

Reference knowledge models for smart applications

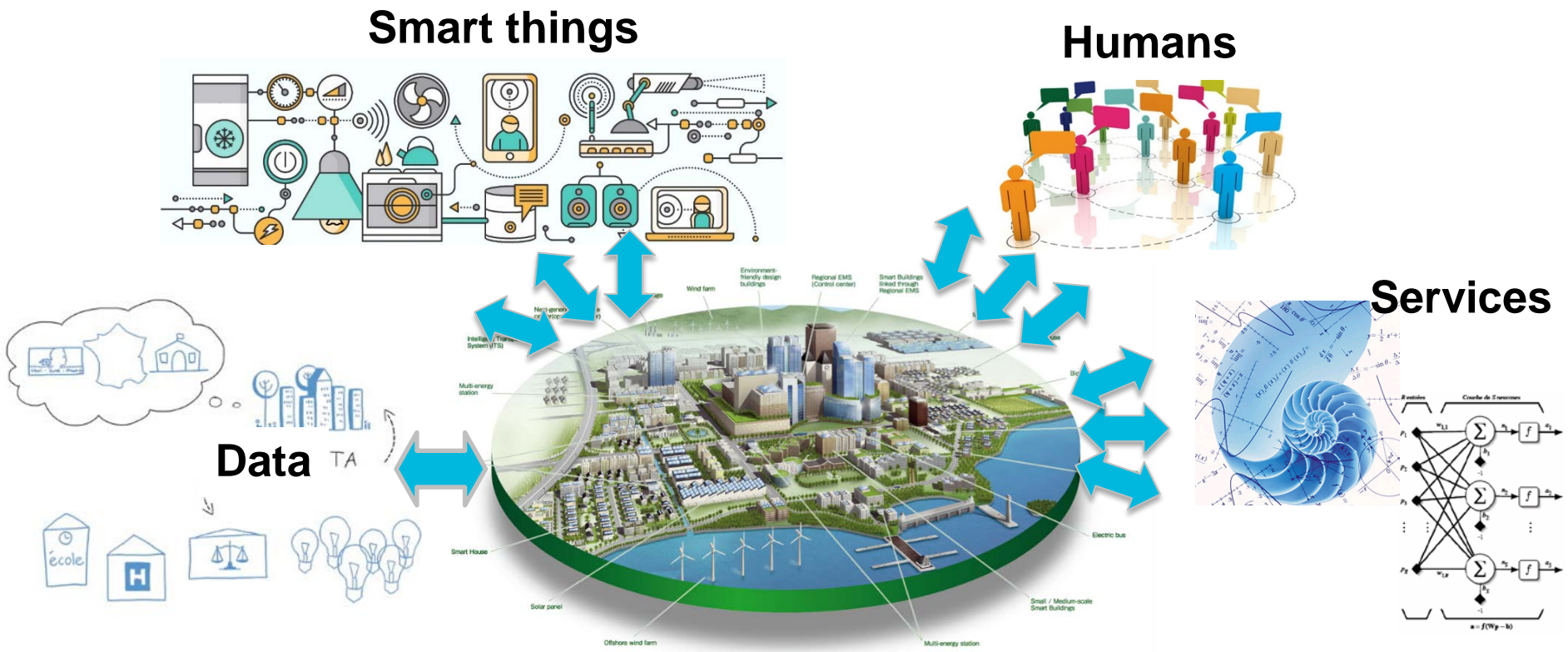
Maxime Lefrançois

Maxime.Lefrancois@emse.fr

<http://maxime-lefrancois.info/>

MINES Saint-Étienne – Institut Henri Fayol
Laboratoire Hubert Curien UMR CNRS 5516

How to reach semantic interoperability between heterogeneous things and services?



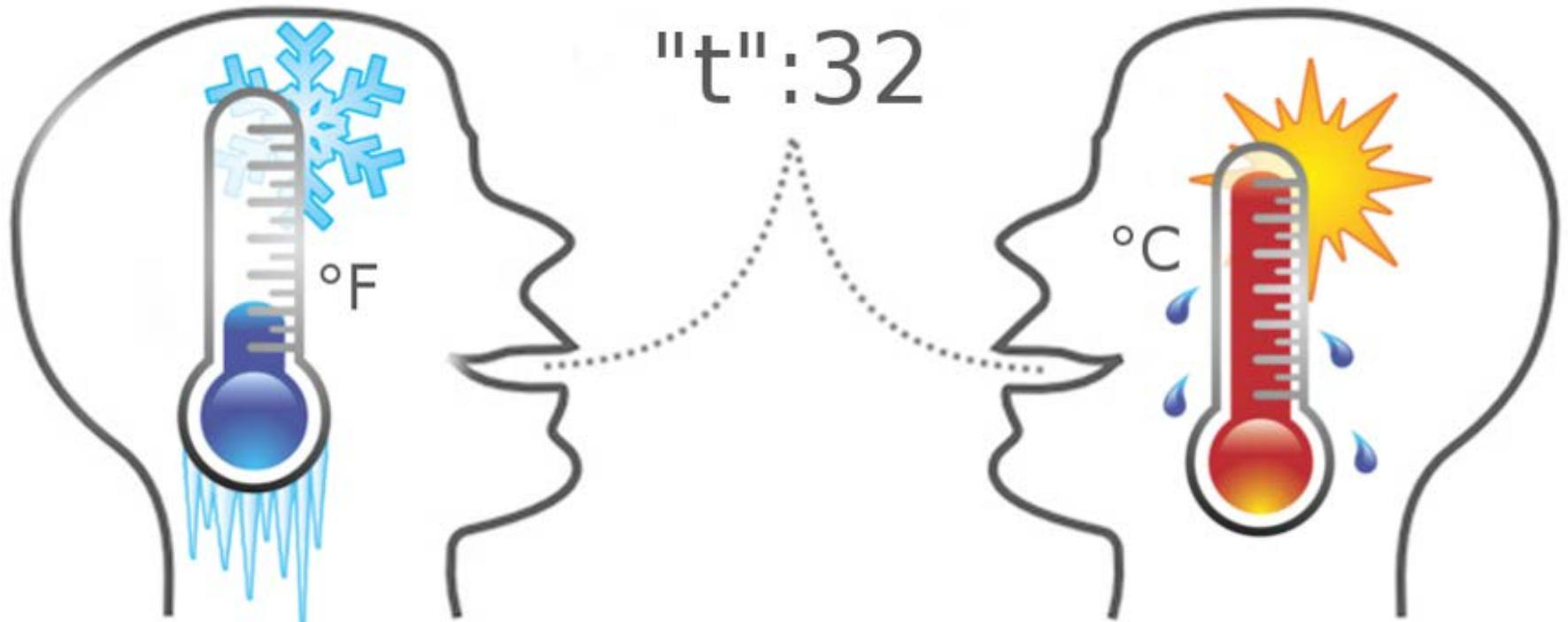
Interoperability required for coordination between services, things, human activities

Interoperability required for 40-60 % of potential value for Internet of Things application

How to reach semantic interoperability between heterogeneous things and services?





How to reach semantic interoperability between heterogeneous things and services?




- describe the device capabilities and context
- describe the interaction and coordination protocol
- describe the exchanged information





How to reach semantic interoperability between heterogeneous things and services?

AIOTI @AIOTI_EU · 8h
@AIOTI_EU in collab w/ @ETSI_STANDARDS @oneM2M @w3c & @isostandards/IECJTC1/SC41 recently published 2 joint WHITE PAPERS on semantic #interoperability to accelerate adoption of semantic #tech in #IoT. 


Link to reports  1 ow.ly/wQ7f50wRbBz 2 ow.ly/5Gyr50wRbBA







W3C @w3c · Oct 23
AIOTI, ISO/IEC JTC1, ETSI, oneM2M and W3C Collaborate on Two Joint White Papers on **Semantic Interoperability** Targeting Developers and Standardization Engineers, by Dave Raggett ift.tt/2PiBJ9T

  5  4 

Ian Oppermann @ian_oppermann · Oct 18
The IEC (International Electrotechnical Commission) has published its 2019 Whitepaper "**Semantic Interoperability**". It may not sound exciting, but if you are into digital and data, it is #privacy #datascience #technologyandsociety #datagovernance #interop...

