Overview of Internet of Things standardization activities in ITU (ITU-T SG20)

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ISO/IEC/ITU Internet of Things workshop, 13 May 2016, Berlin

Outline

- ITU-T organizational aspects for IoT studies

- ITU-T achievements on IoT (only selected topics)

- Relevant ongoing studies on IoT (ITU-T SG20 focus)

- Potential future studies on IoT (personal considerations)

NOTE – Another presentation of this workshop will specifically address the ITU-T activities related to Smart Cities and Communities

Disclaimer: this content does not obviously intend to cover all ITU-T standardization activities related to the IoT
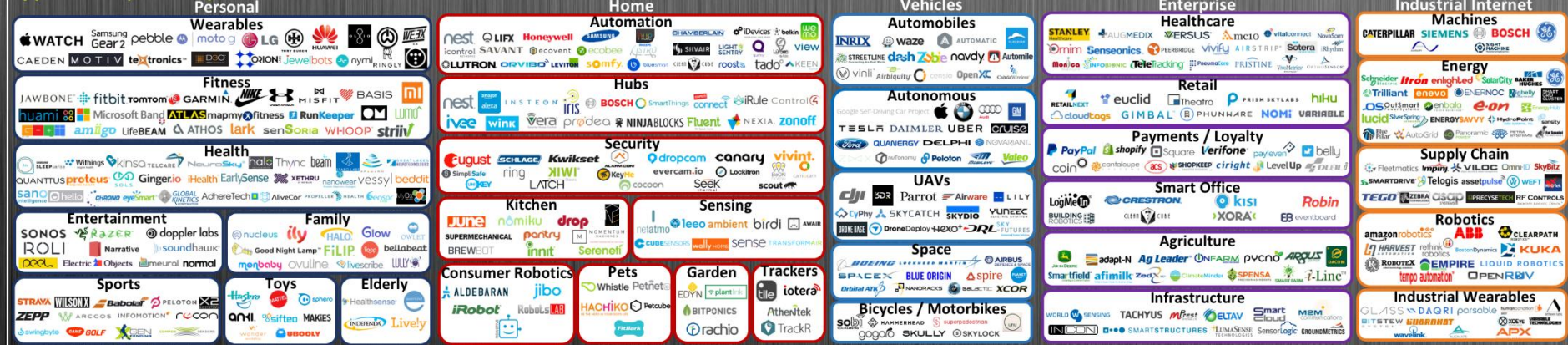
ITU-T standardization: hot topics

- **Internet of Things (including smart sustainable cities and communities)**
- 5G (non-radio) and Future networks
- Security, Privacy and Trust
- Core transport, Access, Home
- Video coding
- e-everything (e.g., e-health)
- ICT and the environment
- Digital Financial Services (e.g., mobile money)
- Global roaming, Over The Top
- Bridging Gaps (standards, technology)
- …

Internet of Things Landscape 2016

© Matt Turck (@mattturck), David Rogg (@davidjrogg) & FirstMark Capital (@firstmarkcap)

Just an example picture of the diversity of the current IoT landscape (domains, solutions … as well as standards)

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ITU-T Study Group 20 (SG20) on "Internet of Things and its applications, including smart cities and communities"

ITU-T SG20 is responsible for international standards to enable the coordinated development of IoT technologies, including machine-to-machine communications , ubiquitous sensor networks, and smart cities and communities

Upcoming SG20 meeting and associated event

- SG20 meeting: 25 July to 5 August 2016, Geneva, Switzerland
- Joint ITU/UNECE/WEF Forum on IoT and Smart Cities on 25 July 2016, Geneva, Switzerland

Past SG20 meetings: Oct 2015 and Jan 2016 (SG20), 2-13 May 2016 (SG20 Rapporteurs Group)

NOTE – Other ITU-T events on IoT and Smart Cities are planned during 2016.

