EUROPEAN BIG DATA VALUE FORUM
14-16 OCT, 2019 - HELSINKI

European Commission

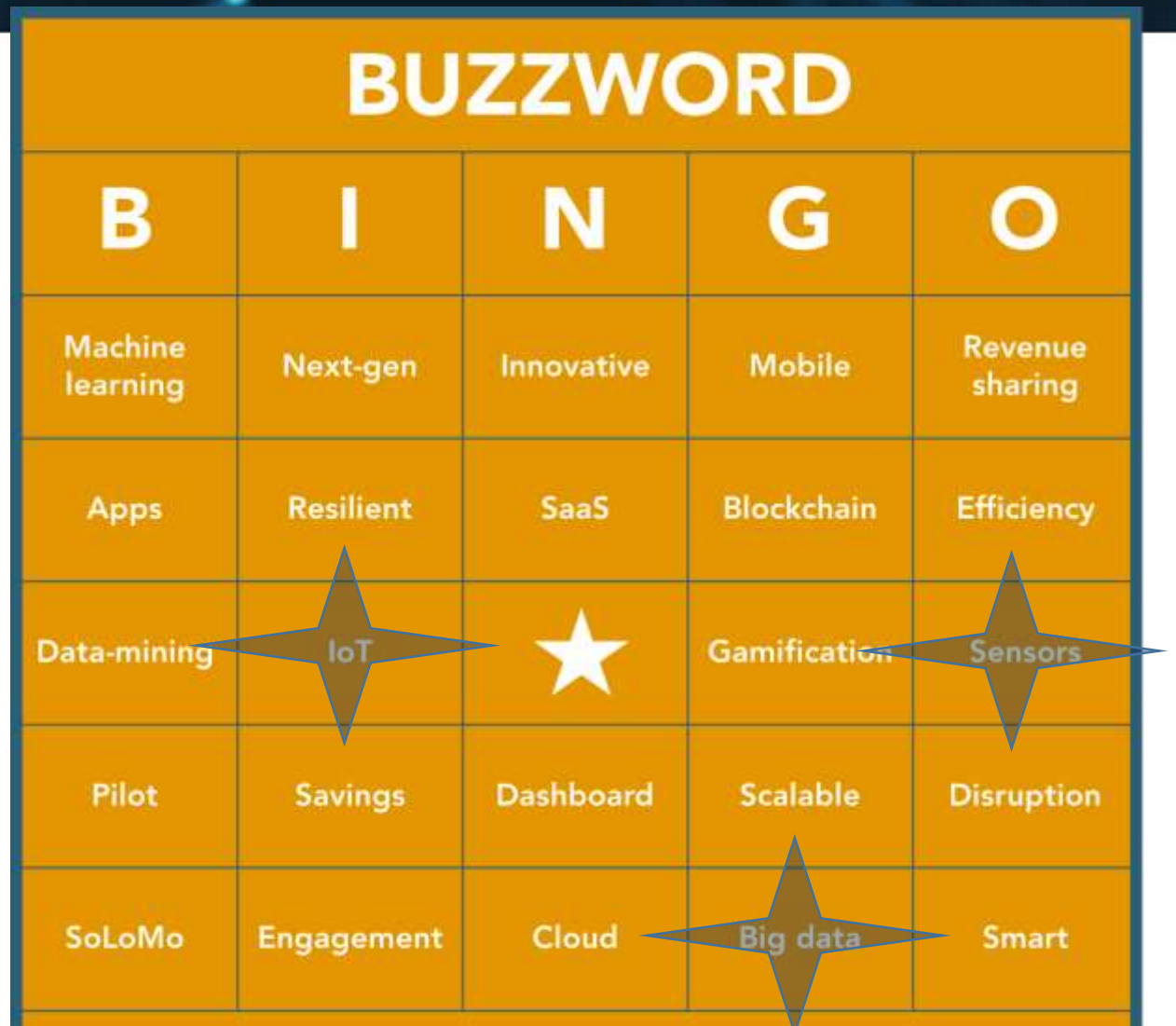
IoT Standardisation and Interoperability
The H2020 and AIOTI approach
from sensors to AI through data lakes

EBDVF 2019 - Helsinki

Franck Boissière

European Commission - DG CONNECT

Thank You Rigo!!!



INTERNET OF THINGS

Research and Innovation

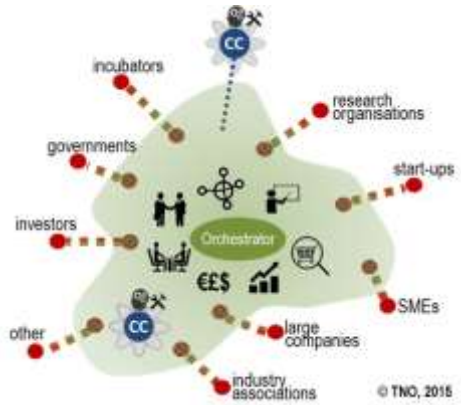
- Around €350 million investments
  → 12 large scale pilots (€ 210 million)
  → coordinated **across different EC policy streams** with DG AGRI, ENER, GROW
- nurturing an ecosystems of SMEs, start-ups
- Leading Global IoT Standards setting

Policy and Stakeholder Engagement

- Key element of **Digitizing European Industry strategy**, e.g. through AIOTI
- Regulatory framework for IoT
- Addressing security and privacy, e.g. GDPR compliance, IoT cybersecurity Certification
- New liability regimes for innovative products based on IoT (with DG GROW, JUST)

Alliance for Internet of Things Innovation

Digital transformation of industry



SPARC
The Partnership for Robotics in Europe

Photonics
A Key Enabling Technology for Europe

BDV BIG DATA VALUE ASSOCIATION

ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

AIOTI

FoF
Factories of the Future
Public Private Partnership

European Commission | Communications Networks, Content & Technology

Policy Dimensions & Interaction

Strategy

- Strategic planning & Recommendations
- International Cooperation
- SME integration
- Requirements Analysis

Standardisation

- Synchronisation of national and international standardisation activities
- Initiation of cross sectoral Standards

Research, Piloting, Testing

- Identifying new research topics
- Practical testing and validation of concepts
- Validated return of results into standardization
- Reliability Testing

Source: DEI-MSP Final Report Task 3

2016-2020 Large Scale Pilots
IoT Focus Area

CREATE-IoT

Cross Fertilisation through Alignment, Synchronisation and Exchanges for IoT: Cross fertilisation of the various IoT Large Scale Pilots (LSPs) alignment with AIOTI . Mapping architecture approaches, interoperability and standards at technical and semantic levels .