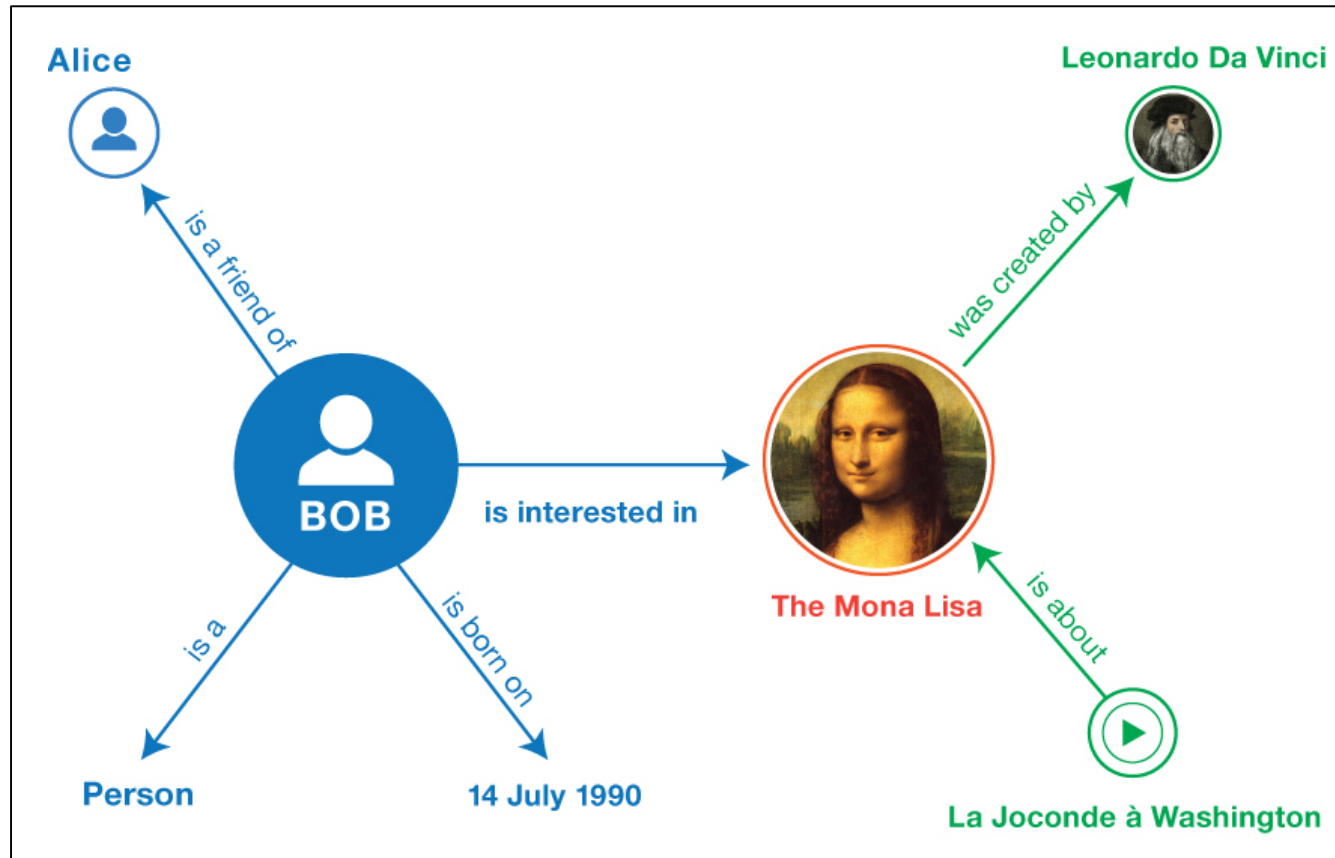
 LinkedIn: Log In or Sign Up
500 million+ members | Manage your professional identity. Build and engage with your professional ...
[linkedin.com](https://www.linkedin.com)

  2  2 

CREATE-IoT @Createlot_eu · Mar 8
We are contributing to the @AIOTI_EU initiative on a white paper for #semantic #interoperability. One of our members, @antoniokung, is now co-editor of ISO/IEC 21823-3 **Semantic interoperability**. #IoT #IoTLSPs

- describe the device capabilities and context
- describe the interaction and coordination protocol
- describe the exchanged information

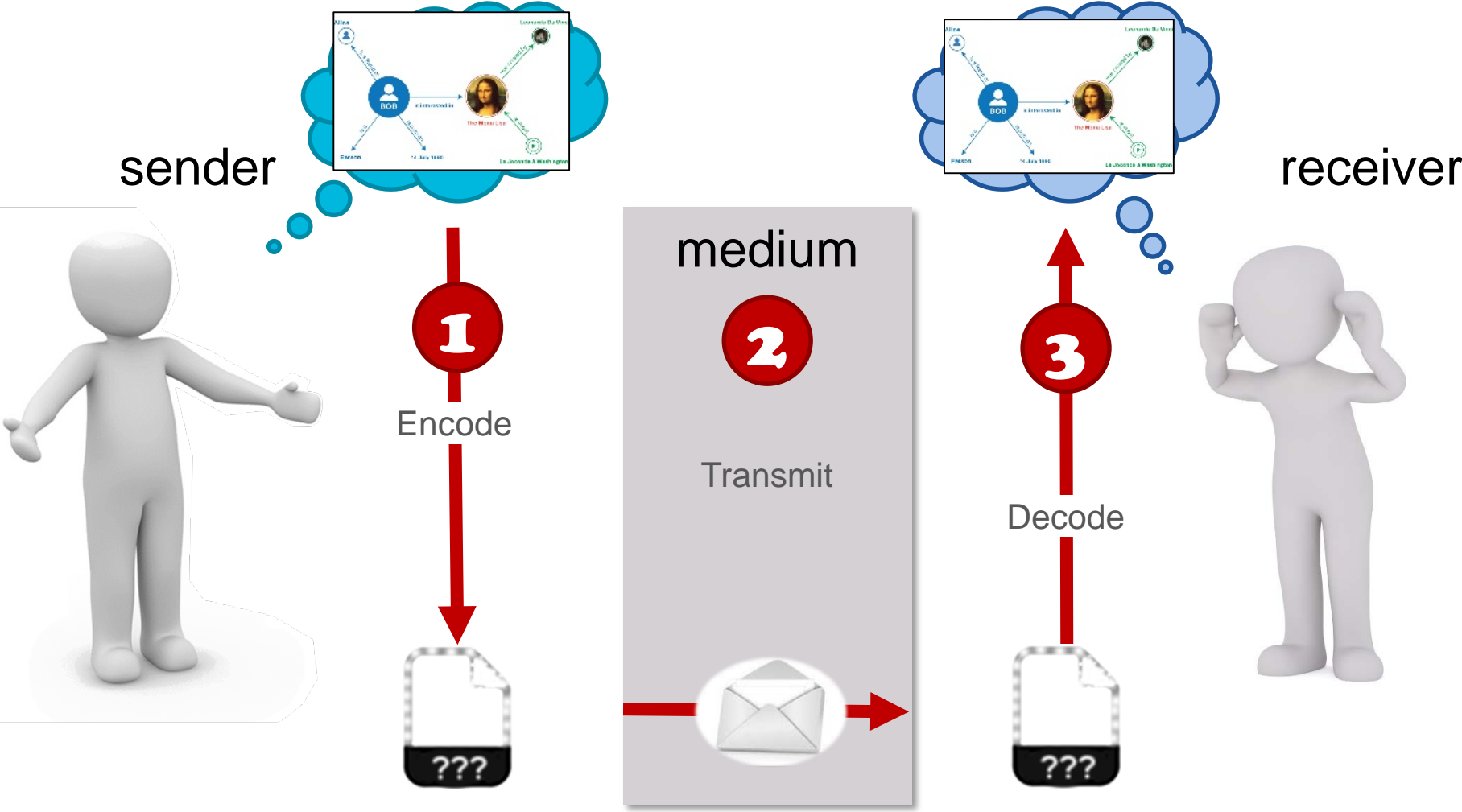
Semantic Web - Ontologies – Knowledge Models



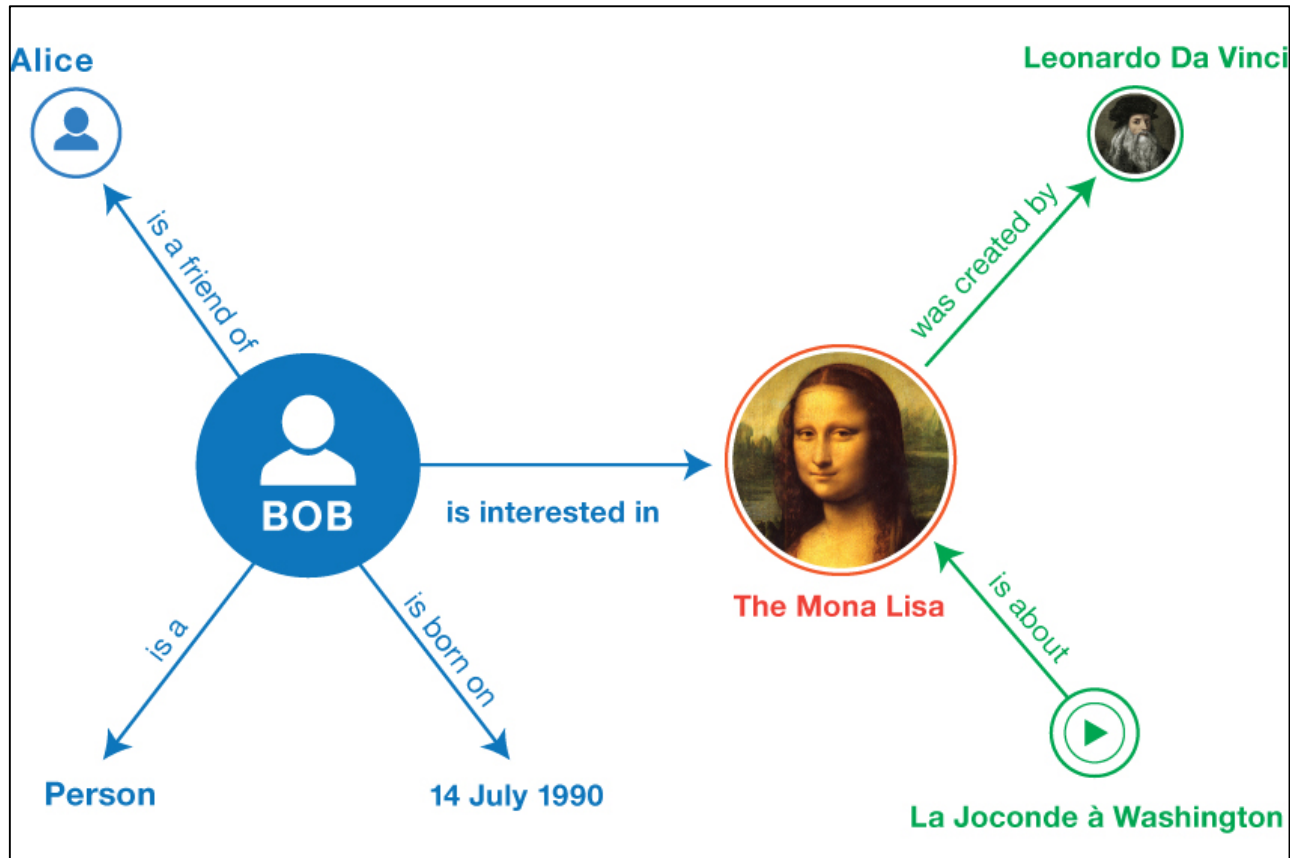
<https://www.w3.org/TR/rdf11-primer/>

Graph-based data models
Knowledge representation (symbolic AI, ontologies)
Identify everything with URIs → Linked data

