IOTWeek

Dublin — June 20-23, 2022

Ontologies in the context of the Green and Digital Transition

Laura Daniele (TNO) and Martin Bauer (NEC)
Chairs of Semantic Interoperability Group - AIOTI WG3

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Agenda

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- Introduction (25min)
- Speakers (30 min)
- Panel (20 min)

Introduction

- Chair: Laura Daniele, TNO
  - Welcome & Agenda (5 min)
- Martin Bauer, NEC
  - Activities of AIOTI expert group on semantic interoperability: Ontology Landscape (10 min)
- Svetoslav Mihaylov, EC
  - EC Perspective on the Twin Green and Digital Transition (10 min)

Speakers

Developing and Using Ontologies for European Green Deal

- Raúl García-Castro, Universidad Politécnica de Madrid
  - Experiences on enabling semantic interoperability in the European Green Deal (5 min)
- Gjalt Loots, TNO
  - Using ontologies on a large scale to InterConnect Smart Homes, Buildings and Grids (5 min)

Usability of ontologies and Requirements from Industry

- Dave Raggett, W3C
  - Usability and Scalability of Knowledge Graphs (5 min)
- Enrico Scarrone, TIM
  - Ontologies, standardization and industry (5 min)

Relations to other Initiatives

- Alberto Abella, FIWARE
  - Agile standardization with the Smart Data Models Program (5 min)
- Aitor Corchero, Eurecat
  - Towards adopting data spaces inside the water sector (related to ICT4WATER cluster) (5 min)

Panel

Discussion based on speakers statements and questions from the audience.
Some initial ideas:

- What do we want to ask to the EC about the Green and Digital transformation in relation to ontologies and semantic interoperability?
- How to deploy semantic interoperability in operational environments?
- What are the gaps still existing between traditional software developers and semantic experts?
- What are the requirements for adoption and usability of ontologies?
- What are the drivers and barriers for using ontologies?
- What is the role of ontologies in Data Spaces?
- What are the different levels of semantic interoperability (e.g., full semantic interoperability and reasoning using ontologies vs. minimal interoperability using limited semantics such as JSON-LD). What are their pros and cons? Are there different scenarios/requirements in which one approach is more suitable than the other?
- ...

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Activities of AIOTI expert group on semantic interoperability

Martin Bauer (NEC)

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Semantic Interoperability Expert Group: What do we do?

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- Value of IoT grows with **available information**

- "IoT" Today characterized by
  - Heterogeneity
  - Silos
  - Tight coupling
  - Multiple representations of the information

- True IoT characterized by
  - Sharing of information
  - Federation across silos
  - Dynamic use of sources

- Explicit **agreement** on **semantics** (= meaning) is vital to the success of IoT

→ **Semantic Interoperability**

→ **Support adoption of semantic technologies**

Semantic Interoperability Expert Group: What do we do?

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- Semantics often perceived as “difficult”, “academic”, “for experts only”
- We are a group of experts from standardization & research

  → Lower barrier for implementing semantic systems

- **Three Whitepapers:**
  - Semantic Interoperability for the Web of Things: http://tinyurl.com/58k93m4f
  - Semantic IoT Solutions: A Developer Perspective: http://tinyurl.com/2p97rhtc
  - Towards Semantic Interoperability Standards based on Ontologies: http://tinyurl.com/5hx79y5r
- **Semantic Tutorial (IoT Week 2021):** http://tinyurl.com/kjrv2uu3
- **Ontology Landscape at http://tinyurl.com/y86s82ac**

Ontology Landscape Report - Overview

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- The Report “Ontology Landscape Release 1.0” has been published in December 2021: http://tinyurl.com/y86s82ac

- Main Aspects
  - Main IoT Ontologies structured by their domain of interest.
  - Classification of IoT Ontologies, in particular regarding sustainability (who is maintaining it?) and technology readiness level (how mature is it?)
- Goal: Make it easier for users to find the right IoT Ontology
- You have an ontology to contribute to Release 2.0?

→ Fill out our survey at **http://tinyurl.com/mr334bap**

Ontology Landscape Report – Content

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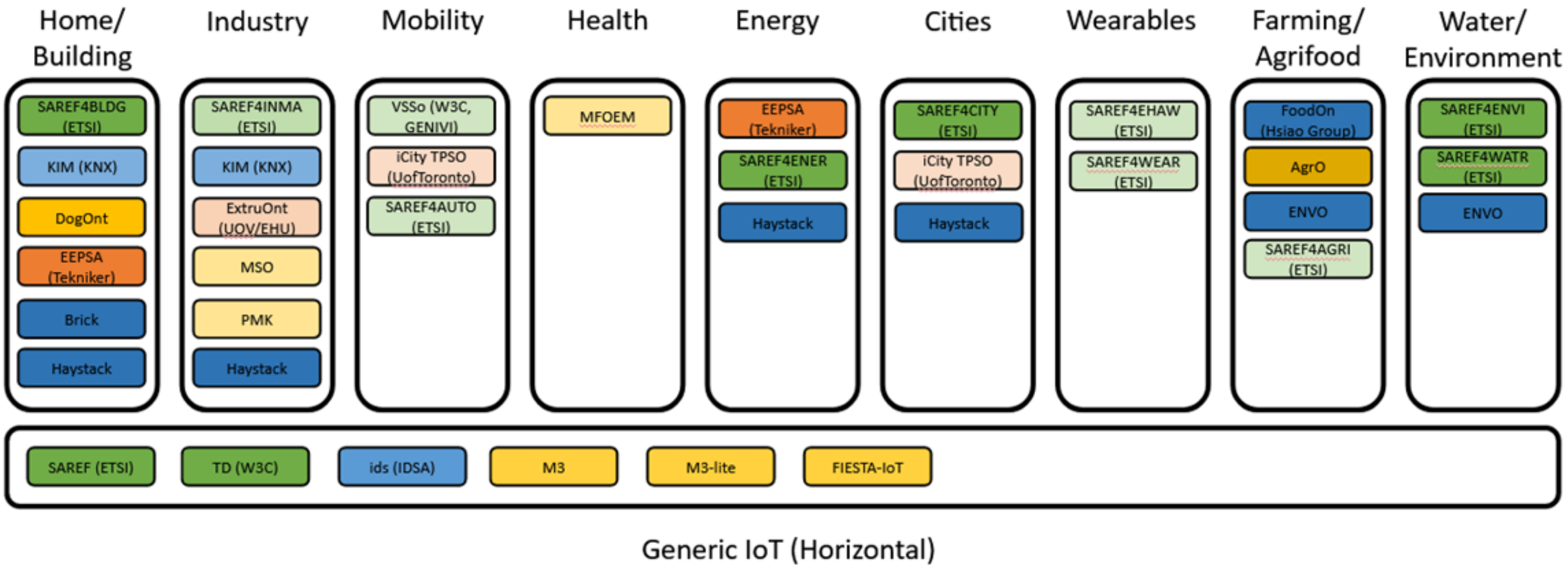
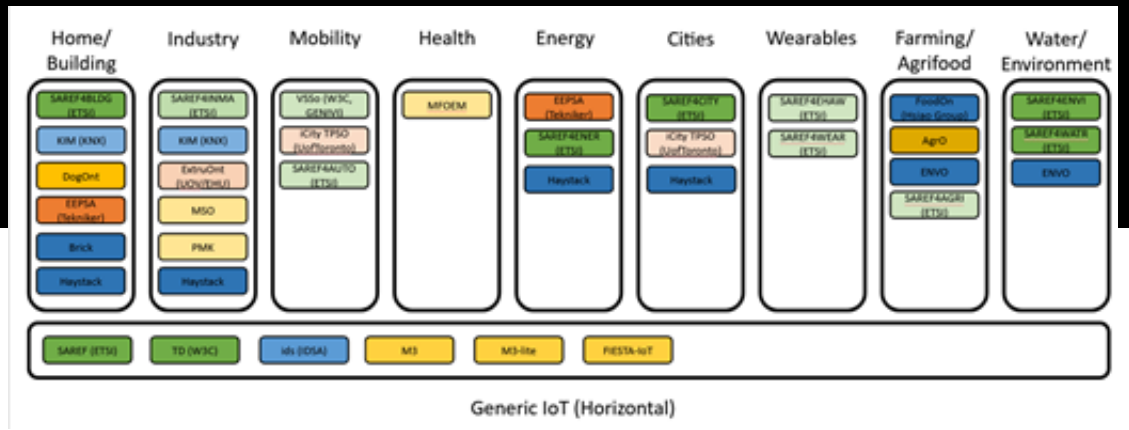
35 ontologies subdivided in **10** different domains.



Ontology Landscape Report – Content



Sustainability & Maintainability Level

Technology Readiness Level (TRL)

TRL / Level	Level 1 Single Maintainer / Project	Level 2 Organization	Level 3 Group of Organizations	Level 4 Standardization Body
4				
5				
6				
7				
8				
9				

Colour code defined to express Technology Readiness Level (TRL) and Sustainability & Maintainability Level

Ontology Landscape Report – Example

Acronym	SAREF	TRL	6	
Name	Smart Applications REFerence Ontology		Main Areas	Generic IoT
Technical Specification			https://www.etsi.org/deliver/etsi_ts/103200_103299/103264/03.01.01_60/ts_103264v030101p.pdf	
URI of Ontology File			https://saref.etsi.org/core/	
License			https://forge.etsi.org/etsi-software-license	
Maintainer			ETSI	
Complete Survey Information			https://drive.google.com/file/d/1J1wk0FCjtOjrMiCt9RPYmN9mP9-Wpl0x/view	
Short Description	The Smart Applications REFerence ontology (SAREF) is intended to enable interoperability between solutions from different providers and among various activity sectors in the Internet of Things (IoT), thus contributing to the development of the global digital market.			