ITU-T Study Group 20 (SG20) on
"Internet of Things and its applications, including smart cities and communities"

Established in June 2015

2 Working Parties

WP1: Internet of Things (IoT)

WP2: Smart cities and Communities (SC&C)

6 Questions

Tasks and objectives:

- Develop framework and roadmaps for the harmonized and **coordinated development of IoT**, including M2M communications, ubiquitous sensor networks and SC&C;
- Study **requirements and capabilities** of IoT and its applications including SC&C;
- IoT end-to-end **architectures**, and **middleware** for IoT systems and applications
- **Interoperability** aspects (for IoT verticals)
- **Quality of Service and Security** aspects for IoT and its applications including SC&C
- **Assess** how the use of IoT has an **impact** on the smartness of cities;
- Develop standards, guidelines, methodologies and best practices to **help cities** (including rural areas and villages) **deliver services using the IoT**, with an initial view to address city challenges;
- **Cooperate** with other regional and international standards-development organizations and industry forums

http://www.itu.int/en/ITU-T/studygroups/2013-2016/20/Pages/default.aspx

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SG20 structure

	TITLE
PLEN	
Q1/20	Research and emerging technologies including terminology and definitions
WP1/20	**Internet of Things (IoT)**
Q2/20	Requirements and use cases for IoT
Q3/20	IoT functional architecture including signalling requirements and protocols
Q4/20	IoT applications and services including end user networks and interworking
WP2/20	**Smart cities and Communities (SC&C)**
Q5/20	SC&C requirements, applications and services
Q6/20	SC&C infrastructure and framework

Joint Coordination Activity on Internet of Things and Smart Cities & Communities (JCA-IoT and SC&C)

- To provide a visible contact point for IoT and SC&C activities in ITU-T, to seek co-operation with external bodies working in the field of IoT and SC&C and enable effective two-way communication with these bodies

- Maintenance of a list of cross-SDO IoT and SC&C standardization items and associated roadmap

http://itu.int/en/ITU-T/jca/iot/Pages/default.aspx

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The first 2 Recommendations approved by ITU-T SG20

Y.4702 (ex Y.IoT-DM-reqts) Common requirements and capabilities of device management in the IoT
[approved on 15 March 2016]

Y.4553 (ex Y.IoT-SPSN) Requirements of smartphone as sink node for IoT applications and services
[approved on 15 March 2016]

The provided common requirements and capabilities are intended to be generally applicable in device management (DM) application scenarios.
The Recommendations focuses on DM requirements for the interaction between devices and DM functional components.

The Recommendation introduces at first the concept of a smartphone working as a sink node of an IoT system. It then identifies characteristics, work modes (local and remote service modes) and high level functional requirements of a smartphone working as a sink node.

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ITU-T achievements on IoT

The achievements of the ITU-T standardization work on IoT include a large number of specifications addressing numerous technical areas [since the initial ITU-T studies on network aspects of identification, ubiquitous sensor networks (USN) and their support by NGNs]

- **A non exhaustive list of these areas (NOTE 1):**
  horizontal aspects (incl. basic requirements and capabilities), machine-oriented communications, tag-based identification services, IoT applications (e-health, home network apps, smart farming, networked vehicles, smart energy, etc.), IoT for emergency management and disaster recovery, security and management.

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

NOTE 1 – This presentation cannot be exhaustive about all ITU-T IoT specs

NOTE 2 – The following slides do not cover achievements and ongoing studies specific to Smart Cities and Communities [another presentation of this workshop addresses the ITU-T activities in this area]

Among the set of ITU-T approved specifications on IoT (just a selection) 1/2

Overview and terminology of the IoT

- Y.2060 [Y.4000 (NOTE)] : *Overview of the Internet of things [2012]*

- Y.2069: *Terms and definitions for the IoT [2012] - Revision expected in SG20*

- Y.2063: *Framework of the web of things [2012]*

Common requirements and capabilities of the IoT

- Y.2066: *Common requirements of the IoT [2014]*

- *F.748.0: Common requirements for IoT applications [2014]*

- Y.2068: *Functional framework and capabilities of the IoT [2015]*

Gateway for IoT applications

- Y.2067: *Common reqts and capabilities of a gateway for IoT applications [2014]*

