ITU Arab Forum on Emerging Technologies
Algiers – Algeria, 14-15 Feb. 2018

Internet of Things and Smart Cities: advances, perspectives, challenges in some technical areas including standardization

Presented by:
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Outline

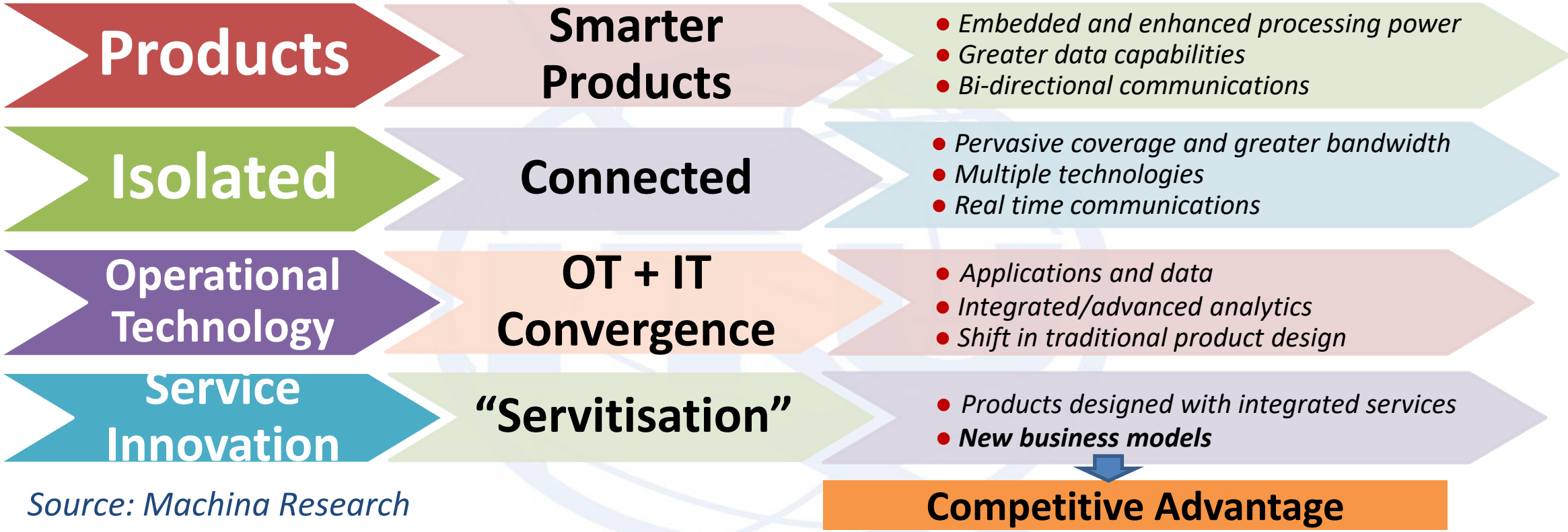
- Internet of Things
- Advances, perspectives, challenges in standardization of IoT and Smart Cities
  - ITU-T and some other relevant international organizations, example of initiatives promoting standardization
  - Advances, perspectives, challenges
- Advances, perspectives, challenges in some technical areas of IoT and Smart Cities
  - Architectures
  - Platforms
  - Smart Cities and (examples of) other IoT application domains
  - Data of the IoT and intelligence from data

NOTE 1 - Along the presentation some references are provided on achievements and/or ongoing work items of ITU-T IoT standardization initiative (led by SG20)

NOTE 2 - Backup slides provide detailed information on standardization activities of ITU-T SG20 (and other mentioned initiatives)

Internet of Things

The IoT is fundamentally changing the business and drives convergence between ICT and industries

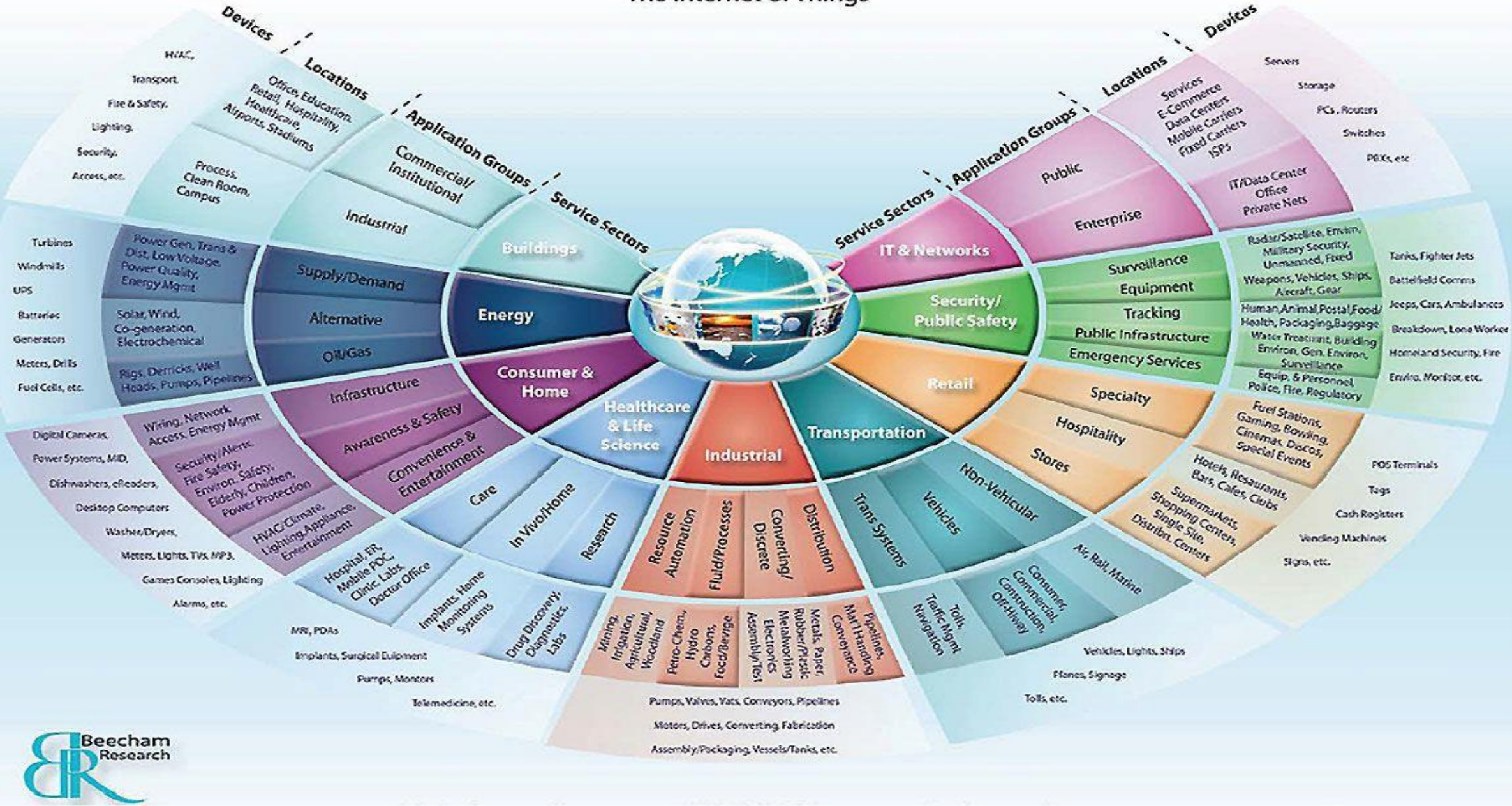


Source: Machina Research

IoT is driving a profound transformation of the industries, the digitalization impacting products, processes, business models and ecosystems, social life

"Ultimately, digitalization is connecting all industries into a giant ecosystem" [source: Harvard webinar]

The Internet of Things



Beecham Research

IoT and leading technologies

The IoT will benefit from the integration of a number of leading technologies, including those for

- Machine to Machine Communications
- Advanced sensing and actuation
- Cloud Computing (and distributed computing)
- Softwarization (incl. Software Defined Networking, Network Functions Virtualization)
- Autonomic Networking
- Big Data management
- Semantics support
- Machine Learning (AI)
- Service Delivery Platforms
- Security, Privacy and Trust

Advances, perspectives, challenges in (technical) standardization of IoT and Smart Cities

ITU activities on IoT and Smart Cities

ITU-T Study Group 20:
Development and implementation of international standards

U4SSC:
UN global platform for knowledge sharing

ITU-T FG-DPM:
Research & pre-standardization work on data processing & management

Resolution 98
Enhancing the standardization of IoT and Smart Cities and Communities for global development

IoT4SDGs: *Considers the importance of IoT to contribute to achieving the 2030 Agenda for Sustainable Development*

ITU-T Study Group 20: Internet of things (IoT) and smart cities & communities (SC&C)

Lead Study Group on

- Internet of things and its applications
- Smart Cities and Communities, incl. its e-services and smart services
- IoT identification

SG20 structure	
WP1/20	
Q1/20	End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C
Q2/20	Requirements, capabilities and use cases across verticals
Q3/20	Architectures, management, protocols and Quality of Service
Q4/20	e/Smart services, applications and supporting platforms
WP2/20	
Q5/20	Research and emerging technologies, terminology and definitions
Q6/20	Security, privacy, trust and identification
Q7/20	Evaluation and assessment of Smart Sustainable Cities and Communities

Established in June 2015 to consolidate the various ITU-T activities on IoT

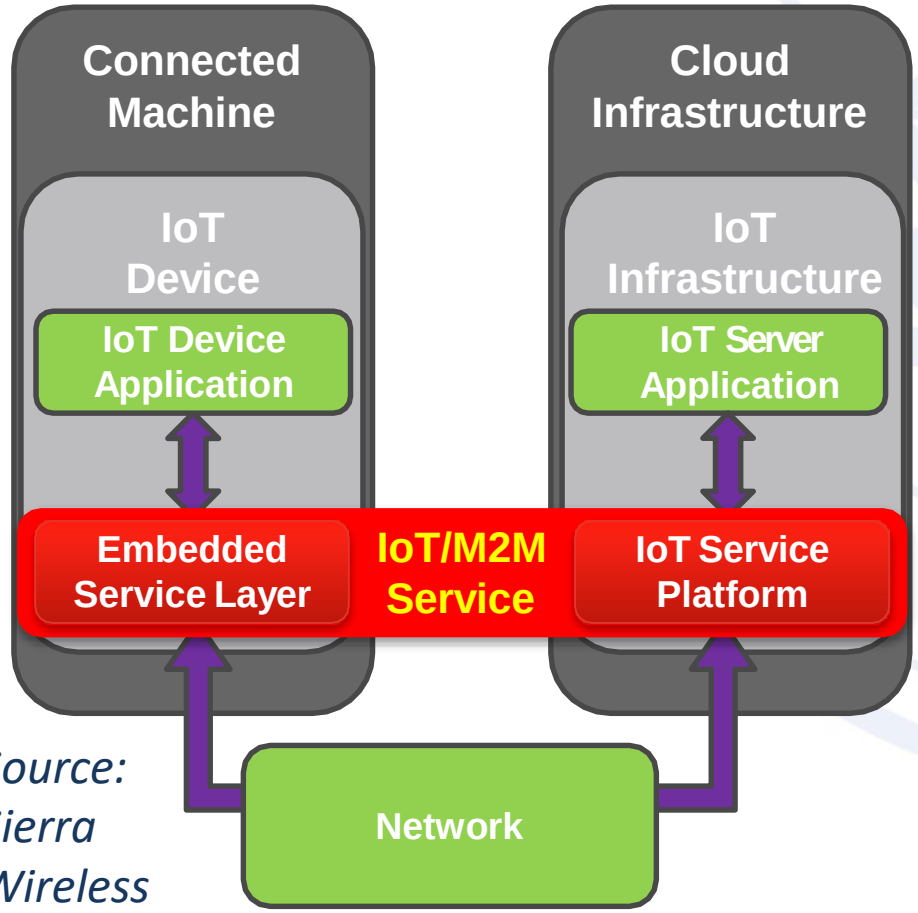
Last SG20 meeting on 4-15 Sept 2017, Geneva

Last SG20/WP1 Rapporteurs Group meeting on 15-24 Jan 2018, Geneva

Next SG20 meeting on 6-16 May 2018, Cairo

SG20 Home page: http://www.itu.int/en/ITU-T/studygroups/2017-2020/20/Pages/default.aspx

oneM2M partnership – working space



Source: Sierra Wireless

The layers of the oneM2M Architecture

Application Layer

Software "framework" that sits between IoT applications and communication networking components

