Semantic Interoperability Framework – enabling cross-sector services in smart buildings

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SUSTAINABLE
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Overview

Background & InterConnect project context

InterConnect Ontologies and Semantic Interoperability Framework

Residential buildings use case from Dutch pilot

Commercial buildings use case from Portuguese pilot

Interoperability in action

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Background

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Green Deal: Europe Climate Neutral by 2050

Building sector accounts for 40% of total primary energy consumption in Europe

Millions of installations providing renewable energy solutions integrated in current energy networks

REPowerEU iniative!

Energy flexibility solutions in (clusters of) buildings are key to achieve European targets

Creation of a more decentralized energy system

Large amounts of data will need to be timely shared among parties with a key role in the energy transition

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InterConnect
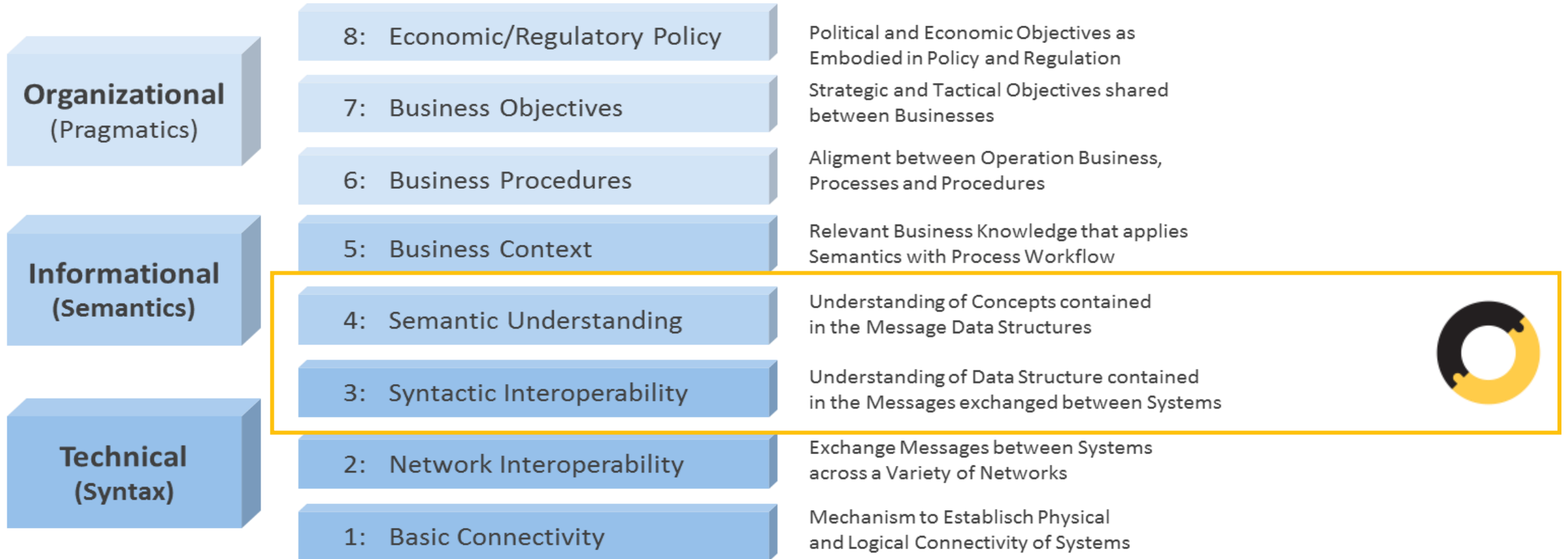
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InterConnect project

- H2020 Large Scale Pilot (2019-2023)

- InterConnect gathers 50 European entities to develop and demonstrate advanced solutions for connecting and converging digital homes and buildings with the electricity sector.

- The project pioneers cross-domain semantic interoperability without a centrally hosted facilitator leveraging SAREF ontology.

- Validation in seven connected large-scale test-sites in Portugal, Belgium, Germany, the Netherlands, Italy, Greece and France.