Next Week
AIOTI Webinar: Ontology Landscape

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- Date: June 29
- Time: 16:00- 17:15 CEST
- Join Webinar: http://tinyurl.com/yfpzt8ke
- Webpage: https://aioti.eu/events/ontology-landscape-report-presentation/

- 16.00h Opening and Welcome
  - Georgios Karagiannis, AIOTI WG Standardisation Chair
- 16.10h Presentation of the report Ontology Landscape Release 1.0
  - Introduction semantic interoperability and importance of ontologies:
  - Martin Bauer, AIOTI WG Standardisation Semantic Interoperability, NEC
  - Overview of the Ontology Landscape report
  - Davide Conzon, AIOTI WG Standardisation Semantic Interoperability, Links Foundation
  - Recommendations and Next Steps:
  - Laura Daniele, AIOTI WG Standardisation Semantic Interoperability, TNO
  - Questions and open discussions
- 17.10 Wrap up and end of Webinar
  Georgios Karagiannis, AIOTI WG Standardisation Chair

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EC Perspective on the Twin Green and Digital Transition

Svetoslav Mihaylov, EC

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Political context

First climate-neutral continent by 2050

Fit-for-55 -by 2030

Digital Decade: a Compass and Common Targets

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Skills

ICT Specialists: 20 millions + Gender convergence
Basic Digital Skills: min 80% of population

Government

Key Public Services: 100% online
e-Health: 100% availability medical records
Digital Identity: 80% citizens using digital ID

Infrastructures

Connectivity: Gigabit for everyone, 5G everywhere
Cutting edge Semiconductors: double EU share in global production
Data – Edge & Cloud: 10,000 climate neutral highly secure edge nodes
Computing: first computer with quantum acceleration

Business

Tech up-take: 75% of EU companies using Cloud/AI/Big Data
Innovators: grow scale ups & finance to double EU Unicorns
Late adopters: more than 90% of European SMEs reach at least a basic level of digital intensity

European Strategy for Data

A **common European data space**, a **single market for data**

Data can flow within the EU and across sectors

Free Flow of non-Personal Data Regulation

Availability of high-quality data to create and innovate

European rules and values are fully respected

GDPR

Rules for access and use of data are fair, practical and clear & clear data governance mechanisms are in place

The European Data strategy

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Cloud actions:
- Cloud Rulebook
- Co-Investments in cloud-to-edge services, cloud federation and marketplaces.

Data actions:
- New legislation (Data Governance Act, Services Act, Data Act, Market Act, Impl. High value data sets …)
- Co-investments in EU Data Spaces

DIGITAL Europe Programme

IPCEI* on Next Generation Cloud
*(*Important Project of Common European Interest)*

Coordination

Complementing & integrating private and public initiatives, e.g.:

Federation & interoperability standards

GAIA-X

Use cases; technical architecture

Common European Data spaces

Data Spaces Support Centre
Coordination and governance

EUROPEAN ALLIANCE FOR INDUSTRIAL DATA, EDGE AND CLOUD

Paradigm Shift: Cloud – Edge – IoT

Trend/Paradigm Shift: from Cloud to Edge
Bringing compute resources closer to the data

Computing Continuum

Far Edge / IoT	Edge	Cloud / HPC
Smart Device	Cloud	Infrastructure

Decentralised swarm intelligence

Federating far edge resources ad hoc via wireless (5G, mesh)
to provide cloud resources close to the edge

Digital and Green

- Green ICT
  - Green data centres and networks
  - Processing at the edge (closer to renewables) – optimising processing vs communication
  - “Green” routing
  - Energy/resource efficient (IoT) devices
  - …
- ICT for Green
  - Smart grids and energy systems (including bi-directional EV-charging and smart homes)
  - Autonomous driving
  - Precision farming
  - Extreme weather and climate impact modeling
  - …

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Experiences on enabling semantic interoperability in the European Green Deal

Raúl García-Castro, Universidad Politécnica de Madrid

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Ontology engineering for cross-sectorial interoperability

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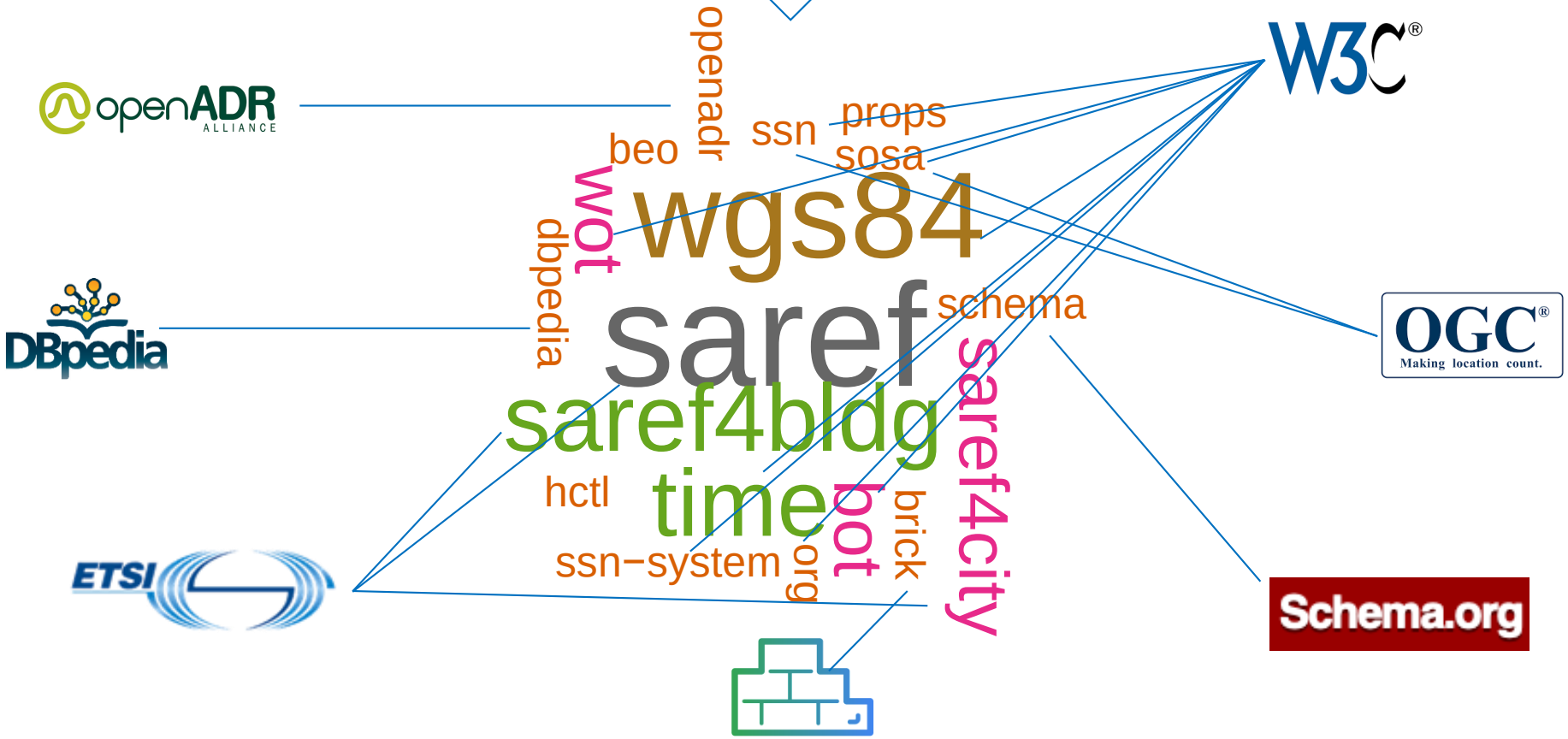
VICINITY 2020 · DELTA · BIMERR RENOVATION 4.0 · ONTO COMMONS (ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS) · COGITO · AURORAL



Ontology engineering for IoT interoperability

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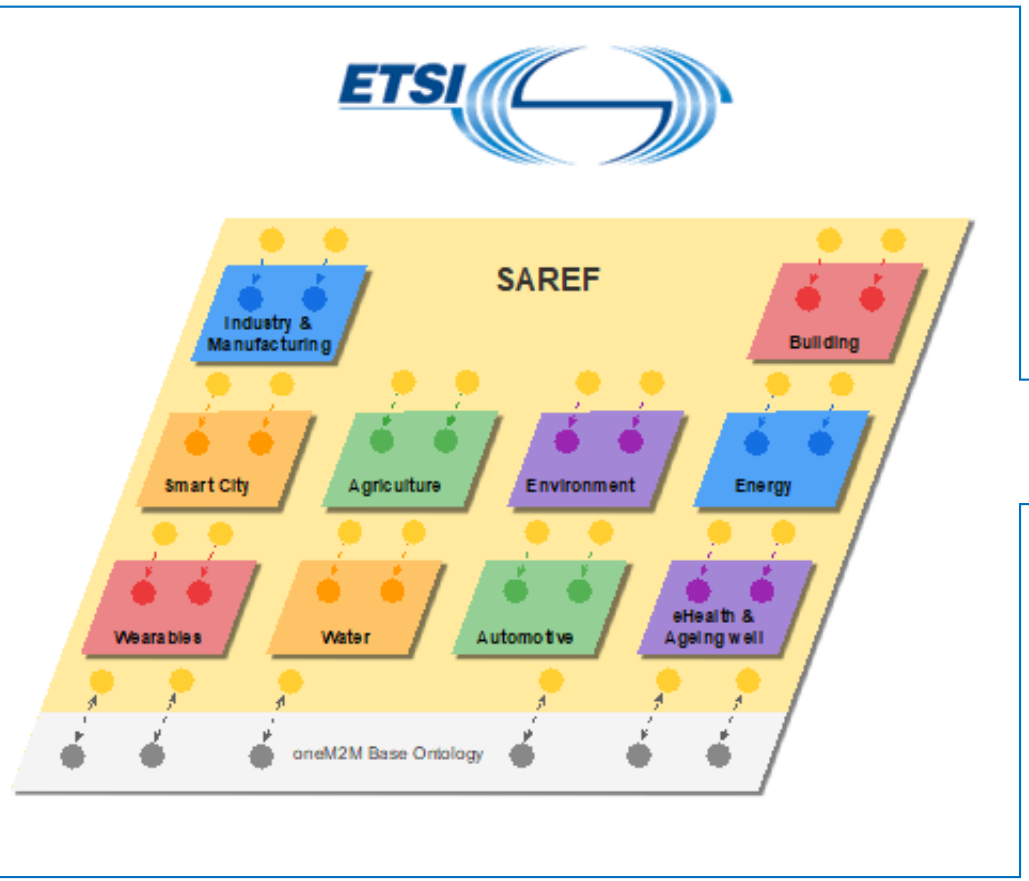