Specific studies on capabilities of the IoT

- Y.2076: *Semantics-based requirements and framework of the IoT [2016]*

- Y.2077: *Requirements of the plug and play capability of the IoT [2016]*

NOTE – All approved specifications have been renumbered within the IoT and SC&C specific series Y.4000-4999 series, see http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=20

Among the set of ITU-T approved specifications on IoT (<u>just a selection</u>) 2/2

M2M service layer (preliminary studies on IoT architectural aspects)

- F.748.5: Requirements and reference architecture of m2m service layer *[2015]*

- Q.3052: Overview of APIs and protocols for m2m service layer *[2016]*

IoT applications and service aspects

- Y.2078: *Application support models of the IoT [2016]*

- Y.2065: *Service and capability reqts for e-health monitoring services [2014] (and Y.2075)*

- H.810: *Interoperability design guidelines for personal health systems – based on Continua Design Guidelines [2015]*

- H.860: *Multimedia e-health data exchange services: Data schema and supporting services [2014]*

- Y.2238: *Overview of Smart Farming based on networks [2015]*

- F.747.6: *Requirements for water quality assessment services using USNs [2014]*

- Y.2074: *Reqts for IoT devices and operation of IoT applications during disasters [2015]*

NOTE – All approved specifications have been renumbered within the IoT and SC&C specific series Y.4000-4999 series, see http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=20
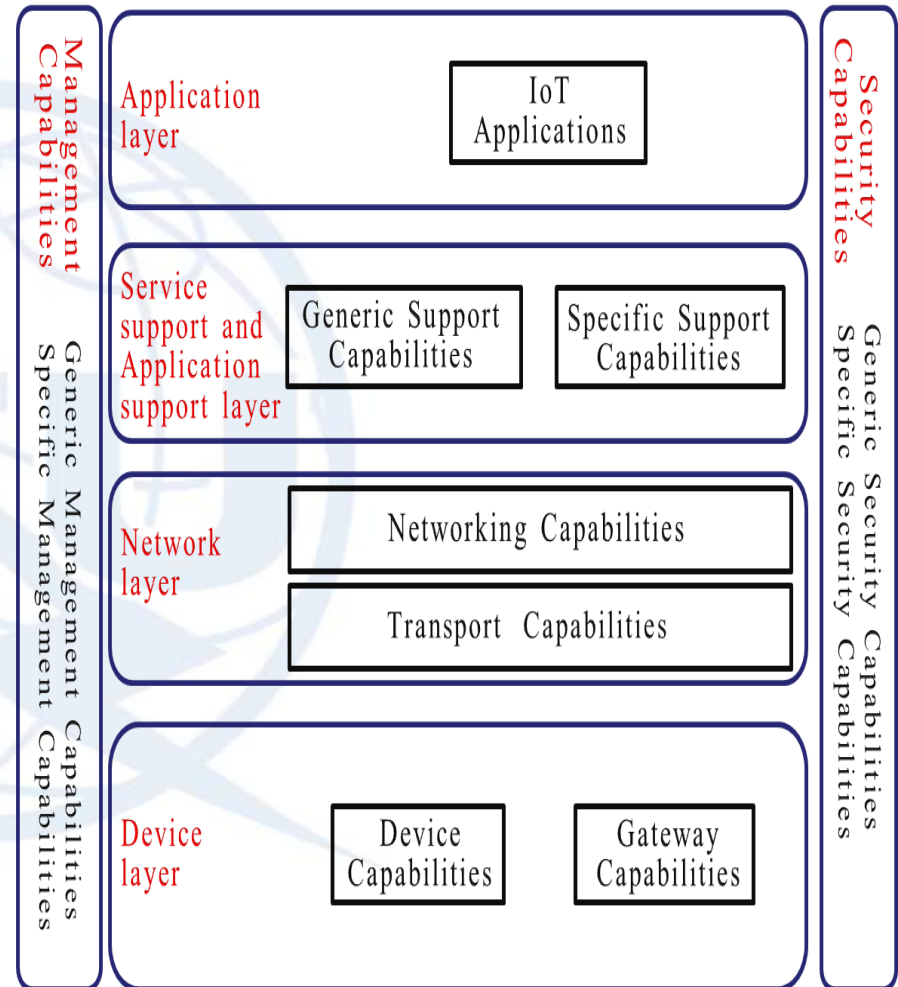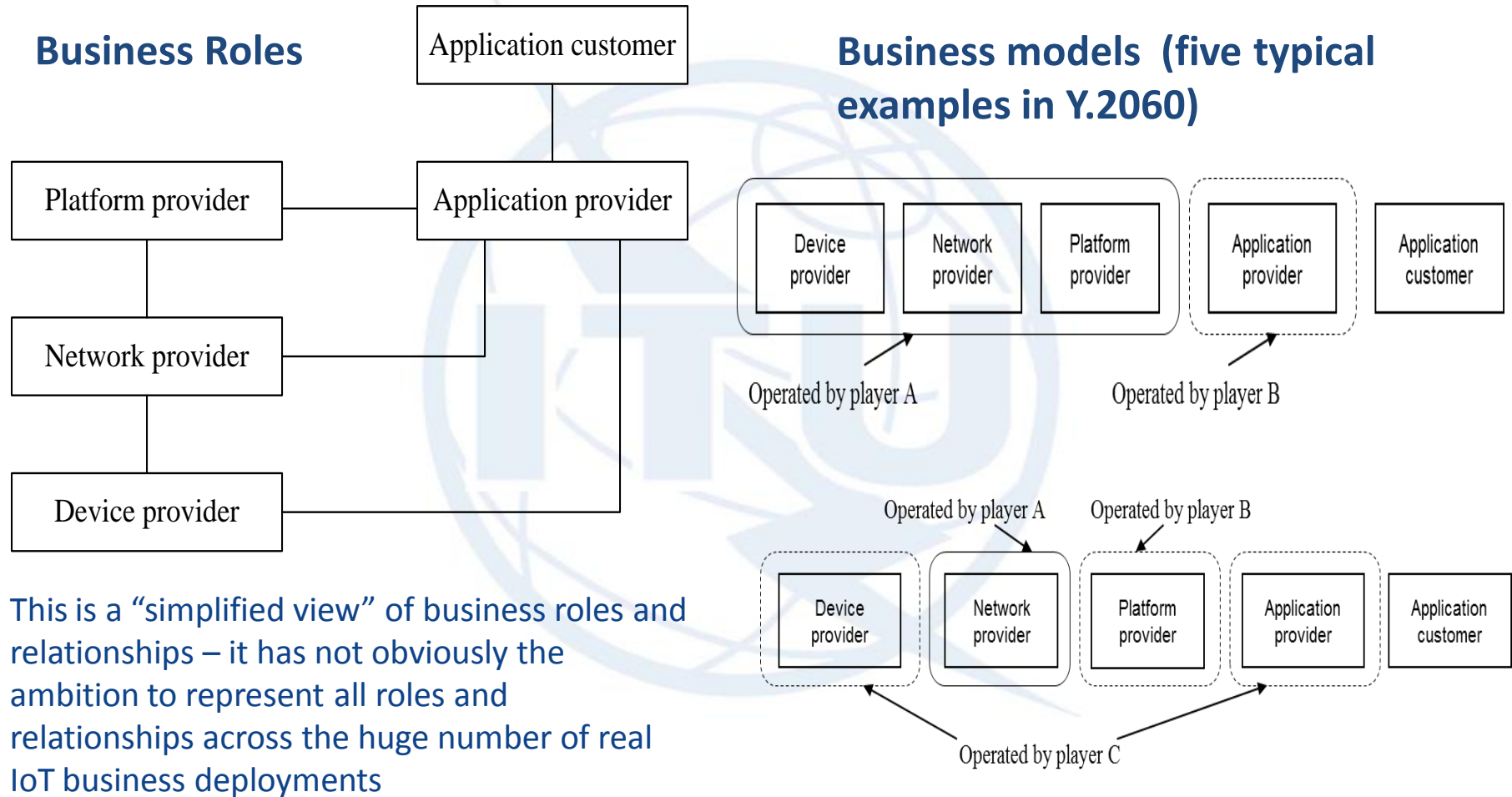
The IoT Reference Model defined in ITU-T

