

# **ITU Workshop on “Standardization on IMT, M2M, IoT, Cloud Computing and SDN”**

**(Algiers, Algeria, 8 September 2013)**

## **Achievements and ongoing work in the ITU-T standardization of the Internet of Things**

**Marco CARUGI**

**ITU-T Q2/SG13 Rapporteur and  
ITU-T FG M2M Service Layer Vice-Chair  
Senior Expert, ZTE Corporation**

[Marco.Carugi@zte.com.cn](mailto:Marco.Carugi@zte.com.cn) , [Marco.carugi@gmail.com](mailto:Marco.carugi@gmail.com)

Algiers, Algeria, 8 September 2013



# Outline

- Internet of Things (IoT) and Machine to Machine (M2M) communications
  - Introduction to market, technology and applications
- Advances in ITU-T standardization of IoT
  - Few organizational details
  - Some key achievements
  - Information on relevant ongoing work

*NOTE – these slides have not the objective to provide an exhaustive coverage of all ITU-T activities related to IoT (incl. published and ongoing specs). E.g., among the ongoing IoT activities not mentioned here, we can find Smart Grids and Home Networks (JCA-SG&HN), Smart Cities, Intelligent Transport Systems (FG CarCOM, open “collaboration on ITS communication standards” (CITS)) and others.*



# **IoT and M2M: introduction to market, technology and applications**

NOTE – application examples are shown via some ZTE deployment cases

# More and more “Things” connected

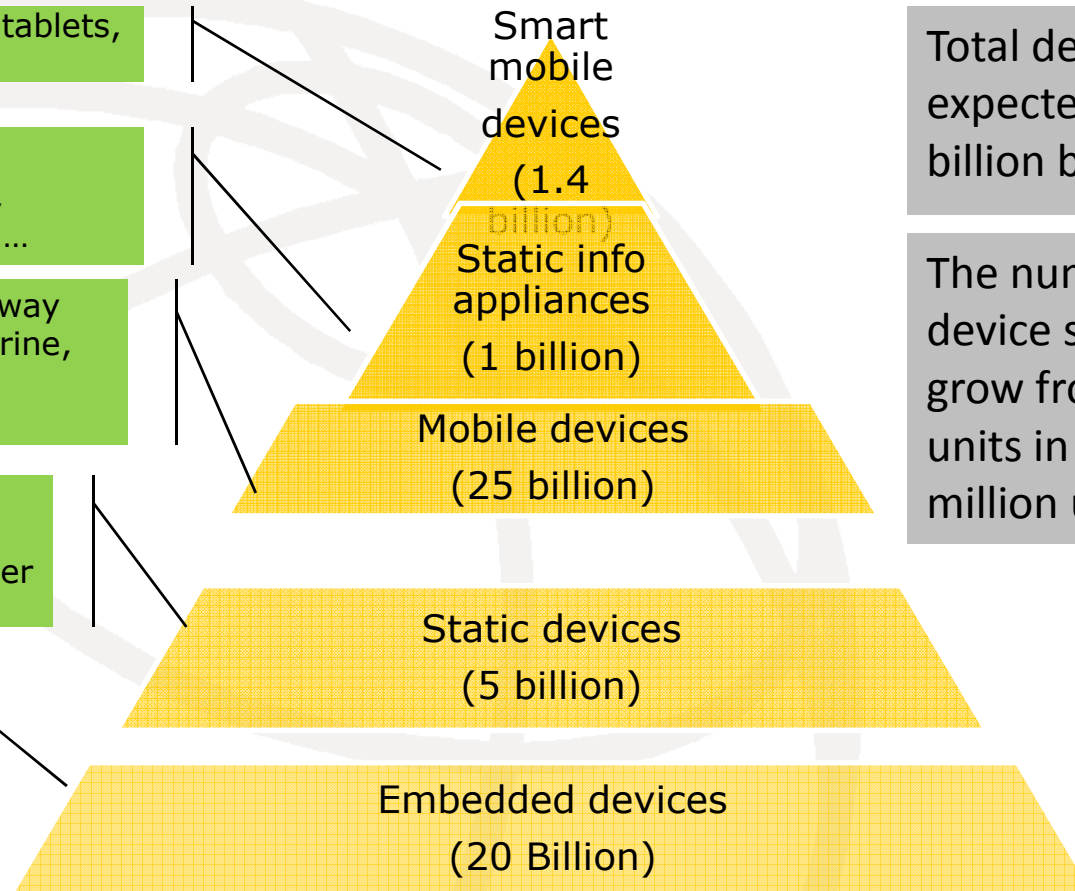
Mobile phones, notebooks, tablets, ...