Service Layer

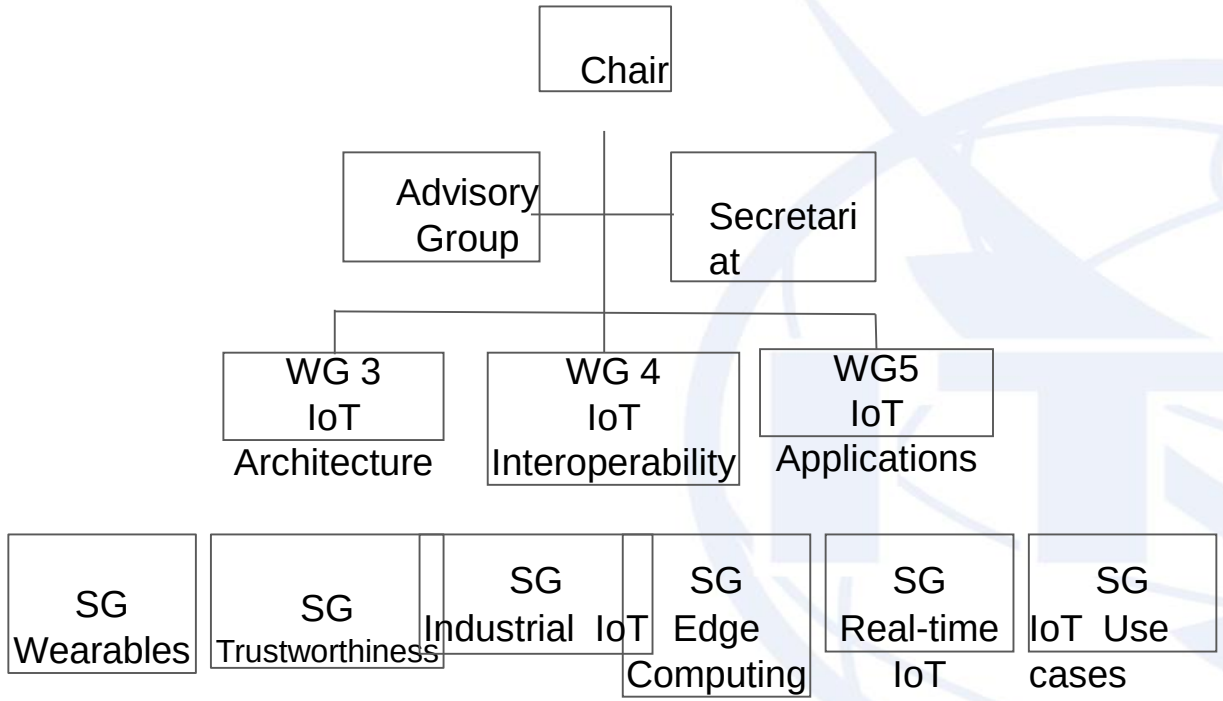
Provides horizontal services that IoT applications across different industry segments commonly need (e.g. data management, security, etc.)

Network Layer

Can be deployed on devices, gateways and servers in highly distributed deployments

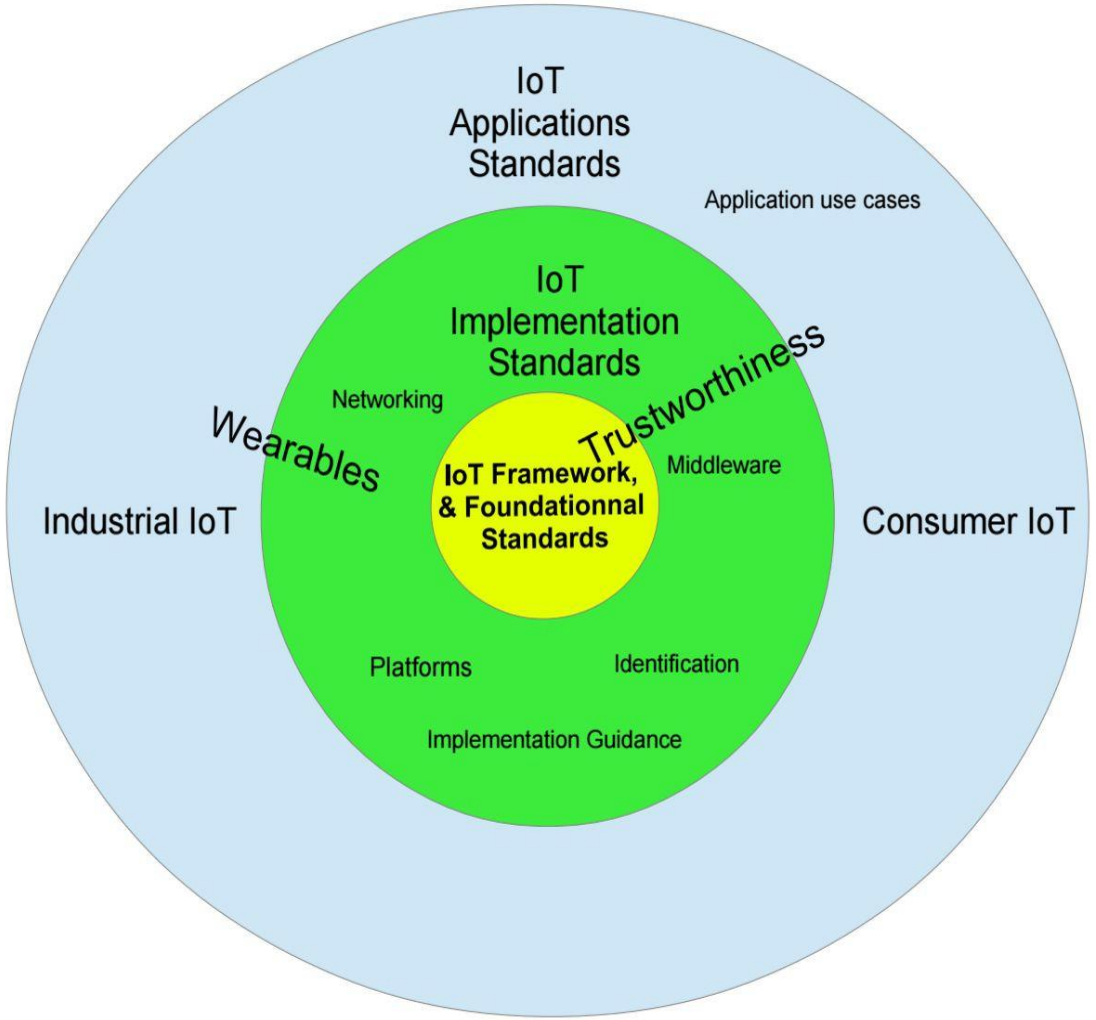
oneM2M was created in 2012 to specify and promote **a standard for an IoT/M2M Common Service Layer**

ISO/IEC JTC1 SC41 - structure and working space



SC41 has been created in 2017 mainly combining two previous ISO/IEC JTC1 efforts: WG10 (IoT) and WG7 (Sensor Networks)

Key IoT study at present: **ISO/IEC 30141 IoT Reference Architecture** (project inherited from WG10)



A preliminary view from SC41 Chair

The Alliance for IoT Innovation (AIOTI) – an example of organization promoting standards convergence/harmonization

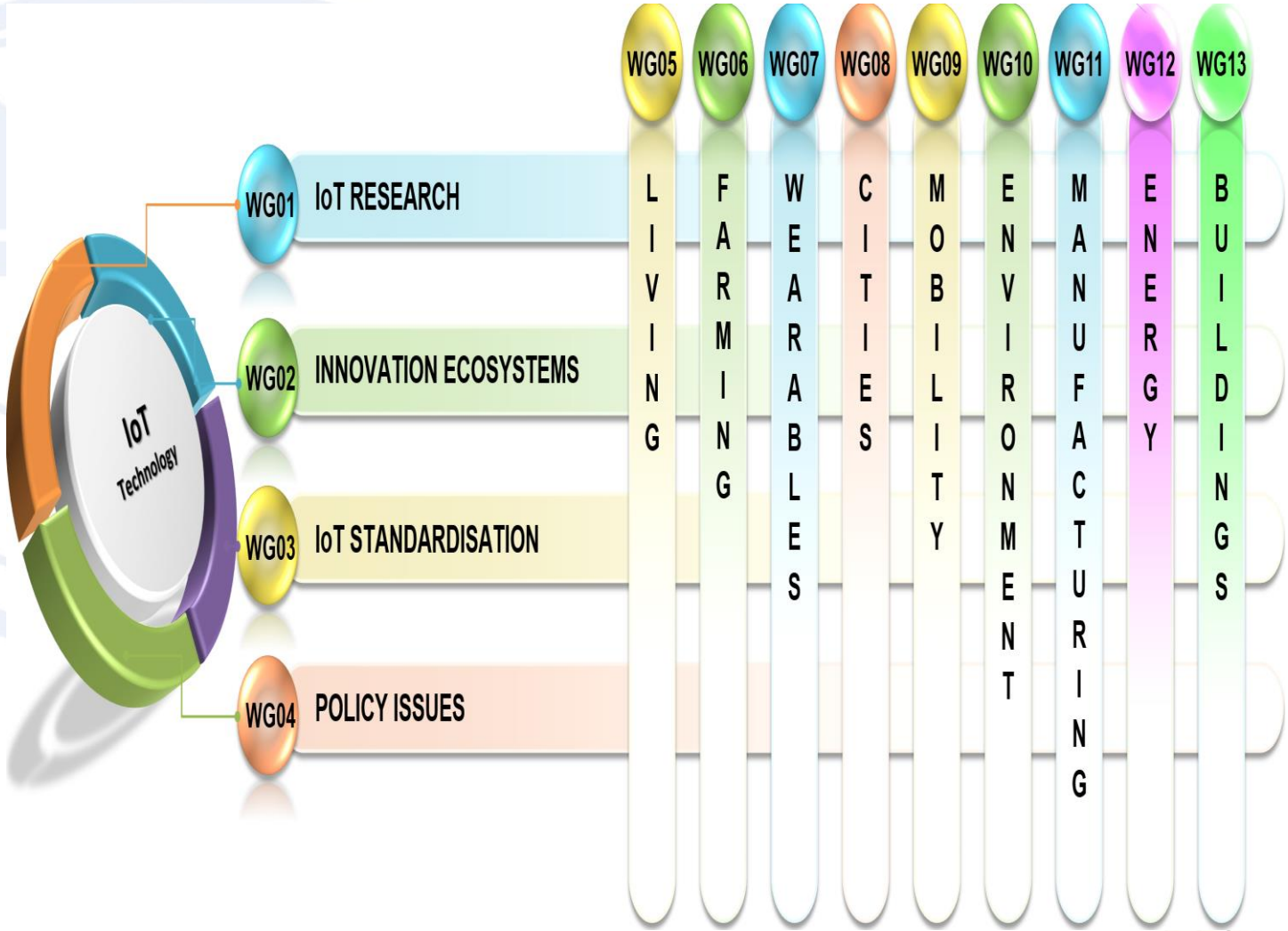
AIOTI

- Initiated by the European Commission in 2015 (now a legal entity on its own)
- Aim to strengthen the dialogue and interaction among IoT players in Europe, and to **contribute to the creation of a dynamic European IoT ecosystem** to speed up the take up of IoT.

AIOTI key strategic challenges

- Addressing rapid technological developments
- User acceptance of IoT innovation, building trust
- Drive towards deployment
- **Managing the risk of fragmentation, converge in a field of international competition**
- Education and information to stakeholders in their context

AIOTI Working Groups



IoT interoperability and the role of Standardization

Market research: “nearly 40% of economic impact of the IoT requires interoperability between IoT systems”
IoT value will come solving interoperability issues within/across IoT domains (different interoperability dimensions)

Key issue with IoT interoperability is current diversity =>> the key role of international SDOs in standards convergence/harmonization (ITU-T as key actor)

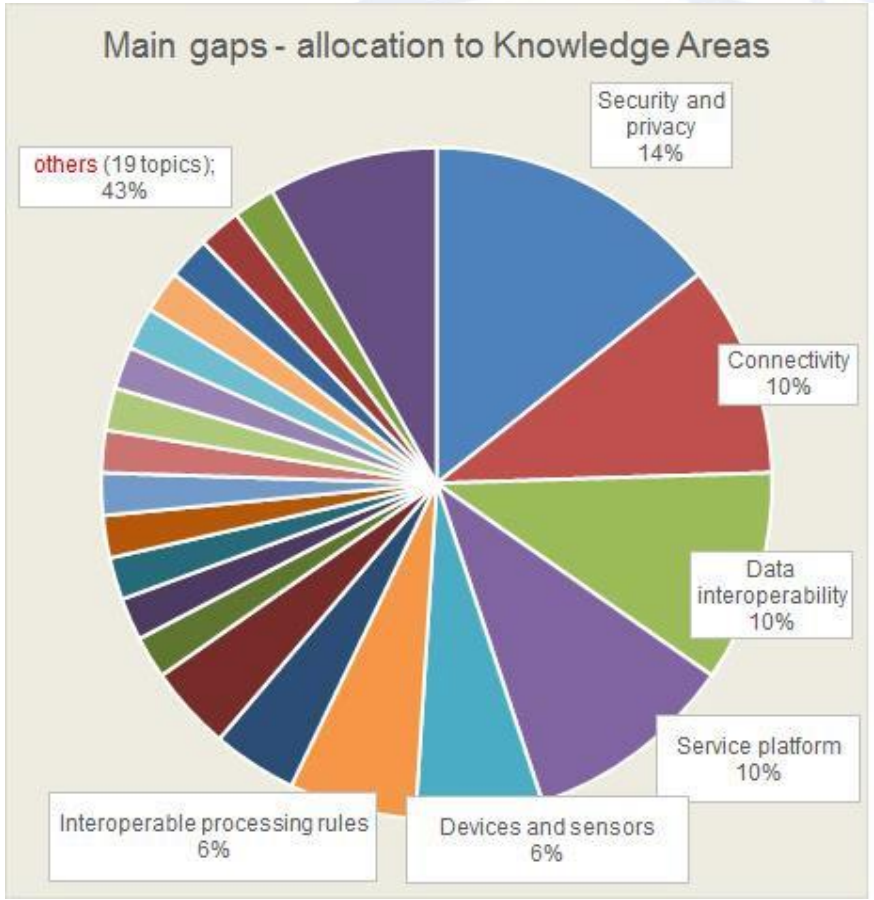
Open innovation systems move fast =>> Standardization needs to cope - process, collaboration