RDF as a data *model* (not a data *format*)



Still.. need to agree on a common vocabulary



<https://www.w3.org/TR/rdf11-primer/>

URIs for **classes, properties, datatypes, individuals ...**

Big ontology catalogs exist

Linked Open Vocabularies

lov.linkeddata.es/dataset/lov/

VOCABS TERMS AGENTS SPARQL/DUMP

Linked Open Vocabularies (LOV)

+ Suggest Documentation Follow

695 Vocabularies in LOV

Category Tags: Methods, Metadata, Geography, Society, Catalogs, Support, Services, Industry, API, Quality, People, IoT

Latest insertions

- fel - A Fine-grained Linking vocabulary 2019-10-24
- r-arco - ArCo Ontology 2019-10-24
- gom - GOM: Geom Metadata Ontology 2019-10-24
- common - The Deli Ontology 2019-10-23
- cdesc - Context De Ontology (ArCo network) 2019-10-23

Latest Updates

- gom - GOM: Geom Metadata Ontology 2019-10-24
- r-arco - ArCo Ontology 2019-10-24
- fel - A Fine-grained Linking vocabulary 2019-10-24
- a-loc - Location Ontology 2019-10-23
- cevent - Cultural Ev (ArCo network)

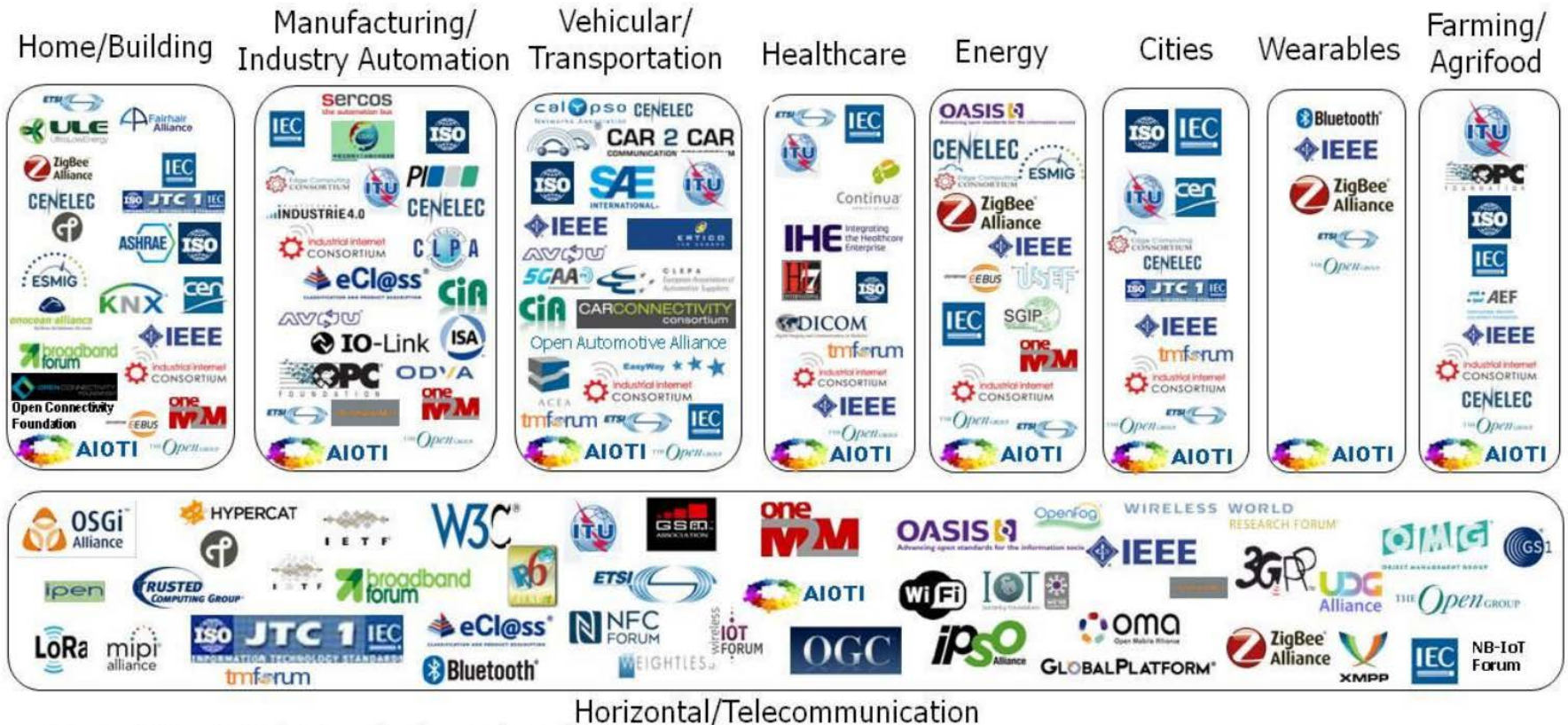
LOV4IoT Ontology Catalog

The LOV4IoT ontology catalog references **542** ontology-based research projects for IoT and its applicative domains:

LOV4IoT									
	Nb onto: 47	Nb onto: 27	Nb onto: 12	Nb onto: 24	Nb onto: 59	Nb onto: 53	Nb onto: 59	Nb onto: 24	Nb onto:
LOV4IoT-Health									
	Nb onto: 67	Nb onto: 11	Nb onto: 5	Nb onto: 15	Nb onto: 14	Nb onto: 42	Nb onto: 6	Nb onto: 2	Nb onto: 4
LOV4IoT-Environment									
	Nb onto: 15	Nb onto: 18	Nb onto: 7	Nb onto: 30	Nb onto: 11	Nb onto: 3	Nb onto: 11		
LOV4IoT Other Topics									
	Nb onto: 6	Nb onto: 2	Nb onto: 5	Nb onto: 5					

What SDOs develop ontologies for the IoT?

IoT SDOs and Alliances Landscape (Vertical and Horizontal Domains)



Horizontal/Telecommunication

Source: AIOTI WG3 (IoT Standardisation) – Release 2.8

What SDOs develop ontologies for the IoT?

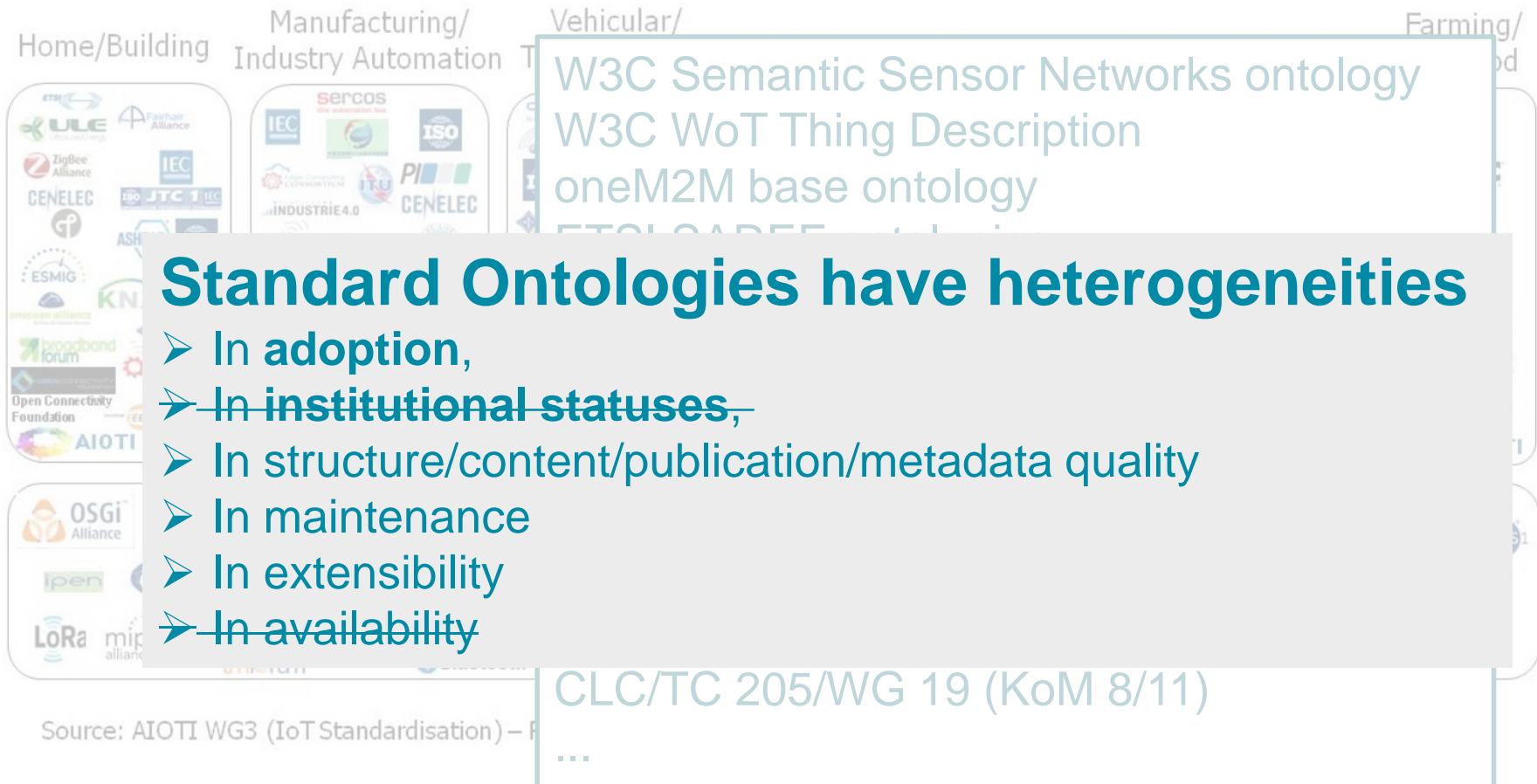
IoT SDOs and Alliances Landscape (Vertical and Horizontal Domains)



Source: AIOTI WG3 (IoT Standardisation) – F

What SDOs develop ontologies for the IoT?