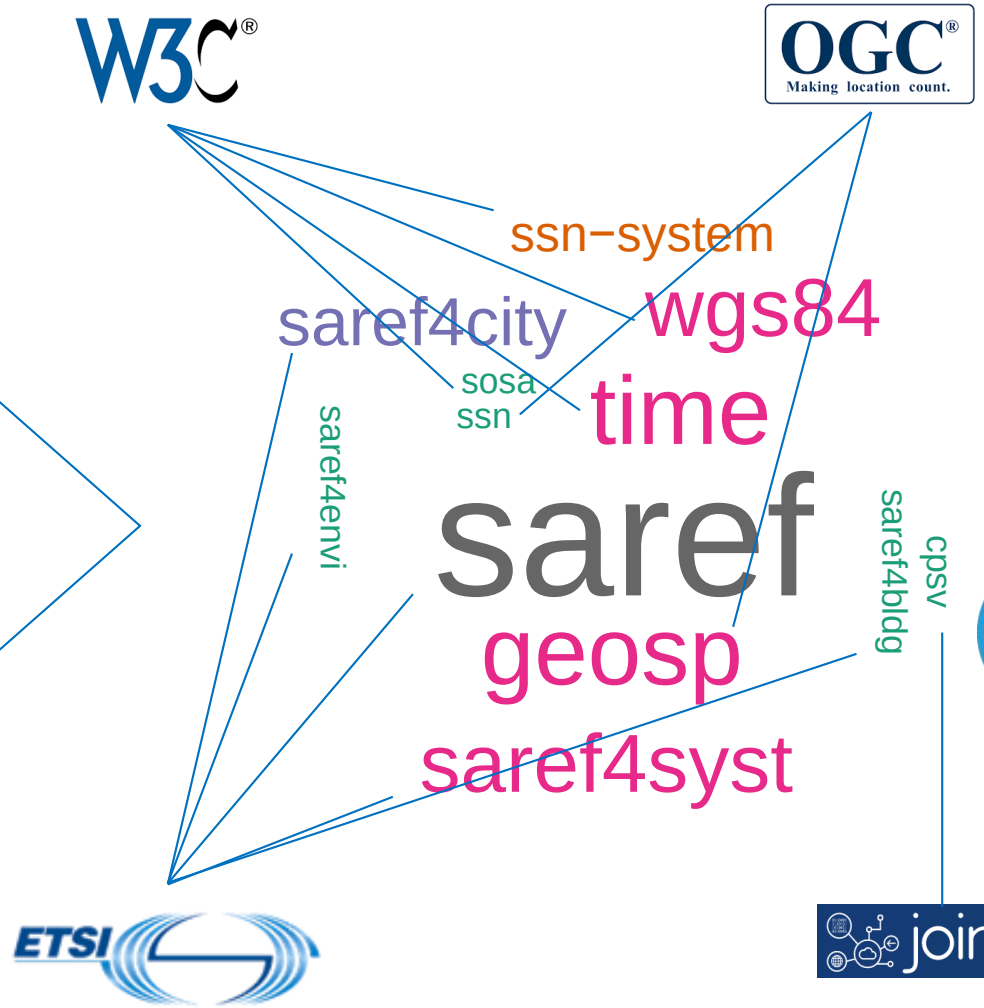

Ontology engineering for smart city interoperability

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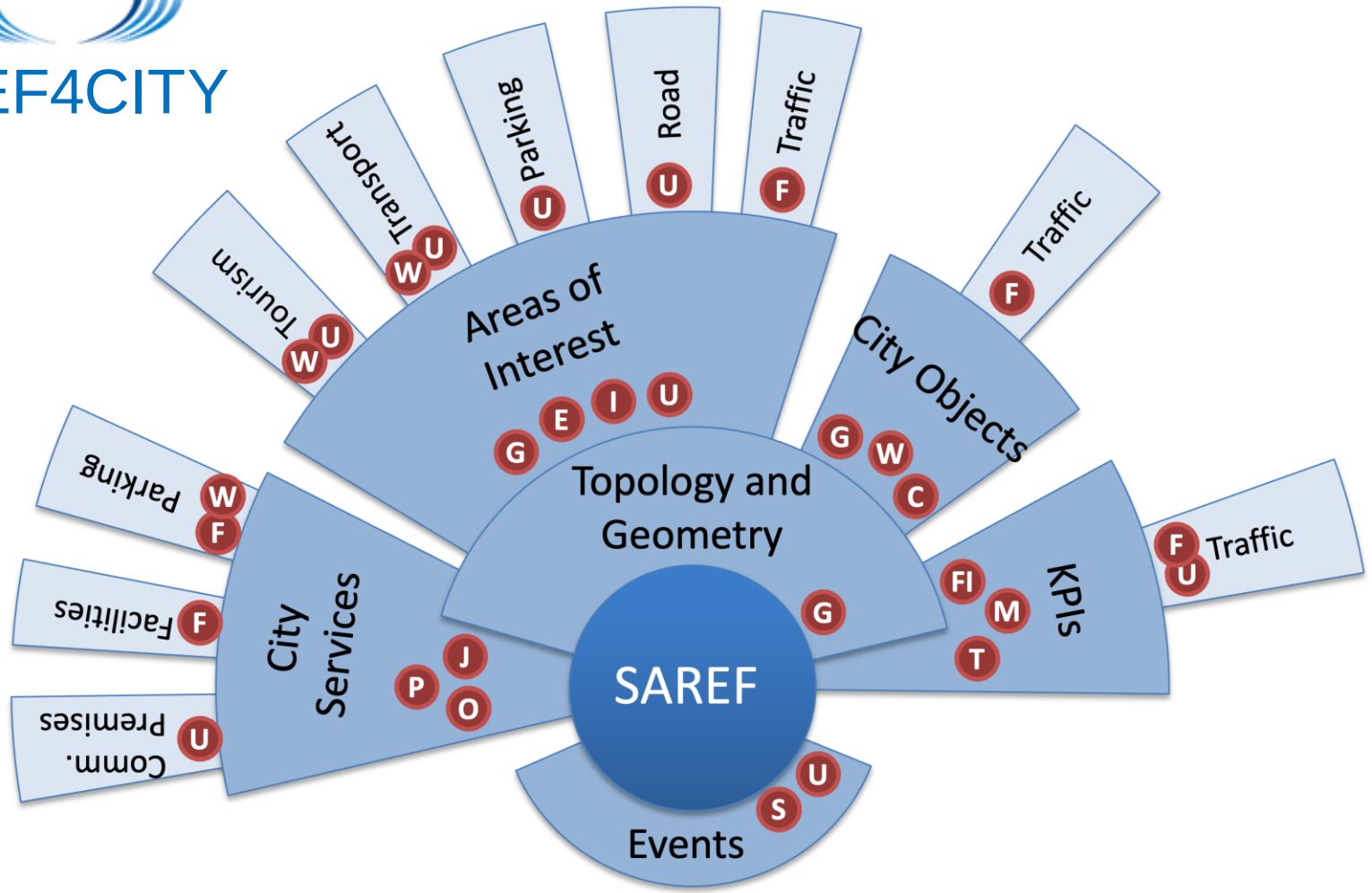
ETSI
SAREF4CITY



Requirements:

- E — EU Metadata Registry
- F — FEMP Open Data Guide exemplary datasets
- FI — FIWARE data model for KPIs
- I — ISA Programme Location Core Vocabulary
- J — Joinup Core Public Organization Vocabulary
- P — Joinup Core Public Service Vocabulary
- C — OGC CityGML
- G — OGC GeoSPARQL
- S — schema.org
- U — Vocabulary referenced by AENOR UNE 178301:2015
- O — W3C Registered Organization Vocabulary
- W — W3C WGS84 Geo Positioning vocabulary
- M — ISO/IEC 30182:2017
- T — ITU-T Y.4903/L.1603 (10/2016)