ACTIVAGE PROJECT

ACTIVAGE - ACTivating InnoVative IoT smart living environments for AGEing well: Active and healthy ageing. Europe (EU contr: 20M€, 48 partners in 9 countries)

european-iot-pilots.eu

European Large-Scale Pilots Programme

AUTOPILOT

AUTOPILOT - AUTOmated driving Progressed by Internet Of Things: Automated driving and infrastructure. Europe (EU contr: 20M€, 43 partners in 14 countries)

MONICA

MONICA - Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural Societal: Wearable devices containing sensors and actuators for massive scale applications. Europe (EU contr: 15M€, 28 partners in 9 countries)

IoF

IoF2020 - Internet of Food and Farm 2020: Strengthen competiveness of farming and food chains in Europe. Europe (EU contr: 30M€, 70 partners in 16 countries)

SYNCHRONICITY

SYNCHRONICITY - Delivering an IoT enabled Digital Single Market for Europe and Beyond: Single digital city market for Europe (EU contr: 15M€, 33 partners in 9 countries)

European Commission | Communications Networks, Content & Technology

2019-2023 Large Scale Pilots
DEI Focus Area

OPENDEI

Aligning Reference Architectures, Open Platforms and Large-Scale Pilots in Digitising European Industry: Creation of common data platforms based on a unified architecture and an established standard. As part of the Horizon 2020 programme, the OPEN DEI project focuses on "Platforms and Pilots" to support the implementation of next generation digital platforms in four basic industrial domains:

Platform building

Comparing reference architectures and open source reference implementations, enabling a unified industrial data platform.

Data ecosystem building

Enabling an innovation and collaboration platform, forging a European network of DIHs, contributing to industrial skills catalogue and observatory

Large scale piloting

Contributing to a digital maturity model, creating a set of assessment methods and a migration journey benchmarking tool

