services in smart buildings

ETSI TS 103 264 V3.1.1 (2020-02)

https://saref.etsi.org/

The InterConnect ontologies



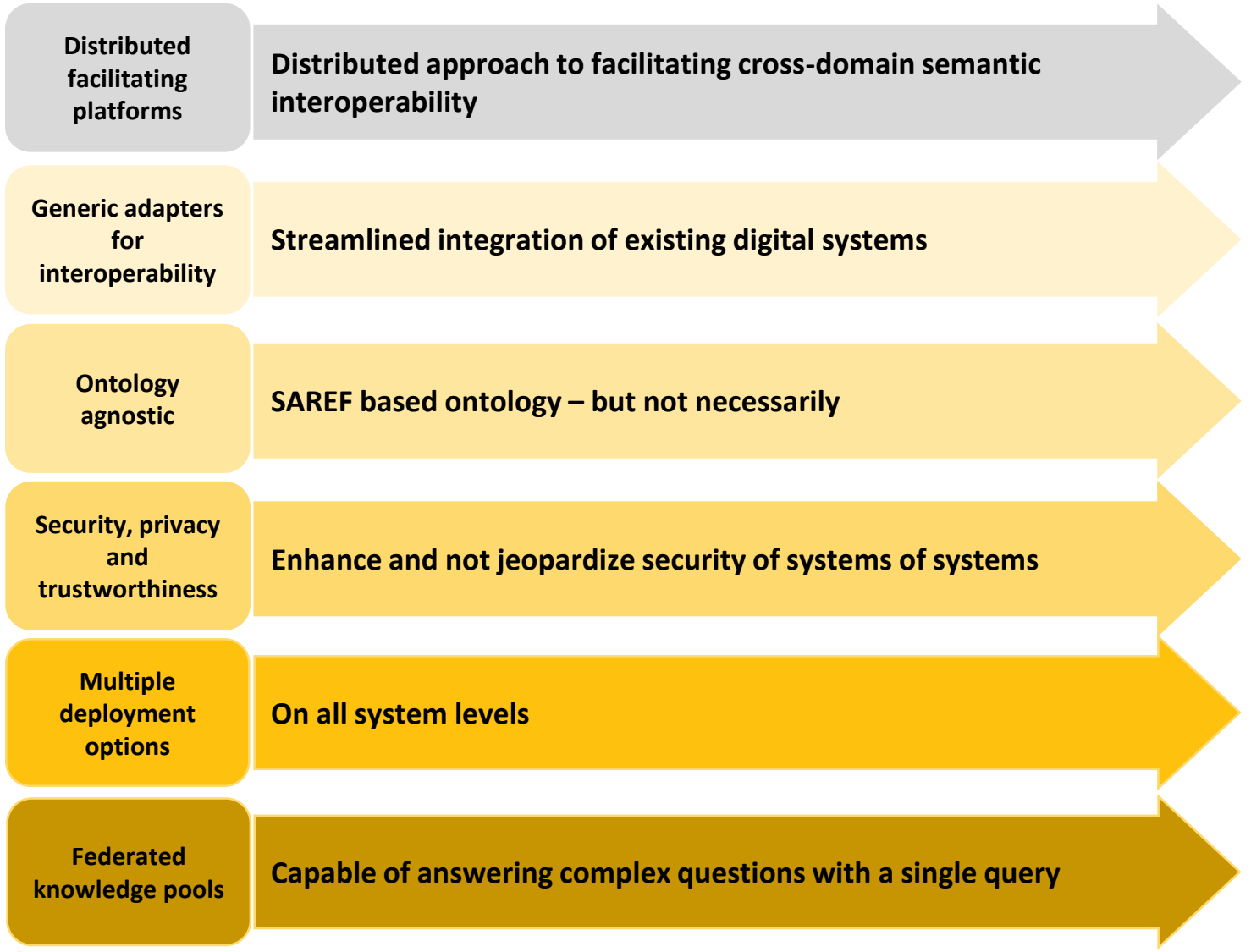
Reuse of the methodology followed by ETSI for SAREF development

Requirements gathering & ontology implementation

- Four workshops
- October 2020 – June 2021
- Deliverable 2.3 submitted in December 2021

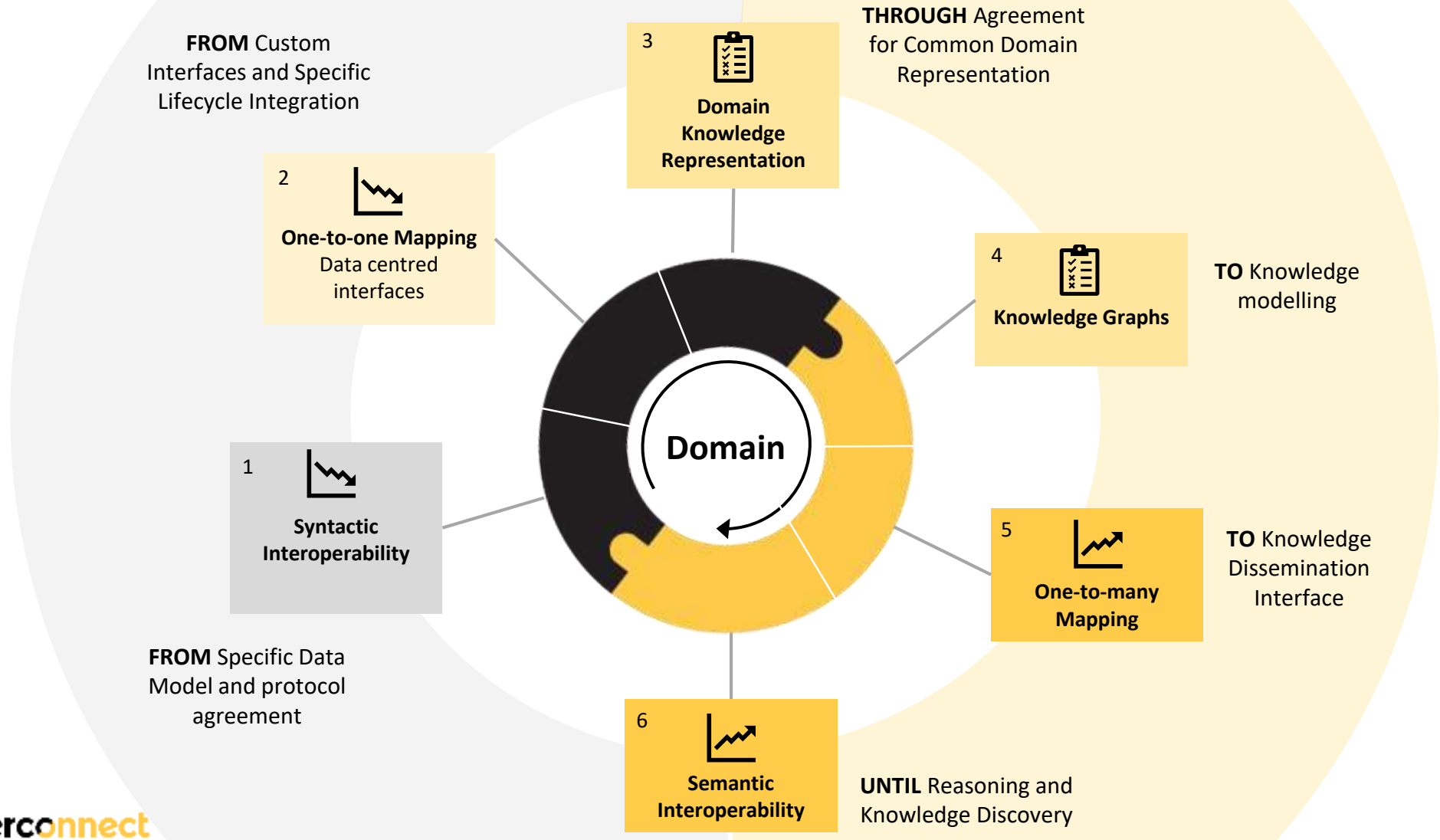
Currently in the process of standardization @ETSI to become part of SAREF

How InterConnect addresses the challenges?