An ecosystem of networks of communities

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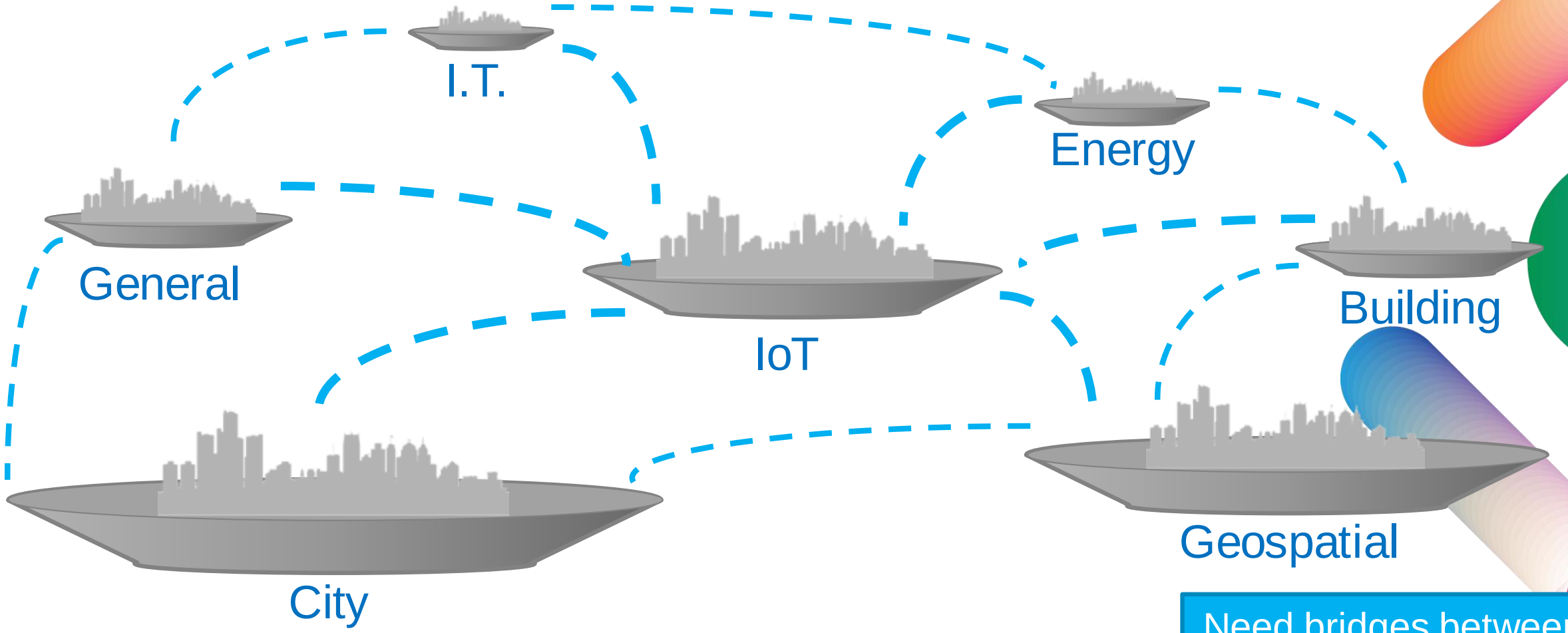

Need bridges between communities

Towards sustainable ontology development in smart communities

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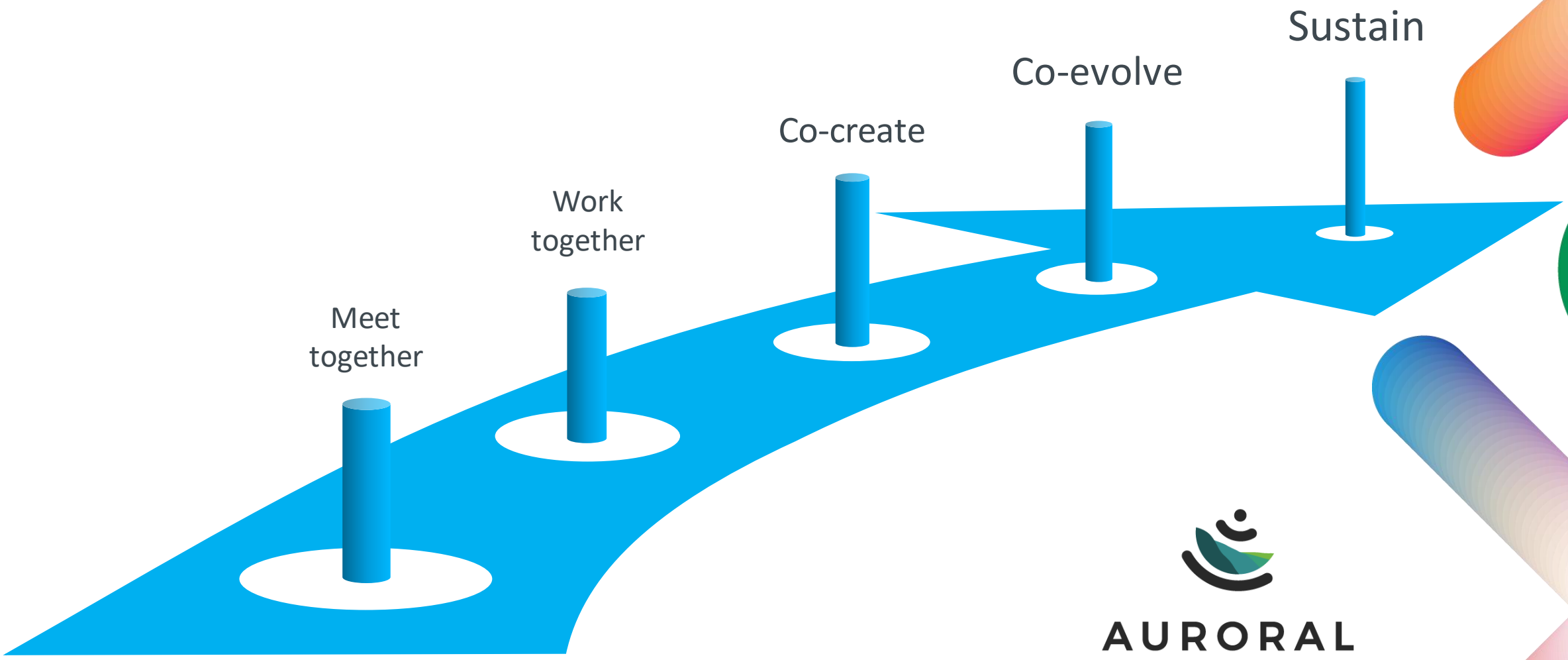

AURORAL

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Using ontologies on a large scale to InterConnect Smart Homes, Buildings and Grids

Gjalt Loots, TNO

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- H2020 Large Scale Pilot
  - https://www.interconnectproject.eu
  - Interoperable solutions connecting smart homes, buildings and grids
  - 50 partners, 7 pilots in Europe
  - Uses SAREF suite of ontologies as pillar for deploying semantic interoperability on a large scale

InterConnect ontologies

- Development of various ontology modules to be incorporated in SAREF based on new use cases and services coming from 7 InterConnect pilots (2019-2022)
  - 112 Use Cases*
  - 66 Services from 21 InterConnect partners, based on 166 APIs, for a total of 864 parameters to be "SAREFized" **
- Kick-off of standardization process of InterConnect ontologies in ETSI (2022)
- Common standardization strategy on InterConnect ontologies that involves both ETSI and CEN/CENELEC (2022 onwards)

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

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

The InterConnect ontologies

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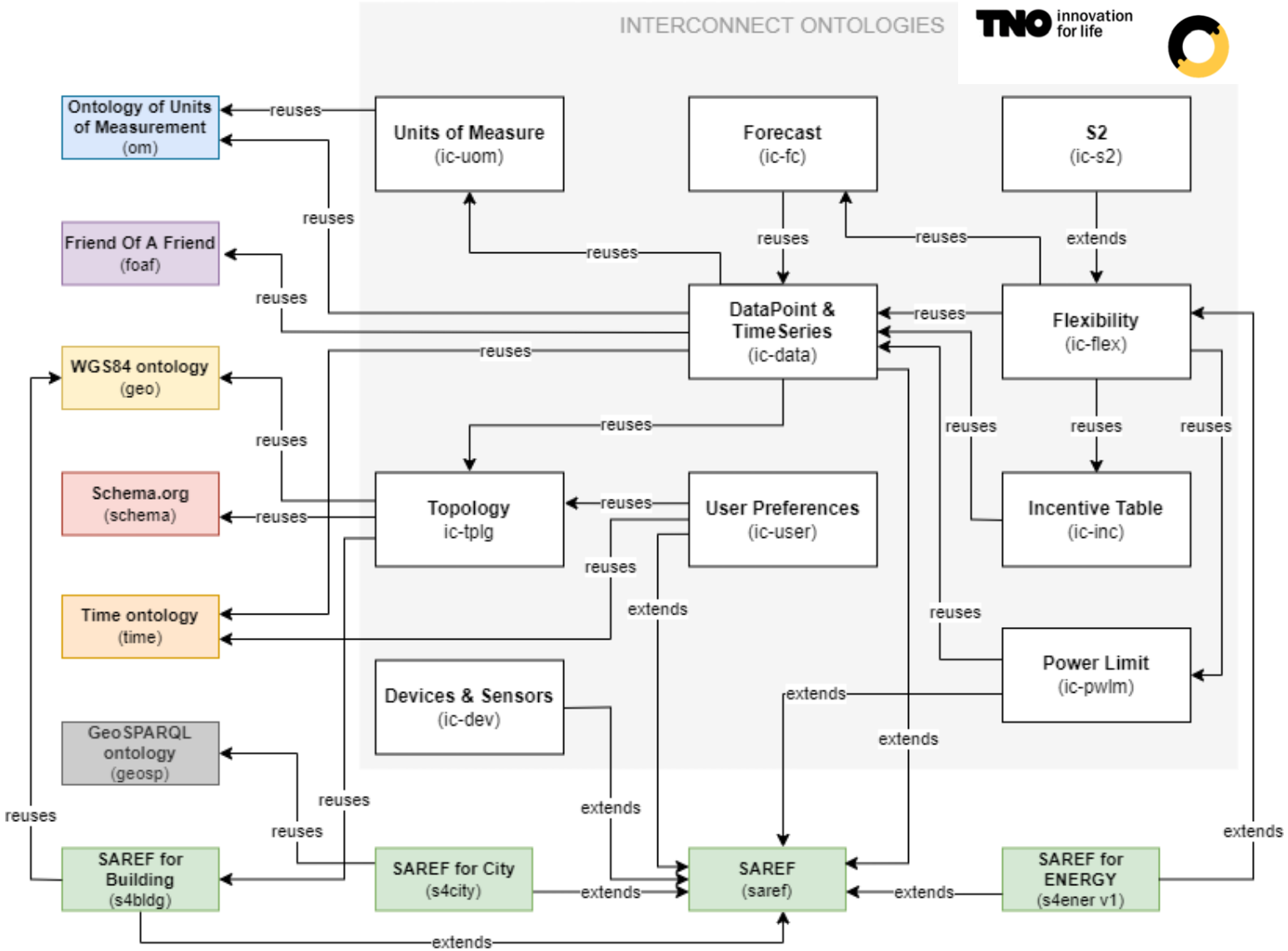