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 "Overview of the Internet of things" [06/2012]

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

Business Roles

Business models (five typical examples in Y.2060)

This is a "simplified view" of business roles and relationships – it has not obviously the ambition to represent all roles and relationships across the huge number of real IoT business deployments

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

ITU-T Y.2076: Semantics-based requirements and framework of the IoT (with respect to the IoT Reference Model)
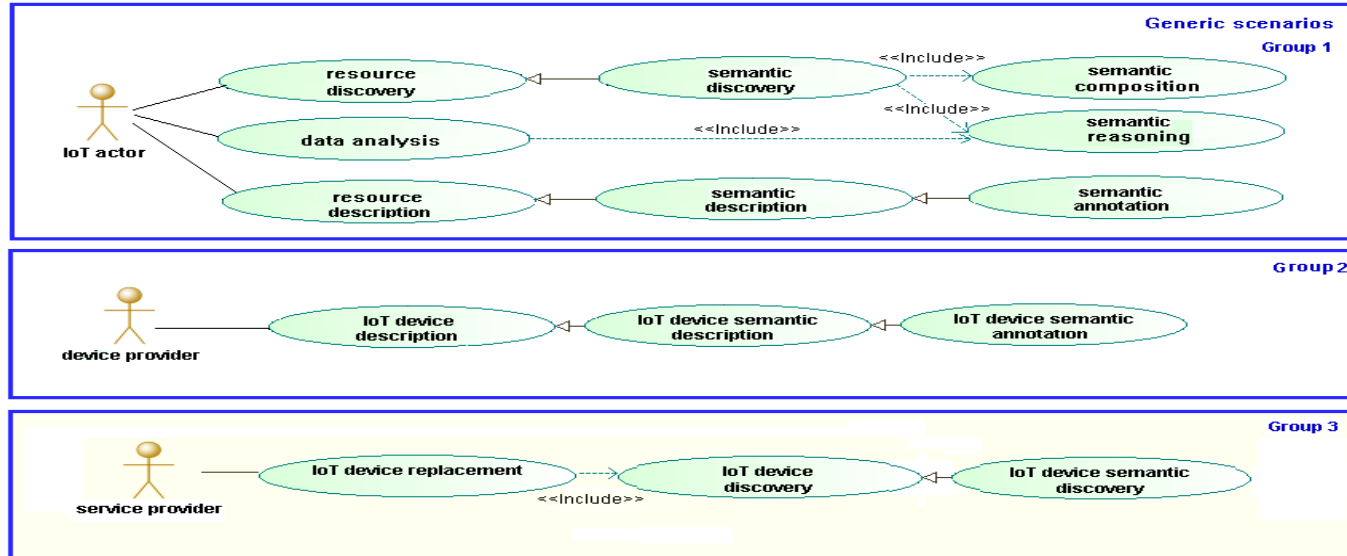
Essential requirements of the IoT infrastructure for data and services include:

- interoperability, scalability, discovery, consistency, reusability and composability, analytics and reasoning for actionable intelligence, automatic operations

