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IoT – ITU-T Standards

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Part I: IoT Overview

The Internet of Things - Introduction

Ubiquitous Computing
+ (Mark Weiser, Xerox Parc)
Ubiquitous Connectivity
=
The Internet-of-Things (ITU)



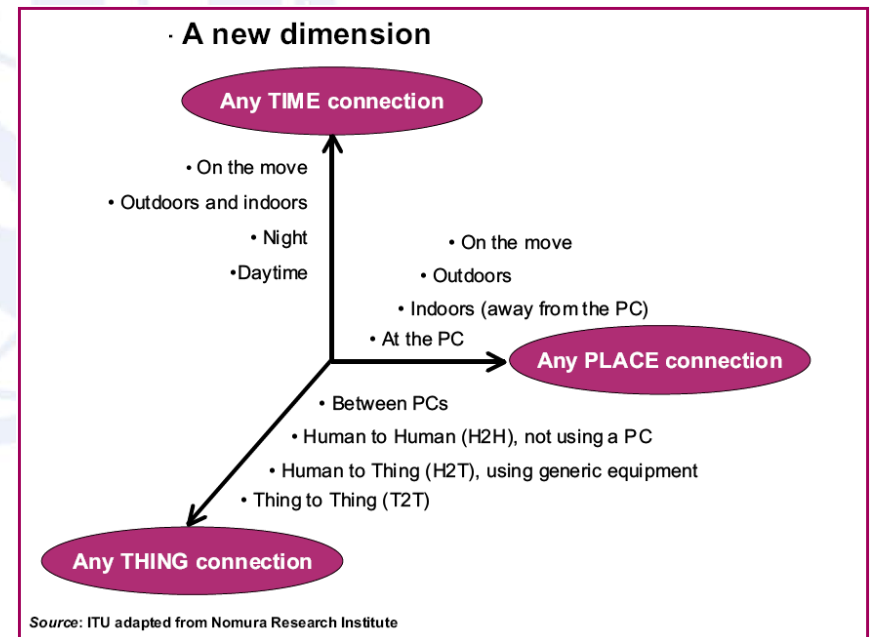
Ambient Intelligence

Related technologies:

- Item identification ("tagging things")
- Sensors and WSNs ("feeling things")
- Embedded systems ("thinking things")
- Nanotechnology ("shrinking things")

Tangible Media

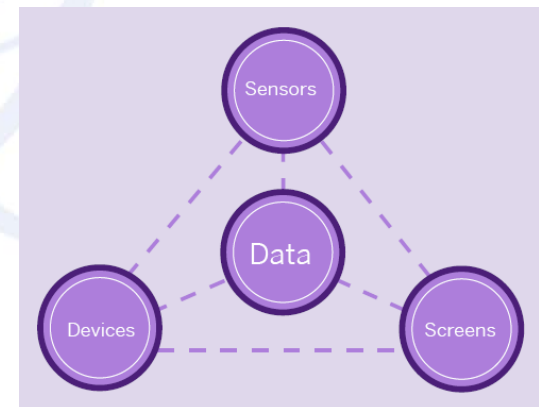
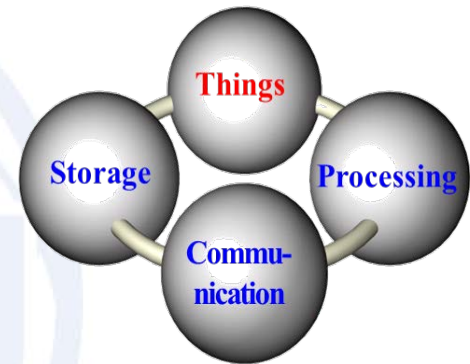
Bridging the gap between the physical and virtual world



IoT Infrastructure

- Enhancements of networking/ service scope/capabilities
 - Extension of **service**
 - Extension of **network**

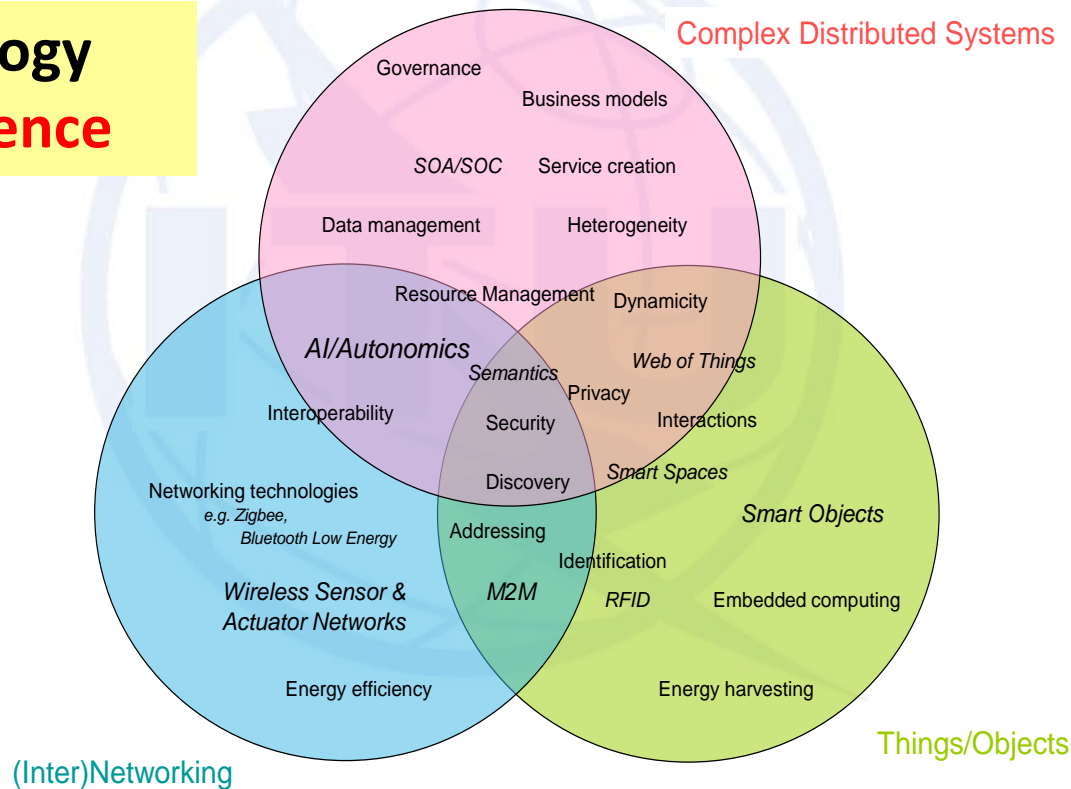
Challenges – readable, recognizable, locatable, addressable and/or controllable via the **Internet**



Source: Technology 2020 (The Future Company)