Standardisation

Conducting cross-domain surveys, performing promotion and implementation

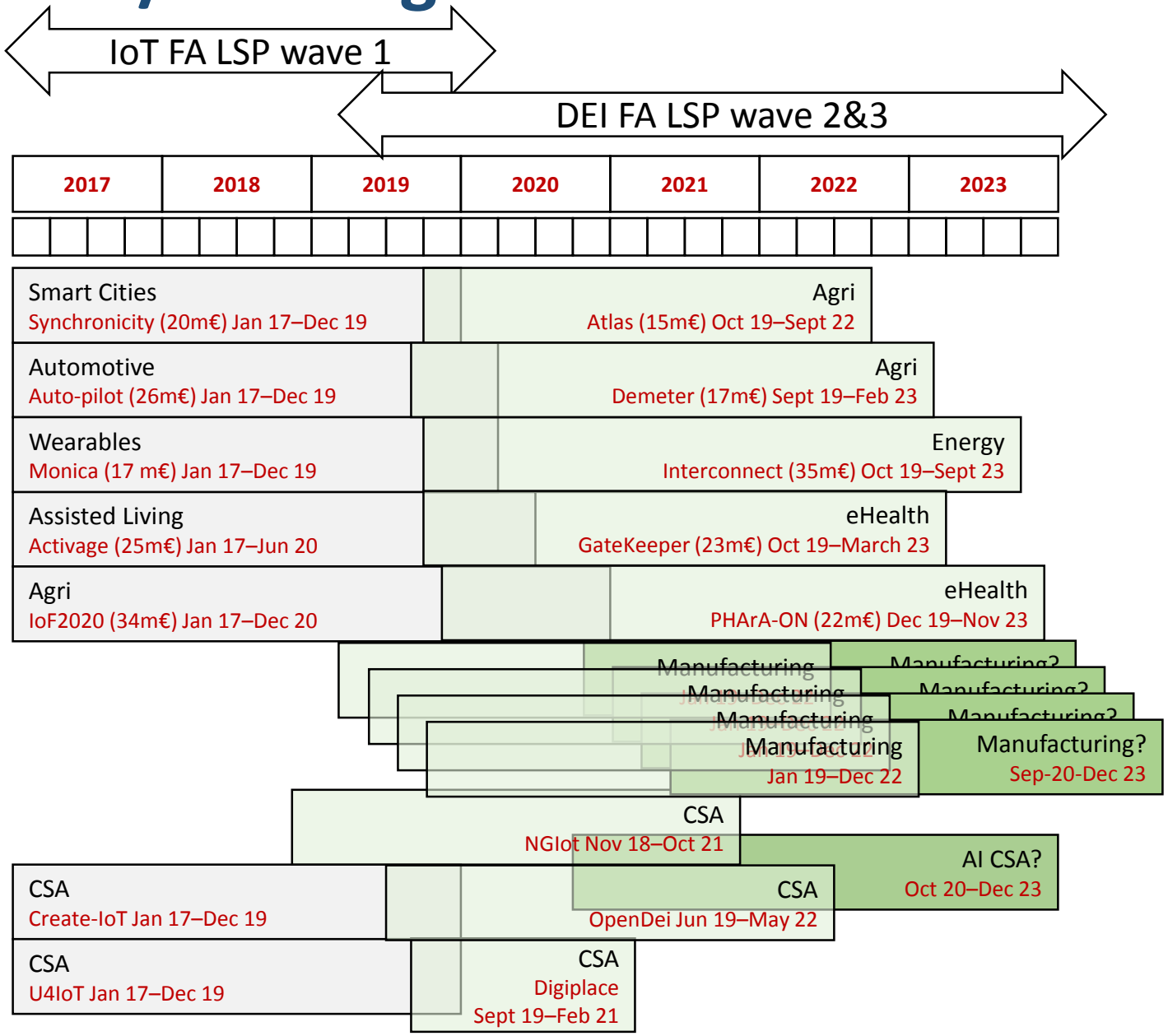
Manufacturing

Agriculture

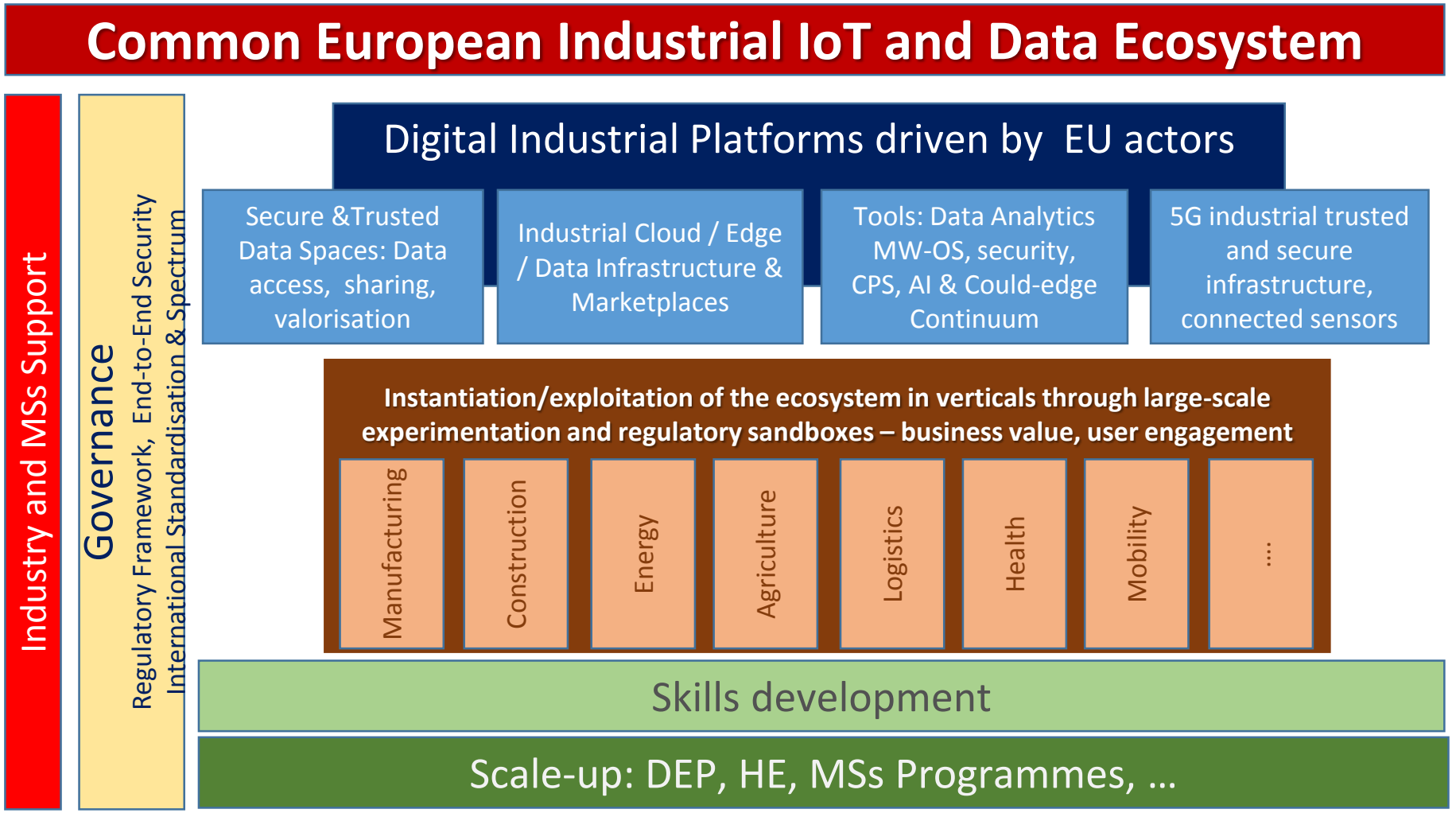
Energy

Healthcare

IoT/DEI Large Scale Pilots

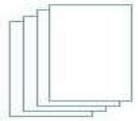


Industrial IoT: Shaping Europe's Position in Global Value Chains



European Commission | Communications Networks, Content & Technology

AIOTI Standardisation WG engagement model



Analyze landscape

Identify gaps, divergences, common concerns

Task sub-teams to address themes

Publish guidance and recommendations

Engage, disseminate and influence

AIOTI WG03

- *High Level Architecture- HLA*
- *Semantic Interoperability*
- *Identifiers, 5G &IoT*
- *Security and Data Protection*

WGs support to AIOTI in:

- **Digital Single Market**
- **Digitising European Industry**
- **EC's H2020 Large Scale Pilots**

WG 01
IoT Research

WG 02
Innovation Ecosystems

WG 03
IoT Standardisation

WG 04
IoT Policy

WG 05 Smart Living Environment for Ageing Well

WG 06 Smart Farming and Food Security

WG 08 Smart Cities

WG 09 Smart Mobility

WG10 Smart Water Management

WG11 Smart Manufacturing

WG12 Smart Energy

WG13 Smart Building and Architecture

Distributed Ledger Technologies

AIOTI

WG03 Highlights (ref. https://aioti.eu/aioti-wg03-reports-on-iot-standards/)

- **IoT Landscape** georgios.karagiannis@huawei.com
  - IoT Landscape maintenance is key to keep the liaisons alive and maintain dialogue on how to foster collaboration to improve interoperability & security, v09 to be published in Q3 2019
  - Gap Analysis and recommendations michelle.wetterwald@netellany.fr ; emmanuel.darmois@commledge.com, 1st release published May 2018, 2nd ongoing (2019)
  - Cooperation with SDOs/Alliances to foster co-creation and interworking georgios.karagiannis@huawei.com, Patrick.Guillemin@etsi.org (e.g., Liaisons: 3GPP, ITU-T, ISO, OSGi Alliance, BBF, 3GPP; MoUs – signed: AII, OSGi Alliance, BDVA, under discussion OPC Foundation, SCI4.0, ISO/IEC JTC1 SC41)
  - IoT relation and impact on 5G thomas.klein@de.ibm.com ; georgios.karagiannis@huawei.com 1st release published in June 2018, 2nd in March 2019

R4, published in June 2018, R5 ongoing (2019)

  - IoT Reference Architecture and its mapping with existing IoT Reference Architectures
  - IoT identifiers juergen.heiles@siemens.com ; henri.barthel@gs1.org 1st release published February 2018
- **SemIoP IoT Semantic Interoperability** Martin.Bauer@neclab.eu; Laura.Daniele@tno.nl new JWP under construction
- **IoT Privacy (with WG04)** vanderwees@arthurslegal.com Nuance of Trust event, Series of GDPR-Centric AIOTI webinars
  - IoT Platform, experimentation, LSPs need concrete standard framework & references to enable "IoT Trust" and IoT "Privacy by design" + STF 547
- **IoT Security (with WG04)** vanderwees@arthurslegal.com; jacques.kruse-brandao@sgs.com; harm.arendshorst@ilabs.ai
  - IoT Security Architecture for Trusted IoT Devices; Baseline Requirements for Security & Privacy up to segment requirements; experimentation, LSPs need concrete standard framework & references to enable "IoT Trust" based on IoT "Security by design" + STF 547
  - Series of new IoT Webinars on Application-Centric (IoT Verticals meet IoT Horizontals). The central themes of the webinars are: Personal Wearables (H2x): Health, Living, Consumer, Public Space, and other verticals, Moving Sensors (M2x): Farm2Fork, Mobility, Consumer, Cities, and other verticals + Long Term Fixed IoT Applications (F2x): Industry 4.0, Cities, Consumer, Water Management, Energy, Construction, Living, and other verticals.
- **Joint MSP/DEI WG on Standardisation** participation / November 2018 report + new plans in 2019

AIOTI

What is Semantic Interoperability?

- *Semantics* is the study of meaning – in our context the meaning of the data being exchanged
- Traditionally, the semantics of data being exchanged is encoded in the producers and consumers of the data, i.e. it is **implicit**ly given as part of the implementation of producers and consumers
- Situation in IoT
  - IoT systems can be huge and dynamic, i.e. there is a large number of changing producers and consumers
  - Producers and consumers do not a-priori know each other
  - Increased value in IoT in case information can be (re-)used for completely new purposes

  → Implicit encoding of semantics not flexible enough + discovery has to be enabled

→ Make semantics **explicit**, i.e. attach the meaning to the data

- It is about the agreement on uniquely identified concepts
- The communicated data are instantiations of the concepts
- Concepts, properties and relationships can be formalized as ontologies
- Semantic Interoperability is about exchanging information on the basis of agreed, formalized and explicit semantics

What is Semantic Interoperability?