  [Some factors driving these requirements: number of interconnected things, variety of devices, types of collected data, number and types of services]

The semantics based approaches reveal outstanding features to support these requirements, increasing the level of interoperability of IoT systems

Semantics based scenarios of the IoT (examples)

ITU-T Y.2076 findings liaised to oneM2M (with positive feedback), and referred in Oct 2015 AIOTI WG3's Technical Report on "Semantic Interoperability"

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

Studies on requirements and basic capabilities, and other cross-domain studies

- Semantics related aspects (description of things)
- Big Data related aspects (specific reqts and capabilities of IoT for Big Data)
- Detailed requirements of networks supporting IoT applications (initial focus on sensors and smart meters as devices)
- Accounting and charging aspects
- Identification, security and privacy (IoT device identity)
- Openness (cross-domain data exchange, network/device capabilities exposure, enhanced IoT gateway)

Cross-domain frameworks and architectural studies

- (Ref.) Architectures (for network/device capabilities exposure, for IoT gateway)
- NGN-based Architecture of the IoT
- Networking frameworks (constrained node, self-organization, social device)
- Web of Things framework (for home and energy management applications)
- Other frameworks (for IoT devices)

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

IoT use cases

- Generic use case template, use cases in different application domains

IoT applications (already identified and newly identified domains)

- Smart Manufacturing (framework in the context of the Industrial IoT)

- E-health

- E-agriculture (Smart Farming)

- Wearable device and services

- Cooperative ITS applications and Transportation Safety Service

- Monitoring and study of Global Processes of the Earth for disaster preparedness

APIs and protocols

- IPV6 for IoT (reference model of protocol suite for IPV6 interoperable IoT deployments)

Potential future IoT studies – personal considerations (1/2)

More studies in areas already addressed by ongoing work items, including:

- (Ref.) Architectures (common functions, profiling (per app. domain or other))

- Interoperability and portability (a number of potential studies incl. single versus multiple systems/platforms/administrative domains)

- Numbering, Naming, Addressing and Identification (e.g. federation of identity schemas)

- Security, Privacy and Trust (e.g. Privacy with respect to data sharing or data analytics)

- Semantics enablement (more scenarios, supporting tools (e.g. ontologies), semantics for verticals and cross-domain applications)

- (Big) Data management (data life cycle governance, ownership, access, quality)

(Stronger) integration of leading technologies with the IoT, including studies related to:

- Enhanced networking (e.g. autonomic networking)

- Network "Softwarization" (including SDN and NFV)

- Cloud Computing and distributed (edge) computing

- Actionable intelligence ((Federated) data analytics, personal analytics, other)

- Advanced capabilities of devices

- Energy management

Potential future IoT studies – personal considerations (2/2)

IoT and 5G (e.g. enhanced simultaneous support of IoT applications with different requirements - via network slicing or other)

APIs and protocols (large spectrum of potential studies)

Performance (KPIs) and testing aspects

Support of specific requirements from developing countries (e.g. low cost systems/applications for rural areas)

The COLLABORATION among the various international efforts on IoT standardization (convergence and/or integration of standards) - including with respect to the intersection of ICT and Vertical industries - IS and WILL BE CRITICAL for the large scale deployment of IoT systems and applications

Thank you very much for your attention

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Backup slides

The "IoT Standards Roadmap" of JCA-IoT and SC&C

Living document collecting IoT standardization activities performed by ITU-T and other SDOs (published and ongoing deliverables). Regularly updated based on exchanges with other SDOs.