The three viewpoints of the Internet of Things

**Technology
Convergence**



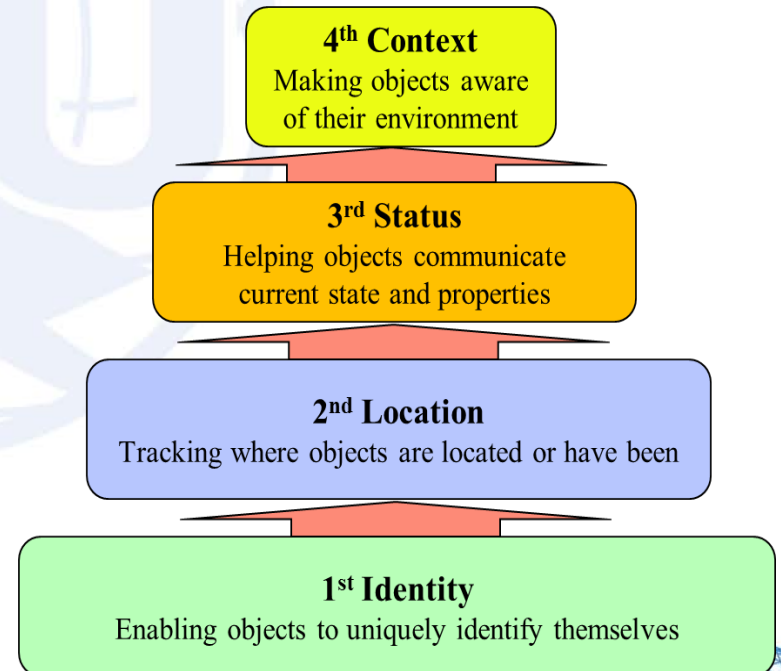
(Source) Gyu Myoung Lee, et al., "Internet of Things," in a book "Evolution of Telecommunication services," LNCS, volume 7768, Springer, ISBN 978-3-642-41568-5, pp.257~282, 2013.

The Promise of the IoT

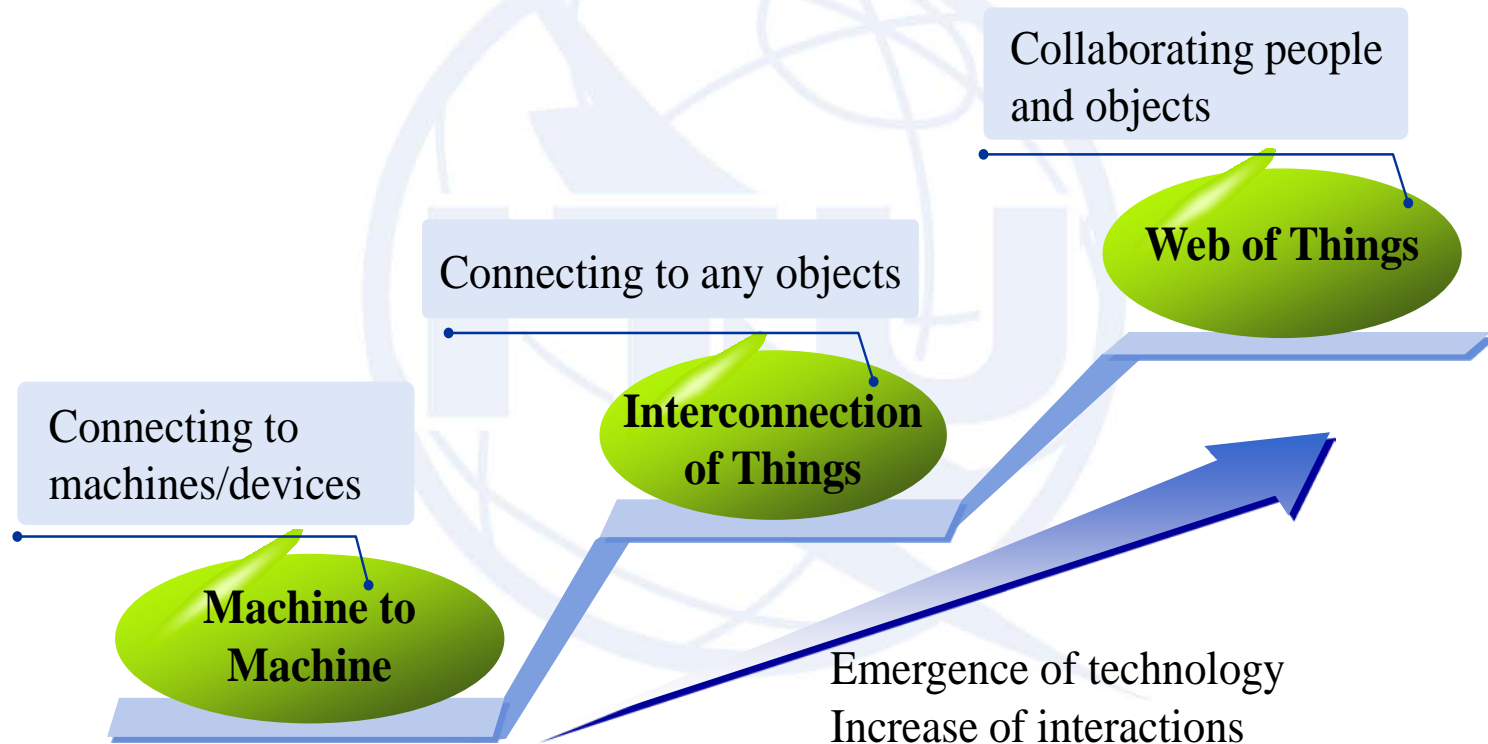


- Characteristics of the IoT
 - IP connectivity
 - Personalization
 - Intelligence
 - Tagging objects
 - Smart devices

Evolution of **Smart Objects**



Technical evolution

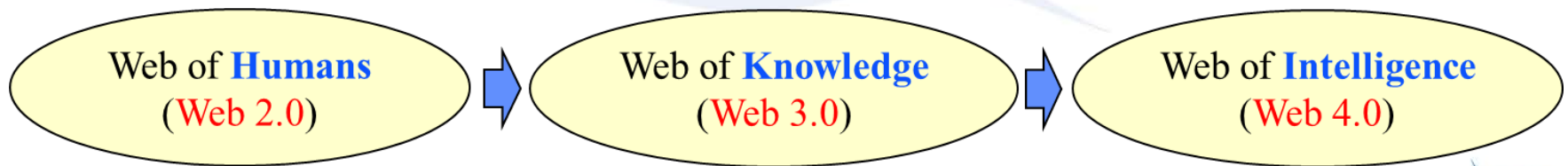


Evolution of Web

- Kevin Kelly: Predicting the next 5,000 days of the web
 - Linking computers (The Net)
 - Linking pages (The Web)
 - Linking data (The One)