- https://interconnectproject.eu/

Semantic Interoperability Framework (SIF)

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The levels of interoperability

	Level	Description
Organizational (Pragmatics)	8: Economic/Regulatory Policy	Political and Economic Objectives as Embodied in Policy and Regulation
	7: Business Objectives	Strategic and Tactical Objectives shared between Businesses
	6: Business Procedures	Aligment between Operation Business, Processes and Procedures
Informational (Semantics)	5: Business Context	Relevant Business Knowledge that applies Semantics with Process Workflow
	4: Semantic Understanding	Understanding of Concepts contained in the Message Data Structures
	3: Syntactic Interoperability	Understanding of Data Structure contained in the Messages exchanged between Systems
Technical (Syntax)	2: Network Interoperability	Exchange Messages between Systems across a Variety of Networks
	1: Basic Connectivity	Mechanism to Establisch Physical and Logical Connectivity of Systems

source GWAC - GridWise Architecture Council

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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

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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/

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The InterConnect ontologies
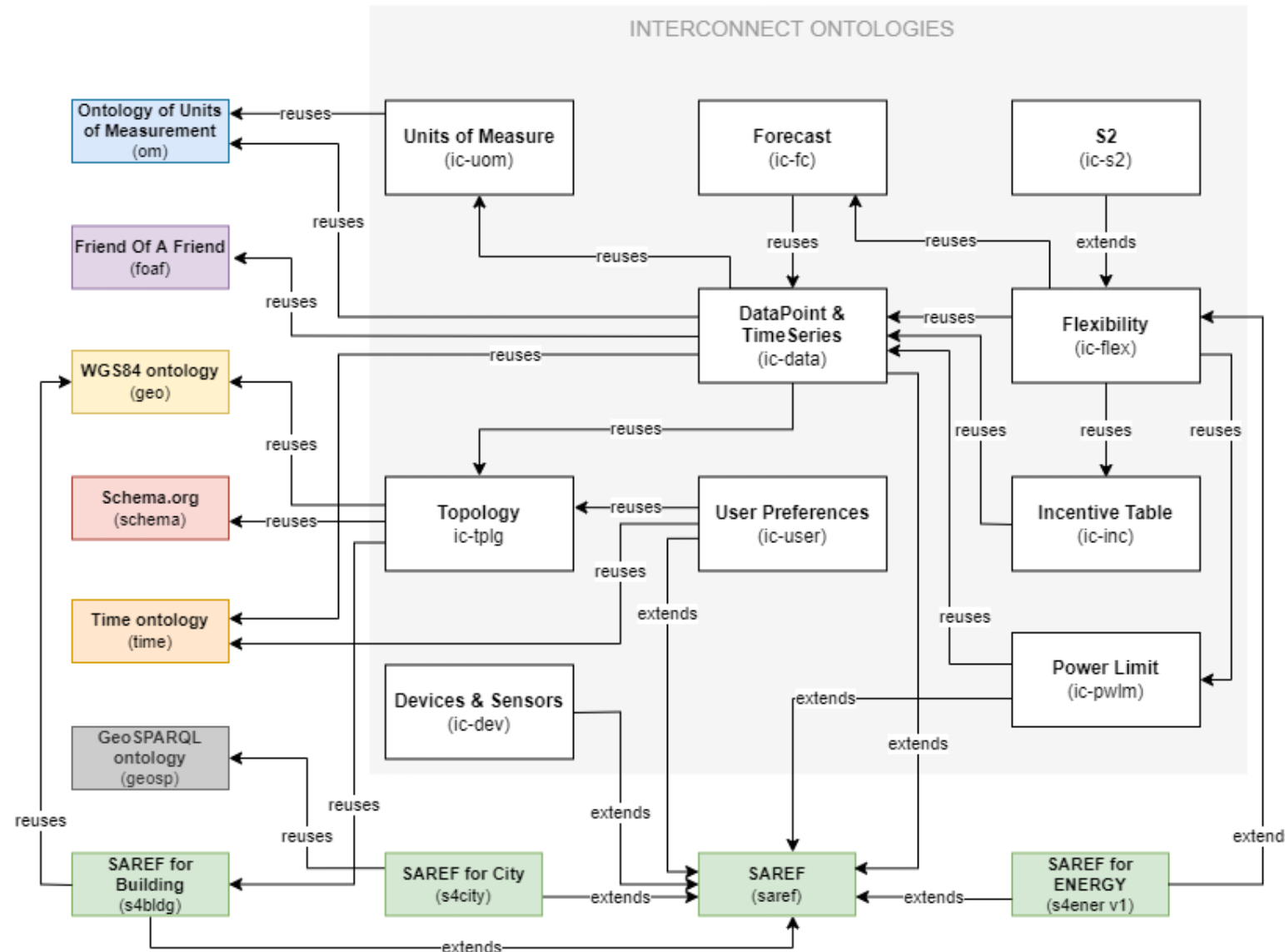
Reuse of the methodology followed by ETSI for SAREF development