InterConnect Semantic Proposition

Service Concepts → Service data models → Knowledge Graphs → Semantic Interoperability



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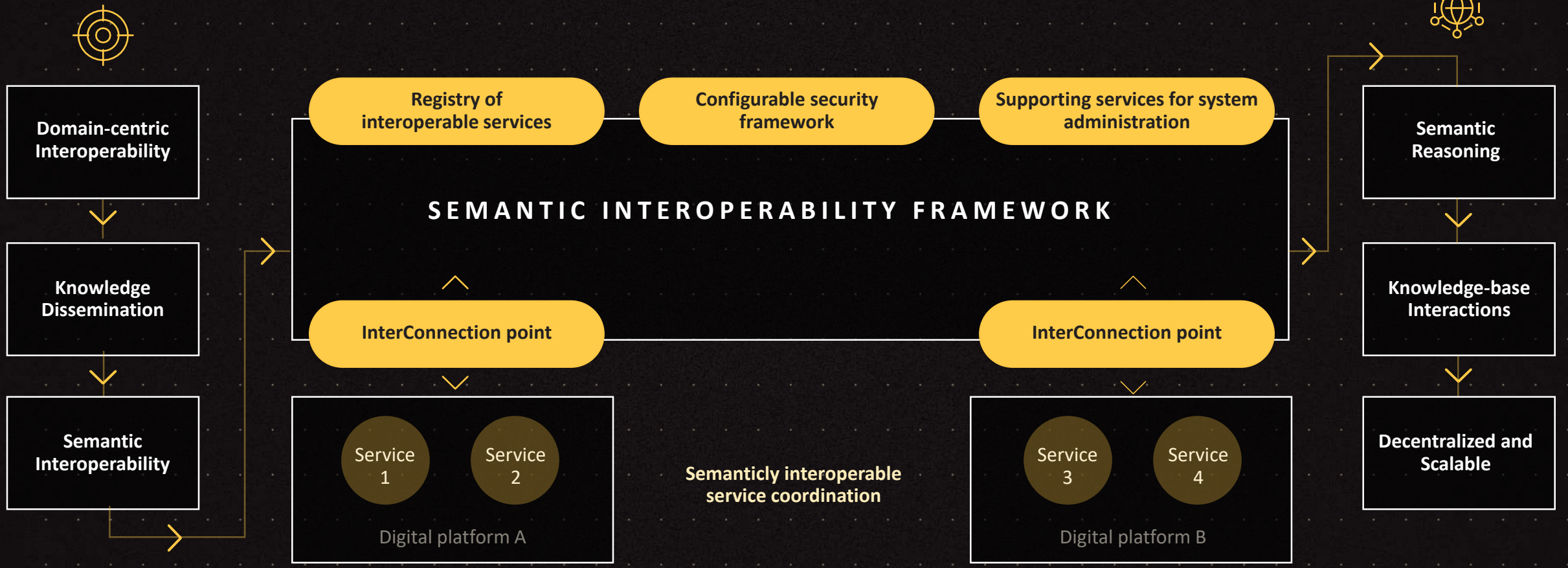
INTERCONNECT

INTEROPERABILITY FRAMEWORK



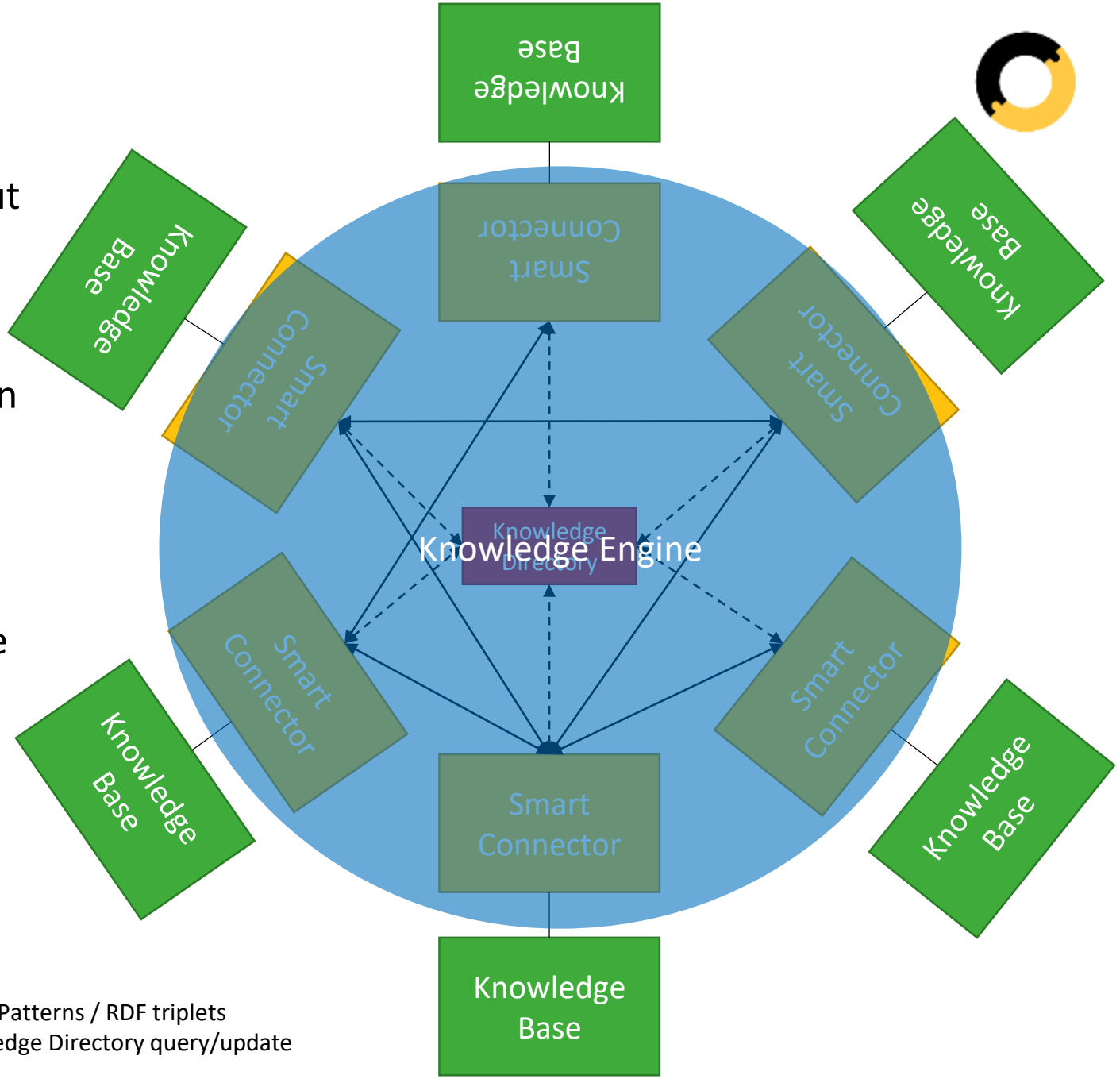
DIGITAL PLATFORMS AND SERVICES BECOME SEMANTICLY INTEROPERABLE

Services use the interoperable tools to publish & discover capabilities and are joint together to enable use case demonstration

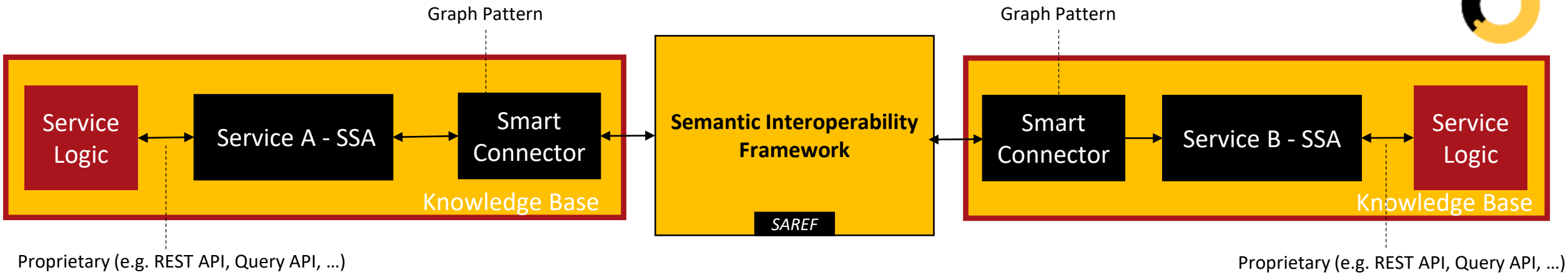
Need to find a slide we use for the store, GA and P2P Marketplace as components of the SIF. Thenwe can decide.