InterConnect ontologies: main concepts

Prefix	Namespace	Main concepts
ic-data	http://ontology.tno.nl/interconnect/datapoint#	Datapoint, TimeSeries, Usage, Message
ic-dev	http://ontology.tno.nl/interconnect/device#	Additional Devices and States (not considered yet in SAREF)
ic-flex	http://ontology.tno.nl/interconnect/flexibility#	Flex Request, Flex Offer, Flexibility Profiles, Flexibility Instruction, Activation Plan
ic-fc	http://ontology.tno.nl/interconnect/forecast#	Forecast, Point Forecast, Stochastic Forecast (Gaussian, Quantile, Trajectory), Gaussian Data Point
ic-inc	http://ontology.tno.nl/interconnect/incentivetable#	Incentive Table, Incentive Tiers, Scope and Type
ic-pwlm	http://ontology.tno.nl/interconnect/powerlimit#	Power Limit (Nominal, Contractual and Failsafe)
ic-s2	http://ontology.tno.nl/interconnect/s2#	Energy flexibility concepts of S2 interface specified in EN50491-12-2 standardized by CLC TC 20520 WG18 (to communicate and control the flexibility of smart devices to a Customer Energy Manager at the consumer premises)
ic-tplg	http://ontology.tno.nl/interconnect/topology#	Topological Location, Grid Segment, Market Segment, Regulation Zone, Electrical Phases
ic-uom	http://ontology.tno.nl/interconnect/units#	Additional Units of Measure (not considered yet in SAREF)
ic-user	http://ontology.tno.nl/interconnect/user#	User, User Profile, Preference, Priority, Interest, Activity, Time, Location

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/ontology
  - 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

Experiences and challenges from InterConnect

- Need for new concepts not present in the SAREF suite to accommodate new use cases
- Large scale development of ontologies with active involvement of so many stakeholders and organizations particularly challenging
- Technical challenges to incorporate the various InterConnect new ontology modules in the SAREF suite, while keeping everything usable without resulting in a too large ontology (modularization is key)
- Steep learning curve of semantic technology and ontologies. Paradigm shift for traditional software developers
- Partners always relying on a few semantic experts, lack of tools and training material for fast adoption of the technology. Unclear for stakeholders how to standardize new contributions to SAREF
- Transfer results to a fast and flexible standardization process able to involve all key stakeholders (e.g., ETSI and CEN/CENELEC) and produce updated (with new use cases) SAREF ontology specifications in short time

Open call

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Interoperable-by-design Prototypes Open Call!

www.interconnect-1-oc.fundingbox.com

FOR EUROPEAN ICT/ENERGY SMEs AND STARTUPS

INTERESTED IN DEVELOPING NOVEL INTEROPERABLE APPLICATIONS FOR SMARTHOMES AND SMARTGRIDS

14 Bottom-up projects will get benefits such as:

- **Financial support: up to 150.000 € per project!**
- **7 months Customized Support Programme**

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Usability & Scalability of Knowledge Graphs

Dave Raggett, W3C/ERCIM

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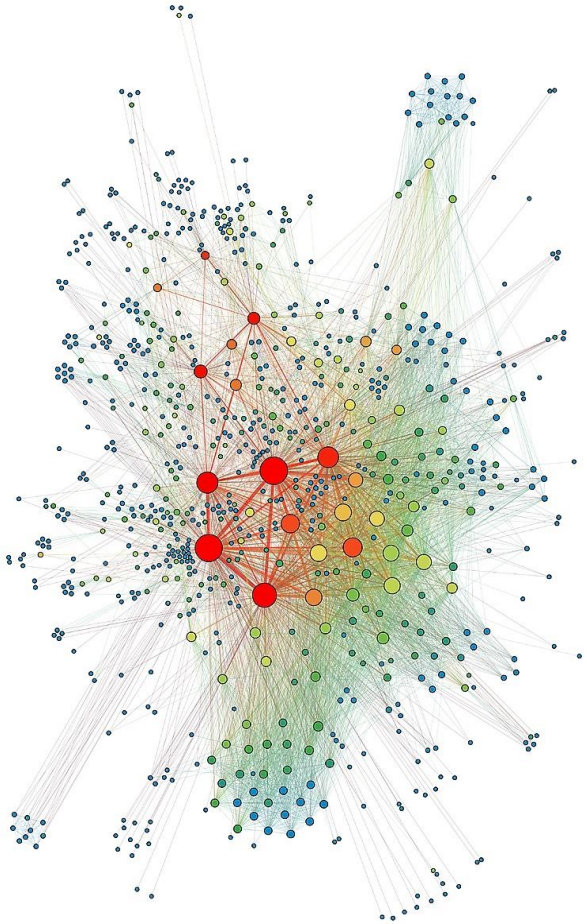
Visualising Knowledge Graphs



Courtesy of UPM's Ontology Engineering Group

- Knowledge graphs combine models (i.e. ontologies) and the data they describe
- Large knowledge graphs can become awkward to browse, query and update
- With graphical views, there is a confusing amount of detail when you zoom out, and a lack of context when you zoom in
- A picture isn't always worth a thousand words!
- **How can we improve the usability of large knowledge graphs?**

Potential Ideas and Challenges

- Some ideas of interest include:
  - Higher level representations and higher level query languages based upon common design patterns,
  - the means to generate dynamic views for contexts of interest,
  - and the means to structure large knowledge graphs in terms of overlapping smaller contextualised graphs
- A related challenge is that different communities (e.g. enterprise business units and departments) will often have different mindsets, vocabularies and requirements
- What about the need for versioning?

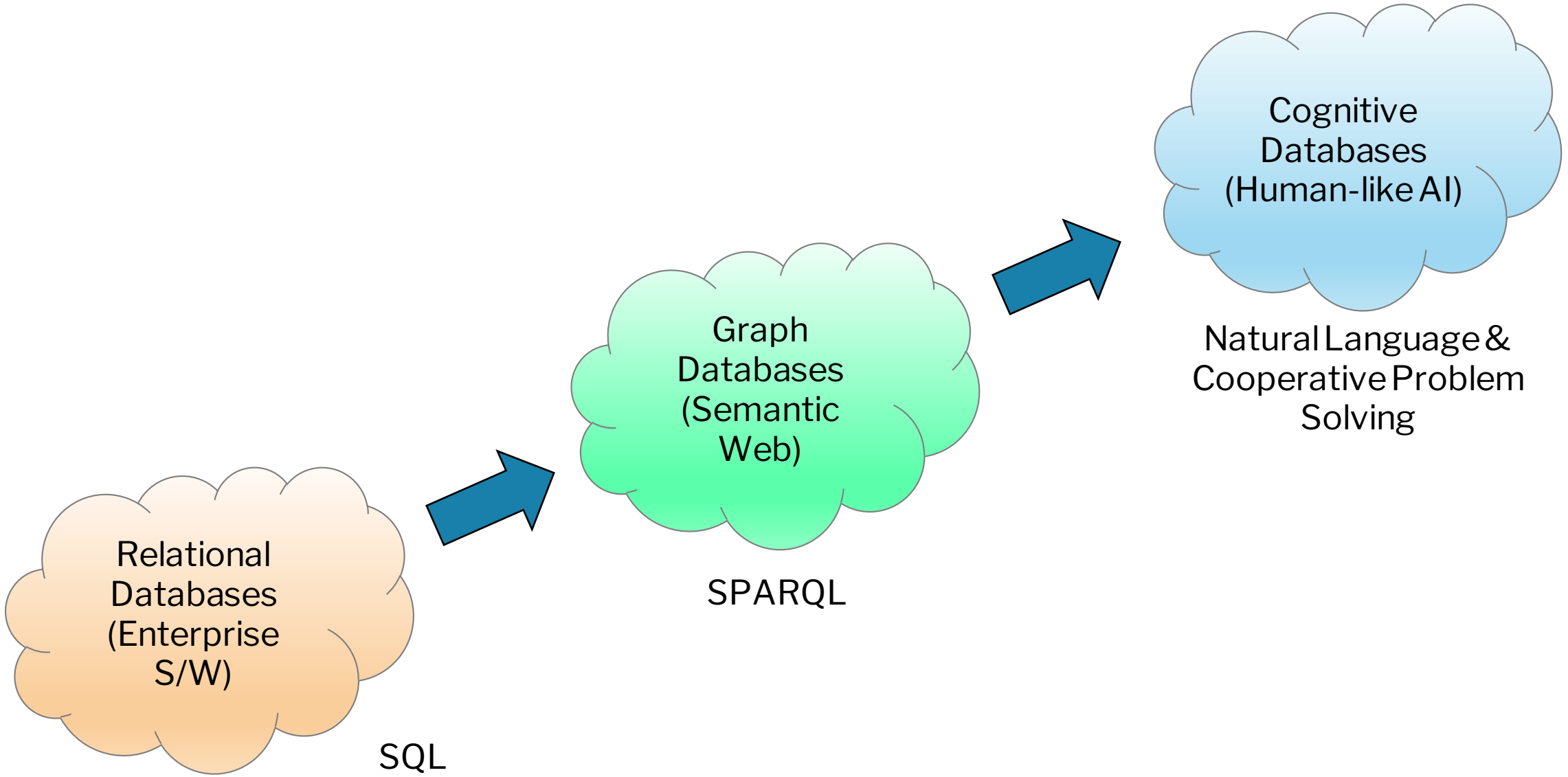
Managing Diversity & Leveraging Familiarity