IoT SDOs and Alliances Landscape (Vertical and Horizontal Domains)



Risk of the xkcd-927 effect

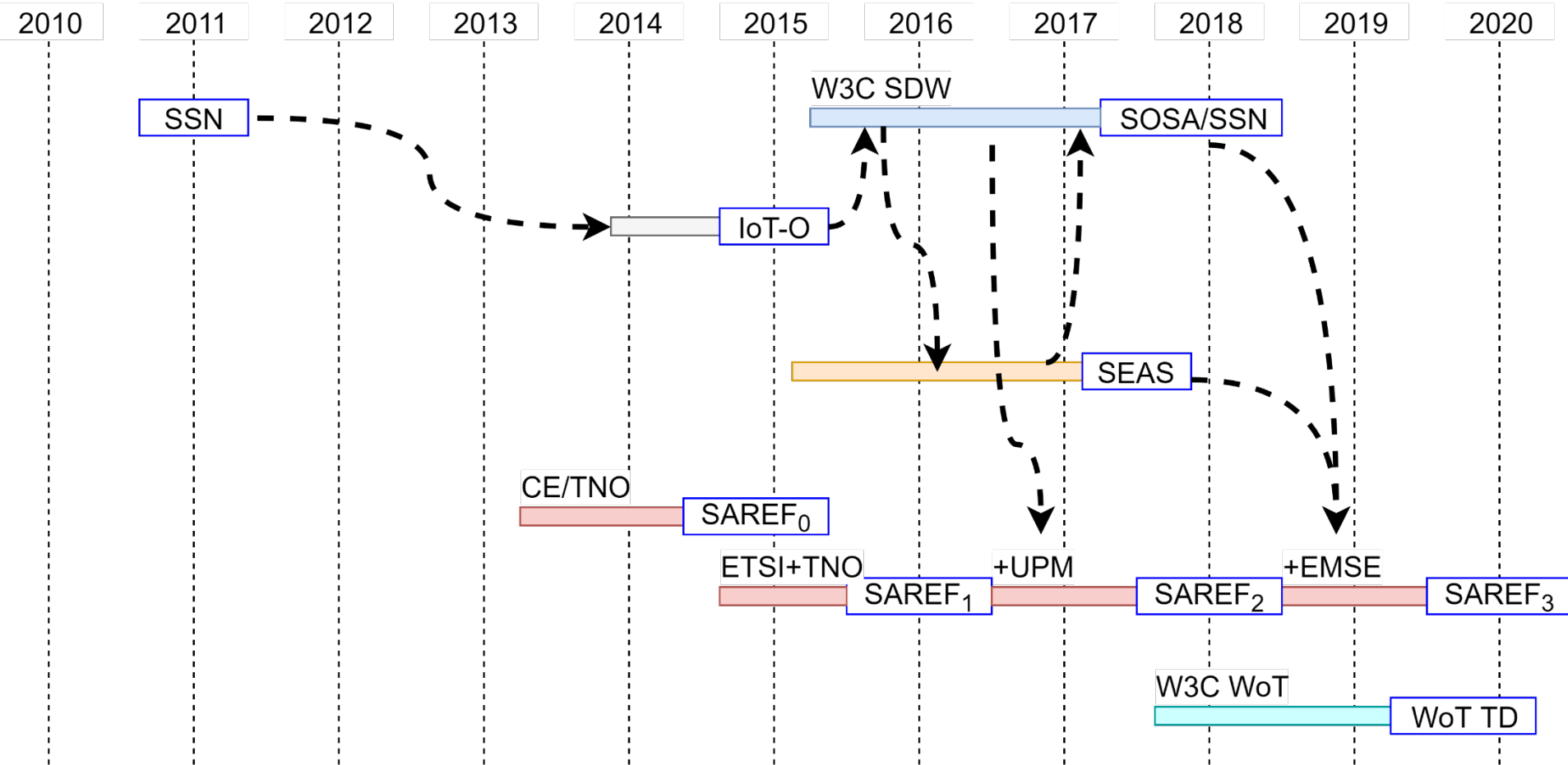
HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)