The Knowledge Engine

- The Knowledge Engine is composed out of Smart Connectors and the Knowledge Directory
- The Knowledge Base is your application
- Each Knowledge Base has its own Smart Connector
- The Smart Connector is a generic piece of software, that facilitates communication and reasoning



Knowledge Dissemination



ASK

POST

```
?f rdf:type ic-fc:PointForecast .
?f saref:hasTime ?sd .
?sd rdf:type time:Interval .
?sd saref:hasBeginning ?bsd .
?bsd time:inXSDDateTimeStamp ?start_date .
?f saref:hasTime ?ed .
?ed rdf:type time:Interval .
?ed saref:hasEnd ?eed .
?eed time:inXSDDateTimeStamp ?end_date .
?f ic-data:hasDataPoint ?hdp .
?hdp rdf:type ic-data:TimeSeries .
?hdp ic-data:hasTopologicalAssociation ?installation_code .
?installation_code rdf:type saref:device .
```

ANSWER

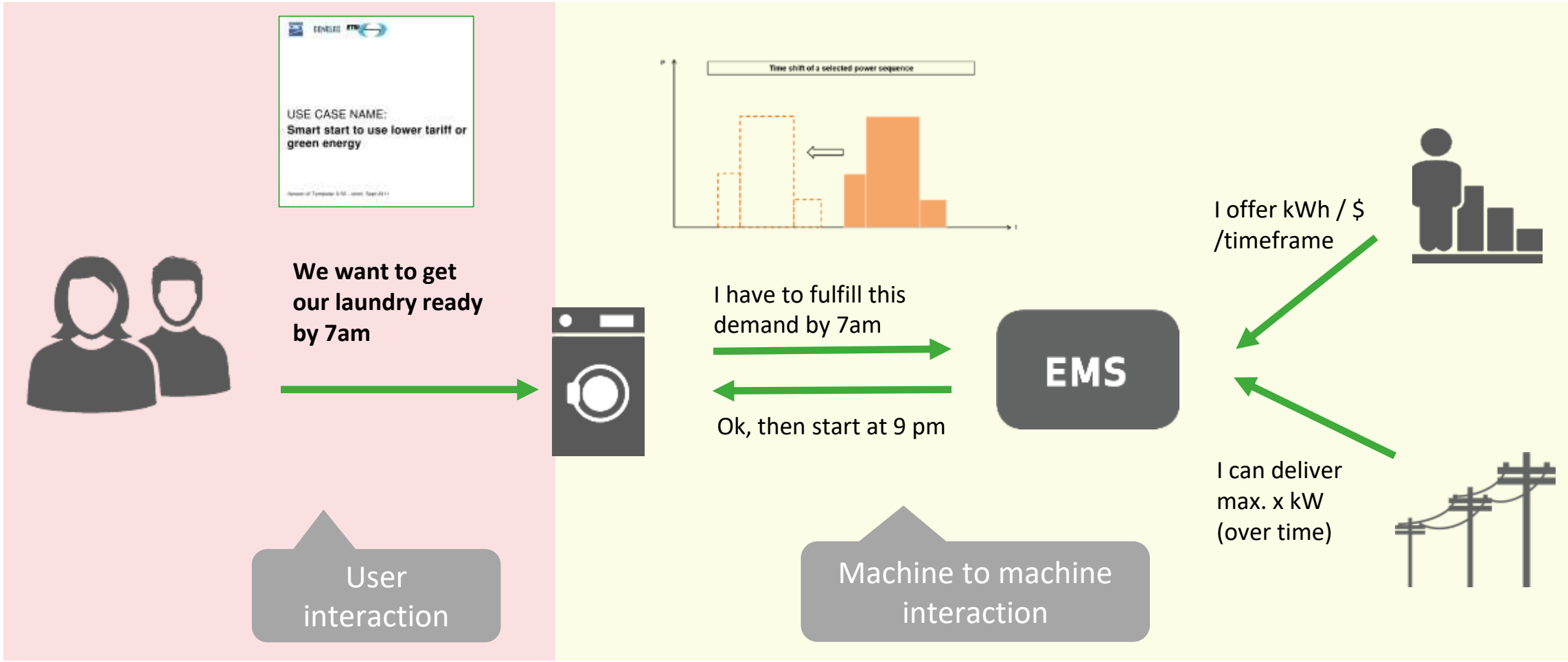
REACT

Interoperability in practice #1

Example use case provided by the Dutch and Portuguese pilots

interconnect

Use case: users allow smart appliances to offer flexibility managed by an Energy Management System



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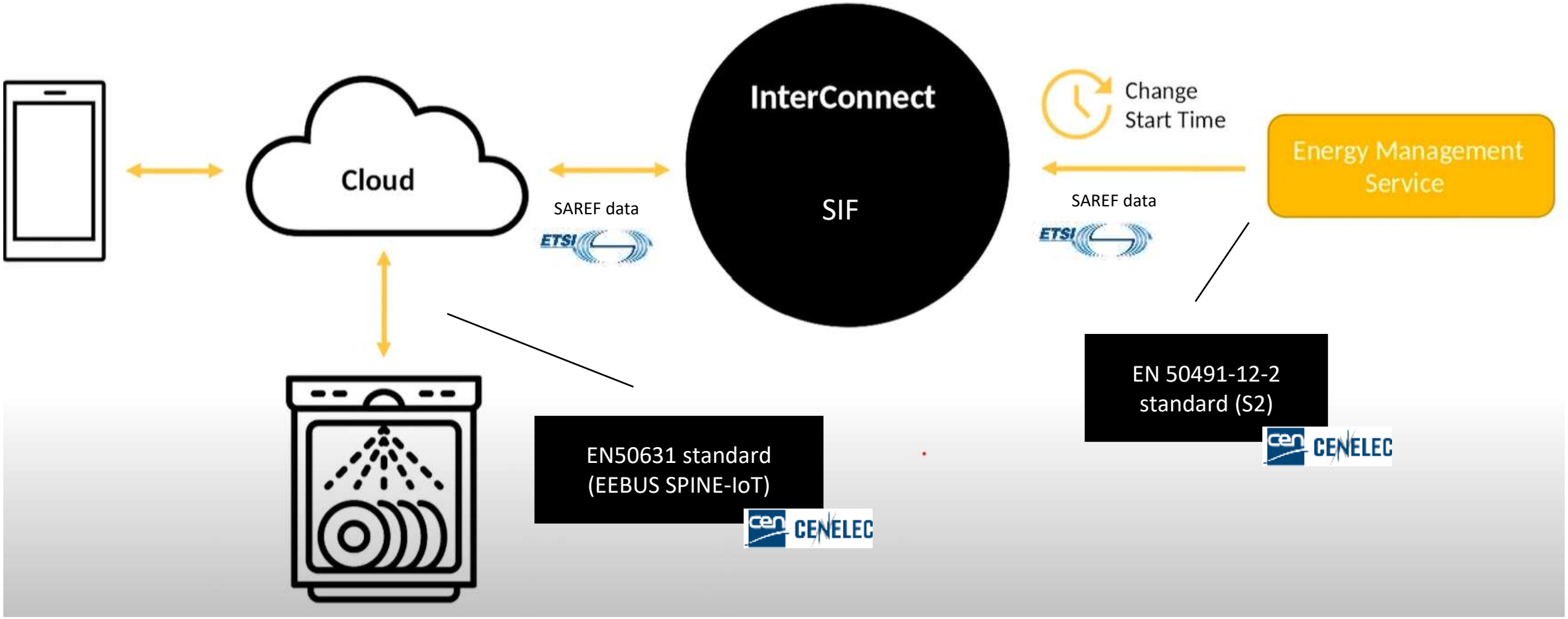
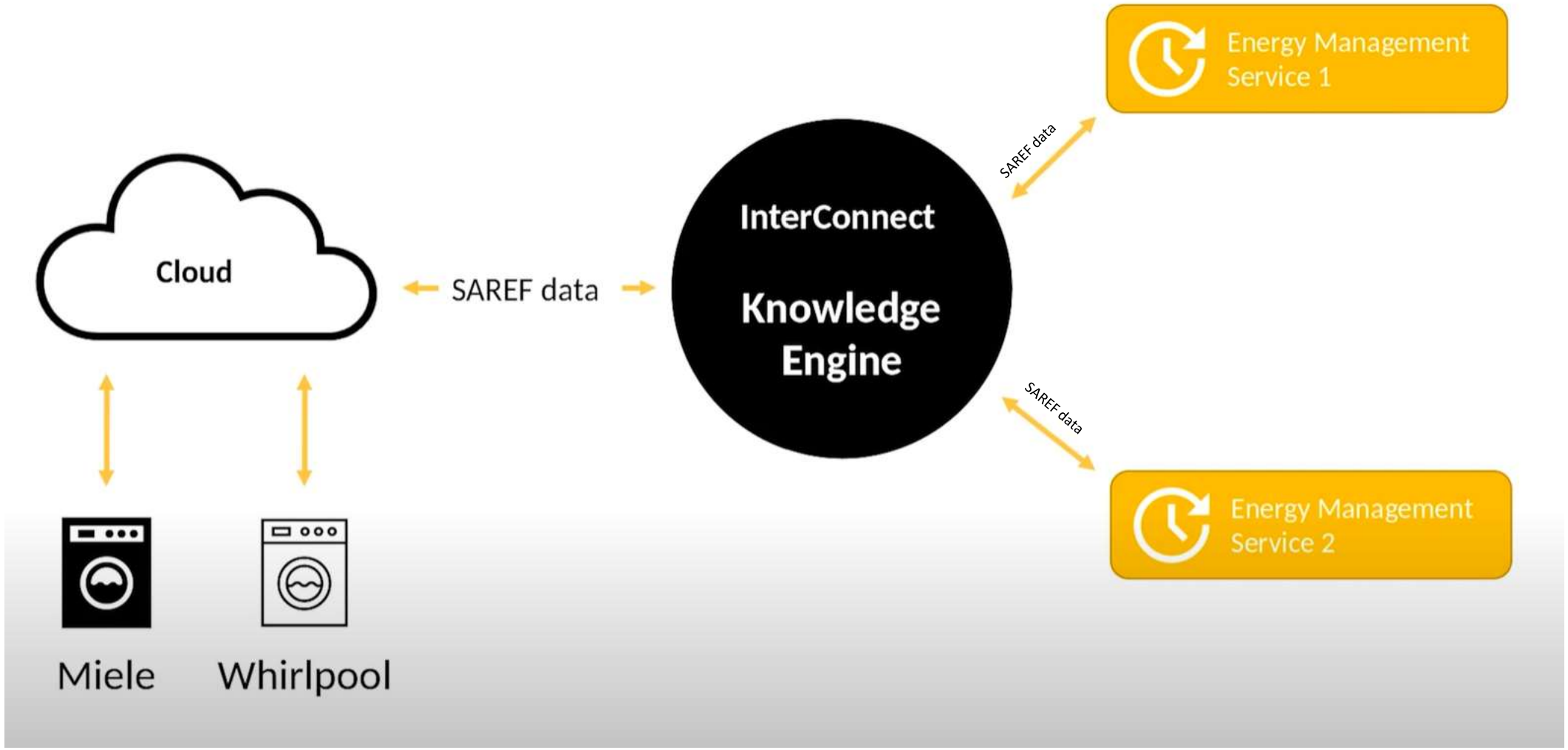
Interoperability plug & play: different standards