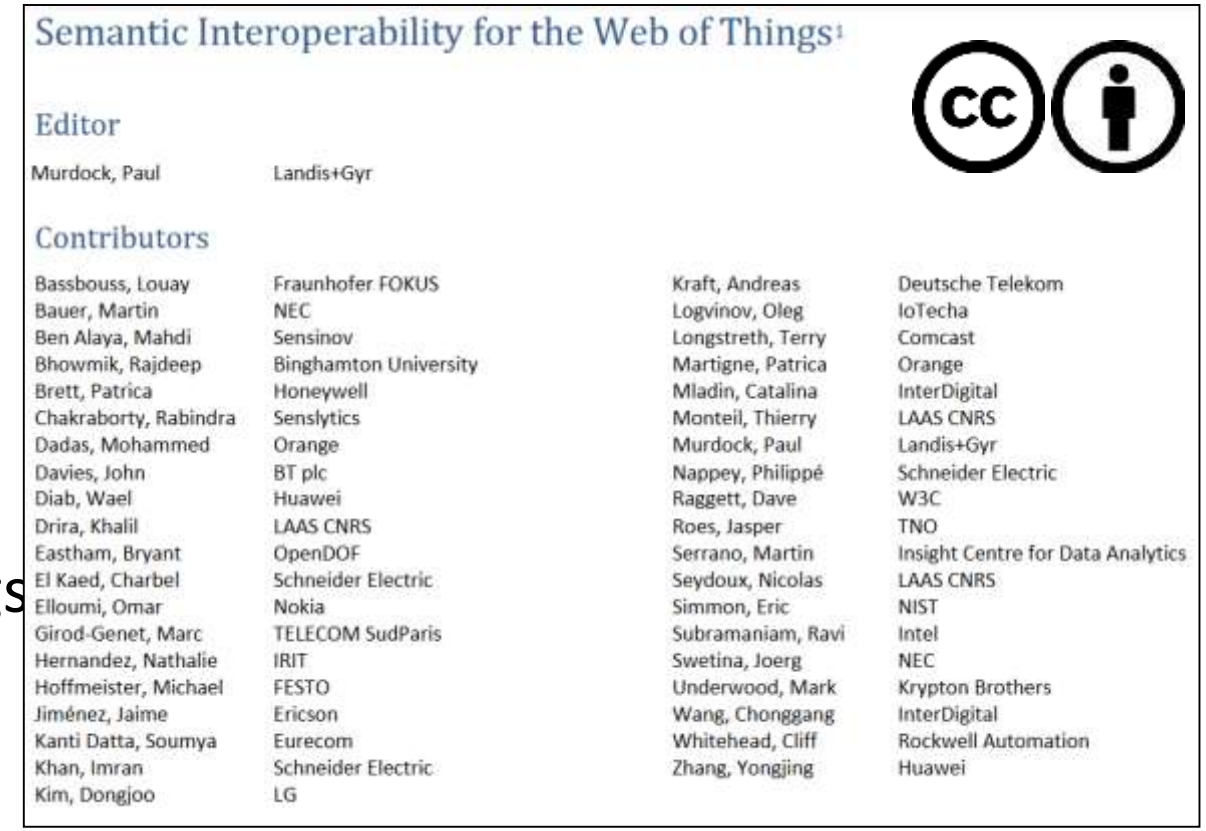
- ***Semantics*** is the study of meaning – in our context the meaning of the data being exchanged
- Traditionally, the **semantics of data being exchanged** is encoded in the producers and consumers of the data, i.e. it is **implicit**ly given as part of the implementation of producers and consumers
- **Situation in IoT**
  - **IoT systems can be huge and dynamic, i.e. there is a large number of changing producers and consumers**
  - **Producers and consumers do not a-priori know each other**
  - **Increased value in IoT in case information can be (re-)used for completely new purposes**
  - **→ Implicit encoding of semantics not flexible enough + discovery has to be enabled**
- **→ Make semantics explicit, i.e. attach the meaning to the data**
- It is about the **agreement on uniquely identified concepts**
- The communicated data are **instantiations** of the concepts
- Concepts, properties and relationships can be **formalized as ontologies**
- **Semantic Interoperability is about exchanging information on the basis of agreed, formalized and explicit semantics**

Initial Joint Whitepaper 2016:
Semantic Interoperability for the Web of Things

- **Idea in AIOTI**
  - Get together experts
  - Improve convergence
  - High visibility
  - Work under Creative Commons License

- **SDOs:** oneM2M, W3C Web of Things, IEEE P2413

- DOI: 10.13140/RG.2.2.25758.13122



Semantic Interoperability for the Web of Things[1]