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

Useful links

- Interconnect ontologies wiki
  - Available at https://gitlab.inesctec.pt/groups/interconnect-public/-/wikis/home#interconnect-ontology
  - It describes the ontologies in detail using diagrams, especially for non-ontology experts, so that they do not need to open the ontologies in Protégé

- InterConnect ontologies repository
  - Available at https://gitlab.inesctec.pt/interconnect-public/
  - Public repository aligned with the Interconnect internal repository used for the collaborative ontology development
  - It follows the same structure of the ETSI SAREF repositories at https://saref.etsi.org

Semantic Interoperability Framework (SIF)

How are the ontologies used in InterConnect to deploy large scale interoperability solutions?

InterConnect Reference Architecture

&

Semantic Interoperability Framework

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
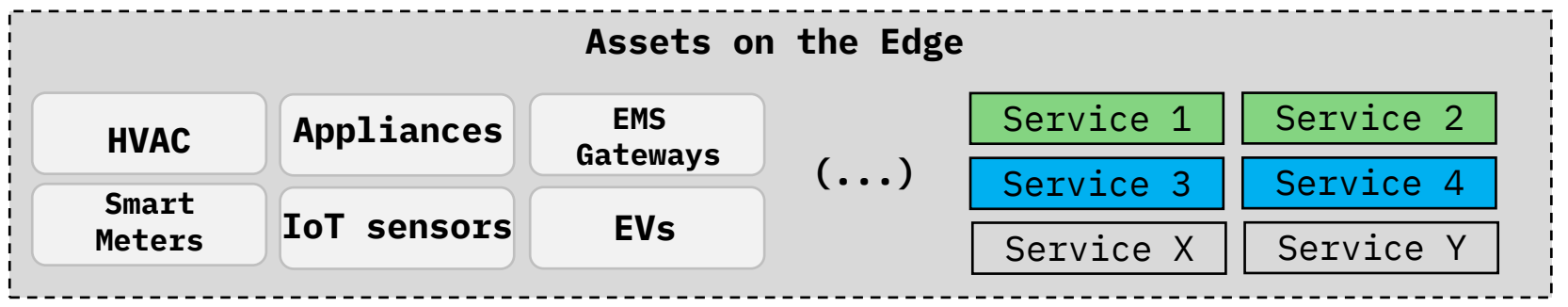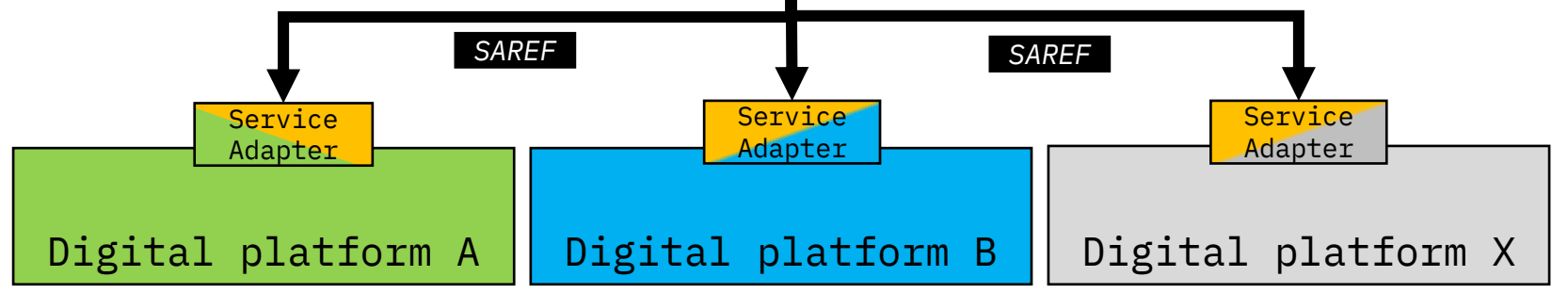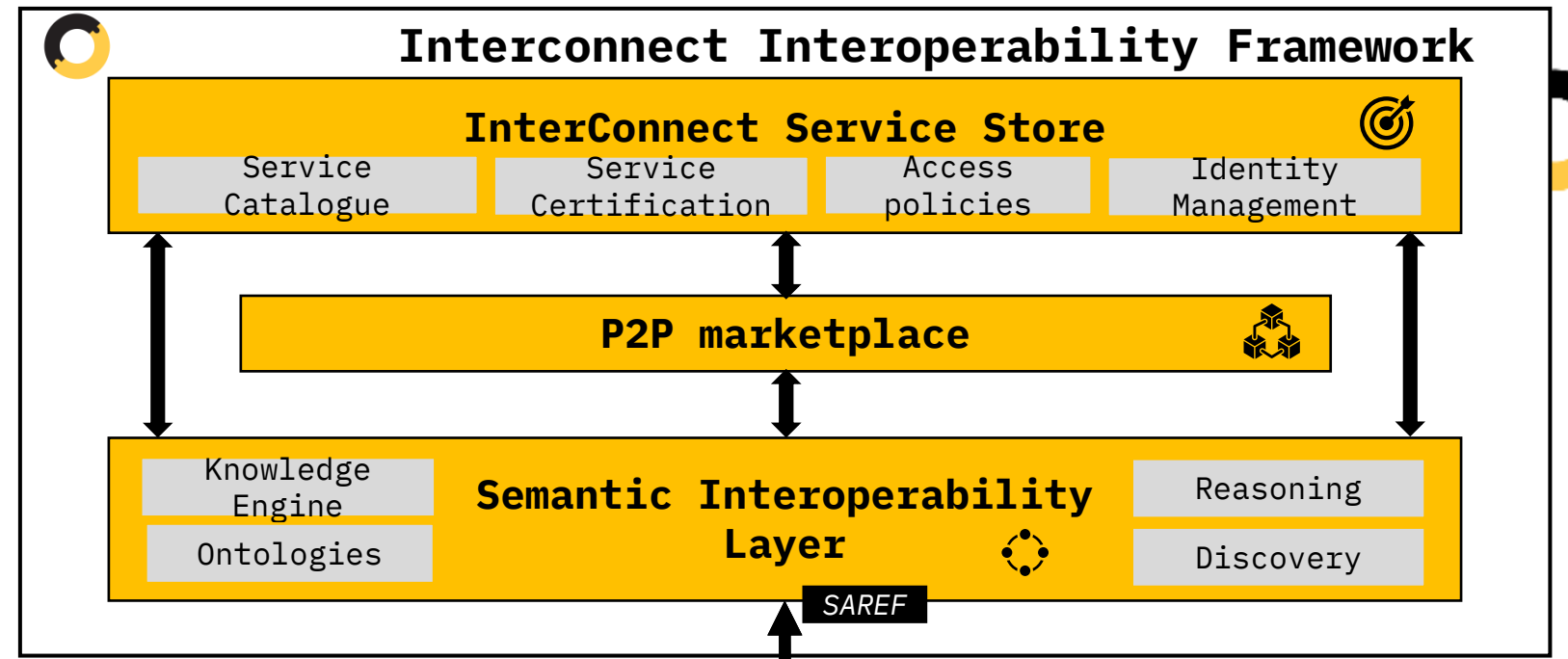
Use cases, Interoperable Services, Standardization

Interconnect Interoperability Framework

InterConnect Service Store

Service Catalogue	Service Certification	Access policies	Identity Management

P2P marketplace

Semantic Interoperability Layer

Knowledge Engine

Ontologies

Reasoning

Discovery

SAREF

SAREF   *SAREF*   *SAREF*

Service Adapter   Service Adapter   Service Adapter

Digital platform A   Digital platform B   Digital platform X

Assets on the Edge

HVAC	Appliances	EMS Gateways
Smart Meters	IoT sensors	EVs

(...)