Plug & play Energy Management Service

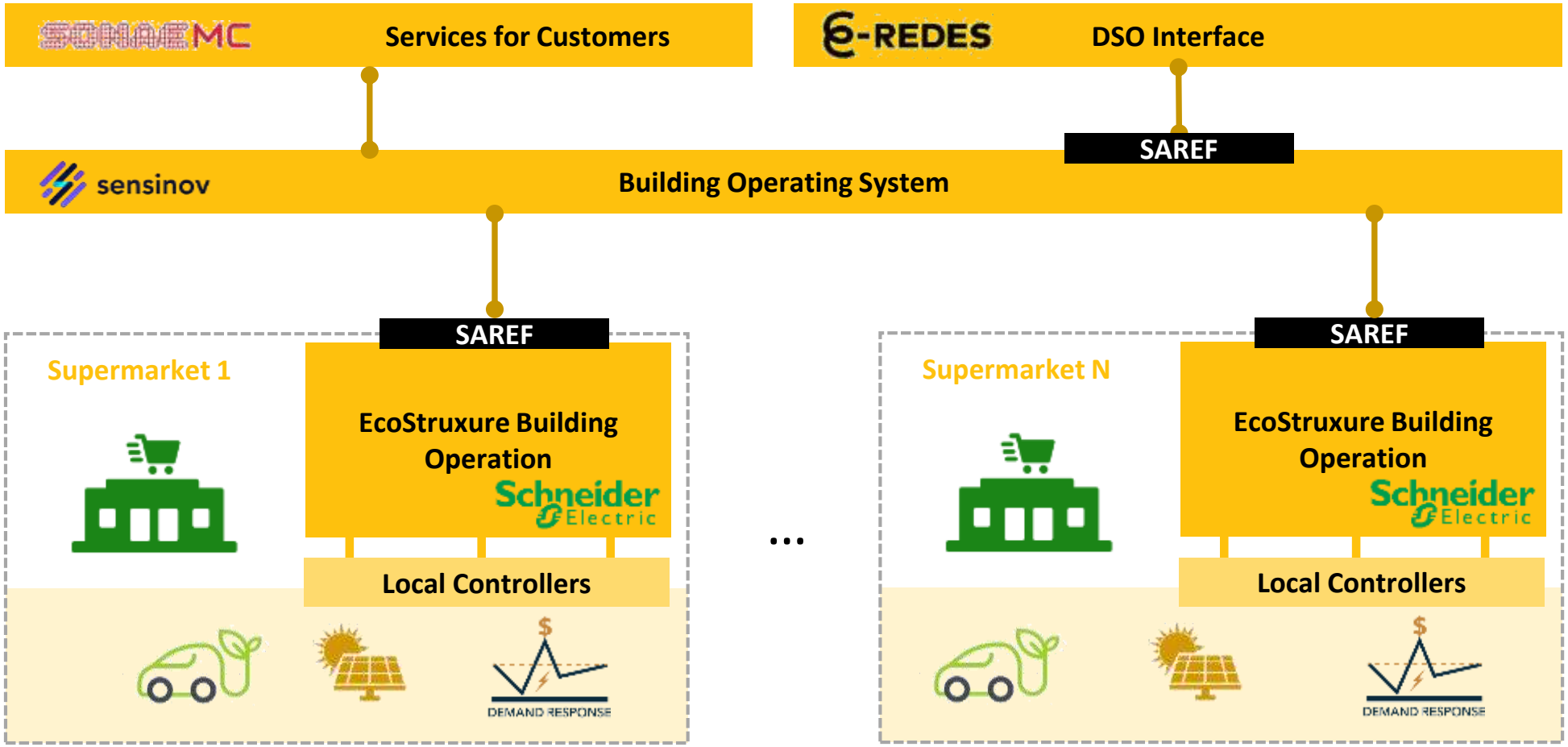


Interoperability in practice #2

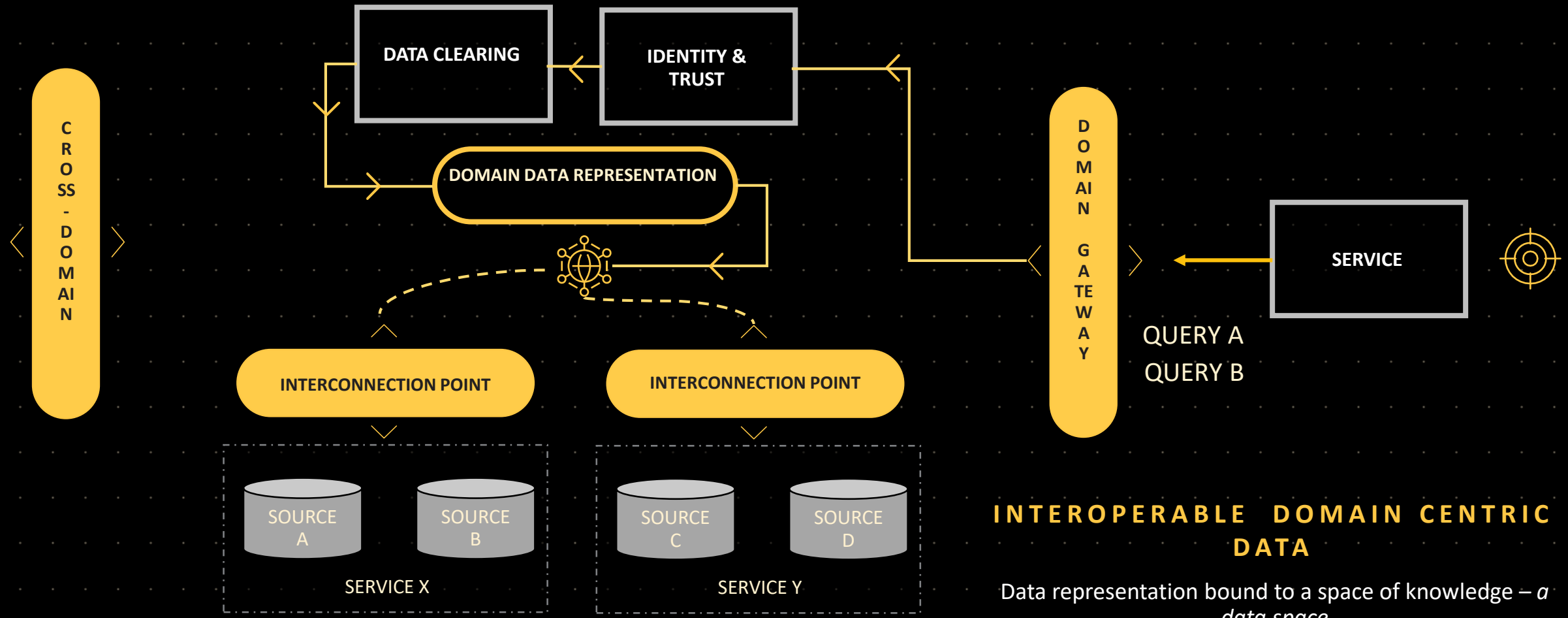
Example use case provided by the Portuguese pilot

interconnect

Commercial buildings use case
Green supermarkets (PT): architecture for semantic practice



Going cross-domain



INTEROPERABLE DOMAIN CENTRIC DATA

Data representation bound to a space of knowledge – *a data space*

interconnect

interoperable solutions connecting smart homes, buildings and grids

FINANCING

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement No 857237

PROJECT CONTACT

interconnect_project@inesctec.pt

DURATION

01.10.2019 / 30.09.2023

Demonstrations

Greece:

- 1000 households (150 with PV)

France:

- 250 households
- 20 tertiary buildings
- 1 school

Portugal

- 250 households
- 12 non-residential buildings

Netherlands

- 200 apartments
- EV charging infrastructure

Germany

- 50 households
- 15 hotels

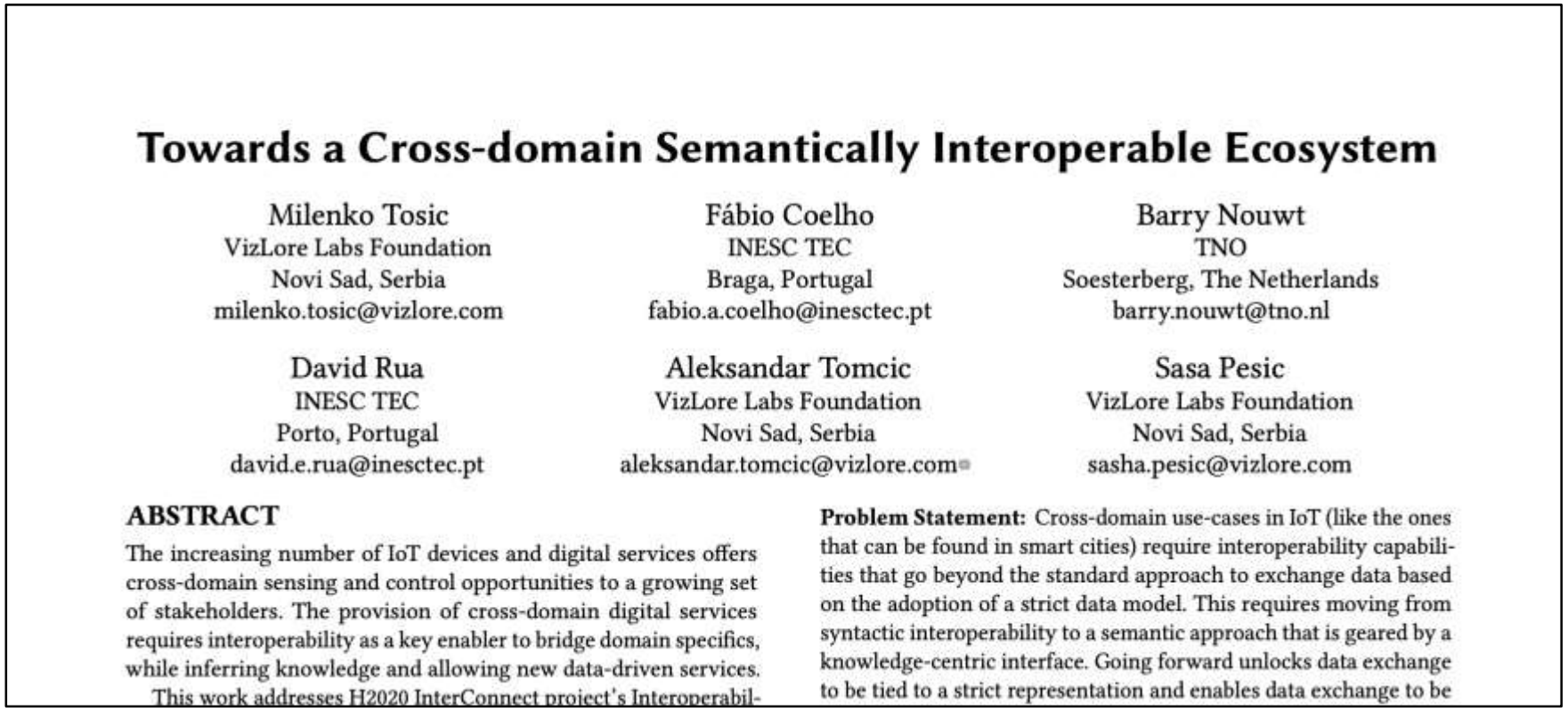
Belgium

- 636 households: 51 buildings and 60 EV charger stations
- Science park + EV chargers

Italy

- 480 social apartments

InterConnect Concept Paper



Towards a Cross-domain Semantically Interoperable Ecosystem

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ABSTRACT

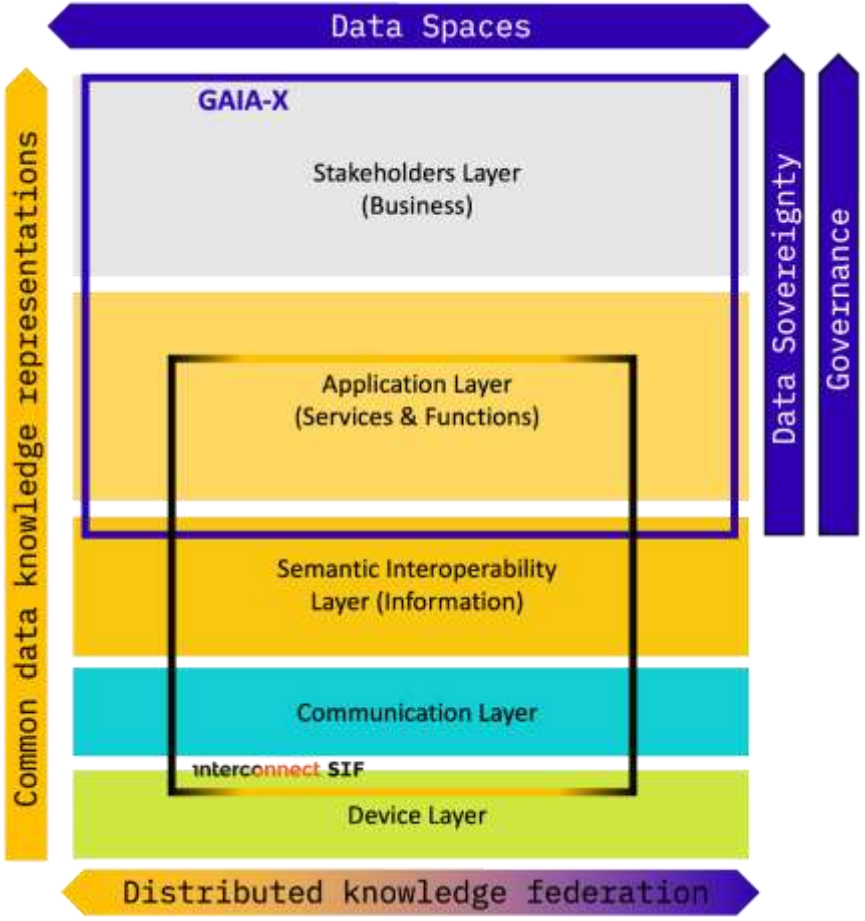
The increasing number of IoT devices and digital services offers cross-domain sensing and control opportunities to a growing set of stakeholders. The provision of cross-domain digital services requires interoperability as a key enabler to bridge domain specifics, while inferring knowledge and allowing new data-driven services. This work addresses H2020 InterConnect project's Interoperabil-

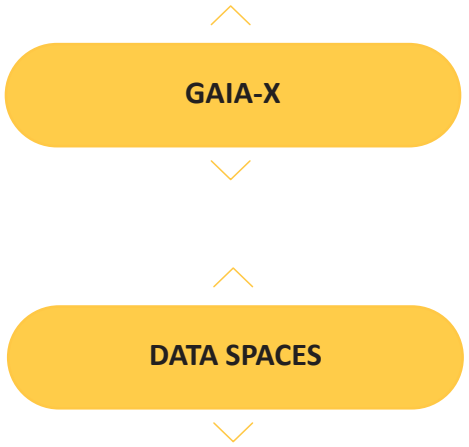
Problem Statement: Cross-domain use-cases in IoT (like the ones that can be found in smart cities) require interoperability capabilities that go beyond the standard approach to exchange data based on the adoption of a strict data model. This requires moving from syntactic interoperability to a semantic approach that is geared by a knowledge-centric interface. Going forward unlocks data exchange to be tied to a strict representation and enables data exchange to be