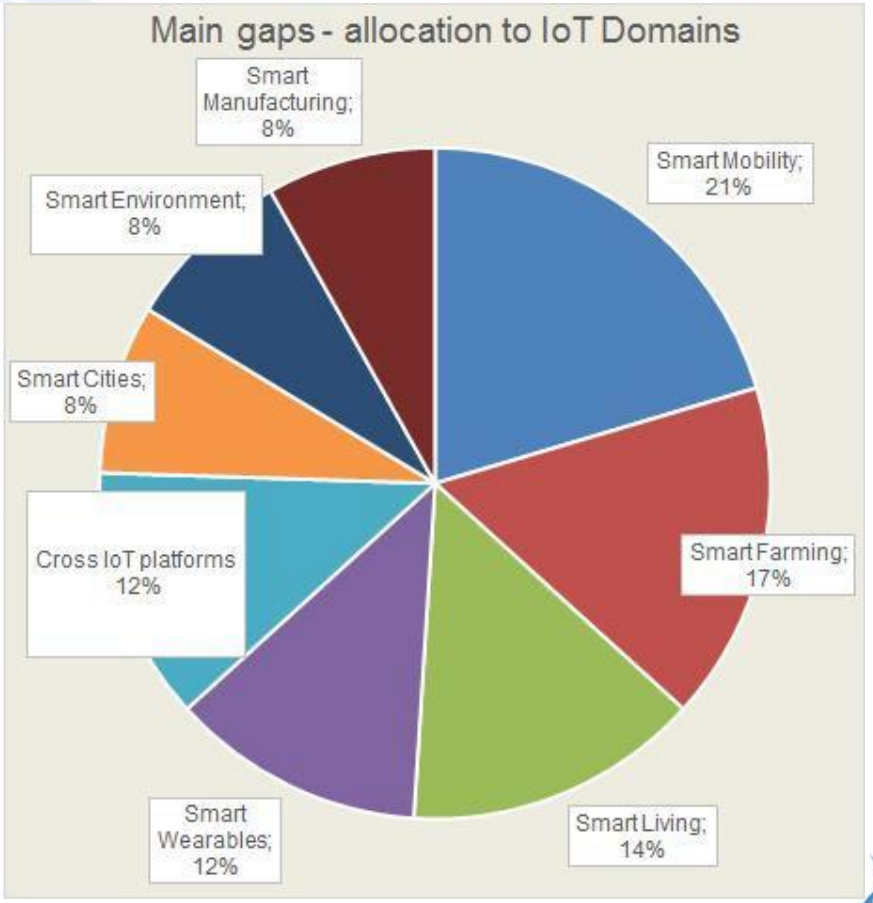
Source: AIOTI WG3 (IoT Standardisation) – Release 2.8

IoT standards gaps (technical, but also business and societal) - view from an AIOTI supporting study (ended early 2017)

Consolidated view of 49 main gaps

Standards gaps as both missing and competing standards





Extract from AIOTI WG03-EC workshop, Feb 2017 (results published as ETSI TR)

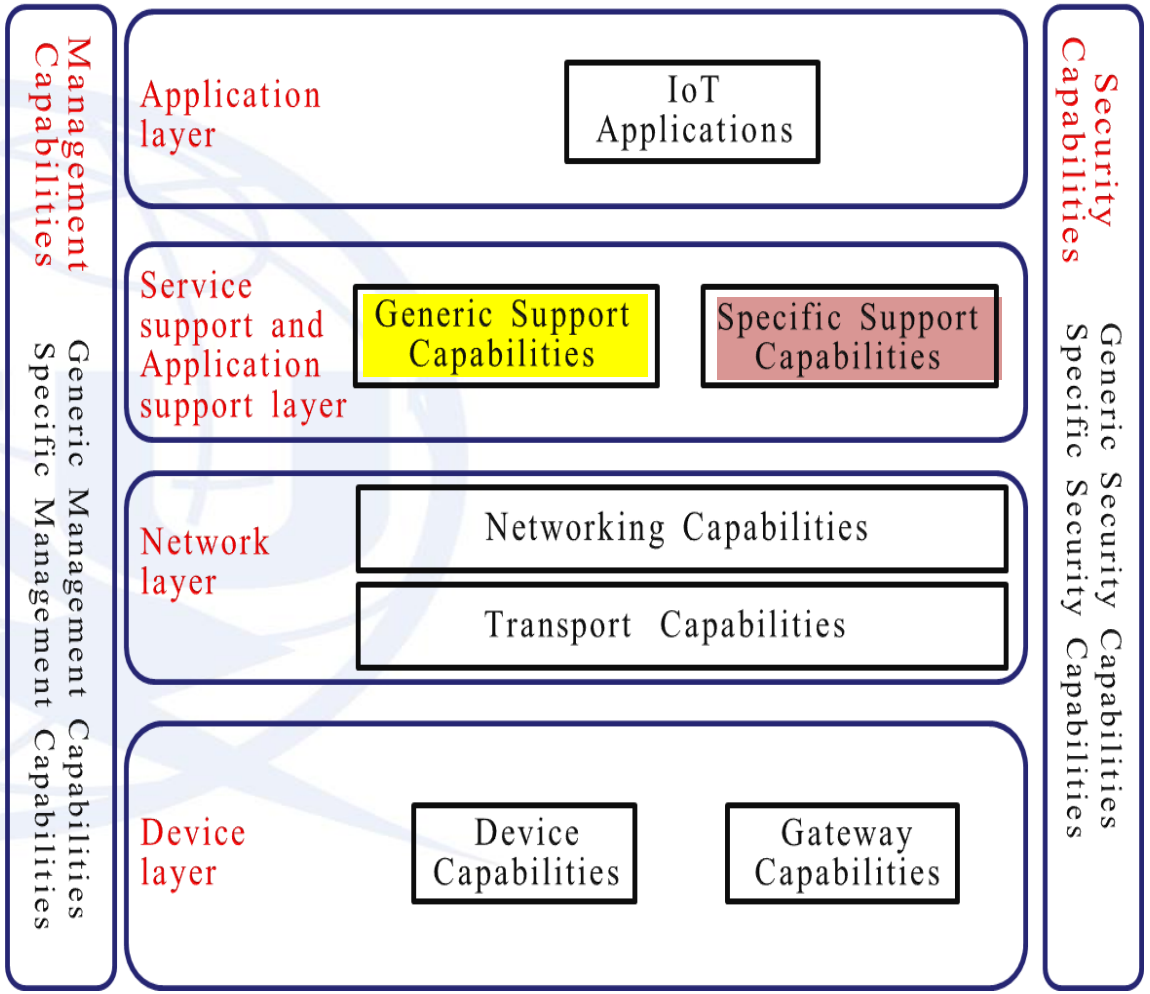
Advances, perspectives, challenges in some technical areas of IoT and Smart Cities

Architectures

A basic reference - the IoT Reference Model defined by ITU-T

Capability view of the IoT infrastructure

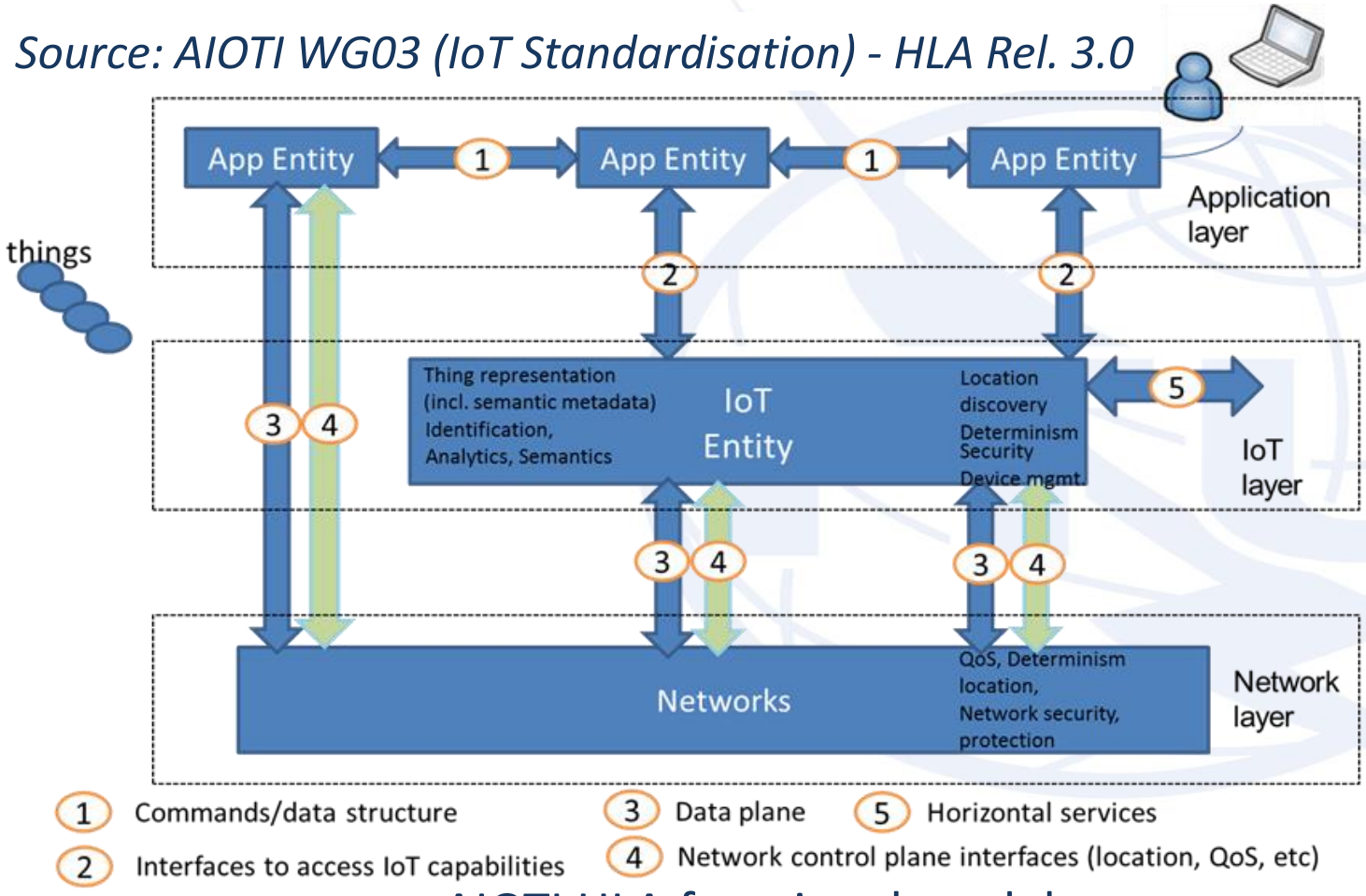
- Application capabilities
- Service Support and Application Support capabilities
- Network capabilities
- Device and Gateway capabilities
- Cross-layer Management Capabilities
- Cross-layer Security Capabilities