Editor

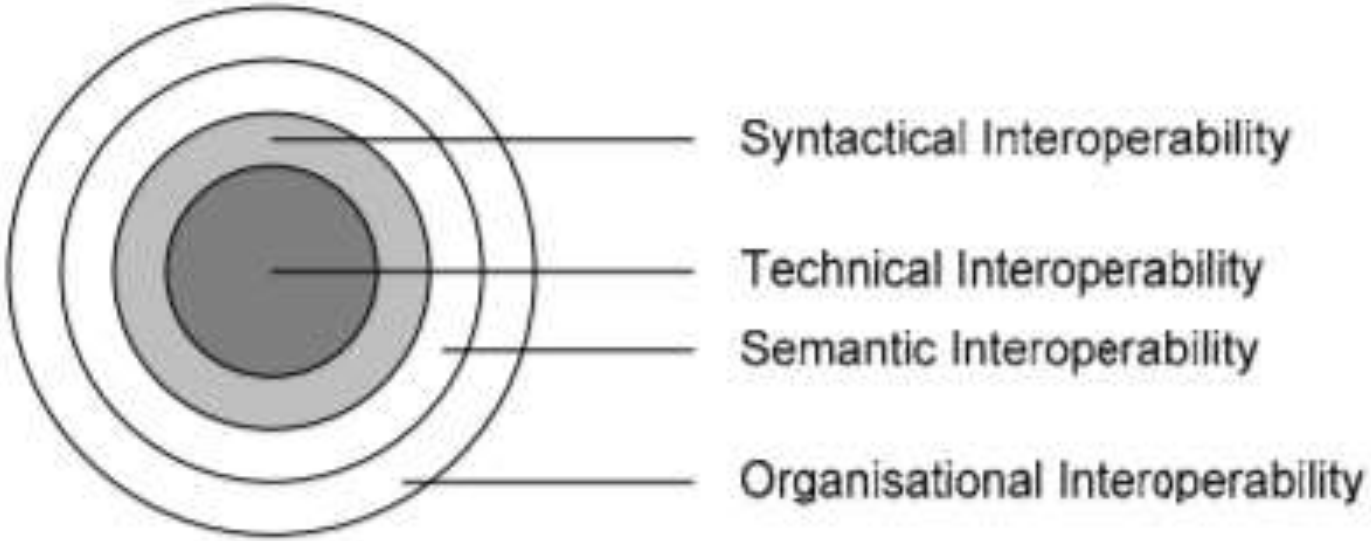
Murdock, Paul	Landis+Gyr

Contributors

Bassbouss, Louay	Fraunhofer FOKUS	Kraft, Andreas	Deutsche Telekom
Bauer, Martin	NEC	Logvinov, Oleg	IoTecha
Ben Alaya, Mahdi	Sensinov	Longstreth, Terry	Comcast
Bhowmik, Rajdeep	Binghamton University	Martigne, Patrica	Orange
Brett, Patrica	Honeywell	Mladin, Catalina	InterDigital
Chakraborty, Rabindra	Senslytics	Monteil, Thierry	LAAS CNRS
Dadas, Mohammed	Orange	Murdock, Paul	Landis+Gyr
Davies, John	BT plc	Nappey, Philippé	Schneider Electric
Diab, Wael	Huawei	Raggett, Dave	W3C
Drira, Khalil	LAAS CNRS	Roes, Jasper	TNO
Eastham, Bryant	OpenDOF	Serrano, Martin	Insight Centre for Data Analytics
El Kaed, Charbel	Schneider Electric	Seydoux, Nicolas	LAAS CNRS
Elloumi, Omar	Nokia	Simmon, Eric	NIST
Girod-Genet, Marc	TELECOM SudParis	Subramaniam, Ravi	Intel
Hernandez, Nathalie	IRIT	Swetina, Joerg	NEC
Hoffmeister, Michael	FESTO	Underwood, Mark	Krypton Brothers
Jiménez, Jaime	Ericson	Wang, Chonggang	InterDigital
Kanti Datta, Soumya	Eurecom	Whitehead, Cliff	Rockwell Automation
Khan, Imran	Schneider Electric	Zhang, Yongjing	Huawei
Kim, Dongjoo	LG		

Semantic Interoperability

- Semantic Interoperability is associated with the **meaning of the content** that is exchanged. This requires **agreement on common concepts and their relationships**.



European Commission | Communications Networks, Content & Technology

Martin Bauer (NEC) Laura Daniel (TNO).

AIOTI WG03 SemIoP Leadership Team

New Joint Whitepapers

@ ETSI IoT Week 2019

Towards Semantic Interoperability Standards based on Ontologies

Target Group: Semantic Experts, Standardization Engineers & SDOs

"How to create standards for semantic interoperability"

Semantic IoT Solutions: A Developer Perspective

Target Group: Developers and Software Architects

"How to develop semantic systems and achieve semantic interoperability"

More AIOTI cooperation

- CEN/CENELEC/ETSI Smart Meter CG, Smart Energy Grid CG, Smart Cities CG (SF-SSCC), CG-Smart Manufacturing, …
- ISO, IEC (TC57, TC65), JTC1 SC41 SC42 SC 27 AG8, OMA, GSMA, BBF, TM Forum, OGC, NIST, NGMN, OASIS, OCF, AIM, ZigBee, Bluetooth, ULE Alliance, IPSO Alliance, IPv6 Forum, LoRa Alliance..
  - Based on exisiting AIOTI participation and contribution levels
    1. Light = IoT Landscape input & update, email exchanged
    2. Participation = conf calls, meetings, surveys, reporting, inputs
    3. Cooperation = liaison, work program sharing, join paper/release
    4. Commitment = task/group/deliverbale leader or co-author
  - Reaching consensus on recommendations, facilitating exchanges
- FoF/EFFRA, 5GIA, BDVA, ECSO, EIP-SCC (Urban Patforms), Eurocities, IoT Forum, BSI, Hyper/CAT…

The SAREF Ontologies Family

SAREF version 2 Technical Specification: TS 103 264 V2.1.1
SAREF extension investigation Technical Report: TR 103 411
SAREF for Energy (SAREF4ENER) Technical Specification: TS 103 410-1
SAREF for Environment (SAREF4ENVI)
Technical Specification: TS 103 410-2
SAREF for Buildings (SAREF4BLDG)
Technical Specification: TS 103 410-3
SAREF for Smart Cities (SAREF4CITY),
Technical Report: ETSI TR 103 506
SAREF for industry and manufacturing (SAREF4INMA),
Technical Report: ETSI TR 103 507
SAREF AgriFood (SAREF4AGRI), Technical Report: ETSI TR 103 511

Semantic interoperability

- SAREF Core
- Energy
- Buinding
- Environment
- Smart Cities
- Industry & manfacturing
- Smart Agriculture
- Automotive
- E-Health/ Well Aging
- Wearables
- Smart Watering

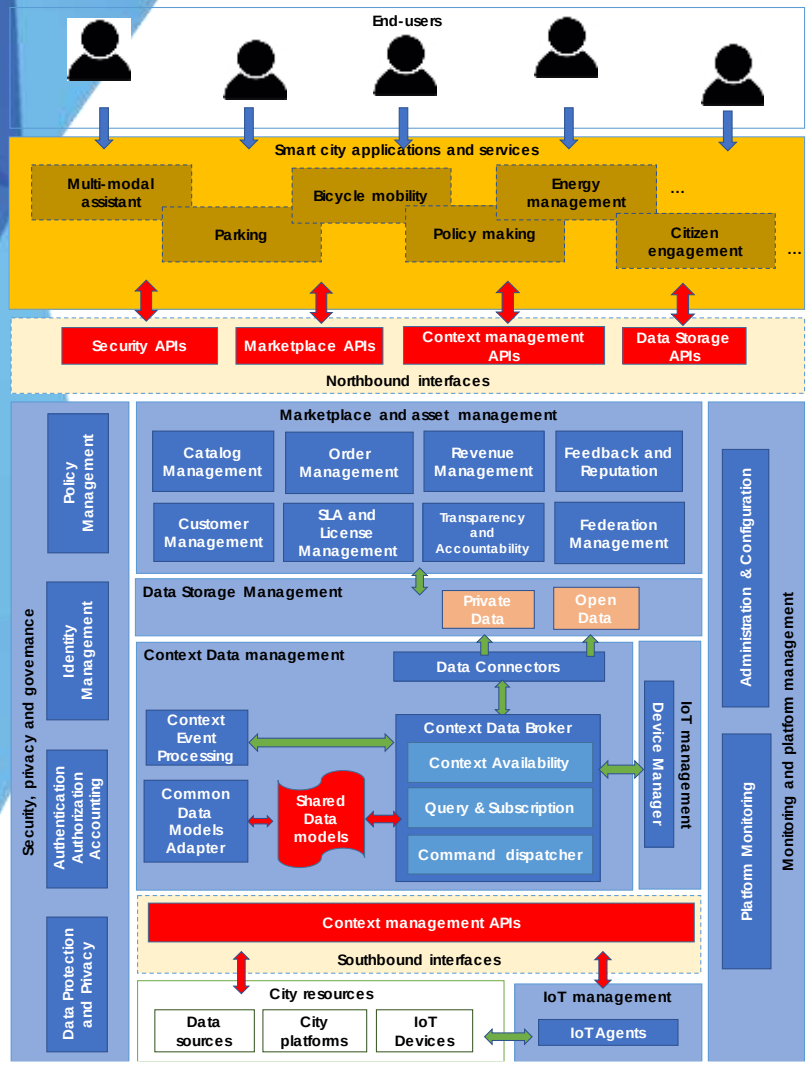
Background & Useful links:

- **Digitising European Industry Strategy (DEI):**
  https://ec.europa.eu/digital-single-market/en/digitising-european-industry → FUTURIUM
- **Supporting and Building Platforms under DEI**
  - https://ec.europa.eu/digital-single-market/en/industrial-platforms-and-large-scale-pilots
- **European Commission's Strategy on Key Strategic Value Chains, Apr. 2019**
- **Conclusions on a EU Industrial Policy Strategy, A vision for 2030**
- **Stakeholder Forum 2019 on 13-15th Nov. 2019 in Madrid**
  - **"Artificial Intelligence and Digital Innovation Hubs for the European industry"**

So Where's the ~~Meat~~ Bread&Butter?

As Always: It's in the Backup Slides ;-)

SynchroniCity Architecture Model



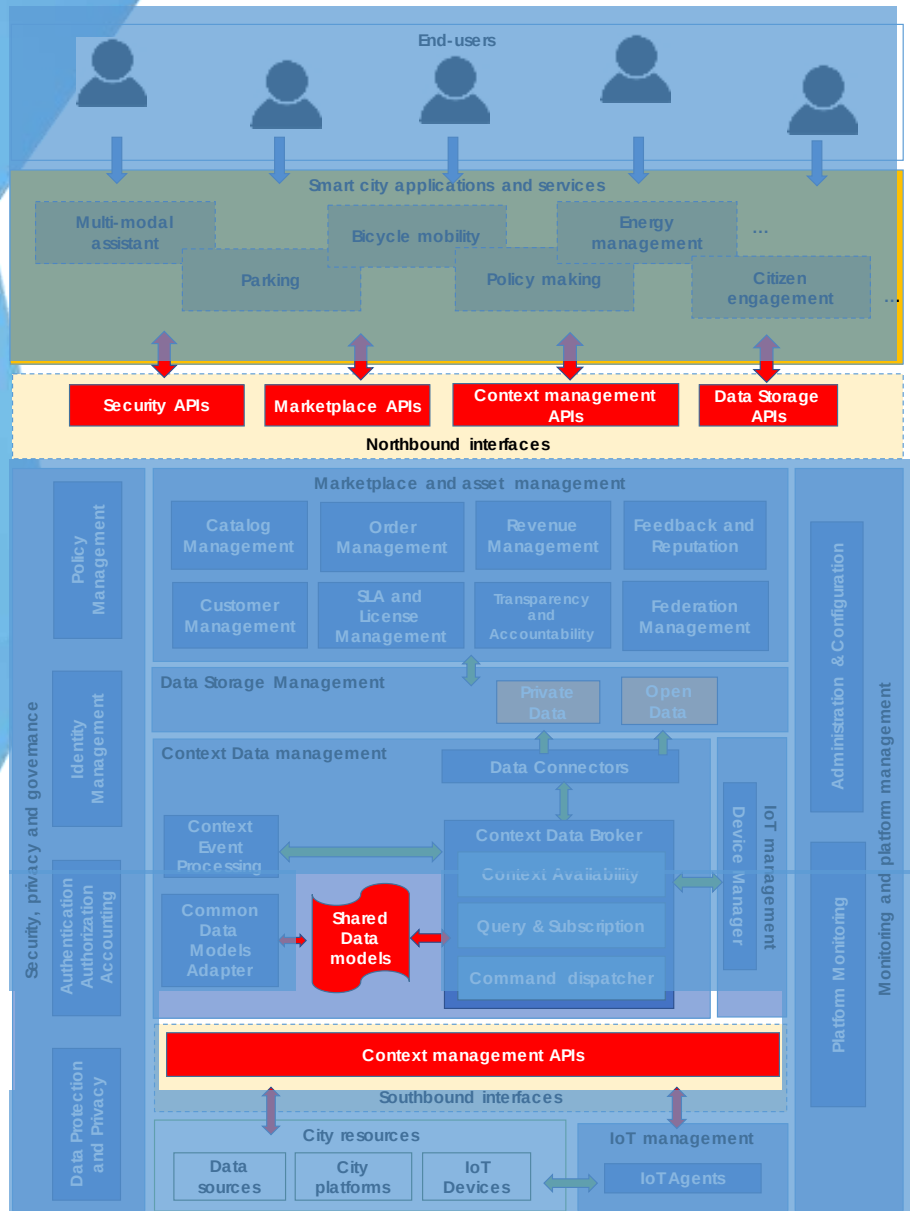
- **IoT Management:** to interact with the devices that use different standards or protocols making them compatible and available to the SynchroniCity platform.
- **Context Information Management:** to manage the context information coming from IoT devices and other public and private data sources.
- **Data Storage Management:** to provide functionalities related to the data storage and data quality interacting with heterogeneous sources.
- **Marketplace:** to implement a hub to enable digital data exchange for urban data and IoT capabilities providing features in order to manage asset catalogues, orders, revenue management.
- **Security**: to provide crucial security properties such as confidentiality, authentication, authorization, integrity, non-repudiation, access control, etc.
- **Monitoring and Platform management**: to provide functionalities to manage platform configuration and to monitor activities of the platform services.

Baseline: SynchroniCity Cities/Reference Zones, OASC, FIWARE, EIP-SCC, NIST IES-CF.

Related standards: ITU-T SG20*/FG-DPM* (*drafts), ISO TC268.

Spec. doc.: Reference Architecture for IoT Enabled Smart Cities (D2.10)
http://synchronicity-iot/docs

Interoperability Points



- **Interoperability Points** represent the main interfaces that allow a city (or any Reference Zone, RZ) and applications to interact with SynchroniCity platform
- Interoperability points are independent from the specific software components that realize them and can be implemented by cities in different steps to reach different levels of compliance
- The architecture has been designed following the OASC principles and the definitions of **Minimal Interoperability Mechanisms** (MIMs). MIMs, are the actual specifications of the interfaces at the Interoperability Points: they are standard API and guidelines that have to be implemented by a city in order to be compliant with the SynchroniCity framework