Service 1	Service 2
Service 3	Service 4
Service X	Service Y

Practical Interoperability Examples

Use cases

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Interoperability in practice #1

Example use case provided by the Dutch pilot

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Residential buildings use case

- Example use case provided by the Dutch pilot in Eindhoven, NL
  - 22-storey building
  - 160 apartments
  - Equipped with smart appliances and smart sensors

- Video available at https://tinyurl.com/yrd69arp by
  - Ronnie Groenewold (Volkerwessels iCity)
  - Jorrit Nutma (TNO)

Interoperability plug & play: different standards
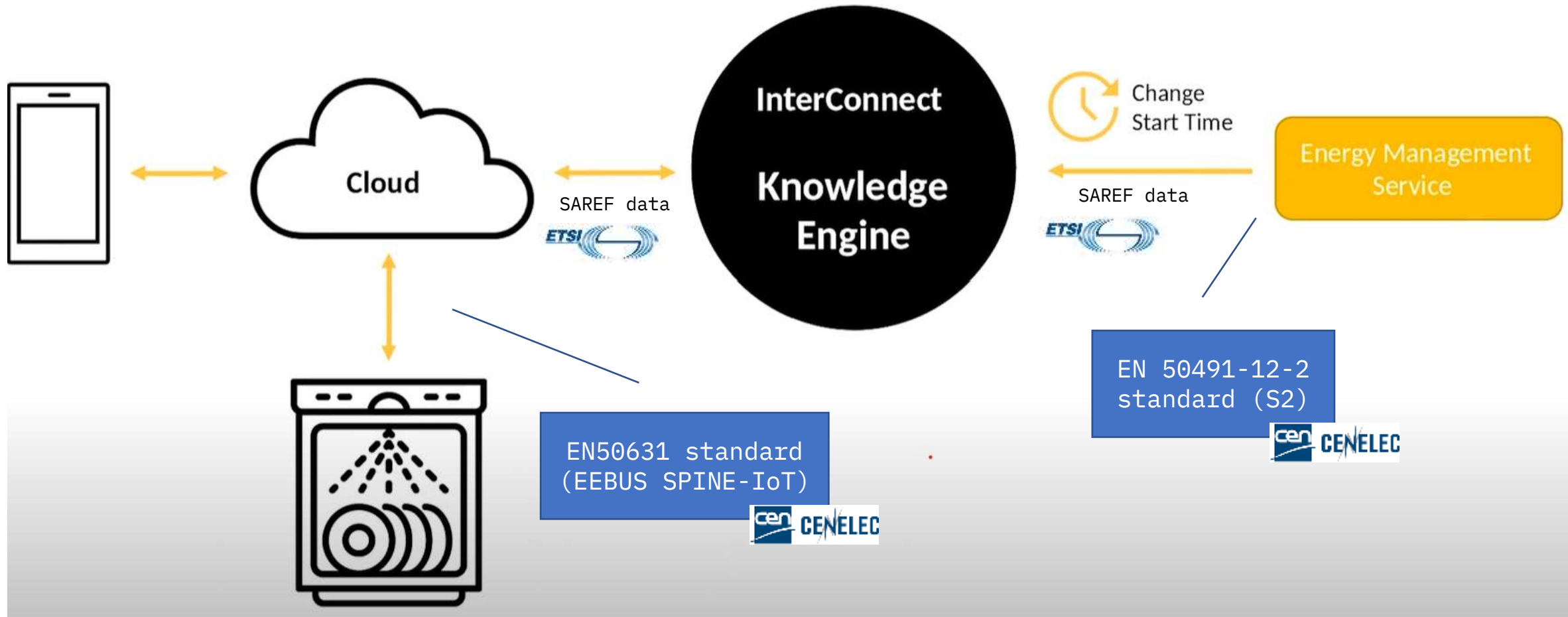
Plug & play Energy Management Service
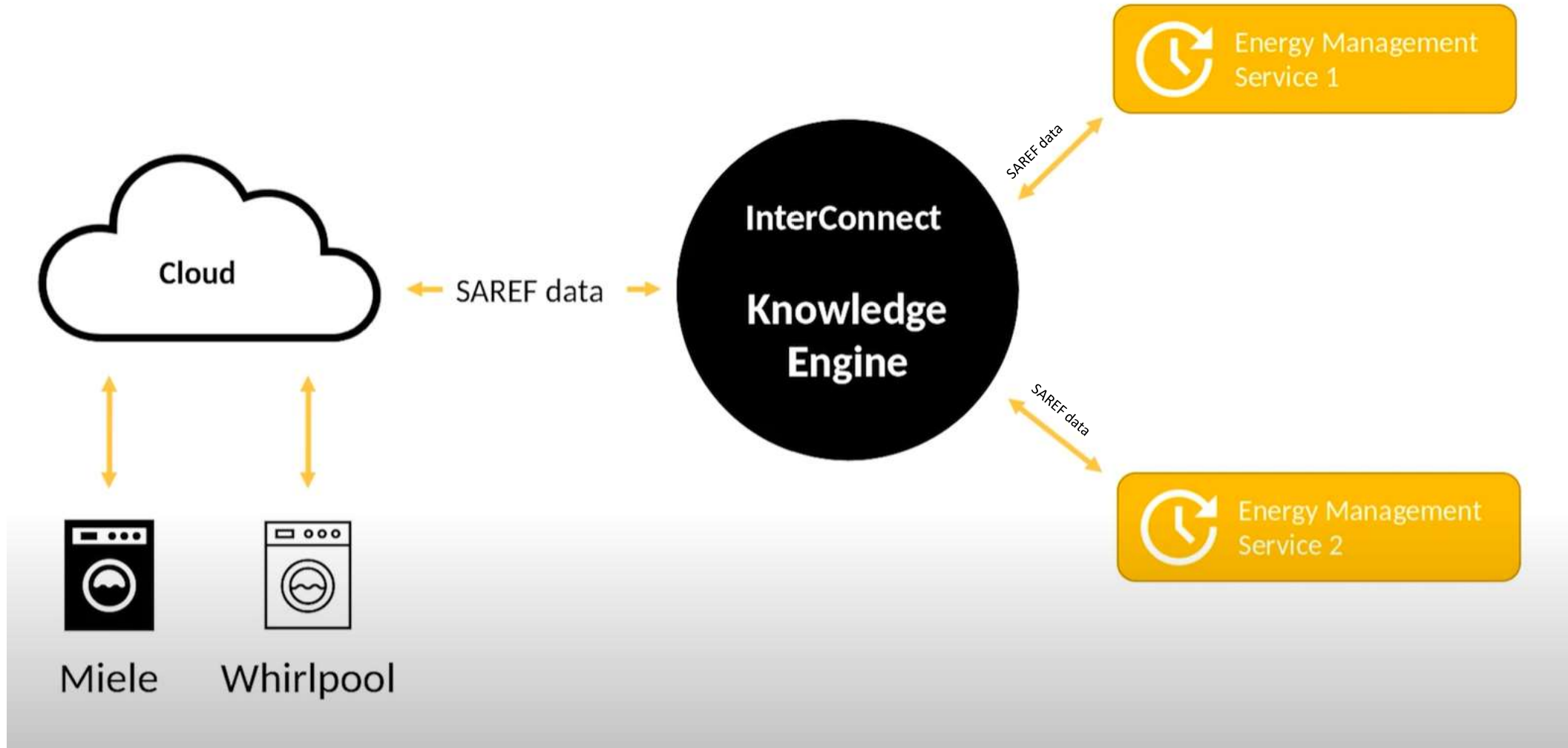
Interoperability in practice #2