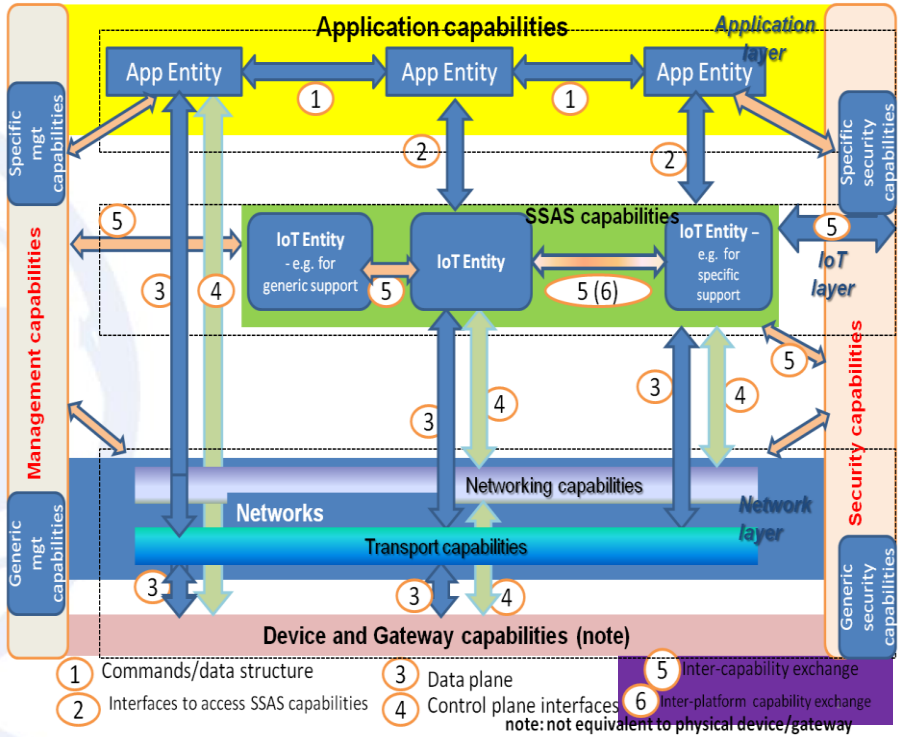
Source: ITU-T Y.2060 /Y.4000 "Overview of the Internet of things"

The AIOTI High Level Architecture (HLA) aiming to promote convergence and harmonization across the different IoT architecture standardization efforts

Source: AIOTI WG03 (IoT Standardisation) - HLA Rel. 3.0



AIOTI HLA functional model



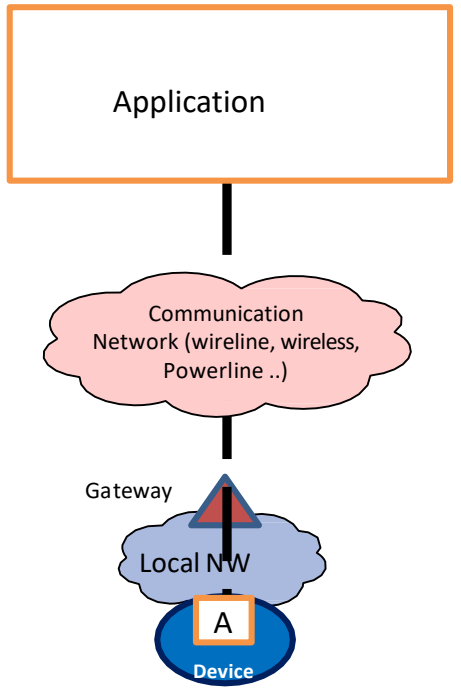
ITU-T IoT Reference Model mapping to the AIOTI HLA

A number of IoT Reference Architectures across SDOs, projects and market deployments

The oneM2M architecture approach

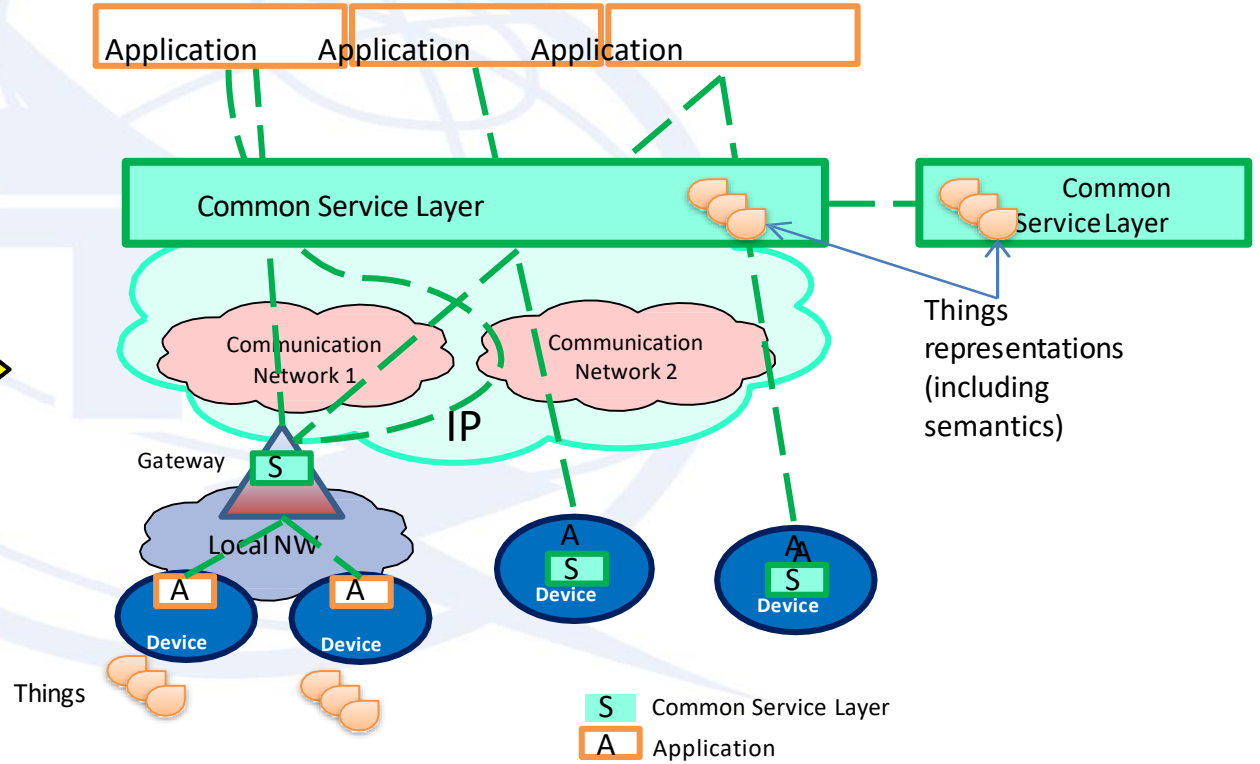
Pipe (vertical):

1 Application, 1 NW,
1 (or few) type of Device
Point to point communications



Horizontal (based on common Layer)

Applications share common service and network infrastructure
Multipoint communications



As result of a concrete collaboration initiative between ITU-T SG20 and oneM2M, a number of oneM2M specifications are under adoption (since Sept 2017) as ITU-T Recs or Supplements (incl. oneM2M Architecture)

However the IoT Architecture studies need to continue …

gaps with reference to the three AIOTI HLA layers [from AIOTI supporting study]

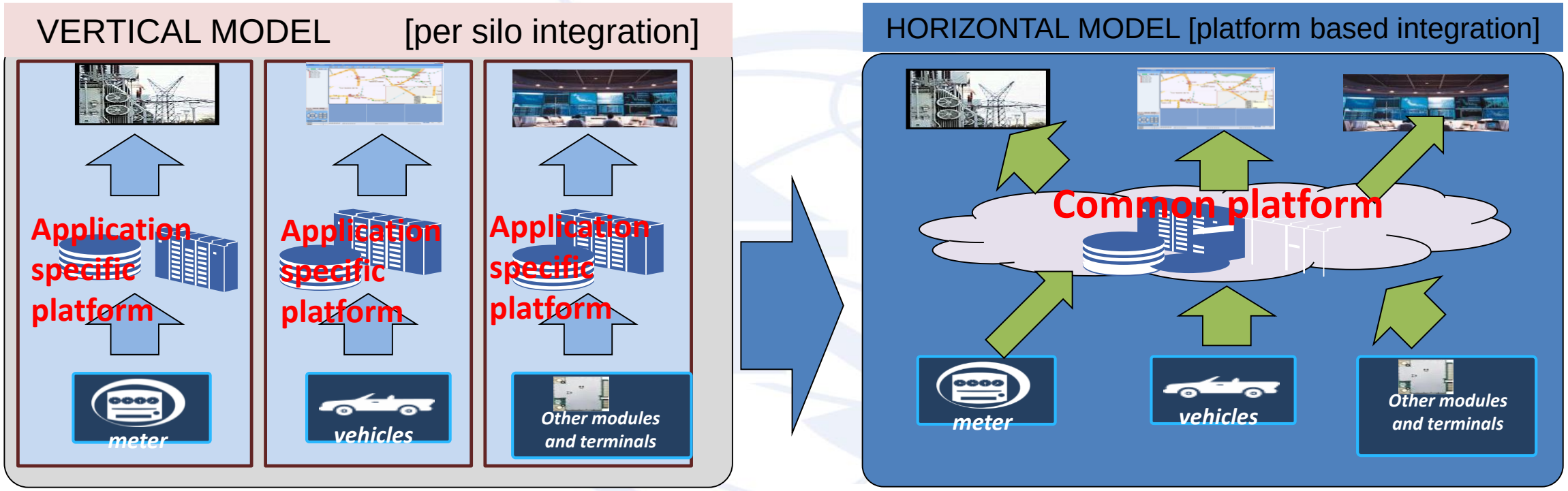
Identified gap	Impact on AIOTI HLA
Competing communications and networking technologies	Network layer
Easy standard translation mechanisms for data interoperability	IoT and application layers
Standards to interpret the sensor data in an identical manner across heterogeneous platforms	IoT layer
APIs to support application portability among devices/terminals	IoT layer
Fragmentation due to competitive platforms	Not specific to HLA
Tools to enable ease of installation, configuration, maintenance, operation of devices, technologies, and platforms	Mostly IoT layer, also Appl. and Network
Easy accessibility and usage to a large non-technical public	Not specific to HLA
Standardized methods to distribute software components to devices across a network	IoT and network layers
Unified model/tools for deployment and management of large scale distributed networks of devices	All layers; critical in IoT layer
Global reference for unique and secured naming mechanisms	All layers
Multiplicity of IoT HLAs, platforms and discovery mechanisms	Addressed by HLA
Certification mechanisms defining “classes of devices”	Network layer
Data rights management (ownership, storage, sharing, selling, etc.)	All layers
Risk Management Framework and Methodology	All layers; interface definition

Source: AIOTI WG03-EC workshop, Feb 2017

Platforms
[a hot topic but also an abused term]

From vertical to horizontal platforms

The situation of technology separation among IoT application domains produces market separation



Platform configured per vertical application (application domain)

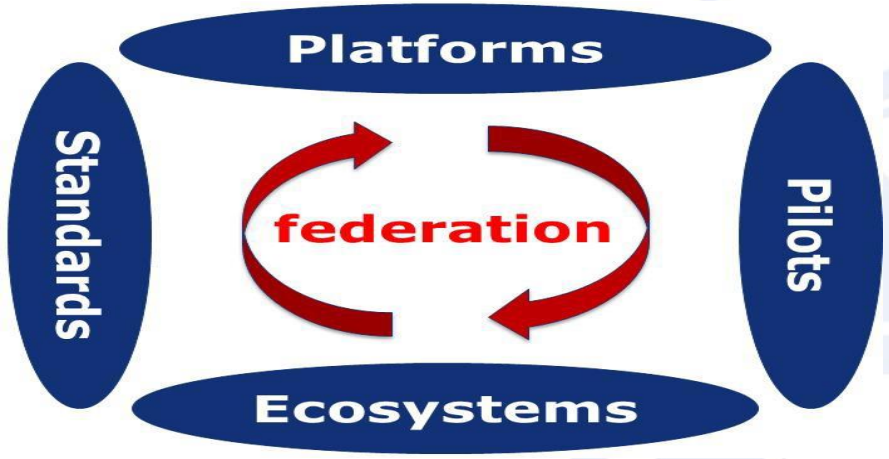
Horizontal platform supporting multiple vertical apps
(with common components and application-specific components)

Deployment reality: different (domain) platforms will continue to co-exist and need to interoperate

Per silo integration *does not scale and limits evolution possibilities*

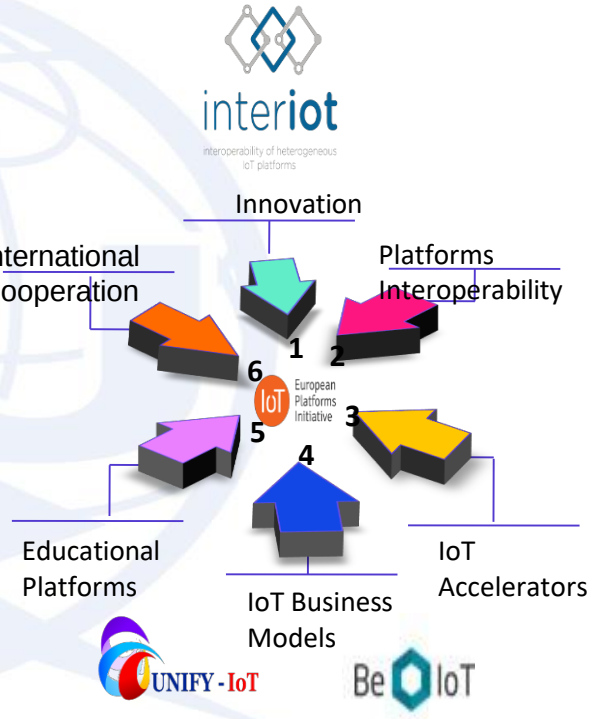
Platform based integration *with the key role of open standards and open source*

Digital Industrial Platforms: pan-European platform building and piloting



- Integration of key digital technologies
- Platforms, reference architectures, …
- Reference implementations, large-scale pilots, experimentation environments
- Ecosystem building and standardisation

IoT European Platforms Initiative (EPI)



NOTE - Technically, "Platform" is an ambiguous term, overused in the market for various distinct purposes (e.g. connectivity management, data exchange).