Role of global partnerships: the OASC example

European Commission

OPEN & AGILE SMART CITIES

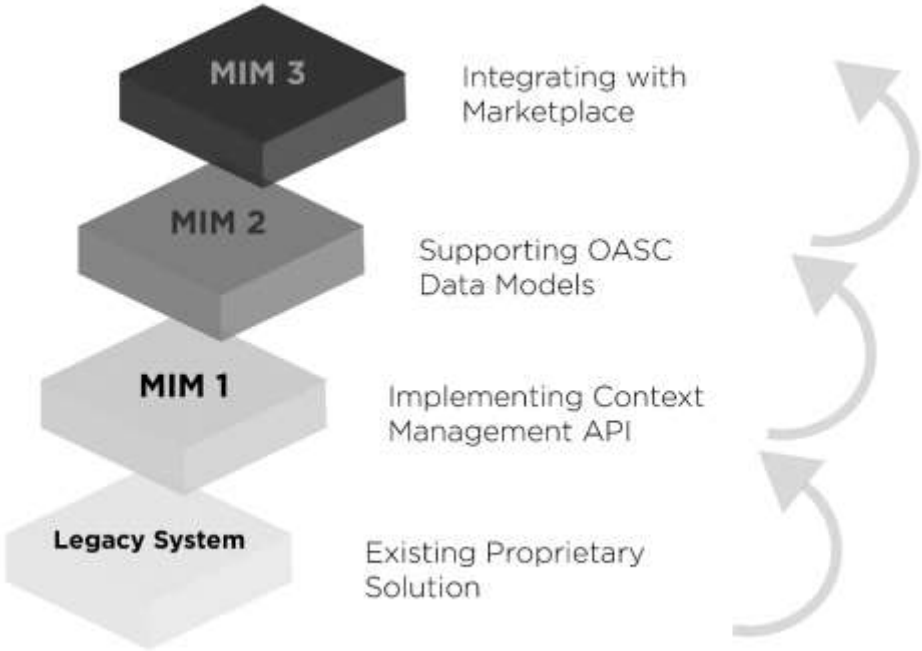
140 cities in 29 countries

Global network of local networks of cities and communities

Standards-based innovation and procurement across sectors.

Minimal Interoperability Mechanisms (MIMs)

A roadmap based on existing standards and mechanisms, governed by cities, supported by suppliers and infrastructure providers.



SYNCHRONICITY

IoT Large-Scale Pilot on Smart Cities & Communities (15/20m€)

Set up to validate and mature the OASC MIMs at scale.

20 cities, 50 services – running on the same common technical ground.

Catalogue of validated services based on standards.

...mmunications Networks, ...ontent & Technology

MIM Value proposition

Supply-side:

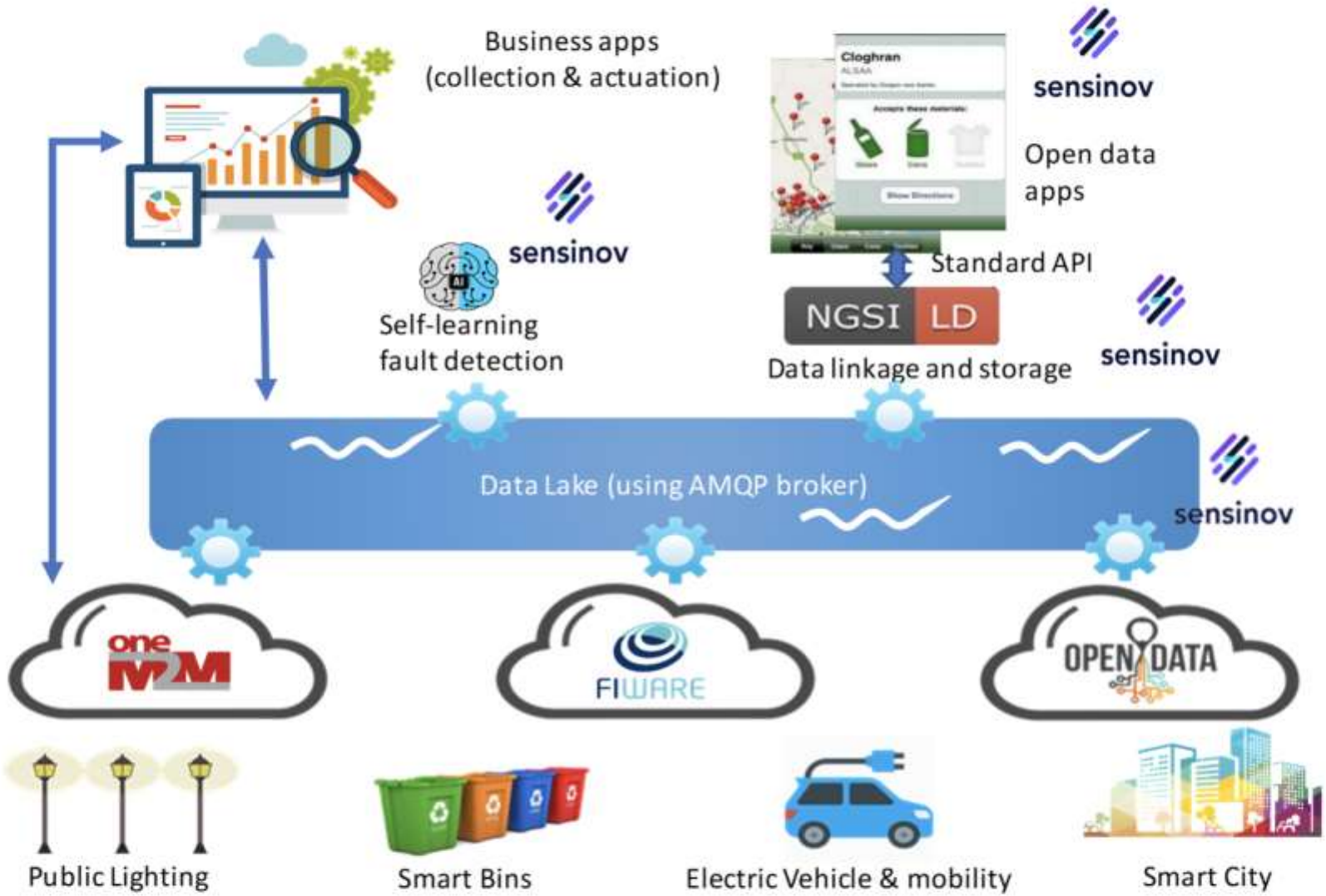
- Scale, agile development/deployment

Demand-side:

- Choice, flexibility, efficiency, value-for-money, independence, economic development