ACM Conference on Web Search and Data Mining 2022

Backup

InterConnect and other initiatives





Sovereignty control/enforcement

Cross-domain services
Identity Centric

INTERCONNECT

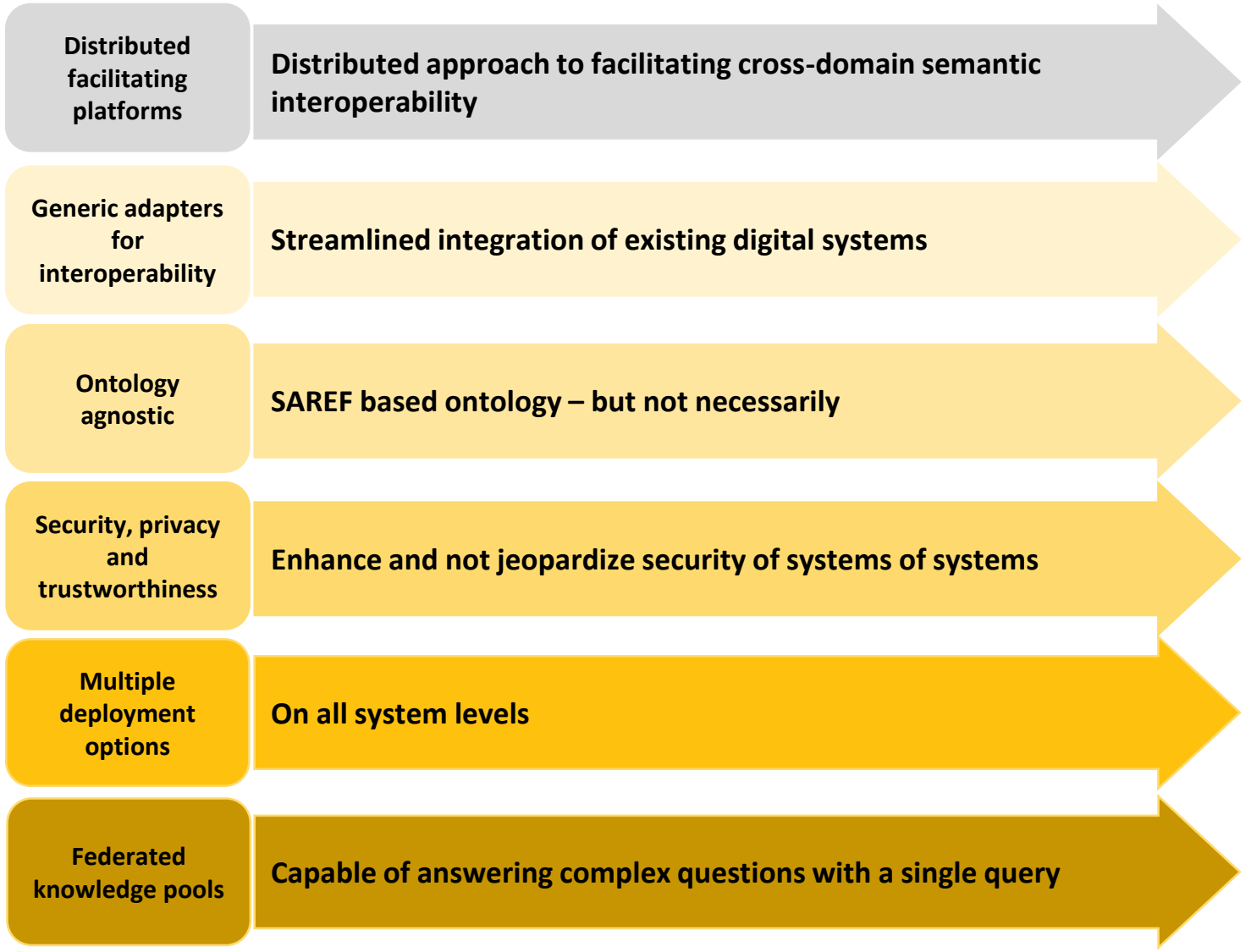
SEMANTIC
INTEROPERABILITY
FRAMEWORK

Enabling semantic data exchange with agnostic toolset
Domain bounded by an ontology (SAREF for Interconnect)
Federation of distributed knowledge

Data spaces require semantic interoperability

- Key requirements for data spaces:
  - **Interoperability**
  - Sovereignty and Trustworthiness
  - Distributed approach
- What are the challenges for semantic interoperability?
  - Steep technology learning/mastering curve.
  - Business alignment.
  - Most solution call for centralized interoperability facilitator. The issues are:
    - Dependability.
    - Data and privacy protection risks.
    - Performance bottlenecks.
    - Limited updates and extensibility.
    - Security – weakest ling in a chain.

How InterConnect addresses the challenges?