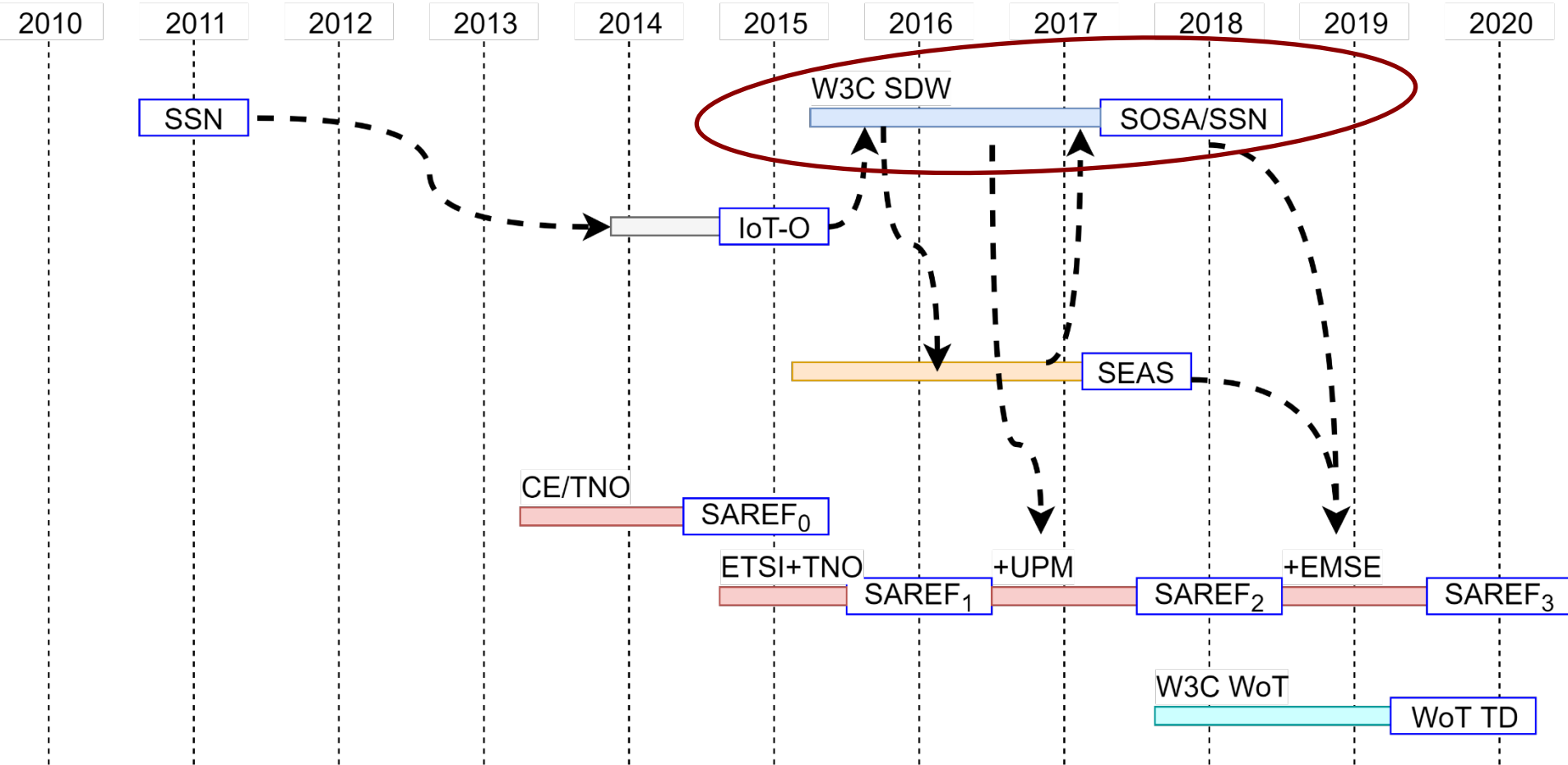
<https://xkcd.com/927/>

Source: AIOTI WG3 (IoT Standardisation) – f

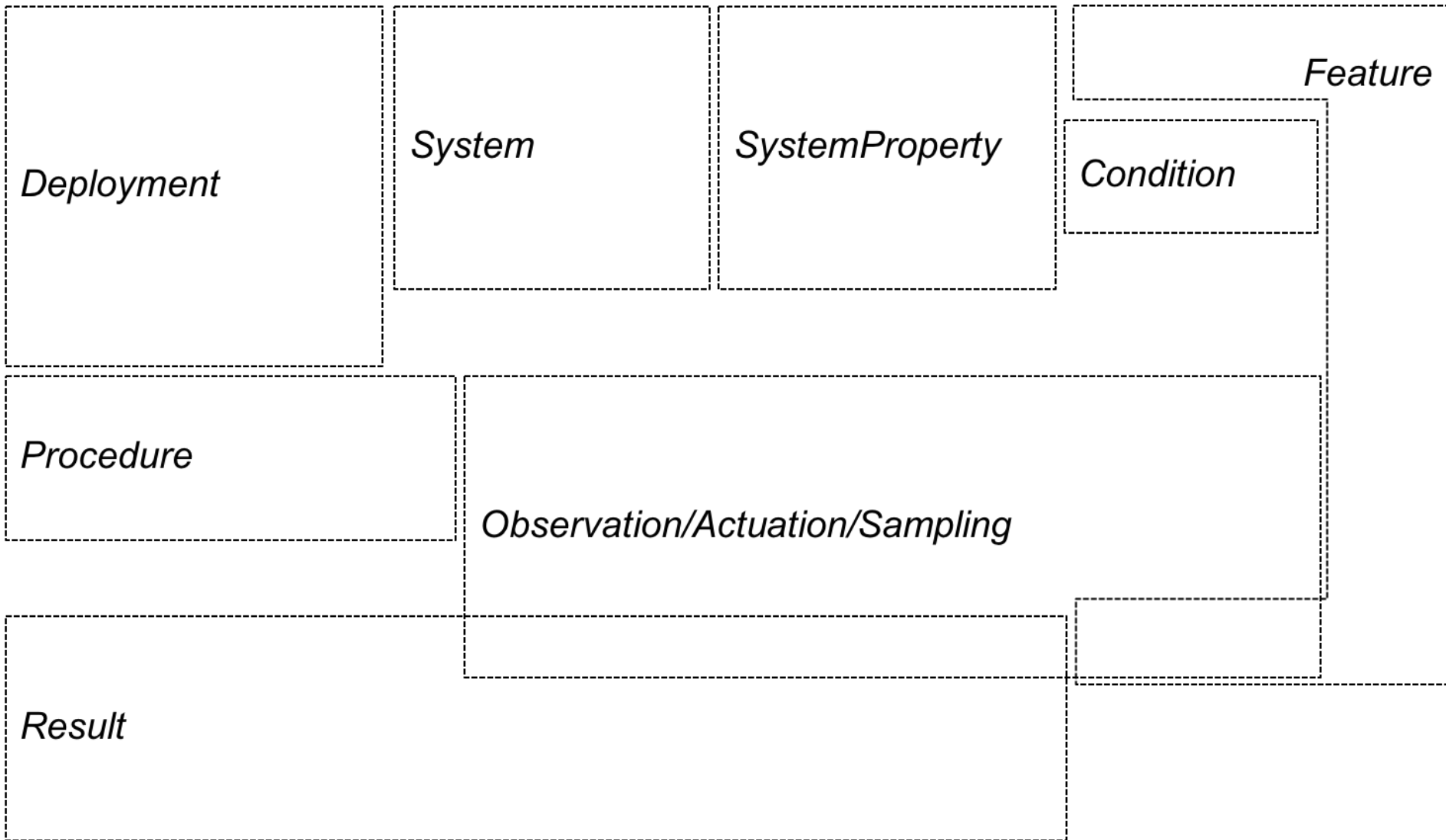
A partial picture on initiatives and influences



A partial picture on initiatives and influences



The OGC&W3C Semantic Sensor Networks Ontology



First integration in schema.org

iotschema.org

Search

Google, Microsoft, Yahoo, Yandex, ...

About

Schemas

Documentation

Actuator

Canonical URL: <http://iotschema.org/Actuator>

[Device](#) > [Actuator](#)

Actuator – A device that is used to change the state of the world.

Property	Expected Type	Description
Properties from Actuator		
Made Actuation	PropertyValue	Relation linking a PropertyValue to the Actuator that made that Actuation.
For Property	Property or Action	Relation between an Actuator and either a Property or an Action that it is capable of actuation.

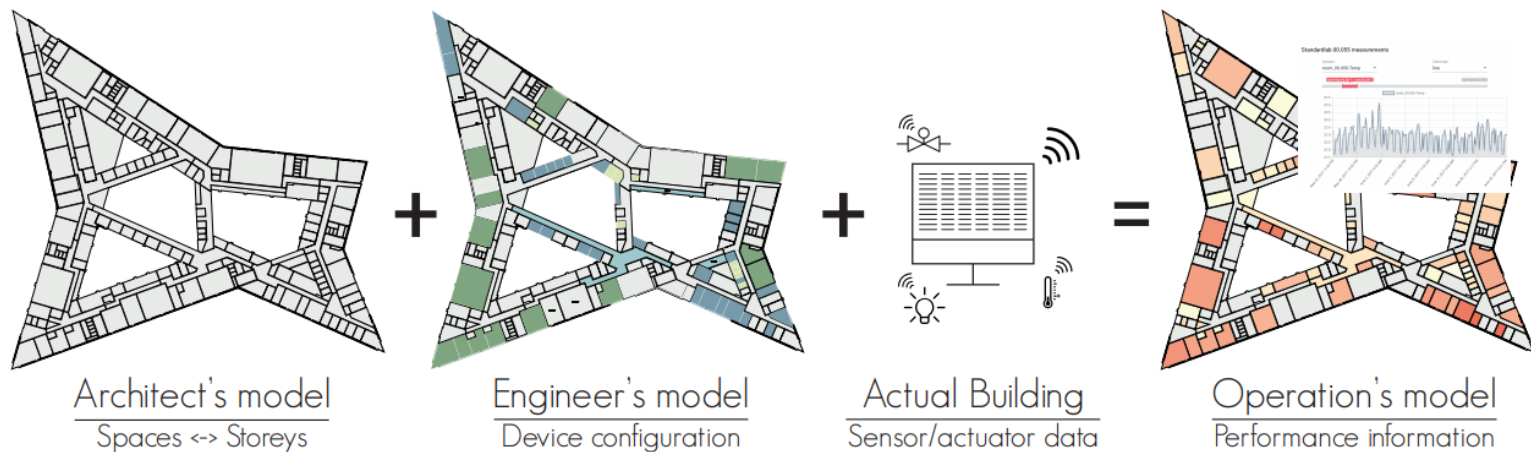
Instances of [Actuator](#) may appear as values for the following properties

Property	On Types	Description
Is Acted On By	Property or Action	Relation between an Action or a Property of a FeatureOfInterest and an Actuator changing its state.

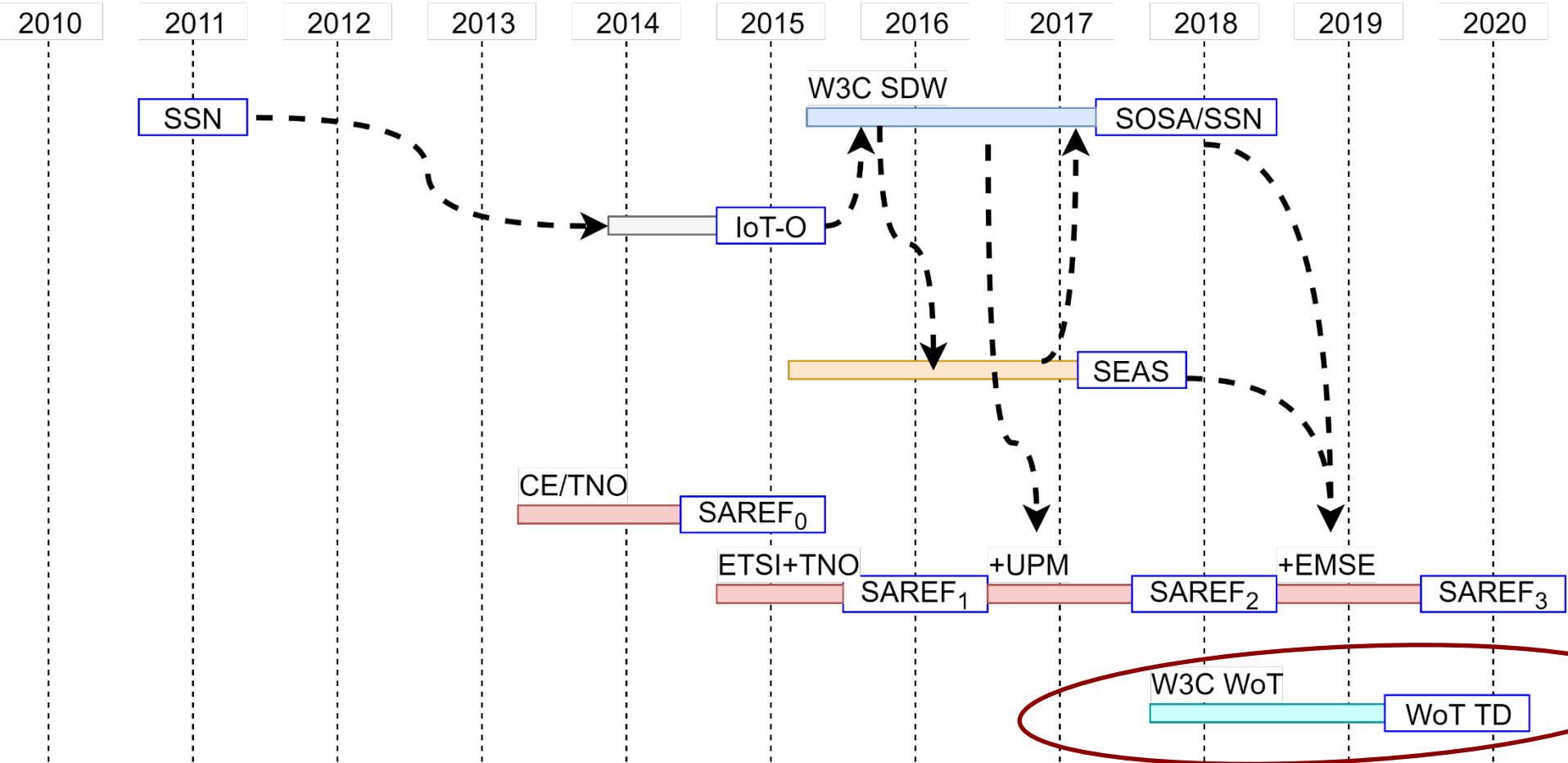
Early SSN adopters (as of 2018)