Ref) <http://www.youtube.com/watch?v=yDYGf4ONh5M>

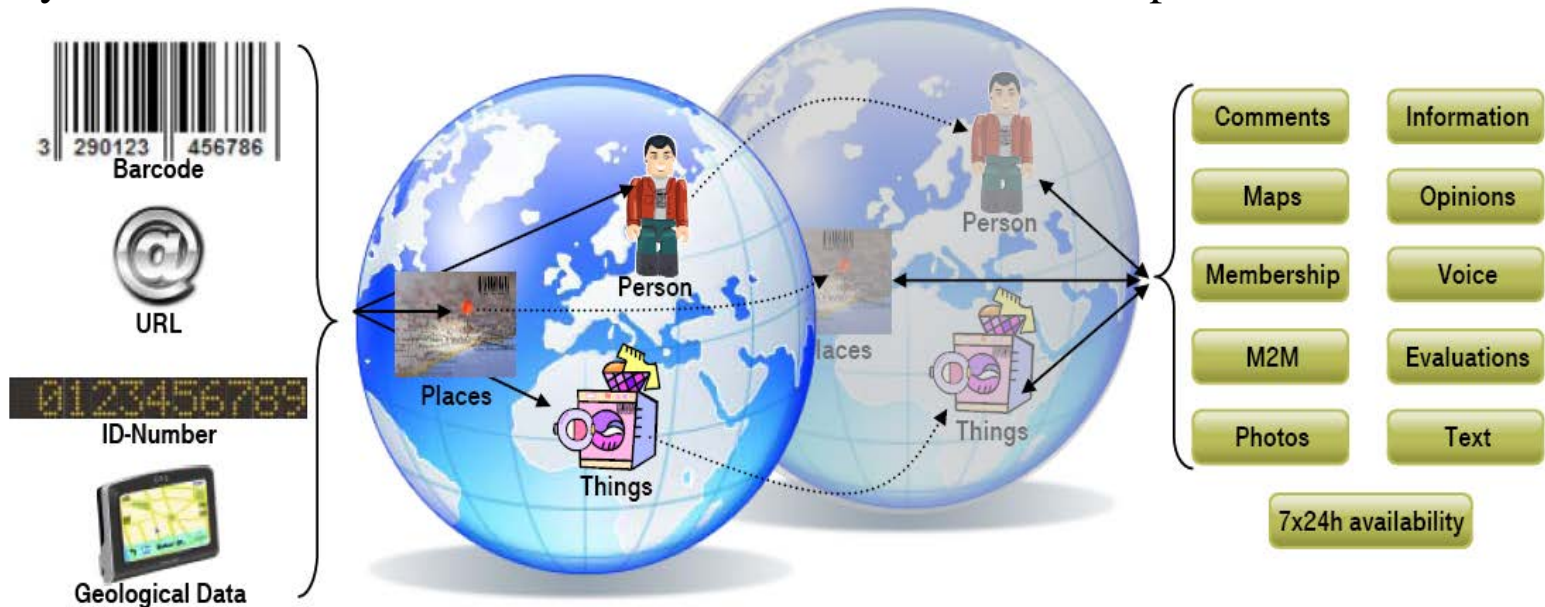
– **Linking things (The World)**



From the IoT to the WoT

Each Physical entity can be part of the Web.

Physical entities are marked in the real-world and become a part of the virtual world.



The integration of the physical world with the Web offers unique opportunities to enable ubiquitous computing applications.

Web enabled objects

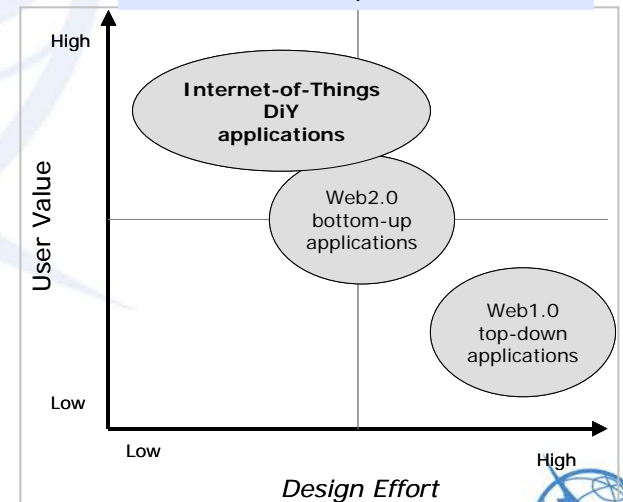
User-created **Web-of-Things** Applications

- Delivering web content
 - Capacity to query and process data streams
- Publishing content
 - Capacity to send data through APIs
- Triggering other objects
 - Capacity to interoperate and share data
- Adapting their behavior
 - Capacity to interpret data streams