- How can we allow for this diversity whilst ensuring effective management of shared enterprise wide models, master data, and associated core vocabularies?
- How can we build on what people are already familiar with, e.g. “knowledge sheets” as an evolutionary step up from today’s spreadsheets, along with live access to distributed knowledge graphs?
- What about using natural language?

What about Reasoning?

- Knowledge is about reasoning with information, i.e. structured labelled data
- But today's implementations embed application logic within the application code
- This makes it costly to update – getting in the way of agility
- How can we make it easier to reason with knowledge graphs?
- Moreover, how can we reason with imperfect knowledge subject to uncertainty, incompleteness and inconsistencies?
- Traditional logic can't cope, and statistical inference may be impractical, as it is difficult to compile the required statistics
- We need to switch to cognitive databases that mimic the cortex

Evolution in action



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IOT: Surfing an incredible dynamic diversity

Enrico Scarrone, TIM

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IOT: Surfing an incredible dynamic diversity

Dr. Enrico Scarrone
TC SmartM2M Chair
oneM2M Steering Committee Chair

IoT week - Ontologies in the context of the European Green Deal **Dublin, 22 June 2022**


TA·FDIT·TPR·POBIL²
ODILITIS·DEI·GABBIDI
DE·BDRGO·DE·PADA
CAPIT·PPLIASISII·D·C
CC·INDICTIONE·III


PVBLICÆ
PIEDE COMMVNE
PASSETTO COMMVNE
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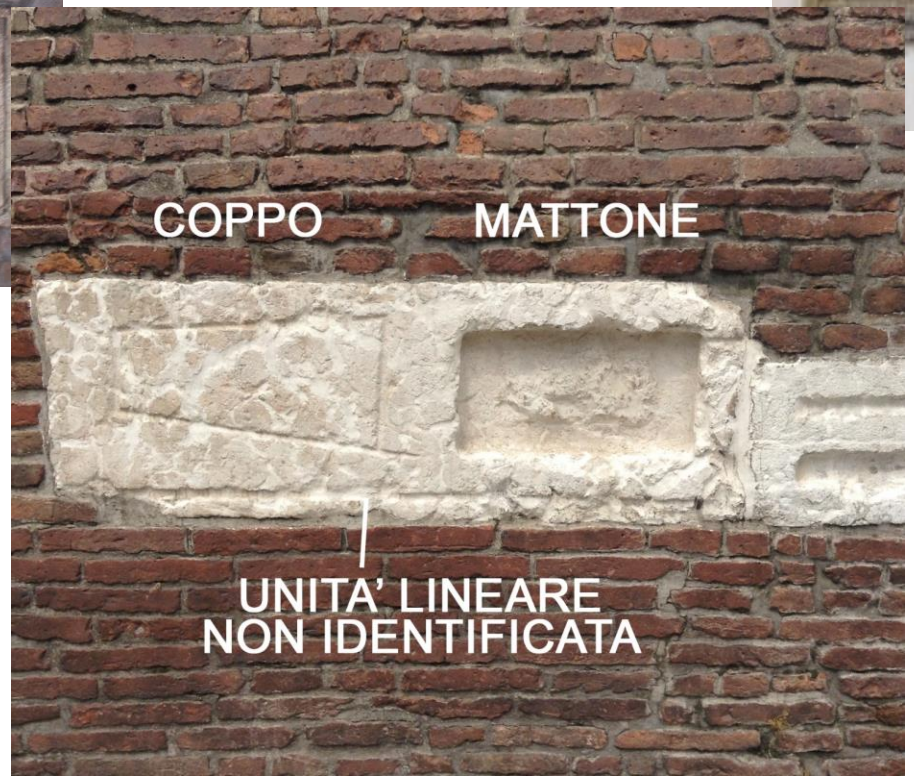
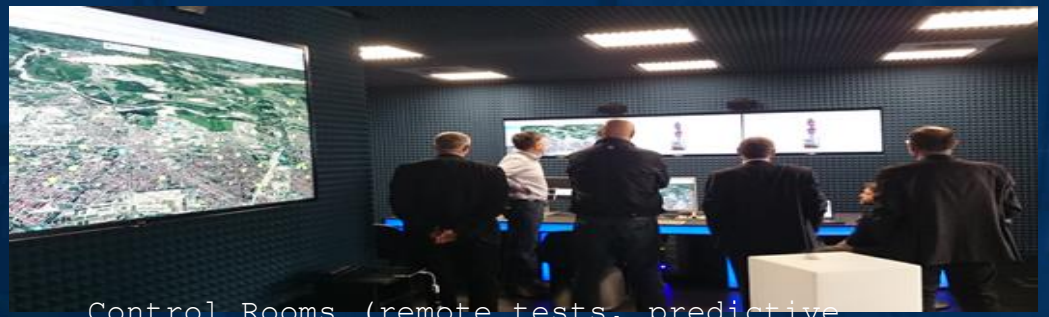


https://ilcapochiave.it/2019/01/15/antiche-unita-di-misura-tra-medioevo-e-rinascimento/

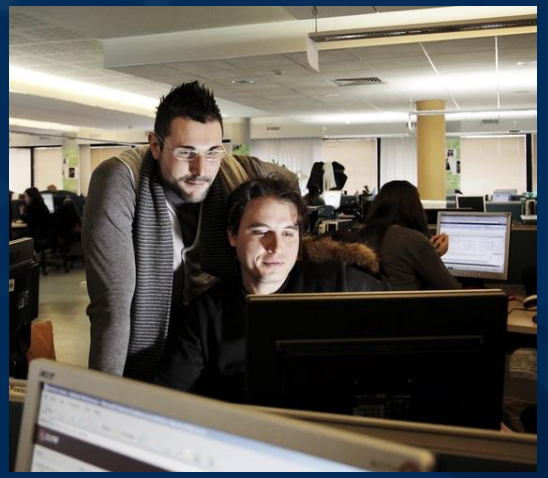
IoT and the Smart Cities:
merging dynamic ecosystems in constant revolution.