Example use case provided by the Portuguese pilot
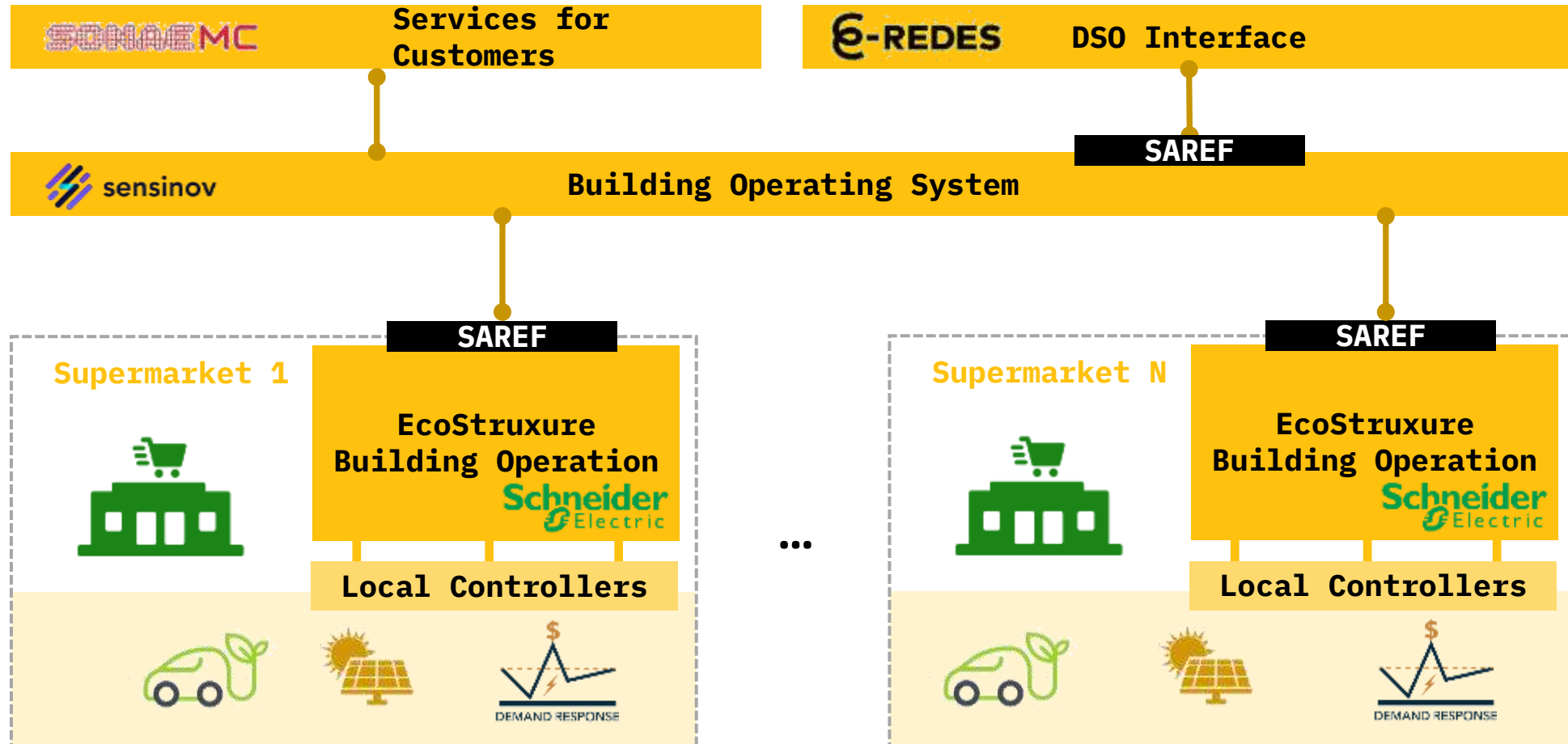
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Commercial buildings use case
# Green supermarkets (PT): motivation