The EPI work is - among others - addressing platform taxonomies for easier technical analysis and more.

Smart Cities

Smart Cities as super application domain of the IoT

Integration of multiple verticals

Citizen-centric services

Still a number of technical challenges, incl. interoperability, scalability, dynamicity, security and privacy

The brain of the city

Data collection, analysis, knowledge, planning, action

The senses of the city

City data sources

Source: Dr. Levent Gürgen

Smart Cities: an incremental and participatory journey

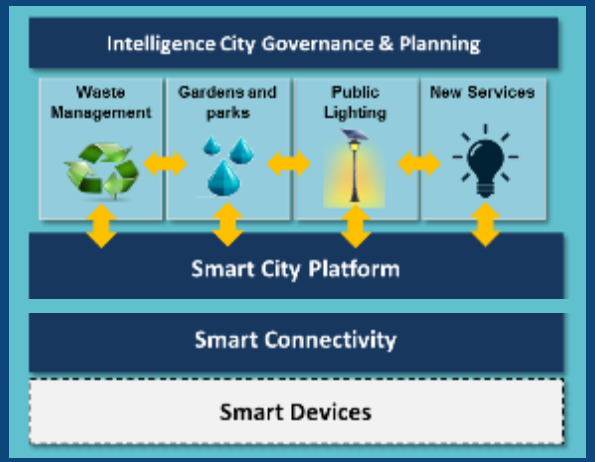
1 2 3 4

Efficient and Open

- Vertical solutions bringing efficiency in silos
- Historic data as open data
- Information still in vertical silos, no global picture

Truly Smart

- Horizontal platform integrating "right-time" context info from different vertical services
- Predictive and prescriptive models



Unleashing Right-time Open Data

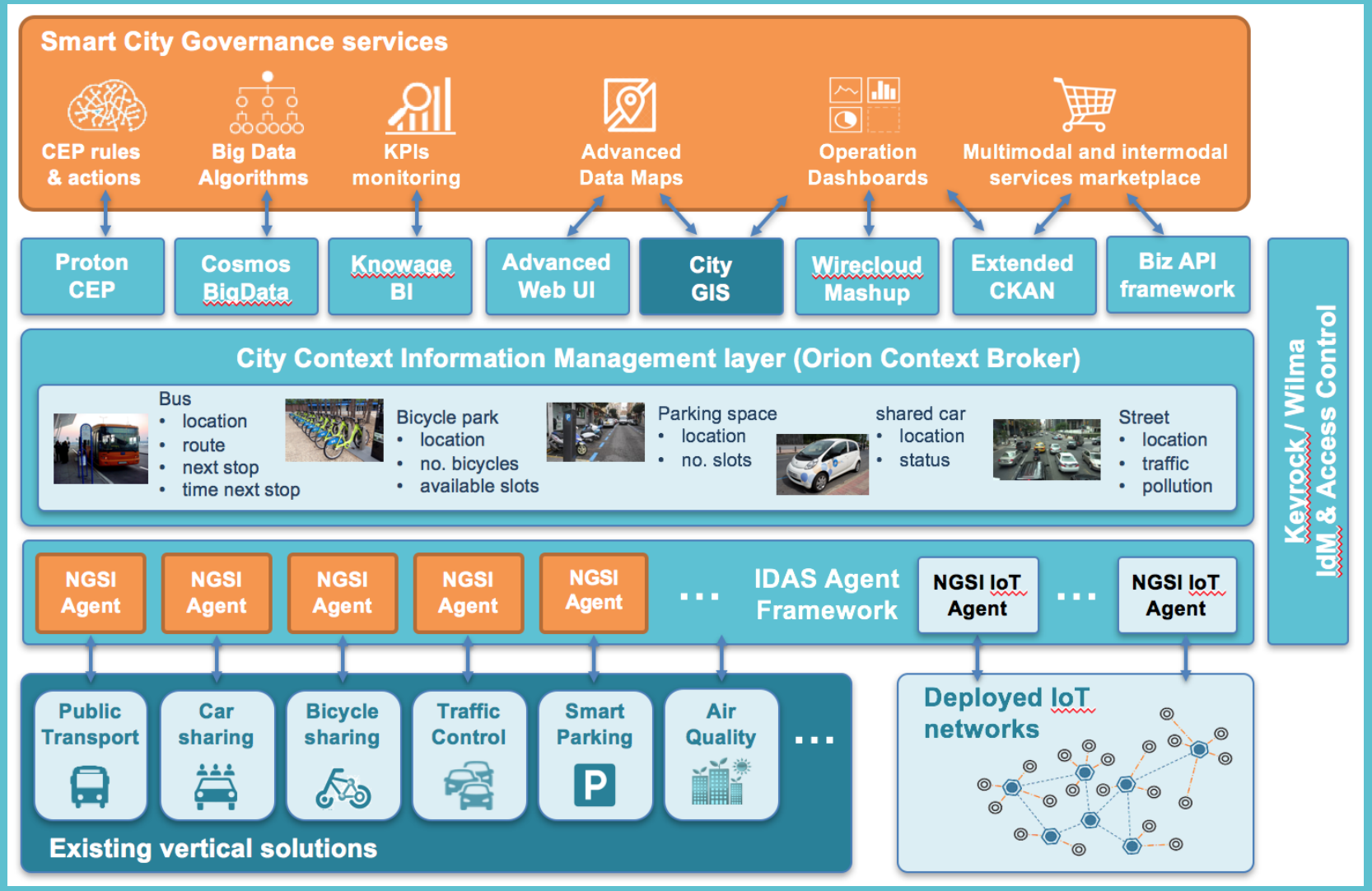
- Right-time context info published to third parties
- Exchange of context info with systems from other domains

Support to Data Economy

- City as a platform including also 3rd party data enabling innovative business models
- Open and commercial data enabling multi-side markets

Source: FIWARE

A lot of Smart Cities architectures: the FIWARE Reference Architecture example

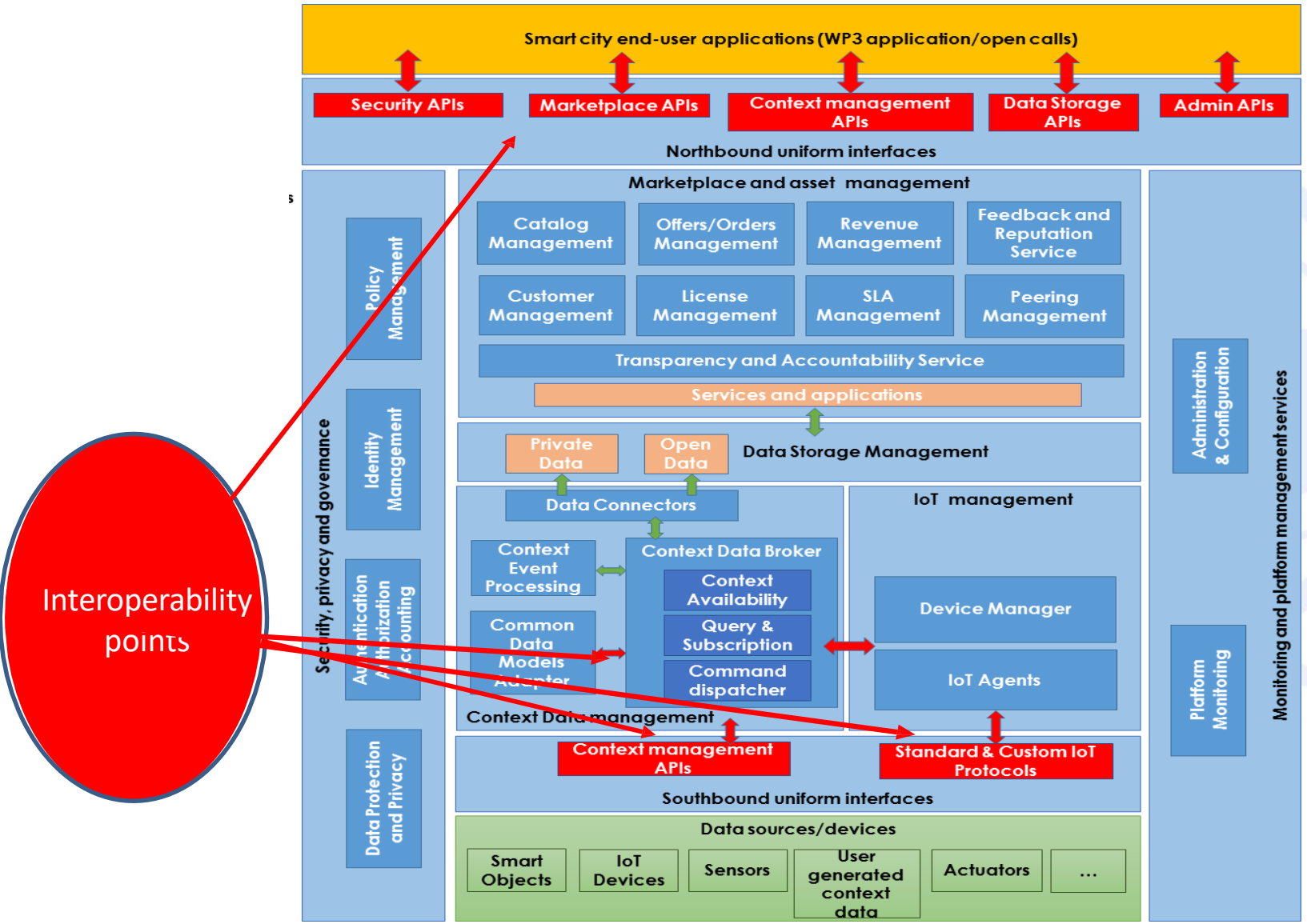


- The Context Information Management layer provides a complete picture of what is going on in the city
- Merging data from:
  - vertical solutions
  - IoT networks
  - processing/analysis

«Context information management layer»: specification target of ETSI Industry Specification Group CIM (Context Information Management)

Source: FIWARE

A lot of Smart Cities architectures: the SynchroniCity Reference Architecture example



Source: SynchroniCity

SynchroniCity is part of the European H2020 Large Scale Pilots programme

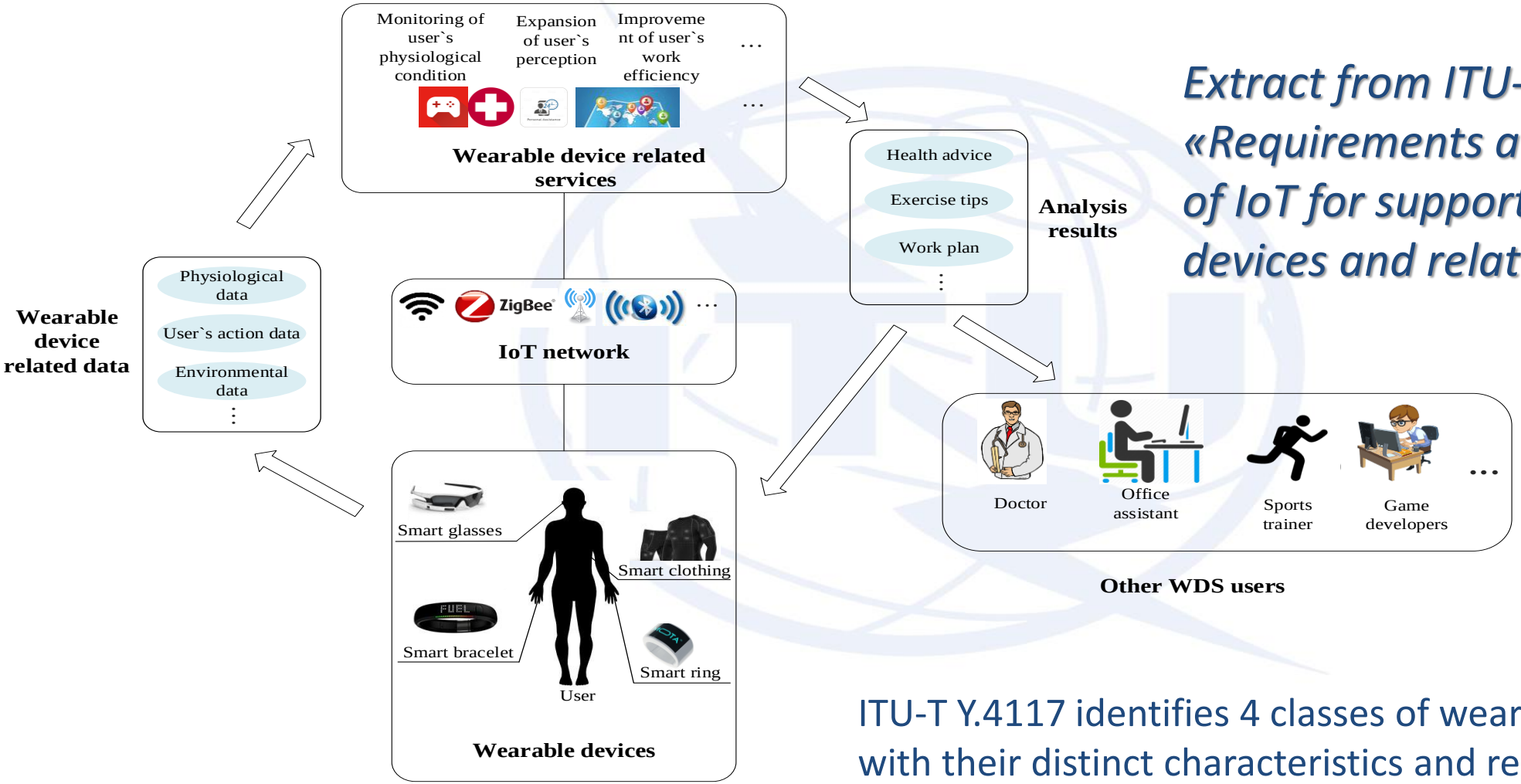
SynchroniCity goal: **start building a Single Digital Market for IoT-enabled Smart City solutions for Europe** (11 reference zones with 8 European cities and 3 outside Europe (Mexico, Korea, US))