Communication networks



Control Rooms (remote tests, predictive maintenance, etc…

Augmented reality for technicians and for users



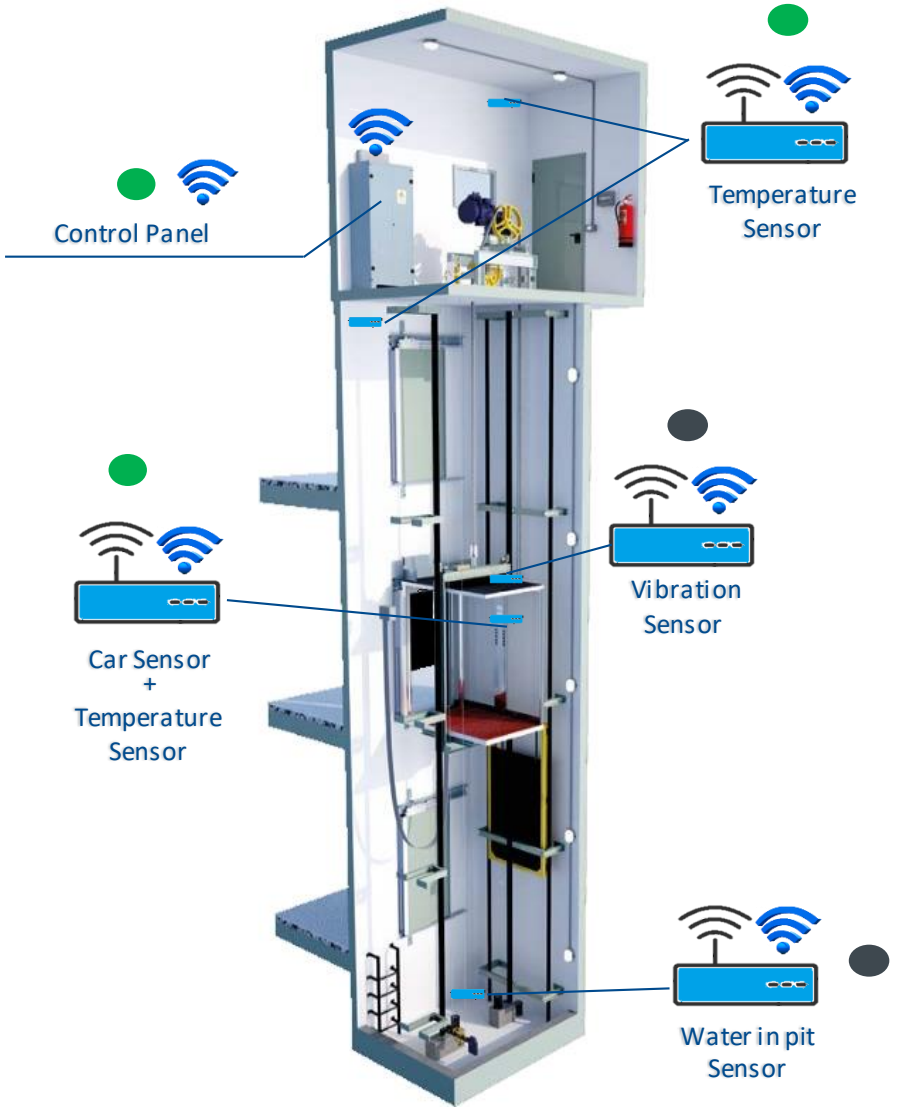
Building Managers

Smart City

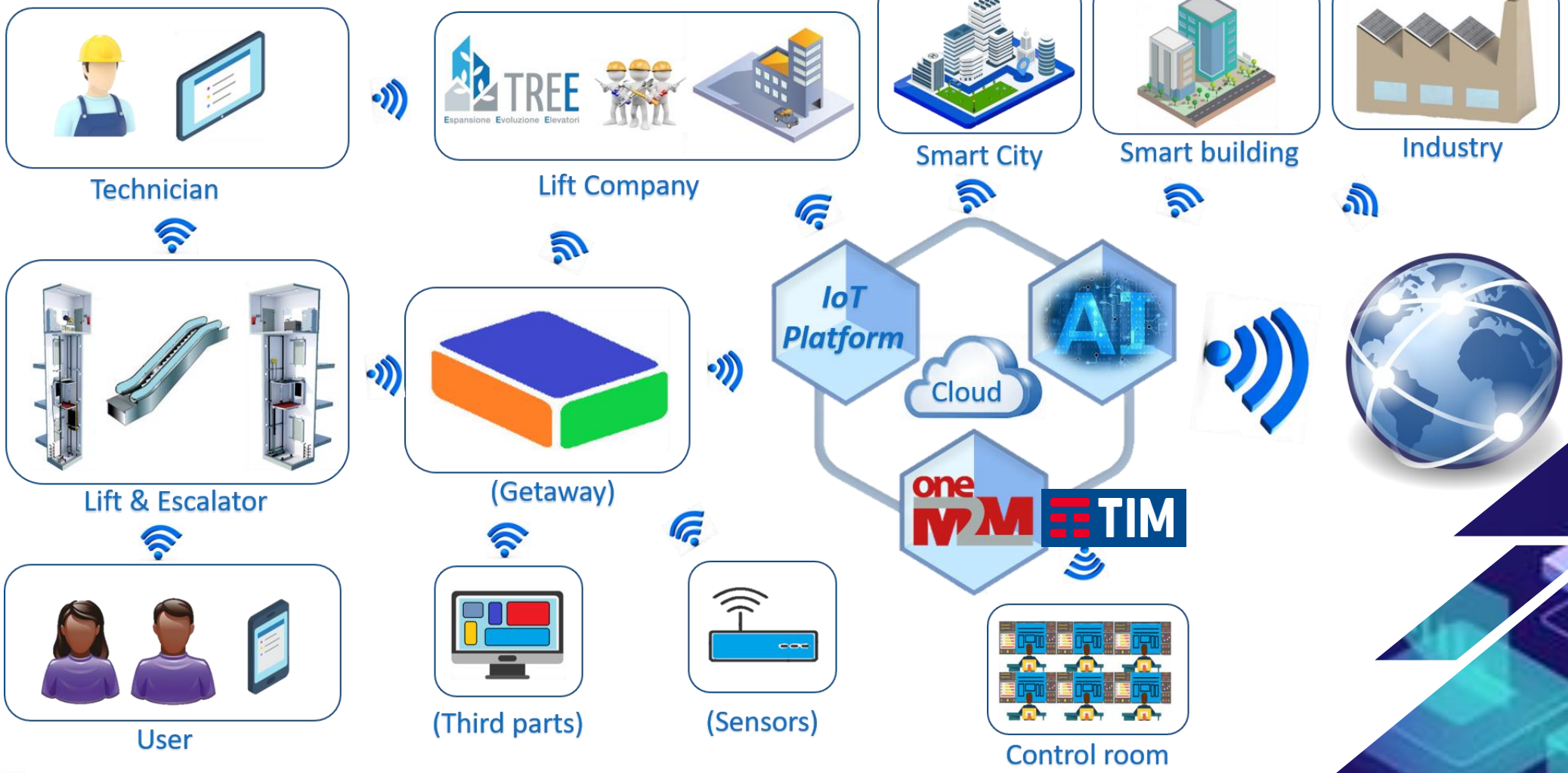
Intelligent services for users

An example - TC SmartM2M: ETSI Smart Lifts Standardization

- TS 103 735 SmartM2M; Smart Lifts IoT System Aiming to evolve the Lifts to IoT and integrate it in the big picture of IoT.
  - Developed with the support of major Lift Stakeholders:
  - Excellent collaboration with vertical stakeholders (www.efesme.org) and (www.ela-aisbl.eu)
  - Parallel PoC (TREE/TIM) developed
  - 9 months to develop the full system specification (leveraging on oneM2M communication/interworking framework)
- TS 103 410-11 SAREF4LIFTS extension developed on the basis of TS 103.735
- A twin specification on escalators is under development:TS 103 849 Smart Escalators IoT System



“Smart Lift – TRE-E - IoT System”



IoT is NOT
about selecting a protocol… nor a platform… nor a cloud….

IoT is
sharing the information and its meaning among
different systems,
different applications,
different business sectors!

Grazie!
Thank you!

Dr. Enrico Scarrone

M2M/IoT Standardization Manager

TIM | Communication and Standards

OneM2M Steering Committee Chairma

ETSI TC SmartM2M Chairman

enrico.scarrone@telecomitalia.it

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Agile standardization with the Smart Data Models Program

Alberto Abella, FIREWARE

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Smart Data Models

Slides available at **https://bit.ly/IotWeek2022**

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Towards adopting data spaces inside the water sector