Extract from the roadmap

Activity domain	Entity	Title of deliverable	Scope of deliverable	Current status	Starting date	Target date
General	ITU-T SG2 Q1	**ITU-T E.101**, Definitions of terms used for identifiers (names, numbers, addresses and other identifiers) for public telecommunication services and networks in the E-series Recommendations	This Recommendation provides terms and definitions for use in the field of identifiers (e.g., names, numbers, addresses and other identifiers (IDs)) for public telecommunication services and networks.	Recommendation		2009-11-24
NID	ITU-T SG13 Q2	**ITU-T Y.2213**, NGN service requirements and capabilities for network aspects of applications and services using tag-based identification	This Recommendation covers: -description and scope of tag-based identification applications and services with some example scenarios; -high-level service requirements of tag-based identification applications and services; and -extended or new NGN capabilities based on the high-level service requirements. Functional requirements and related NGN architecture extensions for support of the described capabilities are out of scope of this Recommendation.	Recommendation		2008-09-12

Tool for consideration concerning collaboration and harmonization of SDOs' IoT standardization efforts (as standards repository and support for gap analysis).

Common requirements of the IoT [ITU-T Y.2066]

The common requirements of the IoT are technical requirements independent of any specific application domain

- **IoT non-functional requirements**: refer to the requirements related to the implementation and operation of the IoT itself
  - Interoperability, scalability, reliability, high availability, adaptability, manageability
- **IoT functional requirements**: refer to the requirements related to the IoT actors (i.e. entities external to/interacting with the IoT); these requirements have been categorized as
  - Application support requirements
  - Service requirements
  - Communication requirements
  - Device requirements
  - Data management requirements
 - Security and privacy protection requirements

Network requirements of the IoT (ongoing ITU-T Y.IoT-network-reqts)

Numerous types of IoT devices, numerous types of access technologies, an increasing number of connected devices **=> it is important to investigate detailed network requirements of the IoT**, e.g. to avoid potential issues such as service failures caused by congestion/overload in the network.

Y.IoT-network-reqts focus : network transport functions (but service support and network performance functions not excluded)

Example use case (issue to be solved): Possible unbalanced load of the ad-hoc network from the core network point of view
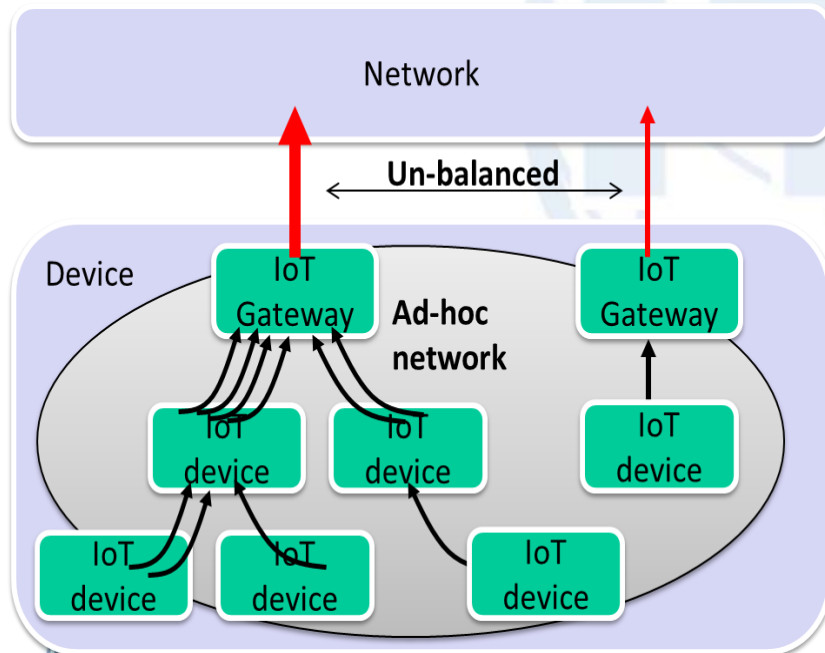
Network-based solution: balancing the topology from the core network point of view
Identified network requirements to be supported: calculation of the optimal ad-hoc network topology by using monitoring information, and notification of appropriate actions based on calculation results
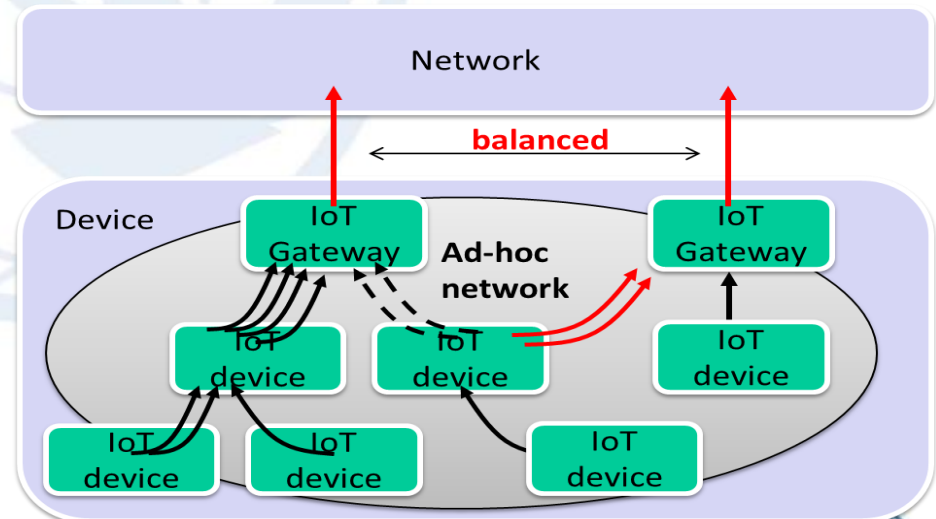
Marco Carugi