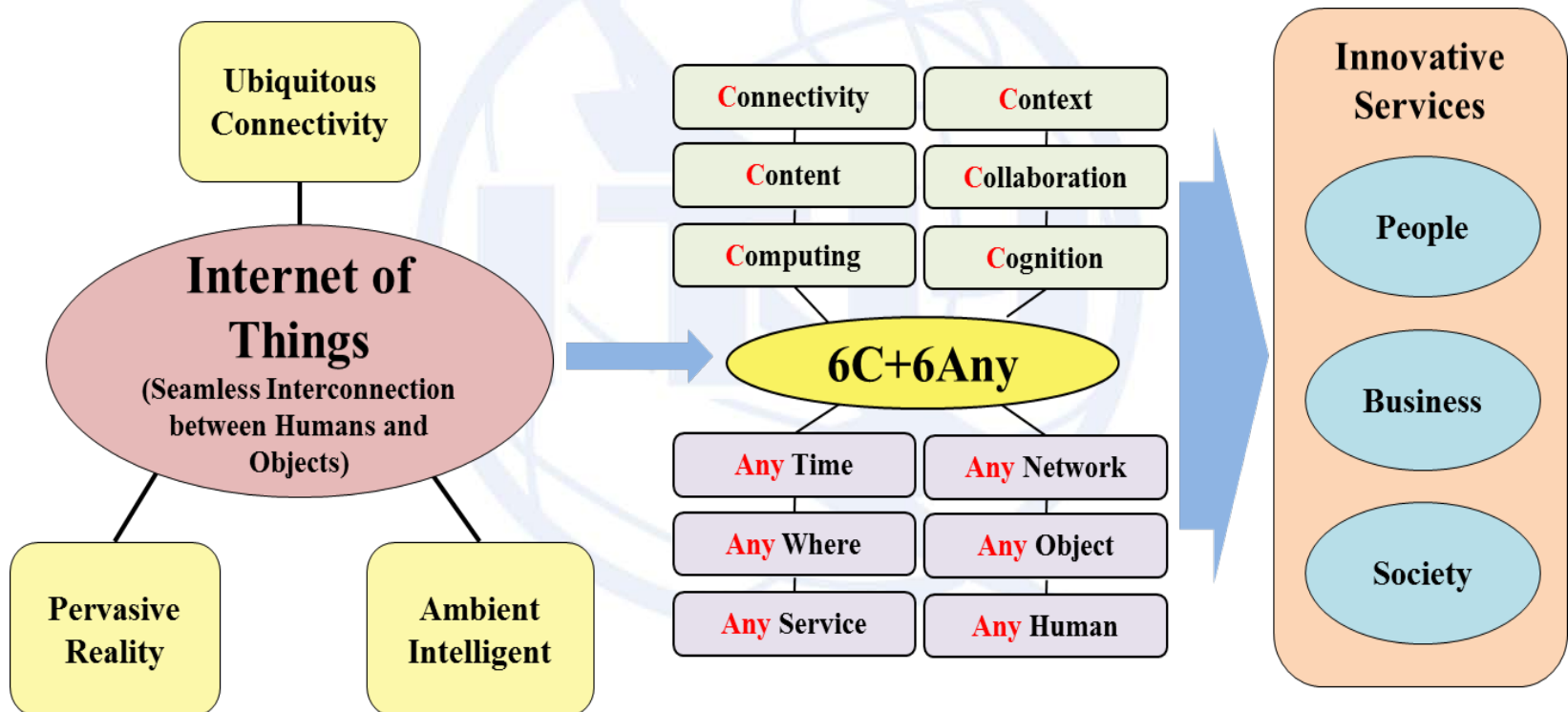
Web's easy application creation



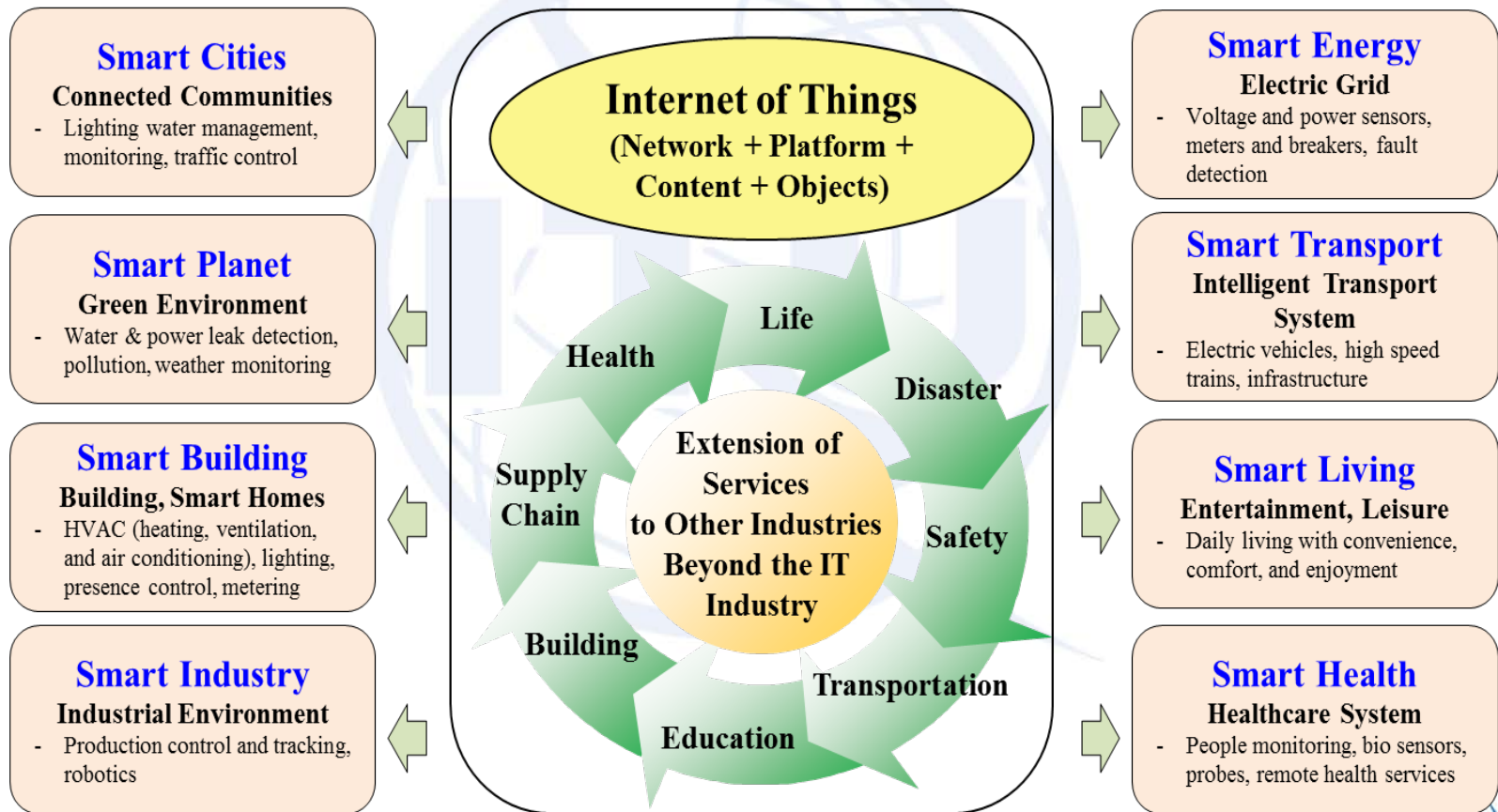
IoT's abundance of connected smart objects



IoT vision and impact



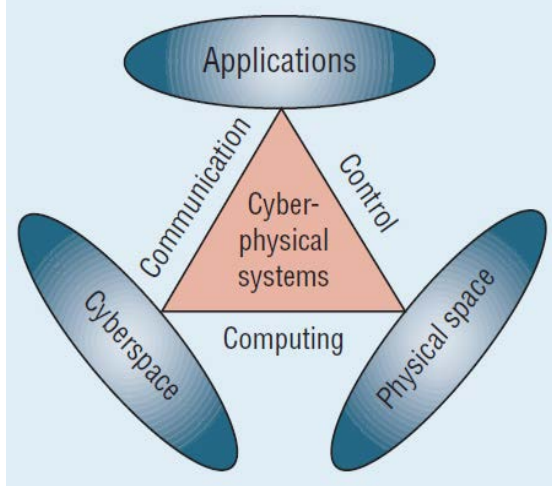
IoT Applications



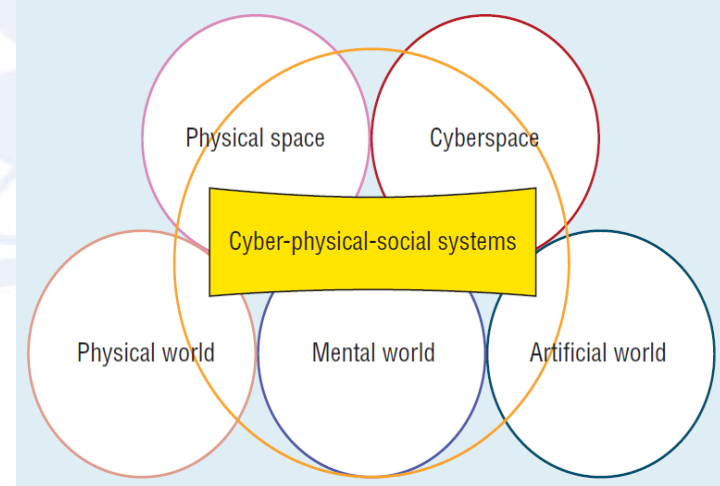
Internet of Things and People (SloT)