- **Exploit demand side flexibility from supermarkets**

- **Meet energy sustainability goals: 100% on-site renewable energy**

- **Supply flexibility in the framework of Directive (EU) 2019/944**

- **Boost interoperability and data-driven energy optimization**

- **Monitoring and control of consumption remains limited**

- **Design a cost-effective IoT platform for food retail**

Commercial buildings use case
Green supermarkets (PT): architecture for semantic practice
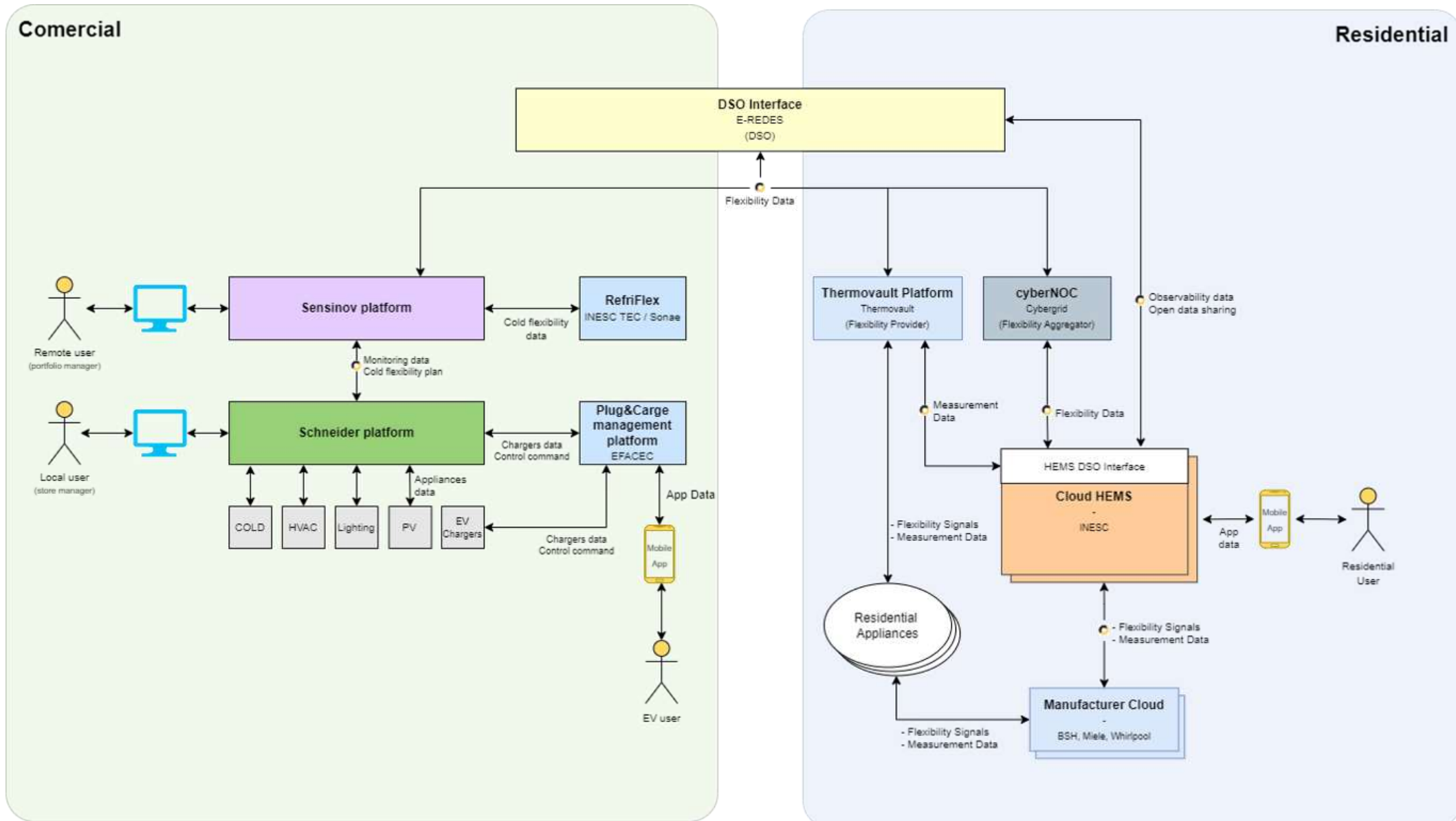
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interoperable solutions connecting smart homes, buildings and grids

Questions?

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DURATION

01.10.2019 / 30.09.2023