Key concept of SynchroniCity Reference Architecture: **definition of interoperable points**

Synchronicity is also working on a set of common data models for different verticals (to promote semantic interoperability)

Other application domains of the IoT (examples)

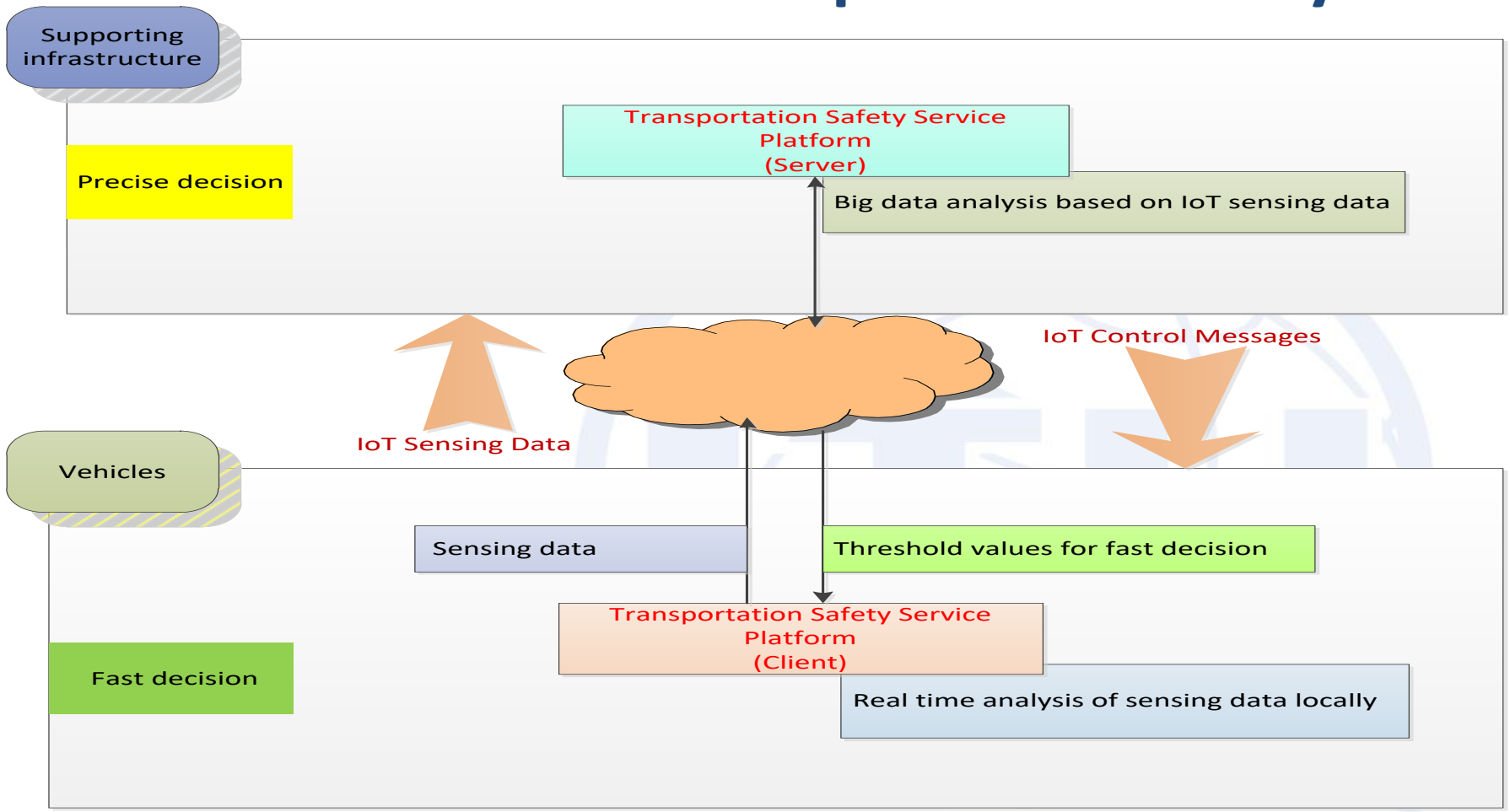
IoT for wearable devices and related services



Extract from ITU-T Y.4117 «Requirements and capabilities of IoT for support of wearable devices and related services»

ITU-T Y.4117 identifies 4 classes of wearable services, with their distinct characteristics and requirements for the supporting IoT network

IoT for transportation safety services



Extract from Y.4116 "Requirements of transportation safety services including use cases and service scenarios"

The picture shows an example of distributed processing-based decision making

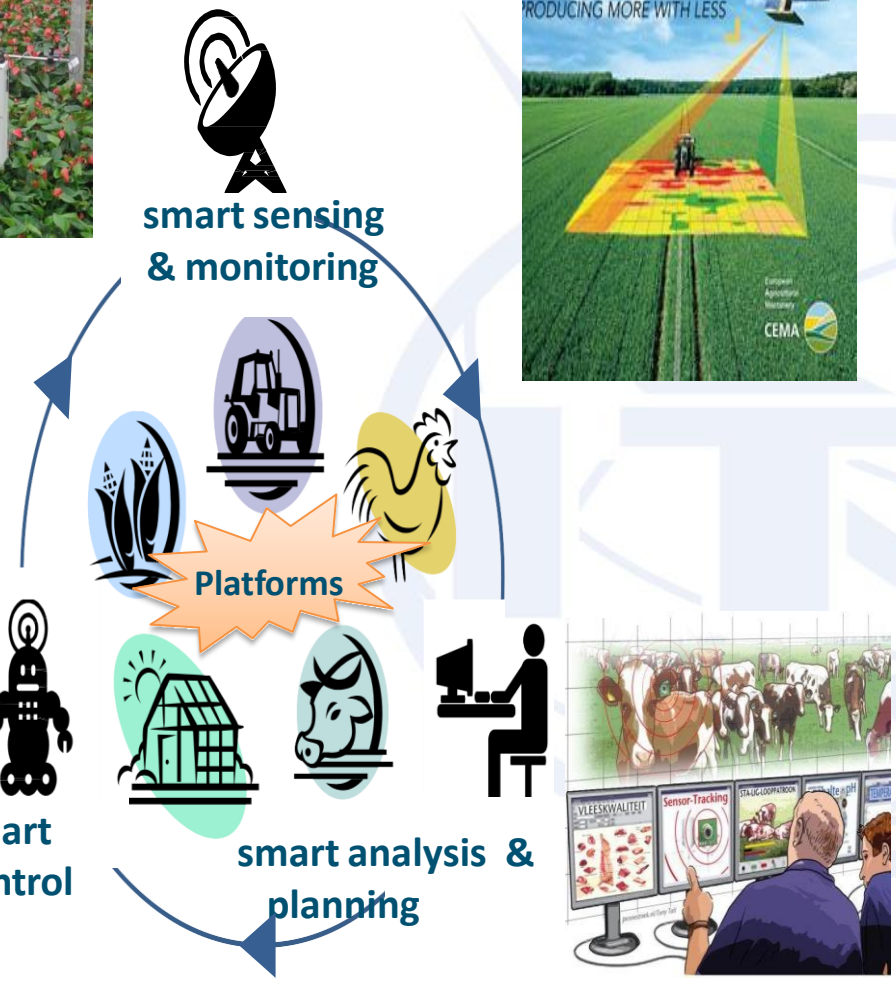
Vehicles locally process and compare **sensing data** to threshold values for fast decision.

Sensing data from vehicles and transportation infrastructure are delivered to the transportation safety service platform (server side).

The platform generates threshold values (e.g. safety indexes) for more accurate decision based on big data analysis.

The generated threshold values are delivered to vehicles for appropriate adjustment of the local decision making process.

Internet of Things in Food & Farming



Source: IOF 2020 INTERNET OF FOOD & FARM

Source: ISO

Data of the IoT and intelligence from data

Internet of Things and Data

Some analysts indicate that by 2020 40% of data will come from sensors

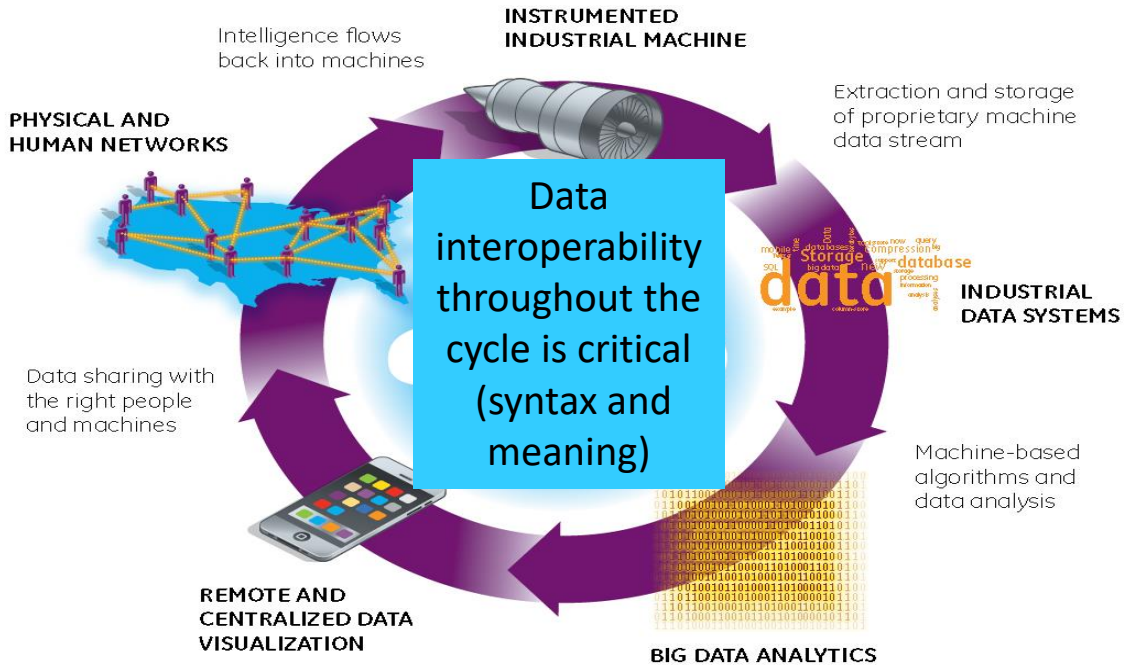
Multiple data sources (things, context, historical data, social data)