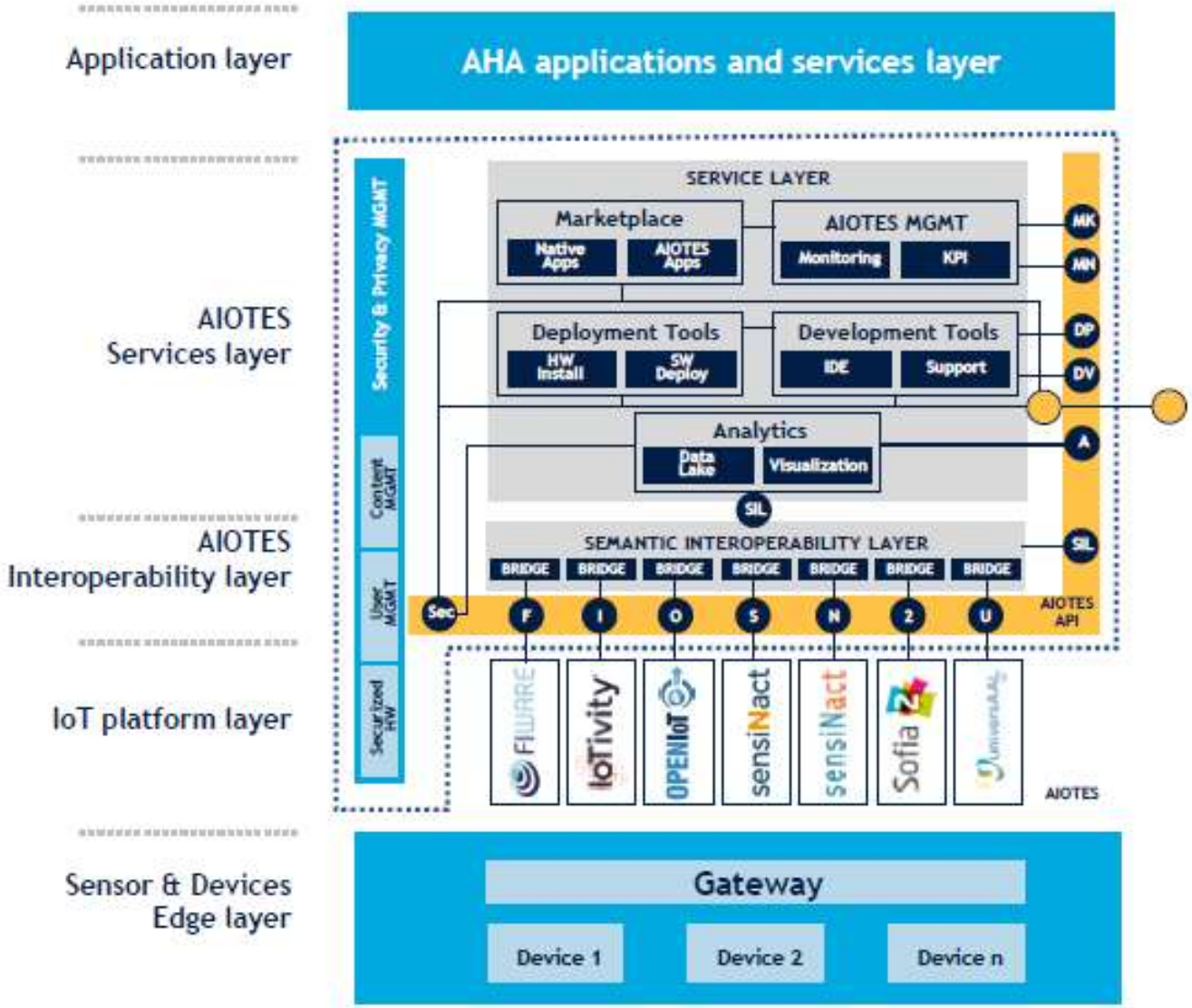
All:

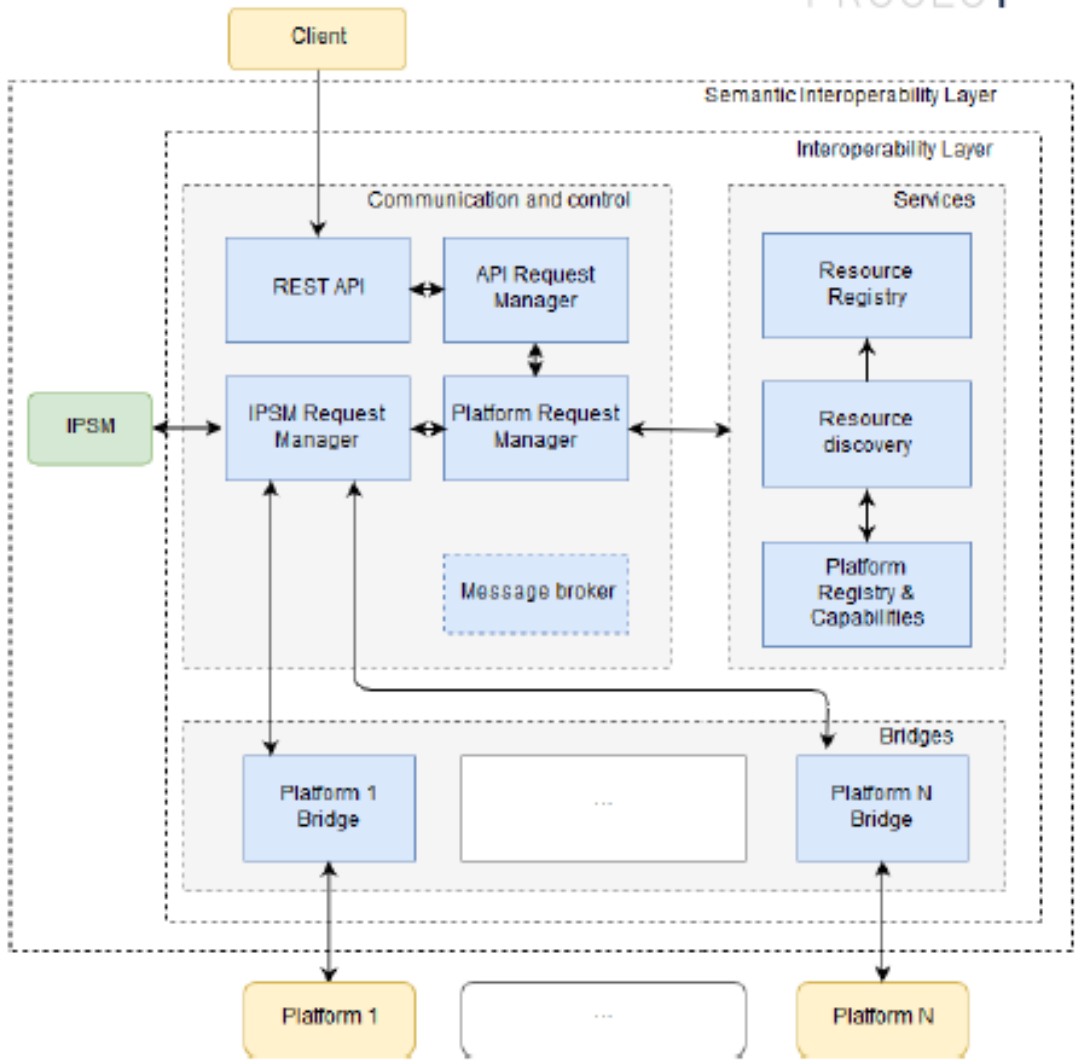
- Reduced risk, increased investments, innovation



ASAP-VALUE : A STANDARDS-BASED APPROACH TO ENHANCING VALUE FROM CITY DATA LAKE

AIoTES ARCHITECTURE



SIL IMPLEMENTATION
ARCHITECTURE

- Provides interoperability among IoT Middleware platforms.
- Scalable architecture.
- Interoperability Layer
  - Communication and control
  - Platform bridges
  - Services
- Semantic Interoperability Layer
  - Interoperability Layer
  - IPSM