- Use the Internet of Things to **connect people**
 - Enriching the Internet of Things by people's content
- **Collaborative Device Communities**
 - Social networking + Internet of Things

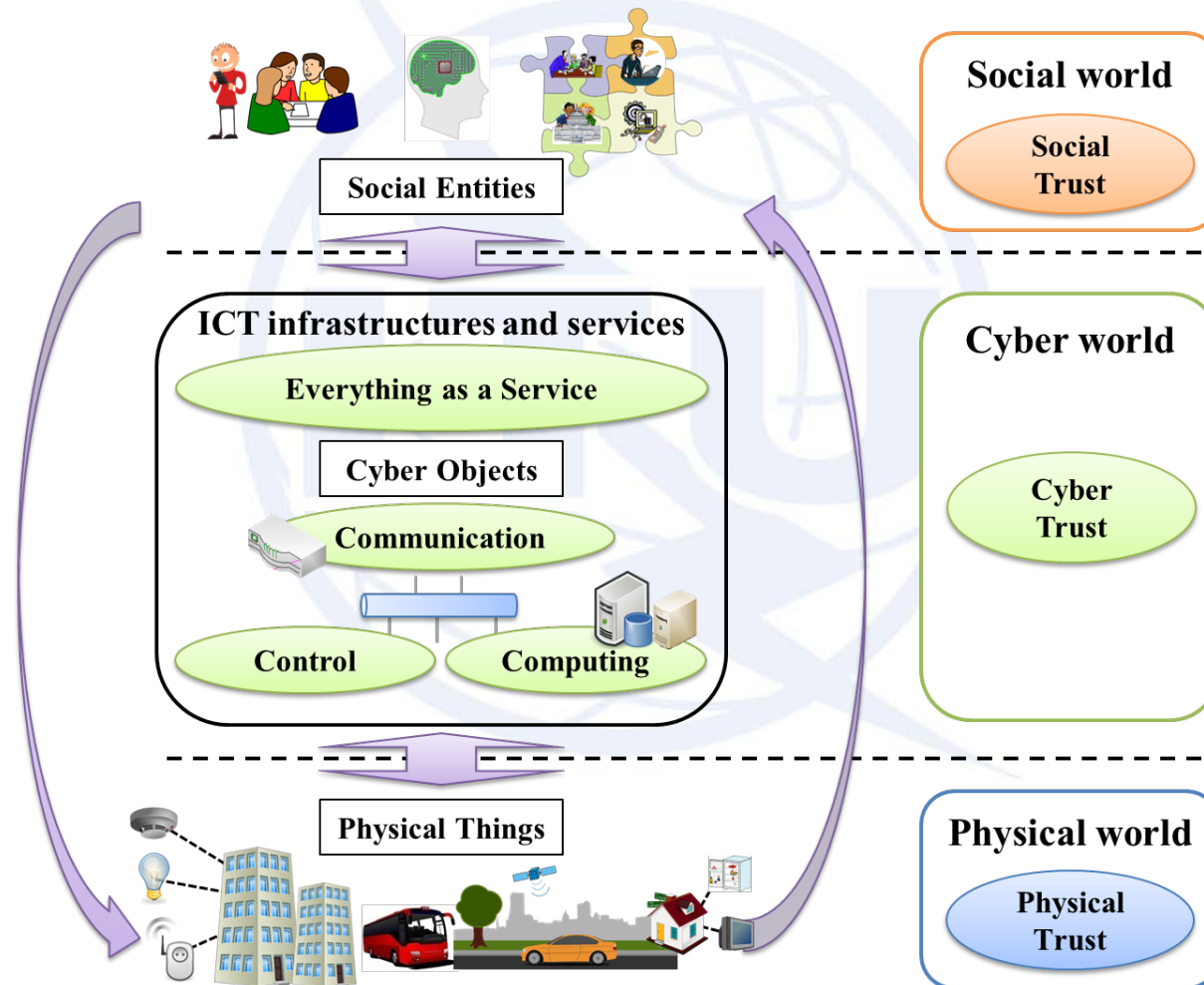
Cyber Physical Systems



Cyber Physical **Social** Systems



Cyber Physical Social System



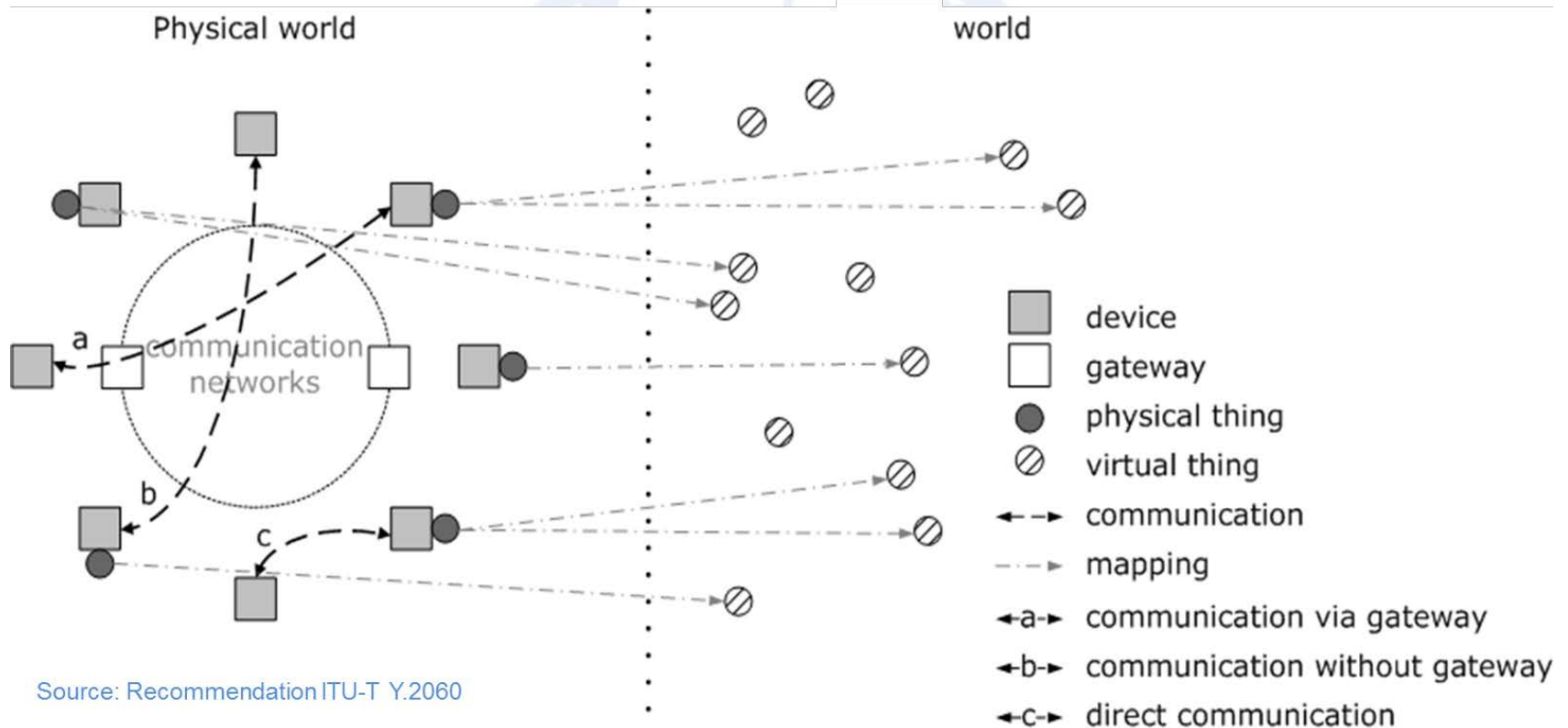
Part II: ITU-T Study Group 20 (IoT and Smart Cities & Communities)



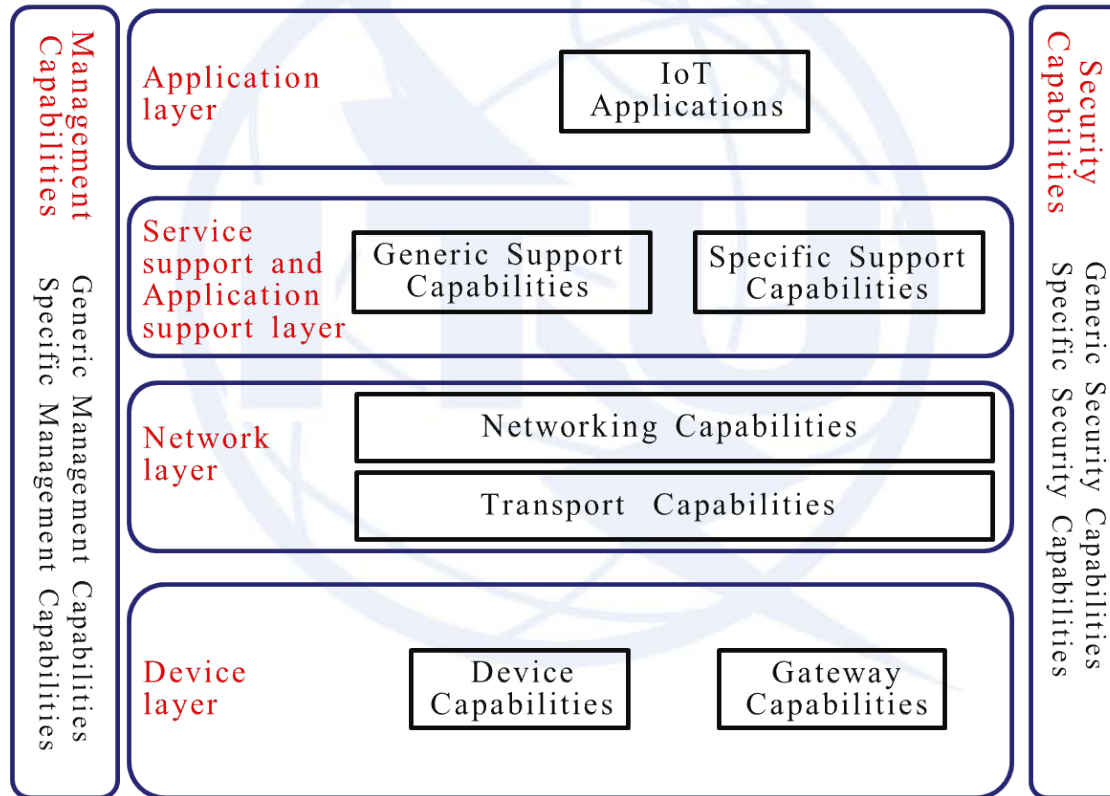
Internet of Things Definition

- A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.
- NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.
- NOTE 2 – From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.

ITU-T Recommendation Y.2060: Overview of IoT (June 2012)



IoT Reference Model



ITU-T SG20 New Structure

	Title
Working Party 1	
Question 1/20	End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C
Question 2/20	Requirements, capabilities, and use cases across verticals
Question 3/20	Architectures, management, protocols and Quality of Service
Question 4/20	e/Smart services, applications and supporting platforms
Working Party 2	
Question 5/20	Research and emerging technologies, terminology and definitions
Question 6/20	Security, privacy, trust and identification
Question 7/20	Evaluation and assessment of Smart Sustainable Cities and Communities

Q1/20

End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C

Work Item	Title
Y.4454 (ex Y.SC-platform)	Platforms interoperability for smart cities