Data with different velocity, formats, precision and confidence levels, quality

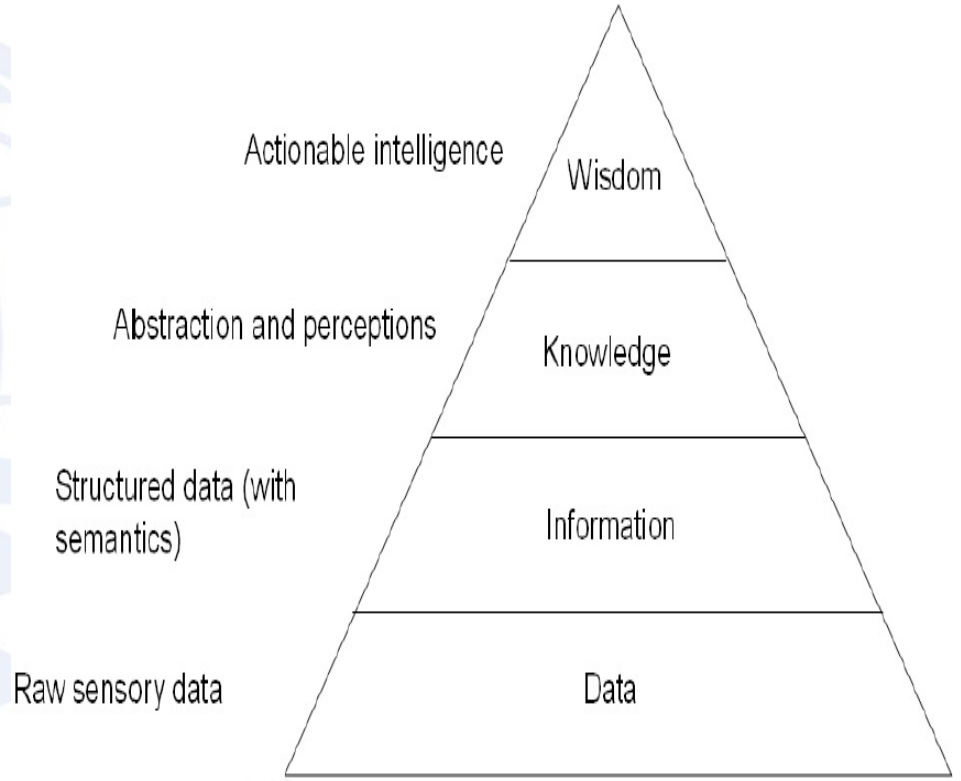
Different operations on data for extraction of actionable intelligence

Target: the right data, at the right time, at the right location

The Industrial Internet Data loop *[source: GE whitepaper]*



Knowledge hierarchy applied in data processing



Source: Barnaghi and al., IJSWIS, 2012

Opportunities and challenges of data in the IoT

Process optimization and data monetization via analytics - driving revenue by sharing, analyzing and interpreting data, for multiple purposes

- Extraction of tangible business and technology value
- **Response and action in real time**, improving productivity/business processes, lowering costs
- **Long-range forecasts enabling strategic actions** - business differentiation, addressing society challenges
- **New/improved business models and service offer**, faster, more efficiently and agile

Technical and non-technical challenges

- **Dealing with the "V"s of data : Volume, Variety, Velocity, Variability, Veracity**
- Discovery of appropriate devices and data sources
- **Integration of heterogeneous devices, networks and data**
- Scalability to cope with large numbers of devices, diverse and huge data, computational complexity of data interpretation
- **Massive data mining, adaptable learning and efficient computing and processing**
- Data query
- Availability and (open) access to data (resources)
- **Trust, security and privacy of data**
- Interpretation (extraction of actionable intelligence from data)
- **Other non-technical challenges also essential (incl. data ownership and data governance)**

An ITU-T initiative specific on data and IoT: the Focus Group on "Data Processing and Management to support IoT and SC&C" (ITU-T FG-DPM)

FG-DPM Working Groups
WG1 **Use Cases, Requirements and Applications/Services**
WG2 **DPM Framework, Architectures and Core Components**
WG3 **Data sharing, Interoperability and Blockchain**
WG4 **Security, Privacy and Trust including Governance**
WG5 **Data Economy, commercialization, and monetization**

Some key deliverables among all WG-specific study items:

- D1.1: Use Cases Analysis and General Requirements for DPM
- D2.1 DPM Framework for Data-driven IoT and SC&C
- D2.2 DPM Functional Architectures
- D3.1 Framework of Open/Private Data
- D3.2 Technical Enablers for Open Data Platform
- D3.6 Blockchain-based Data Exchange and Sharing Technology
- D4.1 Framework of Security and Privacy in DPM
- D4.5 Data Governance Framework for IoT and SC&C

Deliverables in common to all WGs: DPM gap analysis, DPM terms and definitions, DPM standardization roadmap

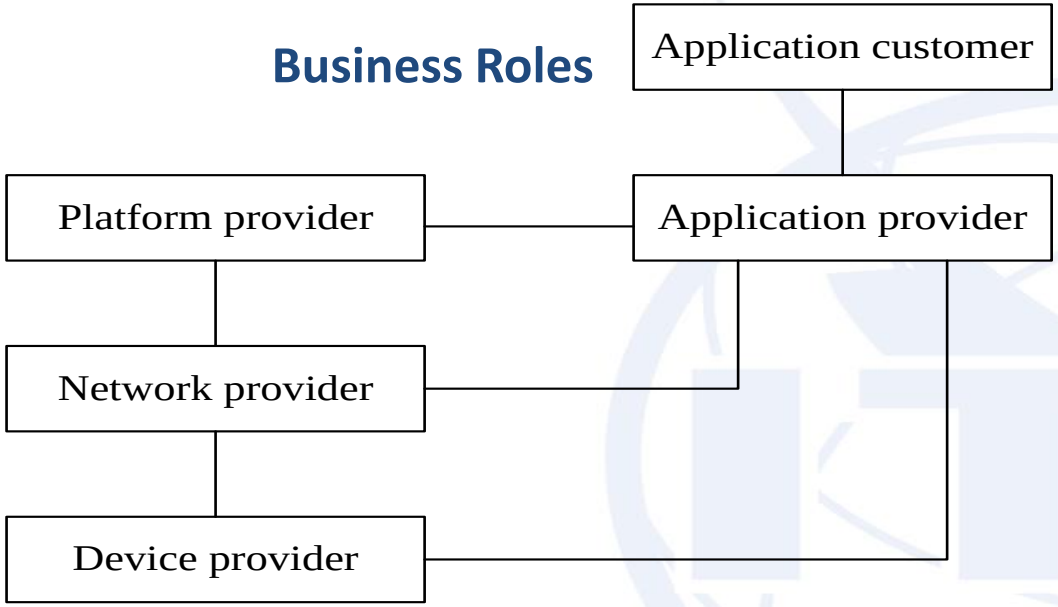
Next FG-DPM meeting: Brussels, 20-23 Feb 2018 (following the 1st workshop on DPM for IoT and SC&C on 19 Feb)

Thank you very much for your attention

Backup information

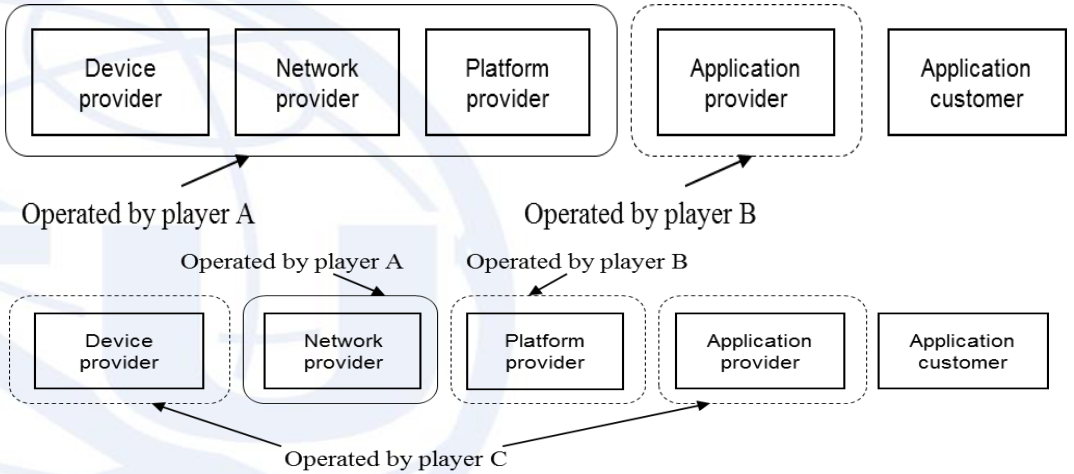
IoT ecosystem(s): business roles and models
(source: Appendixes of ITU-T Y.2060)

Business Roles



"Simplified view" of business roles and relationships (no ambition to represent all roles and relationships across the huge number of real IoT business deployments)

Business models (5 typical examples in Y.2060)



Main objective of this analysis: building a proactive linkage between real deployments and technical standardization (requirements, capabilities and functions, open interfaces)

The exercise has been replicated by ITU-T in specific domains (e.g. e-health, Big Data)

SG20 structure [structure update at March 2017 SG20 meeting]

WP1/20	
Q1/20	End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C
Q2/20	Requirements, capabilities and use cases across verticals
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WP2/20	
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Q6/20	Security, privacy, trust and identification
Q7/20	Evaluation and assessment of Smart Sustainable Cities and Communities
Regional groups	
SG20RG-LATAM	ITU-T SG20 Regional Group for the Latin American Region
SG20RG-EECAT	ITU-T SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia
SG20RG-ARB	ITU-T SG20 Regional Group for the Arab Region
SG20RG-AFR	ITU-T SG20 Regional Group for the Africa Region
Other groups under SG20	
JCA-IoT and SC&C	Joint Coordination Activity on IoT and SC&C [maintains IoT and SC&C standards roadmap]
FG-DPM	FG on Data Processing and Management to support IoT and SC&C

ITU-T published Recs on IoT and SC&C aspects

[10 Jan 2018 status, incl. pre-SG20 achievements]

ITU-T Y.4000 series	Recommendation category	Number of published Recs
Y.4000-Y.4049	General	3
Y.4050-Y.4099	Definitions and terminologies	1
Y.4100-Y.4249	Requirements and use cases	18
Y.4250-Y.4399	Infrastructure, connectivity and networks	3 (+ 2 in AAP)
Y.4400-Y.4549	Frameworks, architectures and protocols	20 (+ 1 in AAP)
Y.4550-Y.4699	Services, applications, computation and data processing	3
Y.4700-Y.4799	Management, control and performance	3
Y.4800-Y.4899	Identification and security	6
Y.4900-Y.4999	Evaluation and assessment	4
Y.4000-Y.4999	**Informative docs (Suppl., Tech. Report)**	20

All approved and ongoing ITU-T IoT and SC&C specifications are collected in the "IoT and SC&C Standards Roadmap" [cross-SDO roadmap] maintained by JCA-IoT and SC&C

SG20 specifications focused on smart cities and communities 1/2

Approved Recommendations

- ITU-T Y.4805 **"Identifier service requirements for the interoperability of smart city applications"**
- **Key Performance Indicators for Smart Cities:** Y.4900/L.1600, Y.4901/L.1601, Y.4902/L.1602, Y.4903/L.1603

Recommendations currently in AAP

- ITU-T Y.4200 (ex-Y.SCP) **"Requirements for interoperability of smart city platforms"**
- ITU-T Y.4201 (ex-Y.frame-SCC) **"High-level requirements and reference framework of smart city platform"**

New work items launched at the Sept 2017 meeting (note - new Supplement on Smart Cities use cases launched at Jan 2018 SG20/WP1 RGM)

Question	Working title	Title
Q2/20	ITU-T Y.SCC-Reqts	Common requirements and capabilities of smart cities and communities from IoT and ICT perspectives
Q4/20	Y.disaster_notification	Framework of the disaster notification of the population in Smart Cities and Communities
Q5/20	Y.MEDT	Methodology for Building Sustainable Capabilities during Enterprises' Digital Transformation
Q6/20	Y.API4IOT	API for IoT Open Data in Smart Cities
Q6/20	Y.FW-IC-MDSC	Framework of identification and connectivity of Moving Devices in Smart City
Q7/20	Y.SSC-IA	Smart Sustainable City Impact Assessment
Q7/20	Y.SSC-MM	Smart Sustainable City Maturity Model
Q7/20	Y.AFDTS	Assessment Framework for Digital Transformation of Sectors in Smart Cities

SG20 specifications focused on smart cities and communities 2/2

Approved Supplements (11 Jan 2018 status)

- ITU-T Y.Supp.34 to ITU-T Y.4000 series **"Smart Sustainable Cities (SSC) - Setting stage for stakeholders' engagement"**
- ITU-T Y.Supp.33 to ITU-T Y.4000 series **"SSC - Master plan"**
- ITU-T Y.Supp.32 to ITU-T Y.4000 series **"SSC - a guide for city leaders"**
- ITU-T Y Supp.45 to ITU-T Y.4000-series **"An overview of smart cities and communities and the role of ICT"**
- ITU-T Y.Supp.37 to ITU-T Y.4050 series **"Definition for SSC"**
- ITU-T Y.Supp.38 to ITU-T Y.4050 series **"SSC - An analysis of definitions"**
- ITU-T Y.Supp.29 to ITU-T Y.4250 series **"Multi-service infrastructure for SSC in new-development areas"**
- ITU-T Y.Supp.30 to ITU-T Y.4250 series **"Overview of SSC infrastructure"**
- ITU-T Y.Supp.27 to ITU-T Y.4400 series **"Setting the framework for an ICT architecture of SSC"**
- ITU-T Y.Supp.31 to ITU-T Y.4550 series **"SSC - Intelligent sustainable buildings"**
- ITU-T Y.Supp.28 to ITU-T Y.4550 series **"Integrated management for SSC"**
- ITU-T Y.Supp.36 to ITU-T Y.4550 series **"Smart water management in cities"**
- ITU-T Y.Supp.39 to ITU-T Y.4900 series **"Key performance indicators definitions for SSC"**