Topics of papers published this year citing SSN

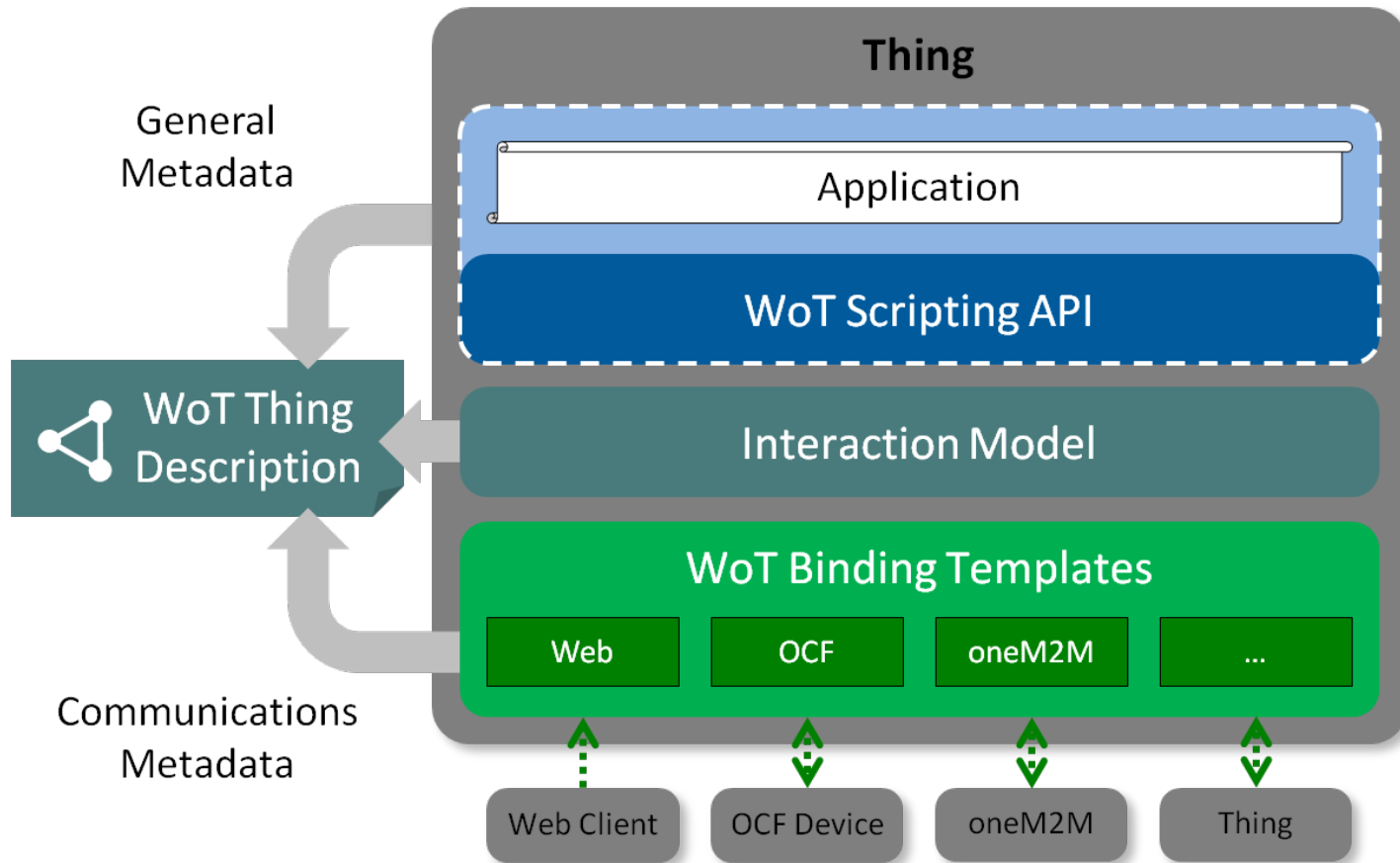
- Smart agriculture (irrigation)
- Smart transportation (sensors generating vehicule signals)
- Smart building (figure below)
- Smart health (Smart homes for seniors)
- Brain-Computer interaction
- GeoScience (earth, meteorology, oceans, events, flooding, ...)
- Smart grids (electric vehicles charging stations)
- Industry of the future



A partial picture on initiatives and influences



The W3C Web of Things working group



The W3C Web of Things working group

Thing Description representation (semantic ~ ?) of:

- the Thing,
- the interaction capabilities it exposes
 - Properties (observable ?, writable ?)
 - Action (an object is generated to monitor, cancel, ...)
 - Event (type pub/sub)
- how to solicitate it (URL, media type and in/out datamodel)

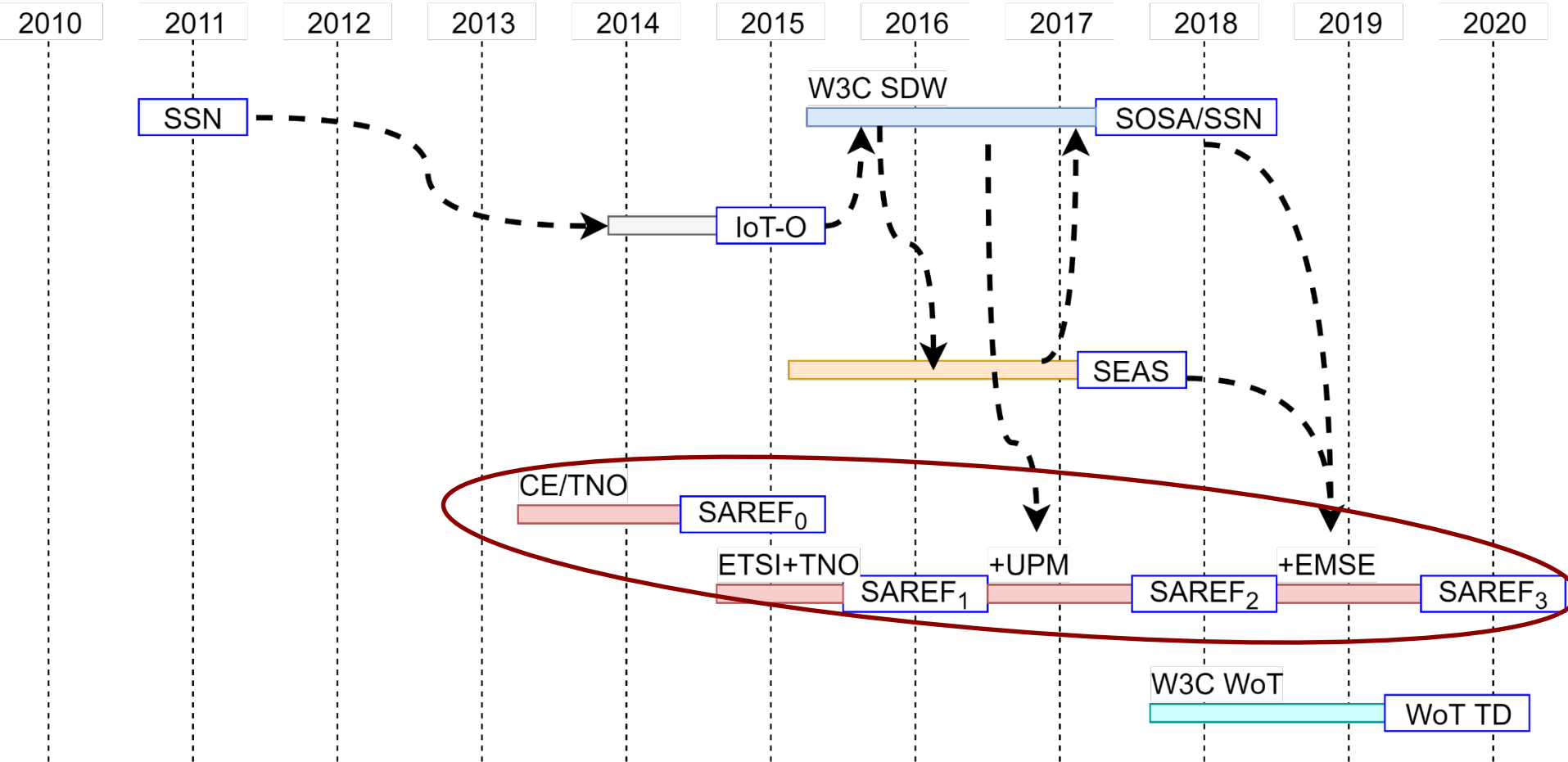
WoT Binding Templates

- every interaction type with every protocol or existing standard
 - ex. OCF light and motion sensor using CoAP on LAN
 - ex. LWM2M+IPSO environmental sensor from MQTT brokers, LAN and cloud
 - ex SmartThings Endpoint API using HTTP cloud-to-cloud