Ecosystem Interoperable Services

- ENERGY
- NON-ENERGY
- CROSS-DOMAIN
- CROSS-PILOT

Interconnect Interoperability Framework

STANDARDS

ETSI · CEN CENELEC · W3C

IN LINE WITH

- FIWARE
- GAIA-X
- IDSA

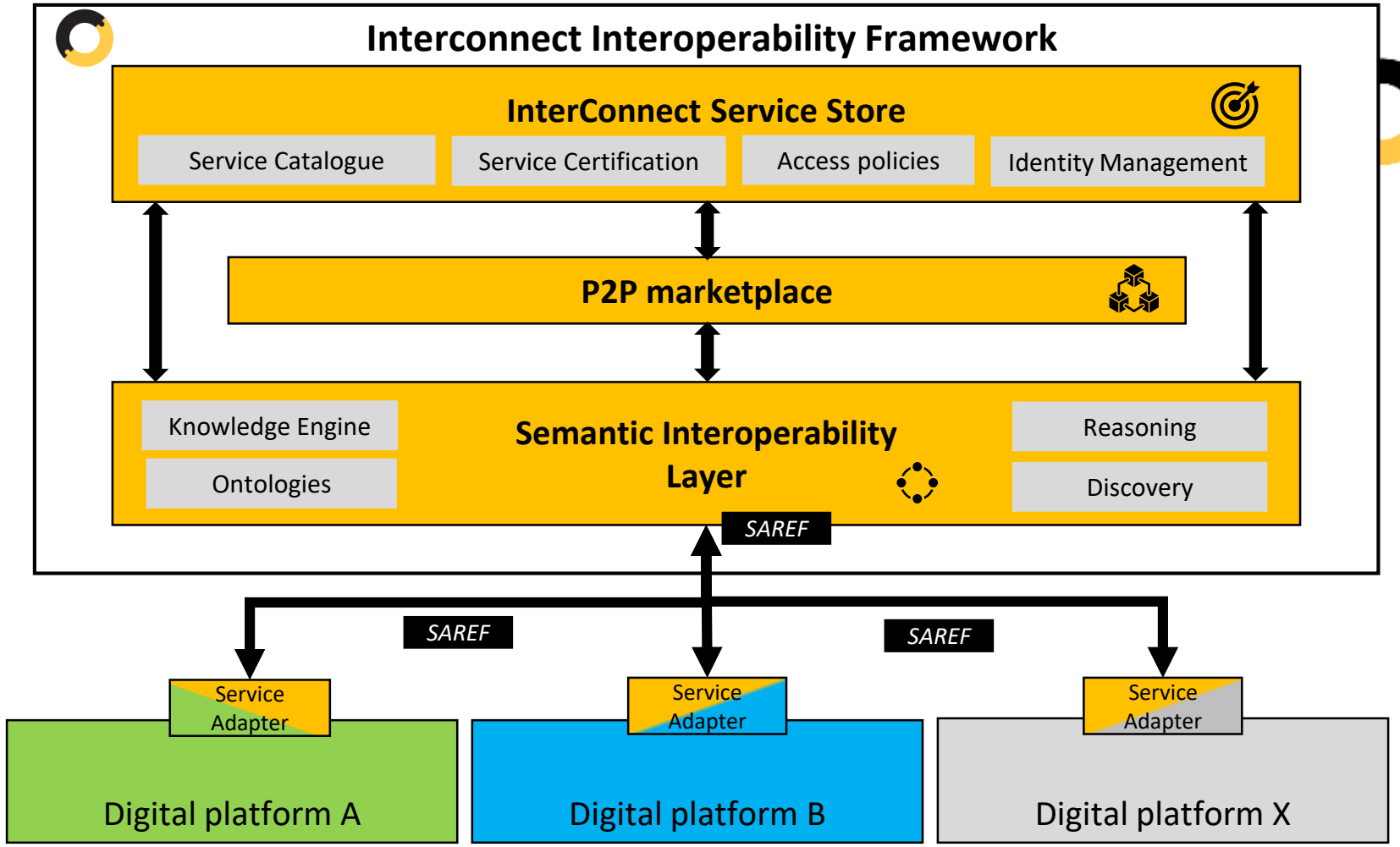
SEMANTIC INTEROPERABILITY BASED ON

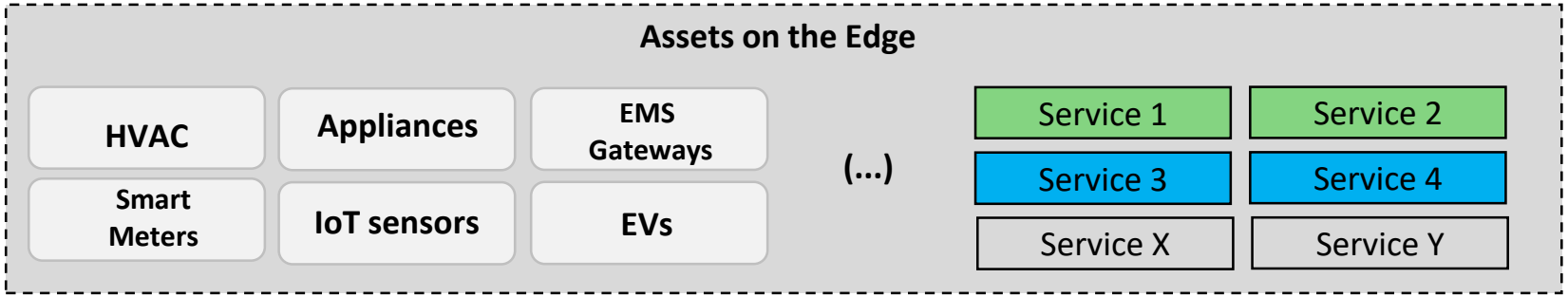
- ONTOLOGIES
- GRAPH PATTERNS
- KNOWLEDGE FEDERATION

Interconnect Stakeholders

- R&D
- CONSULTANCY
- MANUFACTURERS
- ASSOCIATIONS
- DSOs
- RETAILERS
- END USER

Security and privacy framework , Admin and Governance





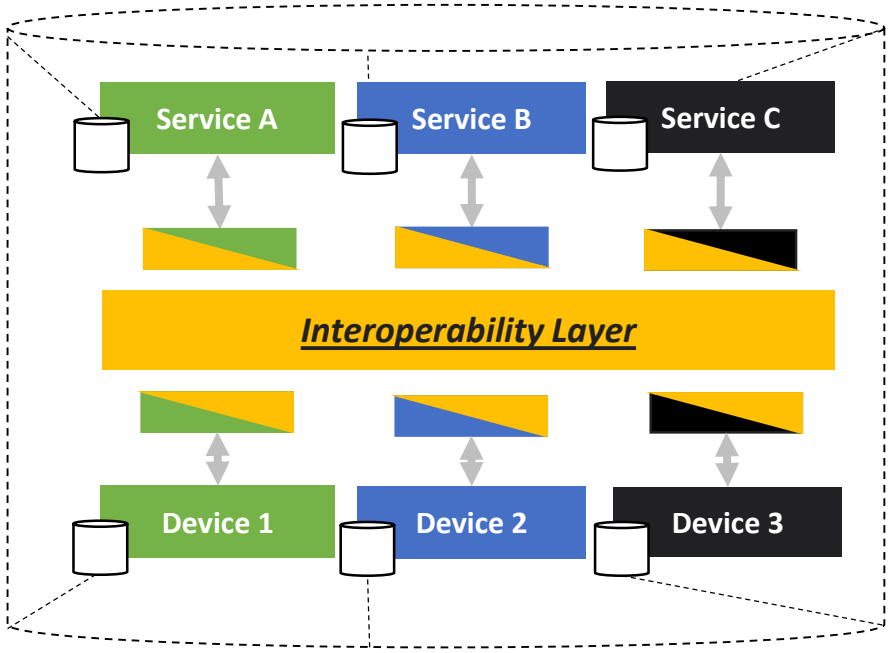
Use cases, Interoperable Services, Standardization

How is the Semantic Interoperability Layer used to build interoperable data space?

Local Knowledge base

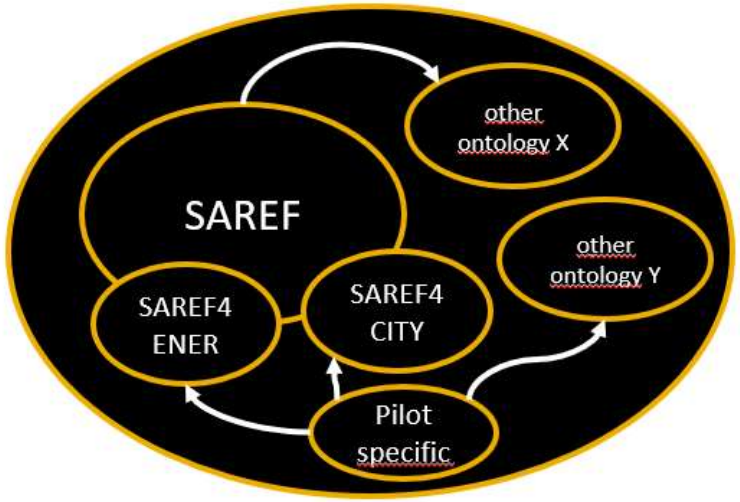
Semantically Interoperable Ecosystems establish Data Space

Adapter



(distributed)

Data Space – Knowledge Federation



DataSpaces for the Digital and Green Transformation

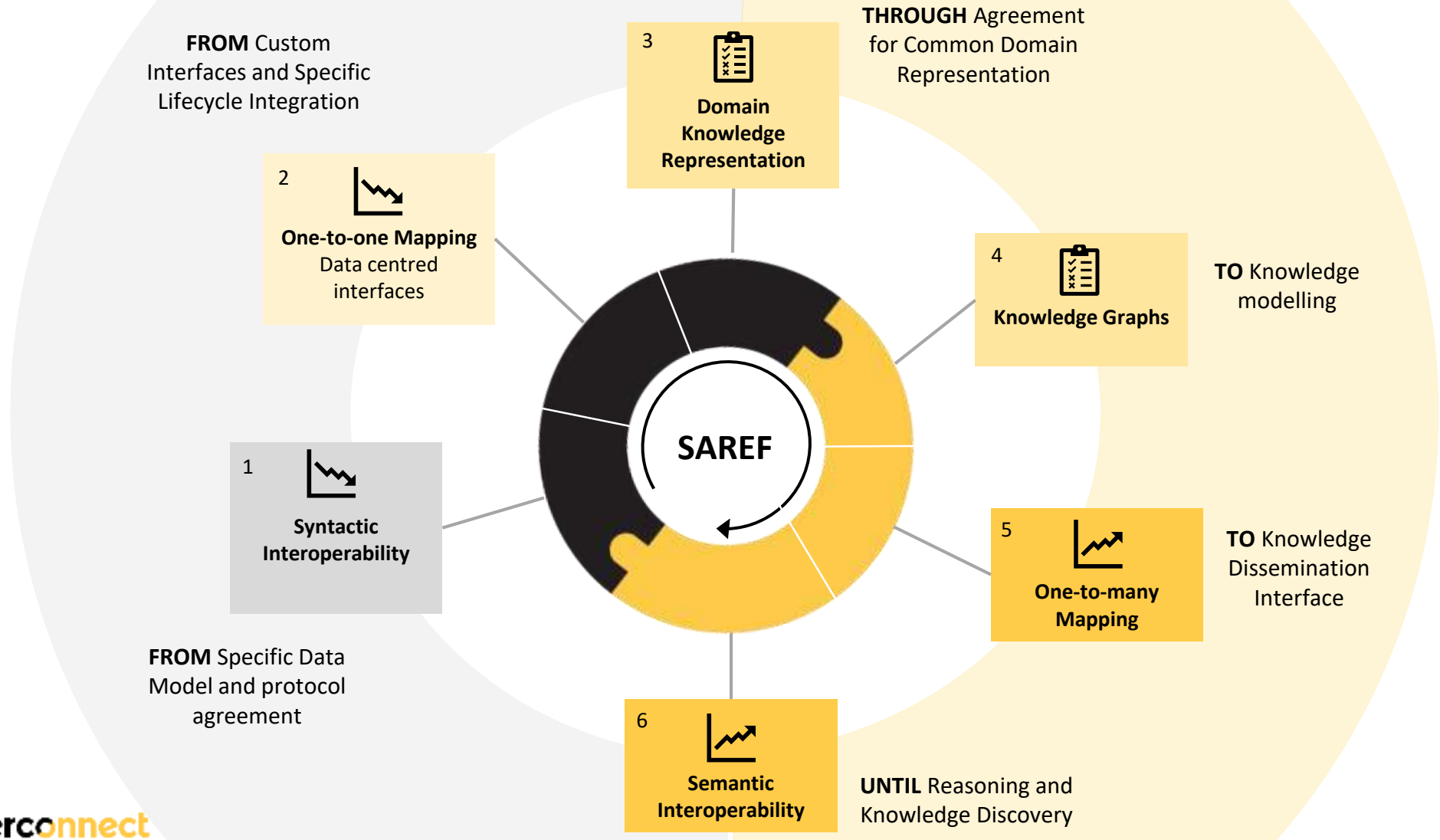
- Action Plan on the Digitalisation of Energy (DoEAP) by the European Commission to be published in autumn 2022
  - Digitalisation prerequisite for efficient and effective operation of energy system and markets
- Data availability and timely sharing and use among relevant players is key for the energy transition
  - Including metering data, data from consumers such as home appliances, building automation, EV charging stations, or prosumers PV panel & inverters
- As a baseline for a data space, data and technology components must be built on formal or pre-normative standards, stakeholder driven, interoperable and open

Text from Data Spaces: Common data models for Energy, Home, Mobility workshop at IoT Week 2022,

organized by Rolf Riemenschneider, European Commission, DG CONNECT and Alberto Dognini, E.ON Energy Research Center

InterConnect Semantic Proposition

Service Concepts → Service data models → Knowledge Graphs → Semantic Interoperability