Aitor Corchero, Eurecat

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Water Digital Technologies

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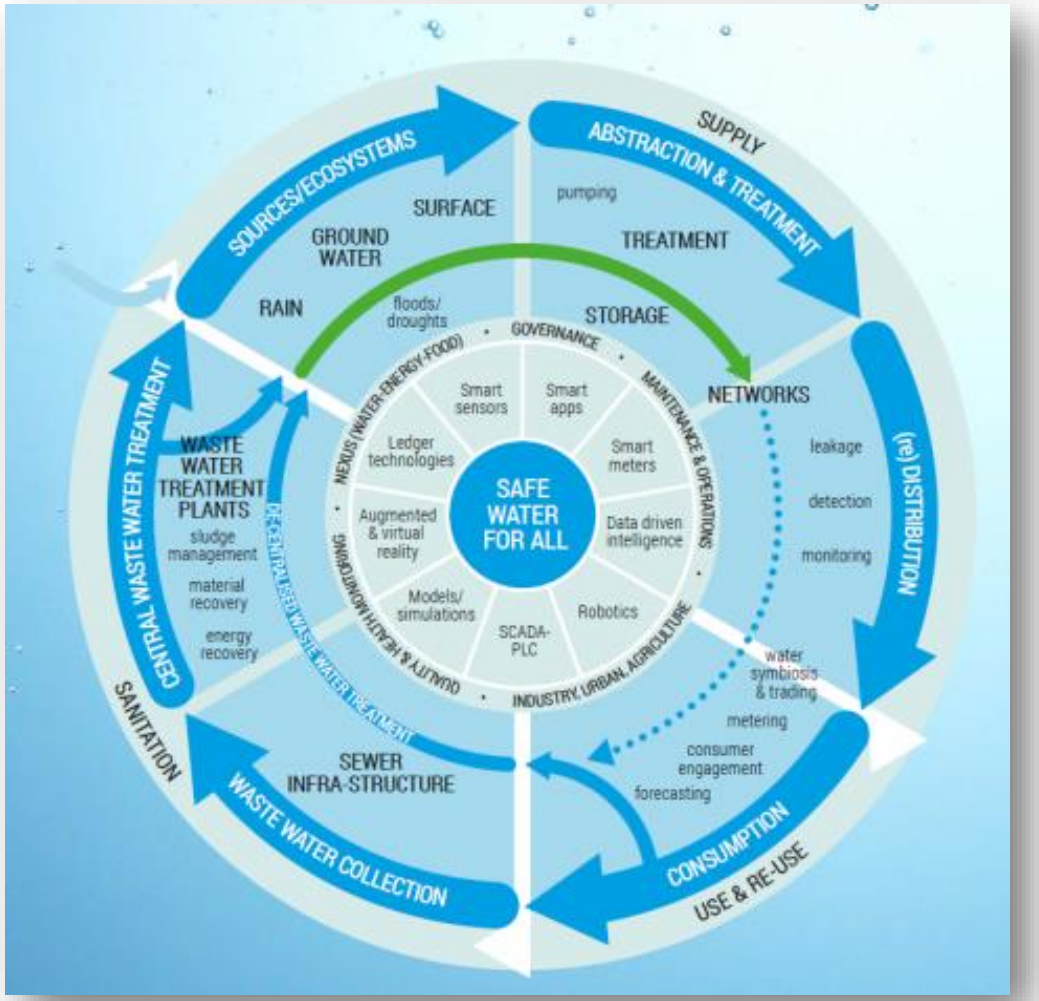
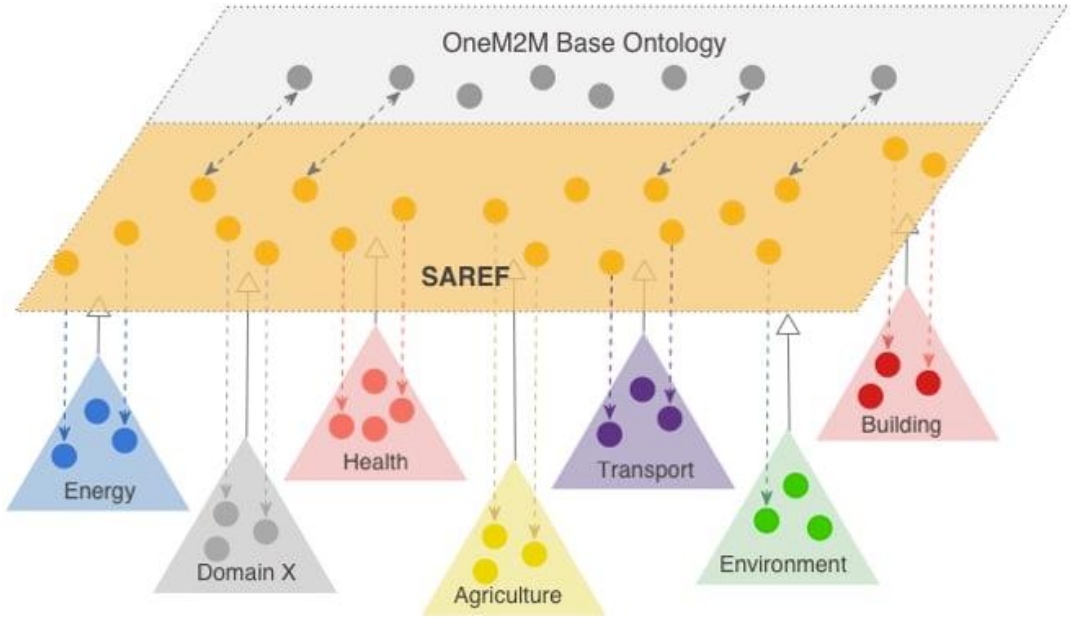
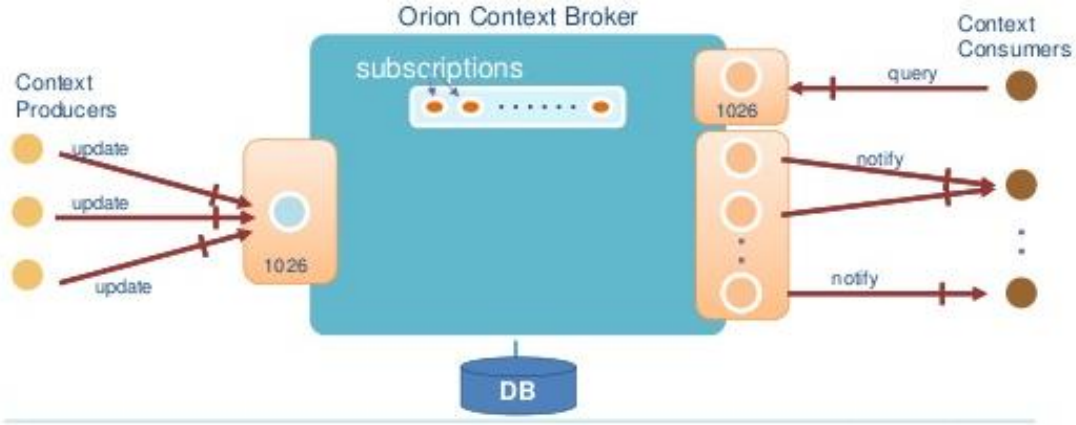


- - Numerous digital innovations are performed inside water sector
- - Isolated digital tools that needs to work together to achieve grater impacts.
- - Bridge between different infrastructures due to operative and planning decision-making similarities.

Semantic interoperability in Water





Water Ontologies

Ontology Specification Draft

language en

Incidence, Emergency Response and Risk Assessment model

Release 2021-07-05

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https://w3id.org/def/pathocert/v0.0.1/
Revision:
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Authors:
Aitor Corchero
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Provenance of this page

Abstract

A SAREF4WATR extenstion to model incidence, emergency response and Risk Assessment modelling. The main intention of the ontology is to interlink water management information with water quality and risk assessment. This ontology has been elaborated under the PATHOCERT H2020 project.

Table of contents

Vocabularies | Vocabulary report

WSISOntology landing page

Here you can find the list of vocabularies that have been found on WSISOntology.

Ontology	Serialization	License	Language	Description
WSIS Ontology Example of CS2 from ULTIMATE project		https://opensource.org/licens...	en	An example of the usage of the WSIS ontology performed under the ULTIMATE project.
WSIS Ontology Example at industrial level considering AQUASPICE-AGRICOLA Case Study		https://opensource.org/licens...	en	An example of the usage of the WSIS ontology performed under the AQUASPICE project.
Water Smart Industrial Symbiosis (WSIS) Ontology	TURTLE	https://opensource.org/licens...	en	An ontology as a catalyst for Water Smart Industrial Symbiosis (WSIS), in which water/wastewater plays a key role within a dynamic socio-economic ... See more

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Vocabularies | Vocabulary report

risk-ontology landing page

Here you can find the list of vocabularies that have been found on risk-ontology.

Ontology	Serialization	License	Language	Description
Cyber-Physic Risk Management Ontology in Critical Infrastructures	RDF/XML	https://opensource.org/licens...		Rioter Extension focused on managing risks in critical infrastructures

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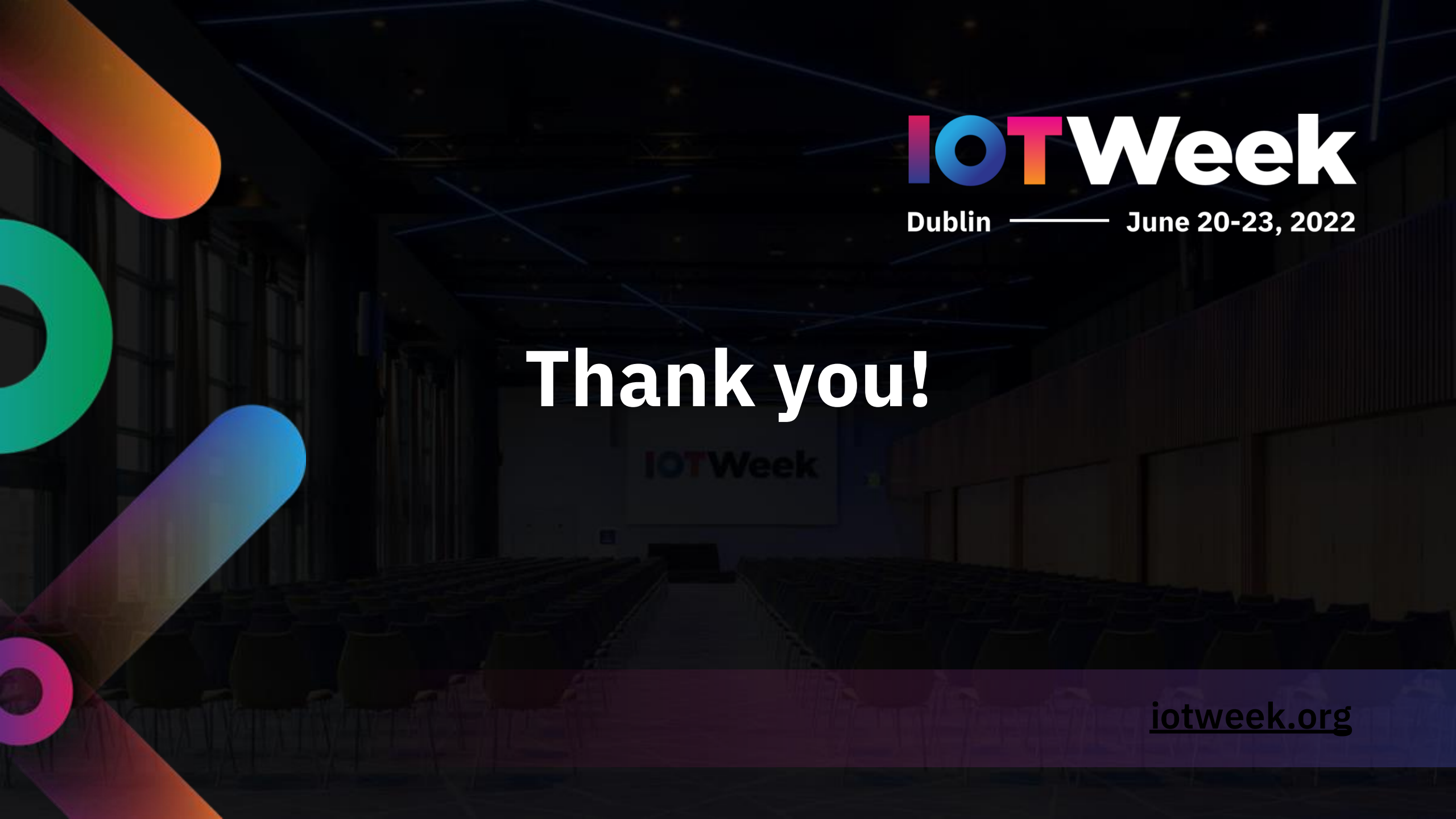
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