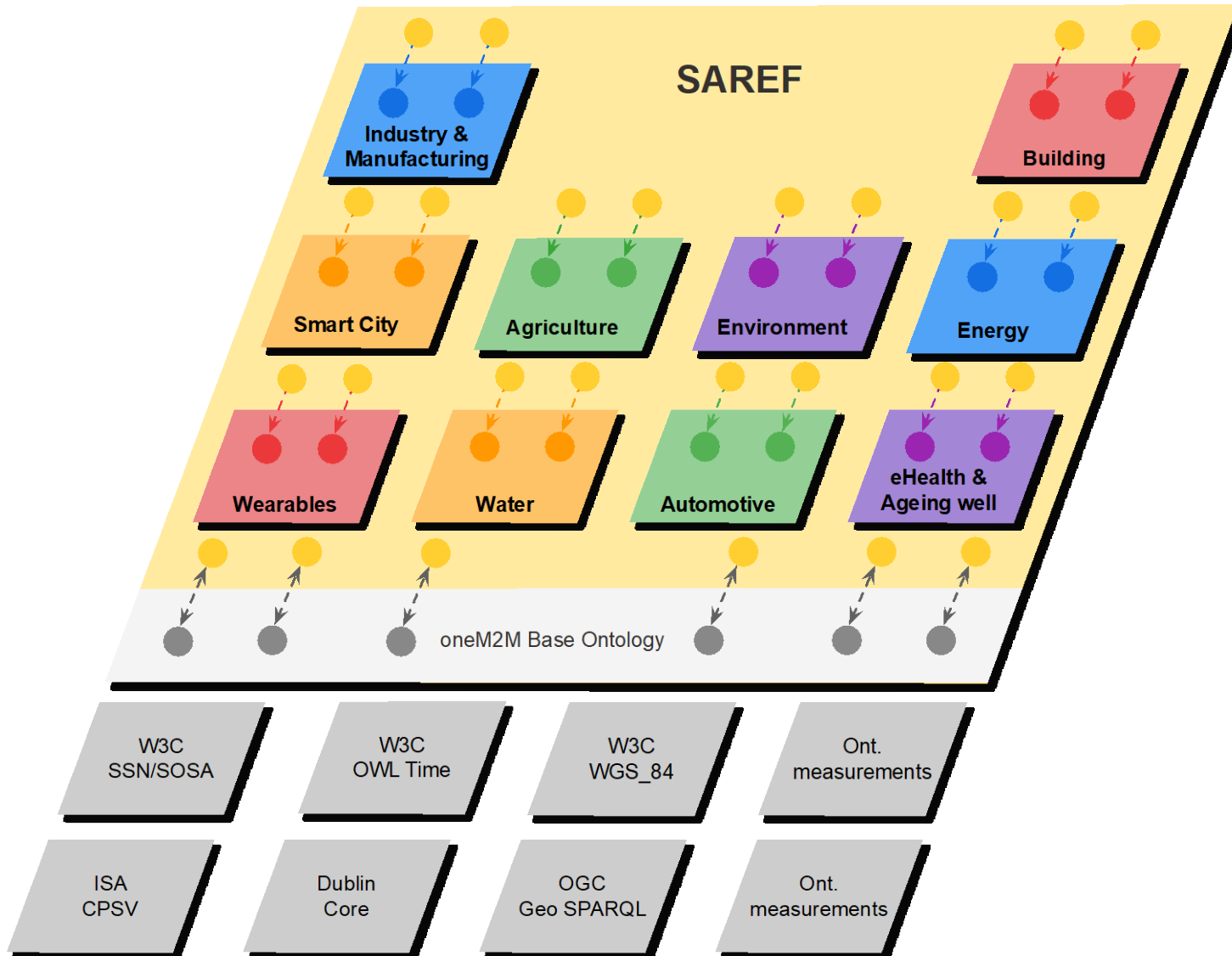
Scripting API

- javacript API to search / discover / solicitate things

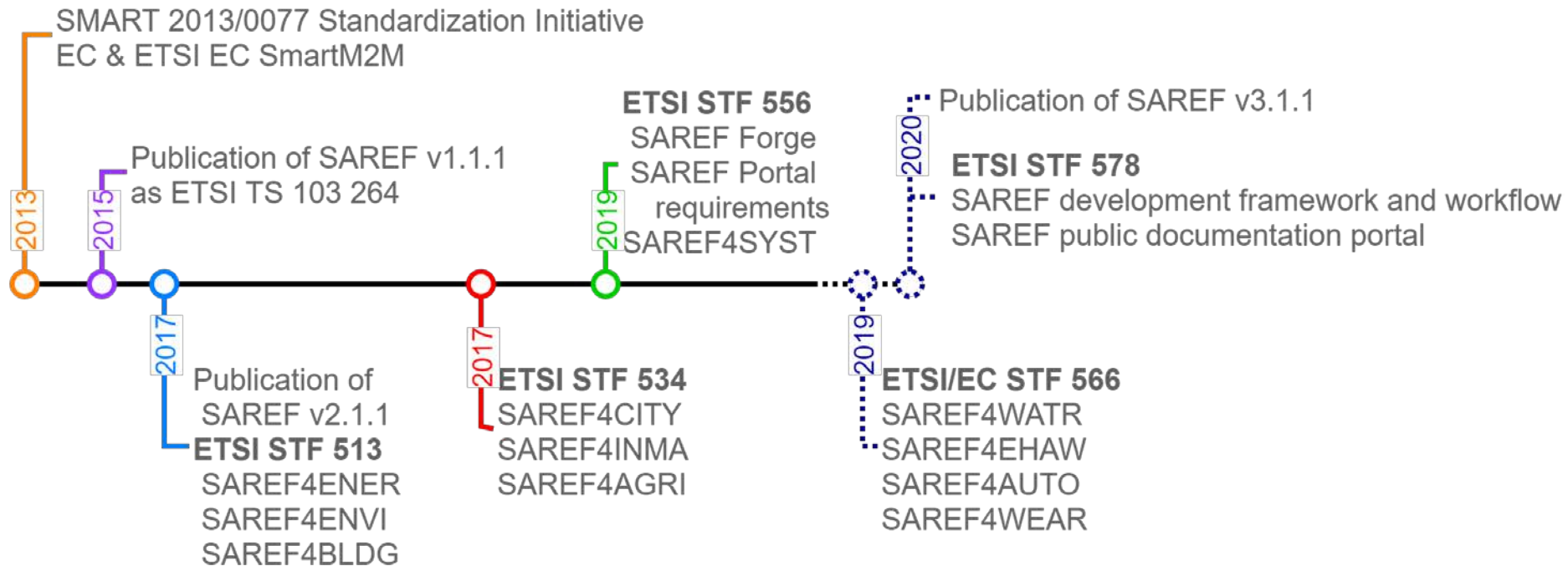
A partial picture on initiatives and influences



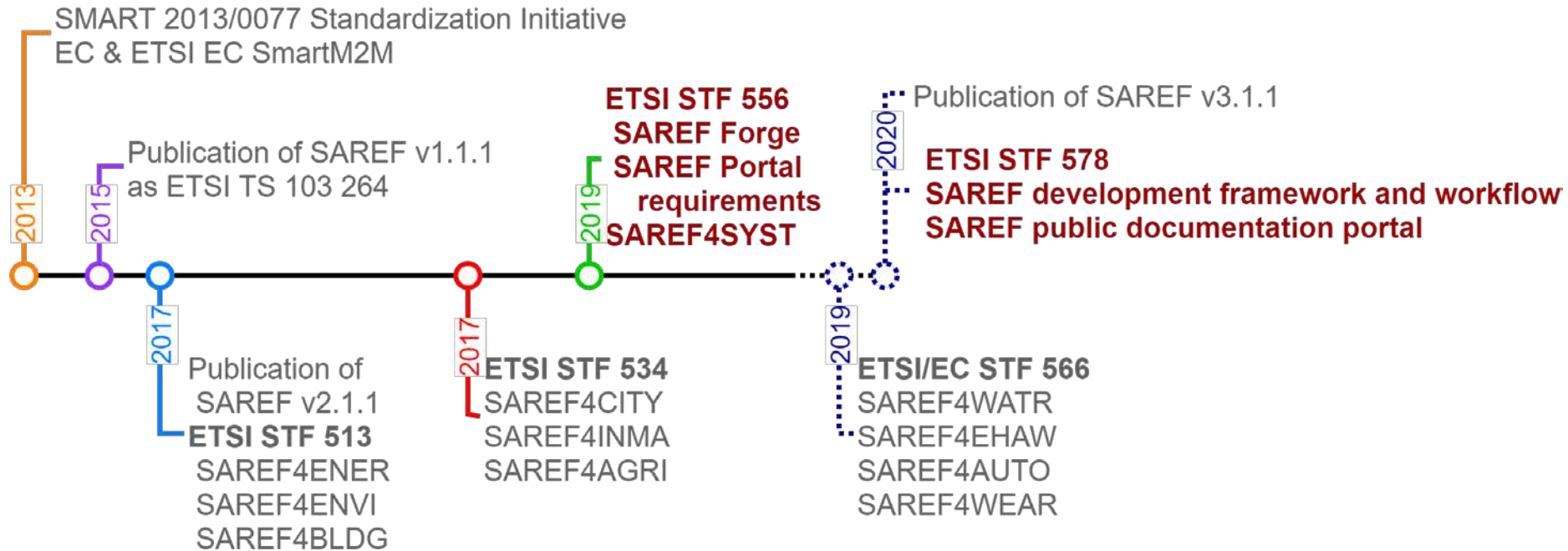
ETSI Smart Applications REFerence ontology



ETSI Smart Applications REference ontology



ETSI STF 556 and 578



The value of an ontology is strongly correlated with the size of its community of users, and also to the agility of its developers to improve the ontology and react to raised issues.

As such, users' community and industry actors need be attracted with clear Web documentation and a clear indication about how to provide their input and the kind of input that they can provide.