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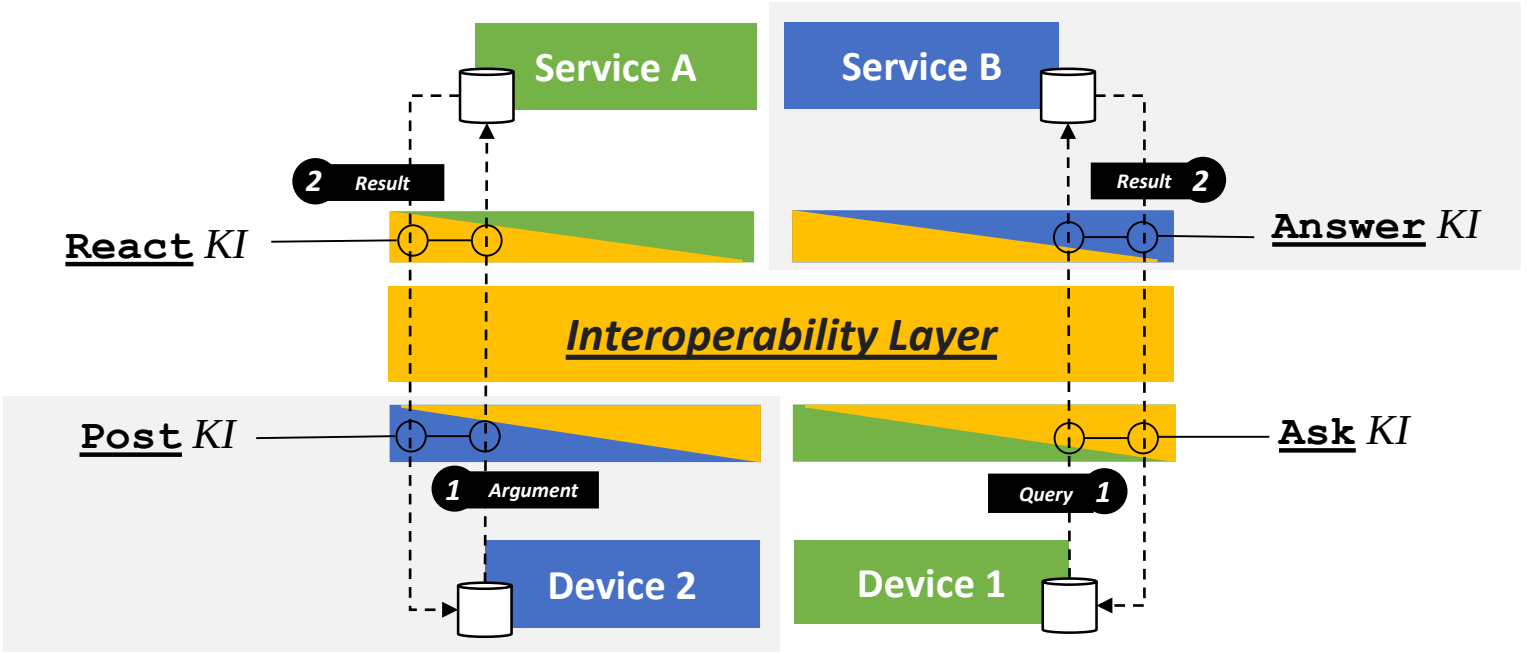
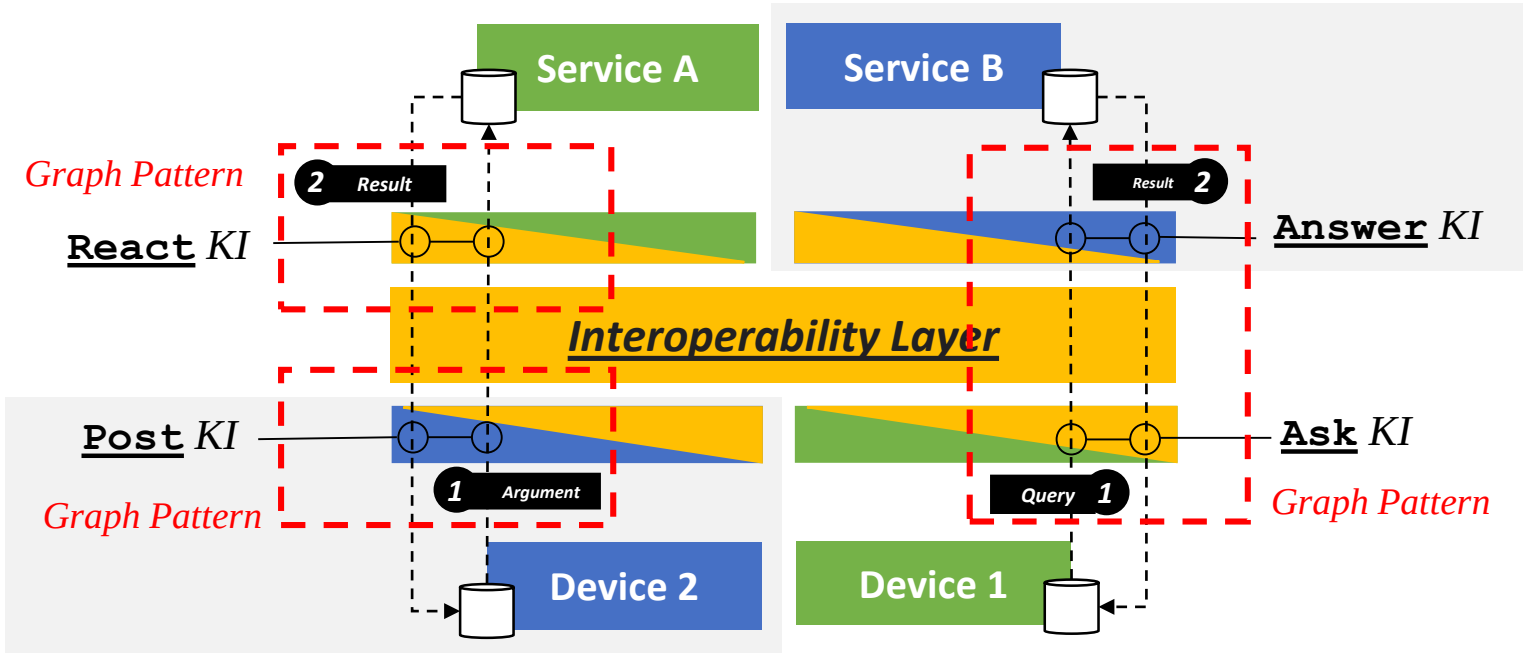
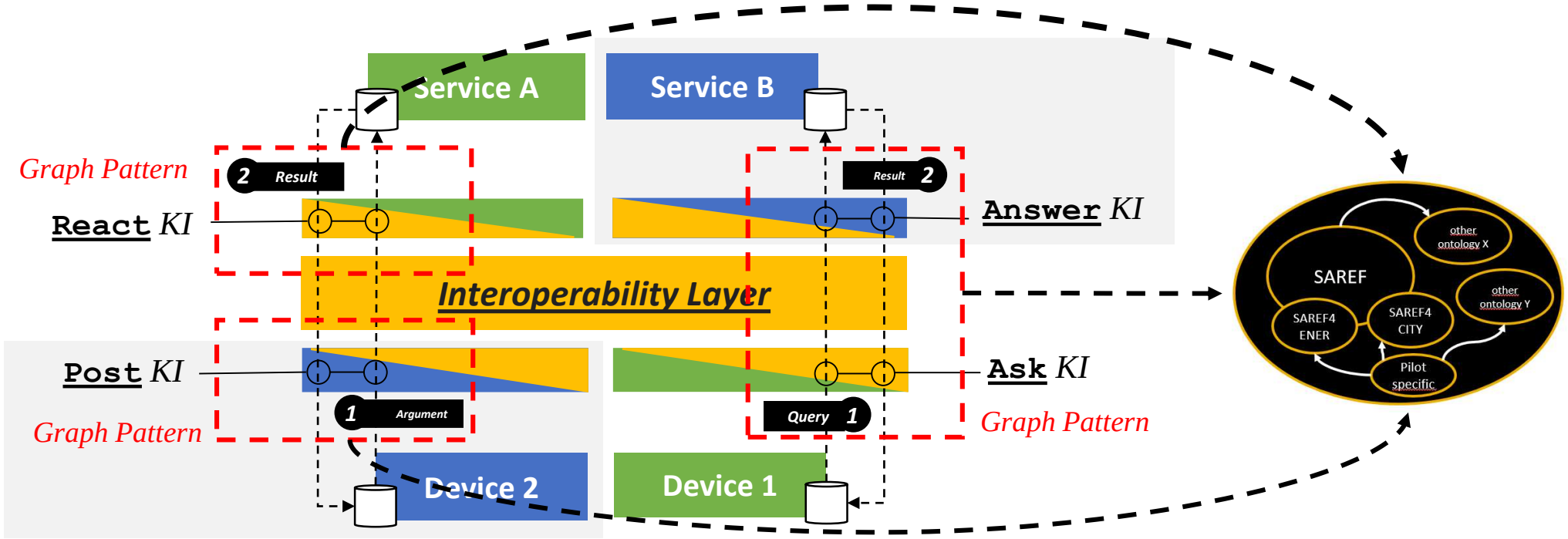
How does the Data Space relate to Knowledge Interactions (KIs)?



How do Knowledge Interactions (KIs) relate to Graph Patterns?



How do Graph Patterns relate to ontologies?



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