Marco Carugi works as consultant on advanced telecommunication technologies and associated standardization, and is currently contractor for NEC representing the company in standards development activities.

During his professional career, he has worked as Telecommunication Engineer in the Solvay group, Research Engineer in Orange Labs, Senior Advisor in the Nortel Networks CTO division and Senior Expert in the Technology Strategy department of ZTE R&D.

Marco is active in standardization since long time, and has held numerous leadership positions, including ITU-T SG13 Vice-Chair, ITU-T Rapporteur in last three study periods, ITU-T FG Cloud Computing WG Chair, OIF Board member, IETF Provider Provisioned VPN WG co-Chair.

He is currently Rapporteur for Question 2 - "Requirements and use cases for IoT" - in ITU-T SG20 (Internet of Things and its applications including smart cities and communities), still maintaining the Rapporteurship for Question 2 - "Requirements for NGN evolution and its capabilities including support of IoT and SDN" - in ITU-T SG13 (Future networks) where he also acts as SG13 Mentor.

Marco has led the development of technical specifications on requirements, capabilities and services for IoT/M2M since the creation of the ITU-T IoT Global Standards Initiative, acting also as convenor of the IoT work plan sessions within IoT-GSI. He is currently the ITU-T JCA-IoT/SG20 Liaison Officer to ISO/IEC JTC1/WG10 and to the Alliance for IoT Innovation (AIOTI) (WG3 on IoT standardization), participating regularly in the activities of the European Commission's Internet of Things Research Cluster [co-author of IERC books edition 2014 and 2013, and AIOTI WG3 Rel.1/2 deliverables on IoT standards landscape, high level architecture and semantic interoperability]. He has also acted as vice-chair of the past ITU-T Focus Group on M2M Service Layer.

NGN evolution and Future Networks, SDN, Cloud Computing and Big Data are other technical areas in which he is involved at present.

Marco has led the development of numerous standards specifications and published in technical journals and books.

He holds an Electronic Engineering degree in Telecommunications from University of Pisa (Pisa, Italy), a M.S. in Engineering and Management of Telecommunication Networks from National Institute of Telecommunications (Evry, France) and a Master in International Business Development from ESSEC Business School (Paris, France). He is currently completing a Certificate on Big Data at Ecole Centrale (Paris, France).