Y.frame-scc	Framework and high-level requirements of smart cities and communities
Y.fsn	Framework and Service scenarios for Smartwork
Y.infra	Overview of city infrastructure
Y.ism-scc	A Technical Framework of Integrated Sensing & Management for Smart Sustainable Cities
Y.isw-scc	The Integrated Sensor Web Resource Metadata for Smart Sustainable Cities
Y.SC-infra-TS	Telecommunication systems as infrastructure in smart cities and communities
Y.SC-OpenData	Framework of Open Data in Smart Cities
Y.SC-Overview	An overview of smart cities and communities and the role of information and communication technologies

Q2/20 (1)

Requirements, capabilities, and use cases across verticals

Work Item	Title
Supp.-Y.IoT Scenarios for Developing Countries	Scenarios of Implementing Internet of Things in networks of developing countries
Supp-Y.IoT-Use-Cases	IoT Use Cases
Y.2067	Common requirements and capabilities of a gateway for Internet of Things applications
Y.4114 (ex Y.IoT-BigData-reqts)	Specific requirements and capabilities of the IoT for Big Data
Y.Accessibility-IoT	Accessibility requirements for the Internet of things applications and services
Y.IoT-AC-reqts	Requirements for accounting and charging capabilities of the Internet of Things
Y.IoT-GP-Reqts	Requirements for an IoT enabled network to support applications for global processes of the earth
Y.IoT-ITS-framework	Framework of Cooperative Intelligent Transport Systems based on the Internet of Things
Y.IoT-Retail-Reqts	Requirements and reference model of IoT applications for smart retail stores