Relevant ongoing IoT studies: some items from current SG20 work in progress 1/2

IoT and SC&C application domains (with relates studies at different levels)

- Smart Manufacturing (framework in the context of Industrial IoT)
- Cooperative ITS applications, Automotive Emergency Response System, Transportation Safety Services
- Smart Retail
- Smart Cities and related (parking, lightning etc.)
- Smart Rural Communities
- Smart Residential Communities
- Smart Port
- Smart Tourist destinations
- Smart environmental monitoring
- Smart Farming/Agriculture
- Unmanned Aircraft Systems
- Monitoring and study of Global Processes of the Earth for disaster preparedness
- Micro-Grids
- Home Networks
- Others (use cases and reqts from developing countries (e.g. e-health), Smart Evacuation during emergencies, …)
- Other oneM2M related

Relevant ongoing IoT studies: some items from current SG20 work in progress 2/2

Other studies

- IoT accessibility requirements
- IoT capabilities (incl. accounting and charging, self-organization, service discovery, network connectivity management)
- IoT architectural studies (incl. oneM2M related)
- APIs for IoT open data
- Blockchain-based decentralized service platform
- Interoperability (smart city platform interoperability, interoperability framework for IoT, identifier service requirements for Smart City applications interoperability)
- Information Management Digital Architecture to combat counterfeiting in IoT
- Identification aspects
- IoT-related Crowdsourced Systems
- Things description
- Capabilities for Business Process support
- Others (oneM2M related, Tech. Report on IoT and AI, SC&C Vocabulary)

Ongoing ITU-T SG20 studies on smart cities and communities - summary view

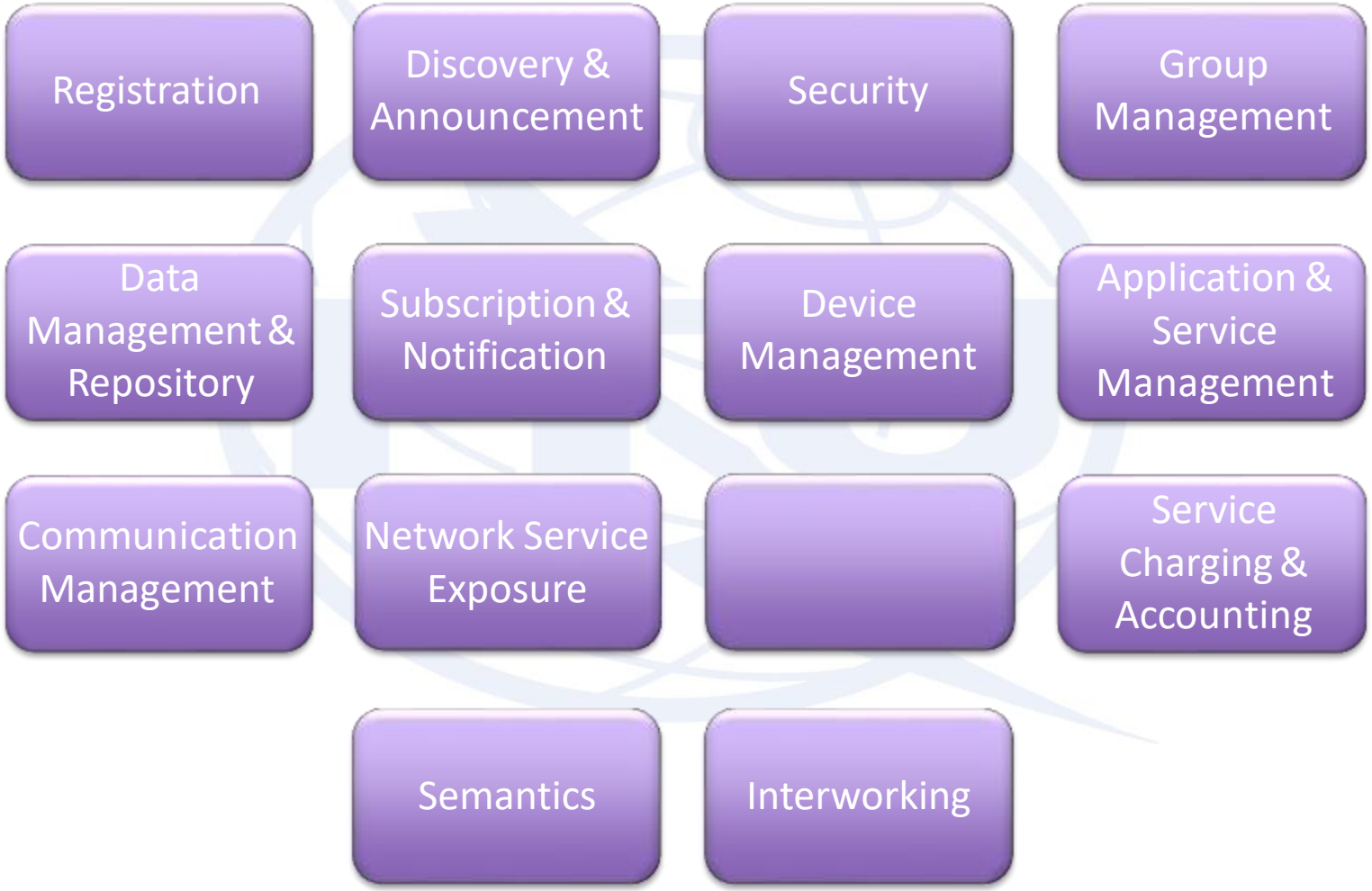
- SC&C related ecosystem, applications and services
  - studies directly related to SC&C include: smart grids, water, mobility, logistic, waste, healthcare, e-government, education, transport, utilities
- Requirements and capabilities from IoT and ICT perspectives
  - including ICT requirements and related comm. technologies to be taken into account when designing SC&C services
- General reference models of SC&C
  - including spatio-temporal modelling for SC&C
- Frameworks
  - impact assessment, maturity model, assessment framework for digital transformation of sectors in SC&C
  - Identification of architectural and service compositions, and views on SC&C
- Entities, functions and reference points required to support SC&C applications
- Efficient service analysis, strategic planning, deployment and implementation of SC&C
  - taking into account different needs of developed and developing countries
- ICT use for SC&C physical infrastructure
- Open Data in SC&C
  - incl. framework, open indicators, APIs

Backup slides provide information on published ITU-T SG20 specifications related to SC&C

IoT SDOs and Alliances Landscape (Technology and Marketing Dimensions)

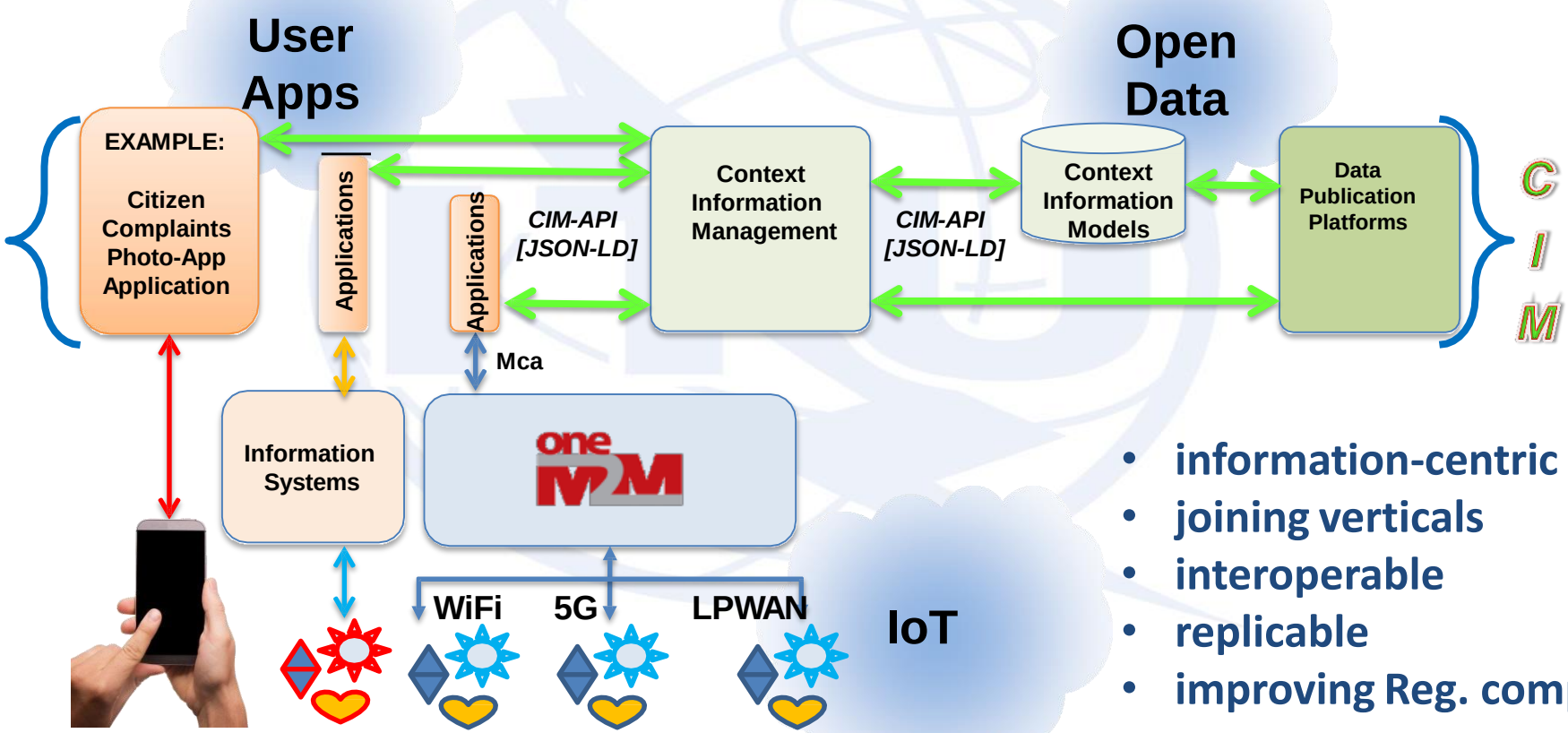
Source: AIOTI WG3 (IoT Standardisation) – Release 2.8

oneM2M Common Service Functions (CSE)



ETSI Industry Specification Group on Context Information Management (ETSI ISG CIM)

ETSI ISG CIM has mandate to establish an info-exchange layer
on top of IoT platforms especially targeting Smart City applications



- information-centric
- joining verticals
- interoperable
- replicable
- improving Reg. compliance

Context Information Management Layer - exchanging information between domains

AIOTI WG03 (IoT standardization): engagement model

WG03 support to AIOTI in:

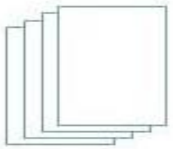
- **Digital Single Market**
- **Digitising European Industry**
- **H2020 Large Scale Pilots**

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*
- *Semantic Interoperability*
- *Identifiers, IoT and 5G*
- *Security and (Personal) Data Protection (with WG4)*

Source: AIOTI WG03

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AIOTI WG03 (IoT standardization)

- Identifies and, where appropriate, makes recommendations to address existing IoT standards, analyses gaps in standardization, and develops strategies and use cases aiming for
  1. Identifying horizontal concerns/general principles for IoT
  2. Bootstrapping trust
  3. Investigating relevant regulations and their potential impact
  4. Community building
  5. Conducting initial studies on the role of people in IoT
- IoT Landscape
  - **IoT Landscape maintenance is key to keep the liaisons alive and maintain dialogue on how to foster collaboration to improve interoperability & security**
  - IoT relation and impact on 5G
  - IoT-EPI IoT Platforms analysis improvement / H2020 UNIFY-IoT
  - Gap Analysis and recommendations / EC funded STF 505, CREATE-IoT
  - **Cooperation with SDOs/Alliances to foster co-creation and interworking**
- High Level Architecture (HLA) - work plan update in progress
  - **IoT Reference Architecture and the mapping of existing IoT Reference Architectures to it,** IoT-Big Data integration
  - IoT identification
- IoT Semantic Interoperability
  - **Important topic of the moment that created a great international collaboration**
- IoT Privacy (with WG04)
  - IoT Platform, experimentation, LSPs need concrete standard framework & references to enable ”IoT Trust” and IoT “Privacy by design”
- IoT Security (with WG04)
  - 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”

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