Our approach in ETSI SmartM2M



Improve how SAREF is published

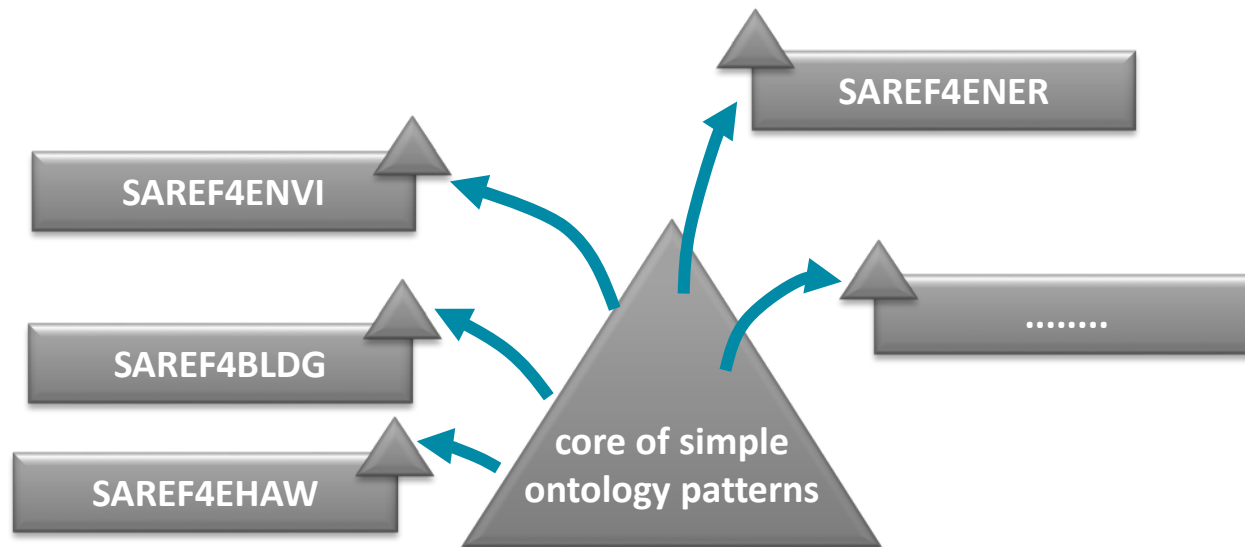
- published on members' institution website
- heterogeneous documentation format

Towards continuous integration and deployment

- fetch source from git repositories
- check quality of the ontologies
 - notify errors asap
 - generate documentation and example
 - modularized and versioned ontology
 - published as Linked Data

Consolidate the structure of the ontology

- One pattern for features of interest and their properties
- One pattern for assigning values to properties
- One pattern for procedures and procedure executions
- One pattern for systems and how they interact



STF 556: Consolidation of SAREF and its community of users, based on the experience of the EUREKA ITEA - 12004 SEAS project (June 2018 – June 2019):

- Deliverables published
 - D1 TR 103 549 Guidelines for consolidating SAREF with new reference ontology patterns
 - D2 TS 103 548 SAREF consolidation with new reference ontology patterns, based on the experience from the EUREKA ITEA SEAS project
 - D3 TR 103 608 SAREF publication framework reinforcing the engagement of its community of users

STF 556: Consolidation of SAREF and its community of users, based on the experience of the EUREKA ITEA - 12004 SEAS project (June 2018 – June 2019):

- Deliverables published
 - D1 TR 103 549 Guidelines for consolidating SAREF with new reference ontology patterns
 - D2 TS 103 548 SAREF consolidation with new reference ontology patterns, based on the experience from the EUREKA ITEA SEAS project
 - D3 TR 103 608 SAREF publication framework reinforcing the engagement of its community of users
- Draft of the portal:
 - development of SAREF migrated to the ETSI Forge
37 issues identified in SAREF, resolutions available, being processed
<https://forge.etsi.org/rep/SAREF/saref-core/>
 - Proof of concept of the SAREF portal
<https://saref.etsi.org/>

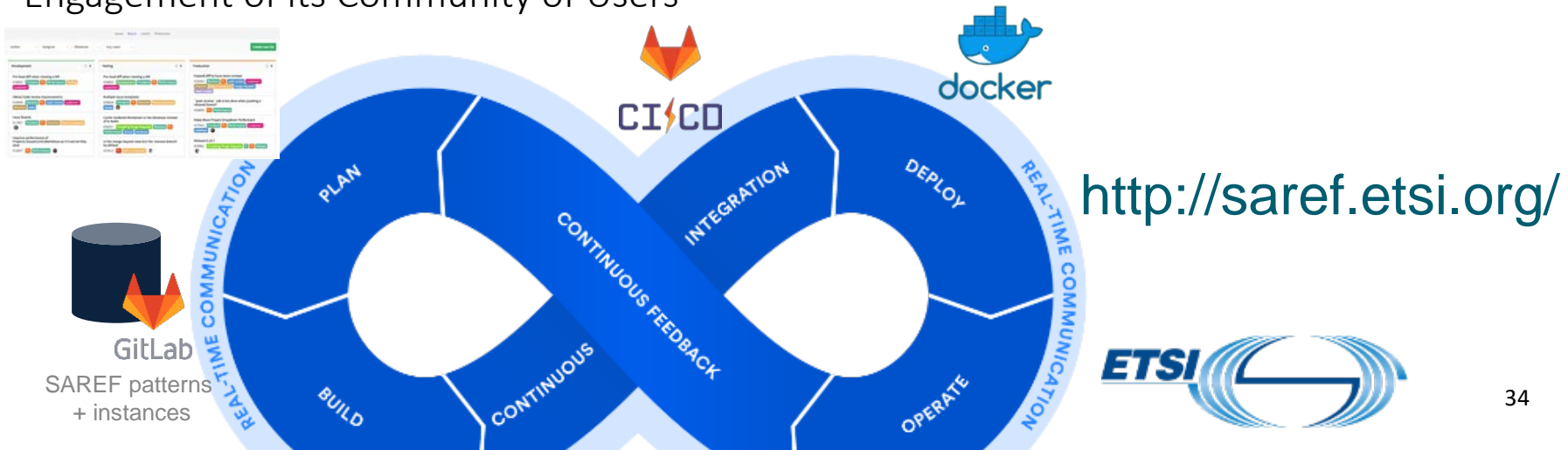
The ETSI SAREF Portal



STF 578: Spec. of the SAREF develop. framework and workflow, and develop. of the Community SAREF Portal for user engagement. Sept 2019 – Sept 2020:

Planned tasks:

- **TS 103 673** SAREF Development Framework and Workflow, Streamlining the Development of SAREF and its Extensions
- **SW1** Development of the SAREF Portal Content Generation from the SAREF sources, Enabling Continuous Integration and Deployment of SAREF
- **SW2** Development of the SAREF Portal Interaction Functionalities, Reinforcing the Engagement of its Community of Users



Stay tuned



AIOTI @AIOTI_EU · 8h

@AIOTI_EU in collab w/ @ETSI_STANDARDS @oneM2M @w3c & @isostandards/IECJTC1/SC41 recently published 2 joint WHITE PAPERS on semantic #interoperability to accelerate adoption of semantic #tech in #IoT. ✓

Link to reports [1 ow.ly/wQ7f50wRbBz](https://ow.ly/wQ7f50wRbBz) [2 ow.ly/5Gyr50wRbBA](https://ow.ly/5Gyr50wRbBA)



Andrea Cimmino @ACimmino · Oct 23, 2019

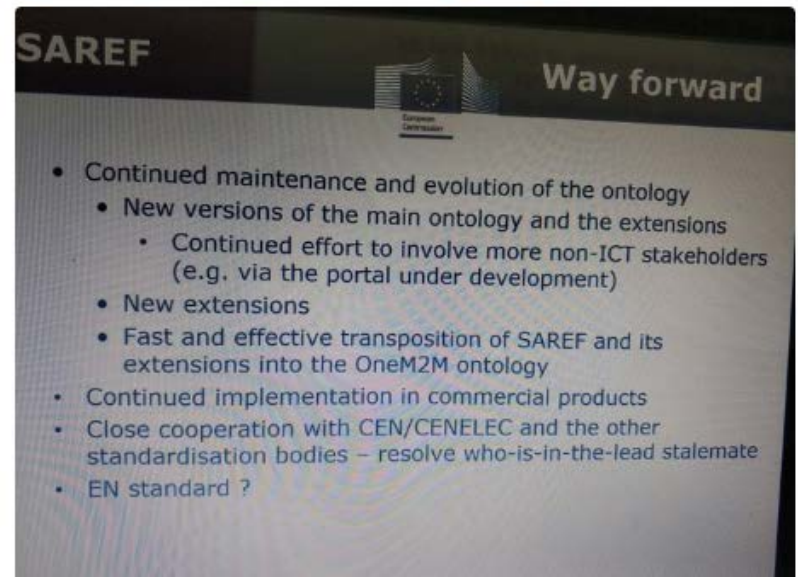
@rgcmme is presenting the beginning of the "Session 6: Semantic for Smart Applications" at the #IoTETSI, with some of its participants @MariaPovedaV and @Max_Lefrancois



Maxime Lefrançois

@Max_Lefrancois

The importance of STF578 the future portal mentioned in the introductory presentation about SAREF in the EU Picture by DG CONNECT, European Commission. @MINES_StEtienne @Territoire_EMSE @ConnectIntellig @oeg_upm



Reference knowledge models for smart applications

Maxime Lefrançois

Maxime.Lefrancois@emse.fr

<http://maxime-lefrancois.info/>

MINES Saint-Étienne – Institut Henri Fayol
Laboratoire Hubert Curien UMR CNRS 5516