Q2/20 (2)

Requirements, capabilities, and use cases across verticals

Work Item	Title
Y.IoT-things-description-reqts	Requirements of things description in the Internet of Things
Y.IoT-WDS-Reqts	Requirements and capabilities of Internet of Things for support of wearable devices and related services
Y.SEM	Requirements and capability framework of Smart Environmental Monitoring
Y.SmartMan-IIoT-overview	Overview of Smart Manufacturing in the context of Industrial Internet of Things
Y.Smartport	Requirements of smart management of supply services in smart port
Y.SRC	Requirements for deployment of smart services in Rural Communities
Y.TPS-req	Requirements of transportation safety service including use cases and service scenarios
Y.WPT-usecase	Use cases of Wireless Power Transfer Application Service

Q3/20

Architectures, management, protocols and Quality of Service

Work Item	Title
Supp-Y.IPV6-IoT	IPv6 Potential for the Internet of Things and Smart Cities
Y.gw-IoT-arch	Functional architecture of gateway for IoT applications
Y.IoT-ics	Requirements and functional architecture of Open IoT identity correlation service
Y.IoT-NCE	Reference architecture for IoT network service capability exposure
Y.IoT-sd-arch	Functional architecture of Service Discovery for Interworking between Heterogeneous IoT Platforms
Y.IoT-son	Framework of self-organization network in the IoT environments
Y.IPV6RefModel	Reference Model of IPv6 Subnet Addressing Plan for Internet of Things Deployment
Y.IPV6-suite	Reference Model of Protocol Suite for IPV6 interoperable Internet of Things Deployments
Y.NGNe-IoT-arch	Architecture of the Internet of Things based on NGNe

Q4/20

e/Smart services, applications and supporting platforms

Work Item	Title
Y.del-fw	Framework of delegation service for the IoT devices
Y.IoT-SQ-륜	Service Functionalities of Self-quantification over Internet of things
Y.ISG-fr	Framework of IoT-based Smart Greenhouse
Y.Pops	Postproduction service of Smart Farming on the network
Y.Psfs	Functional model for production service of Smart Farming
Y.SC-Residential	Requirements of Smart Residential Communities
Y.smart-evacuation	Framework of Smart Evacuation during emergencies in Smart Cities and Communities
Y.social-device	Framework of the social device networking
Y.SPL	Requirements and Reference Framework for Smart Parking Lots in smart city
Y.SL	Requirements and Reference Framework for Smart Street Light
Y.STD	Reference Model for Smart Tourist Destinations: platform interoperability and functionalities
Y.TPS-afw	Architectural framework for providing transportation safety service
Y.WoO-hn	Service capability and architecture in web of objects enabled home network



Q5/20

Research and emerging technologies, terminology and definitions

Work Item	Title
<u>Y.CrowdSystems (ex Y.Reg-Arch-CS)</u>	Requirements and Functional Architecture of IoT-related Crowdsourced Systems
<u>Y.HEP</u>	Framework for Home Environment Profiles and Levels of IoT Systems
<u>Y.SCC-Terms</u>	Vocabulary for Smart Cities and Communities

Q6/20

Security, privacy, trust and identification

Work Item	Title
<u>Y.4805 (ex Y.SC-Interop)</u>	Identifier service requirements for the interoperability of Smart City applications
<u>Y.IoT-DA-Counterfeit</u>	Information Management Digital Architecture to combat counterfeiting in IoT
<u>Y.IoT-Interop</u>	An Interoperability framework for IoT
<u>Y.IoT-IoD-PT</u>	Identity of IoT devices based on secure procedures and ensures privacy and trust of IoT systems
<u>Y.IoT-sec-safety</u>	Security capabilities supporting safety of the Internet of Things

Q7/20

Evaluation and assessment of Smart Sustainable Cities and Communities

Work Item	Title
<u>Y.IoT-EH-PFE</u>	Performance evaluation frameworks of e-health systems in the IoT
<u>Y.ODI</u>	Open Data Indicator in smart cities

New work items (March 2017)

TD reference	Question	Working title	Title
TD 185 Rev.1	Q1/20	Y.SSCP	"Requirements for interoperability of smart and sustainable city platforms based on a layered model"
TD 179 Rev.2	Q2/20	Y.IoT-NCM-reqts	"Requirements and capabilities of network connectivity management in the Internet of Things"
TD 186 Rev.1	Q2/20	Y.IoT-AERS-reqts	"Requirements and capability framework for IoT-based automotive emergency response system"
TD 183 Rev.1	Q3/20	Y.IoT-rmc	"Reference architecture of accessing IoT resources for management and control"
TD 234	Q4/20	Y.energy-mMG	"Application model for energy services on multiple microgrids"
TD 217	Q4/20	Y.IoT-BoT-fw	"Framework of blockchain of things as decentralized service platform"
TD 219	Q4/20	Y.STIS-fdm	"Function description and metadata of Spatio-temporal Information Service for SSC"
TD 237	Q4/20	Y.smart-evacuation	"Framework of Smart Evacuation during emergencies in Smart Cities and Communities"
TD 212	Q4/20	Y.SSL	"Requirements and Reference Framework for Smart Street Light"
TD 123 Rev.1	Q5/20	TR.AI4IoT	Artificial Intelligence and Internet of Things

Creation of SG20 Regional Groups

- SG20 decided to create the following four regional groups:
 - ITU-T SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia ([TD 117](#))
See: <http://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgeecat/Pages/default.aspx>
 - ITU-T SG20 Regional Group for the Latin America Region ([TD 118 Rev.1](#))
See: <http://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rglatam/Pages/default.aspx>
 - ITU-T SG20 Regional Group for the Africa Region ([TD 119 Rev.2](#))
See: <http://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgafr/Pages/default.aspx>
 - ITU-T SG20 Regional Group for the Arab Region ([TD 120 Rev.2](#))
See: <http://www.itu.int/en/ITU-T/studygroups/2017-2020/20/sg20rgarb/Pages/default.aspx>

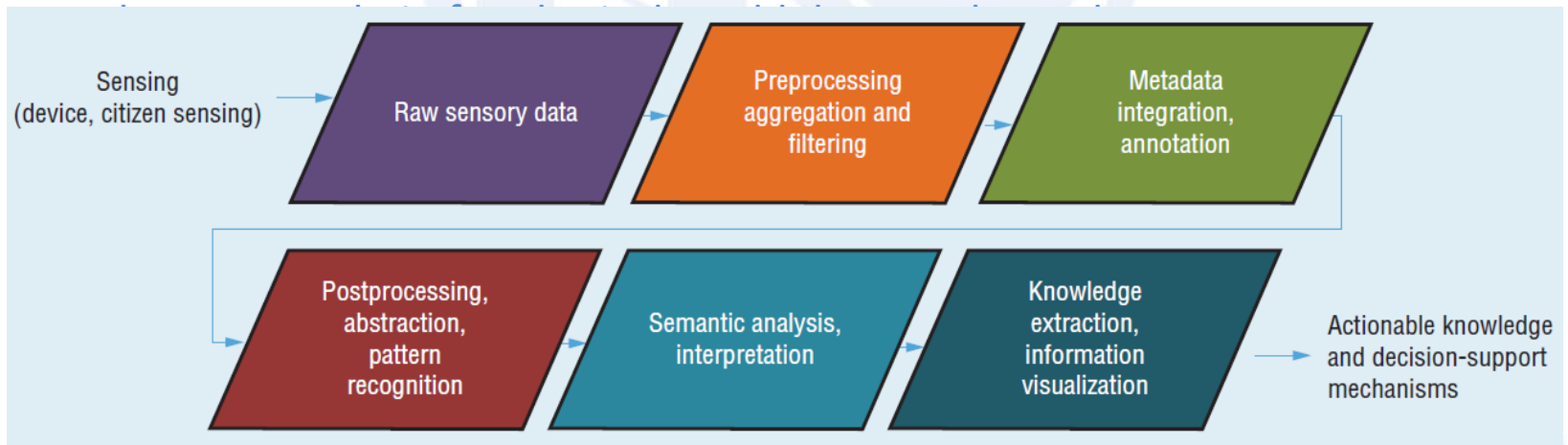
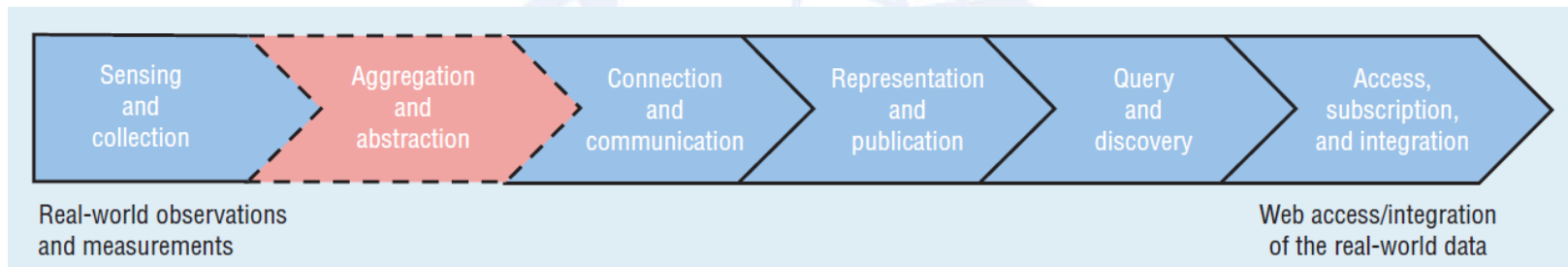
ITU-T FG-DPM

- SG20 created a new Focus Group on "Data Processing and Management to support IoT and Smart Cities & Communities".
- **Overall objectives:**
 - promote the establishment of trust-based data management frameworks for IoT and SC&C
 - investigate existing and emerging technologies
 - Identify and address standardization gaps and challenges

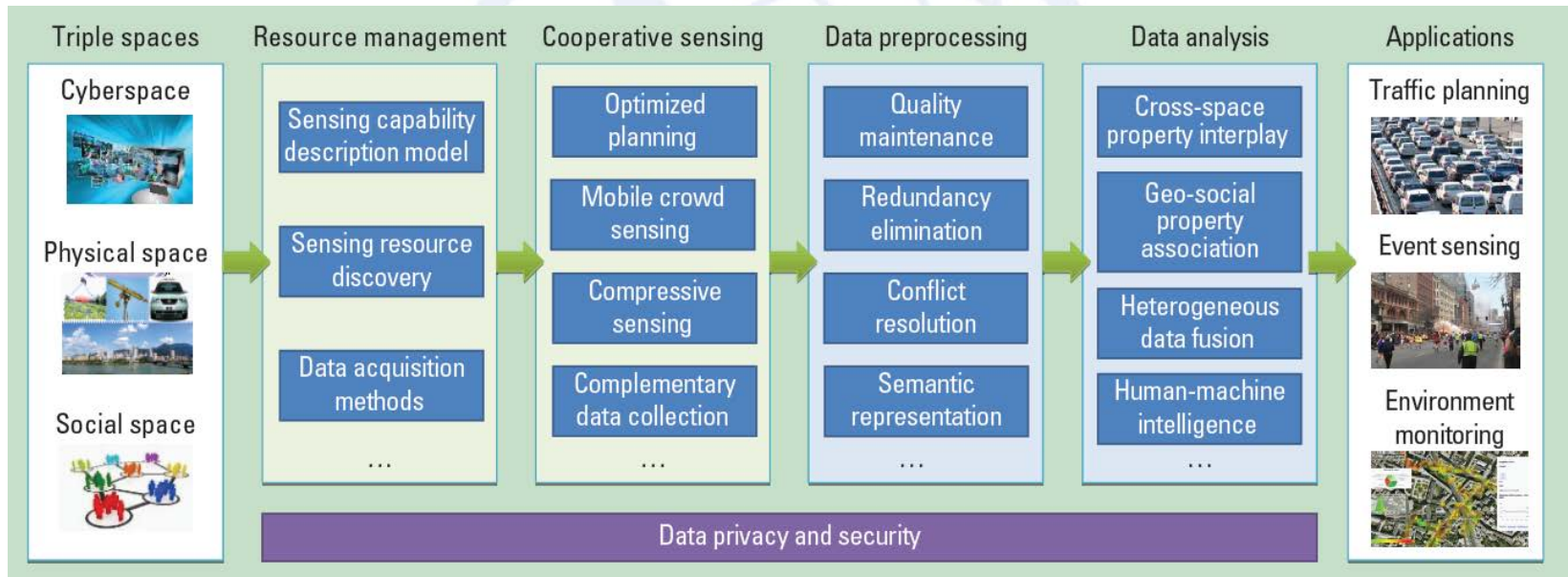
<https://www.itu.int/en/ITU-T/focusgroups/dpm/Pages/default.aspx>

From Data to Actionable Knowledge

- The data production and access chain



Data-driven cyber-physical-social systems



“A Data-Centric Framework for Cyber-Physical-Social Systems”, IEEE IT Professional, Nov.-Dec. 2015.

Conclusion – Putting all together