PC, servers/storage, routers/switches/gateways, printers, game equipment, ...

Commercial equip, off-highway vehicles, air/rail/transit/marine, navigation systems, mobile healthcare devices

Building equipment, Retail/Vending/PoS/ATMs, healthcare equipment, power distribution equipment

Controllers, sensors, instruments, meters



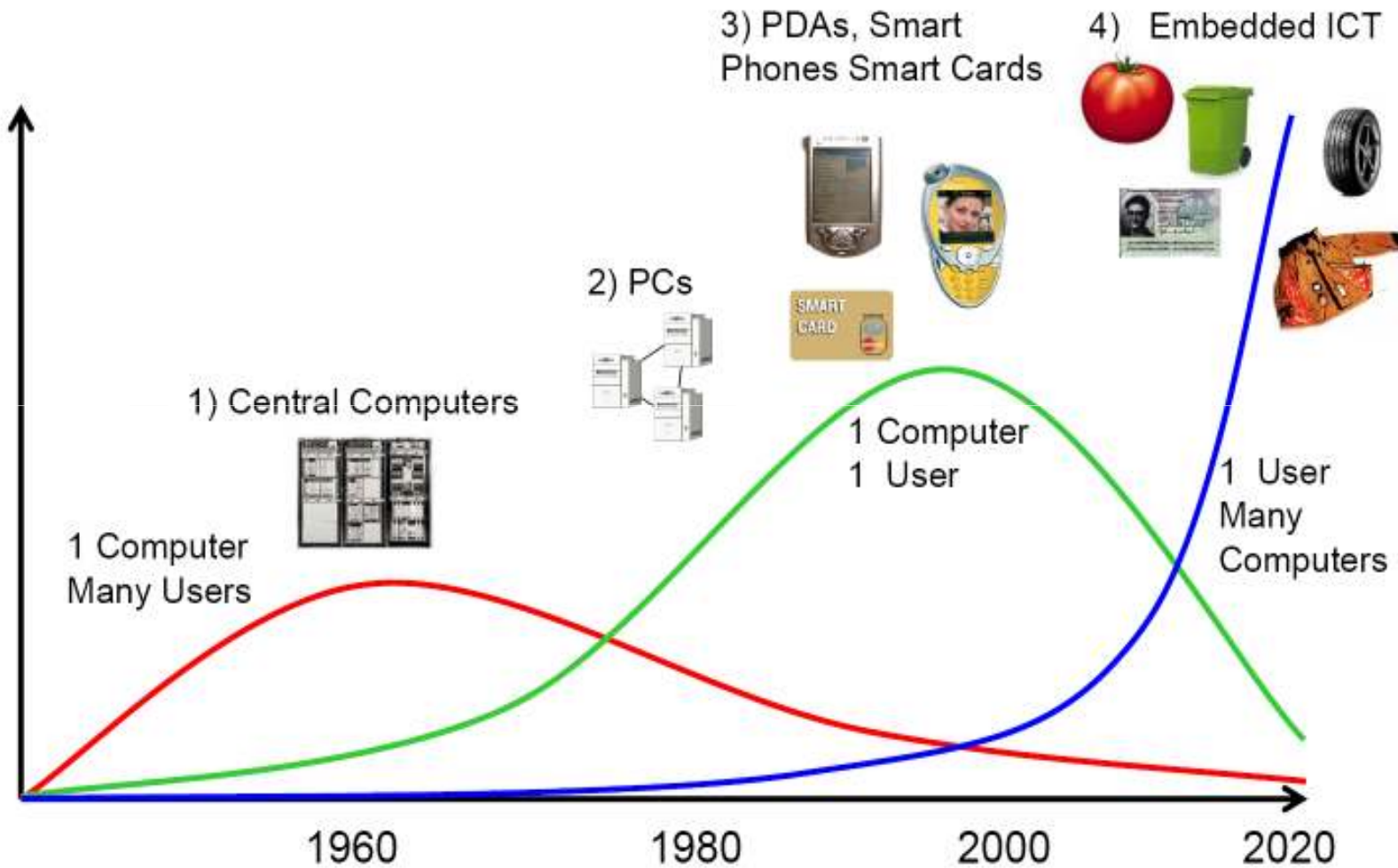
Total device revenue is expected to exceed \$12 billion by 2013

The number of intelligent device shipments will grow from 73 million units in 2008 to 430 million units in 2013

Source: Harbor Research, Inc. (2010)

**“Internet of Things”: one of Gartner’s 2012 top 10 strategic technologies**

# The Internet of Things: the post-PC era



Source: DFKI, German Research Center for Artificial Intelligence

# Convergence of Internet of Things and Internet of People

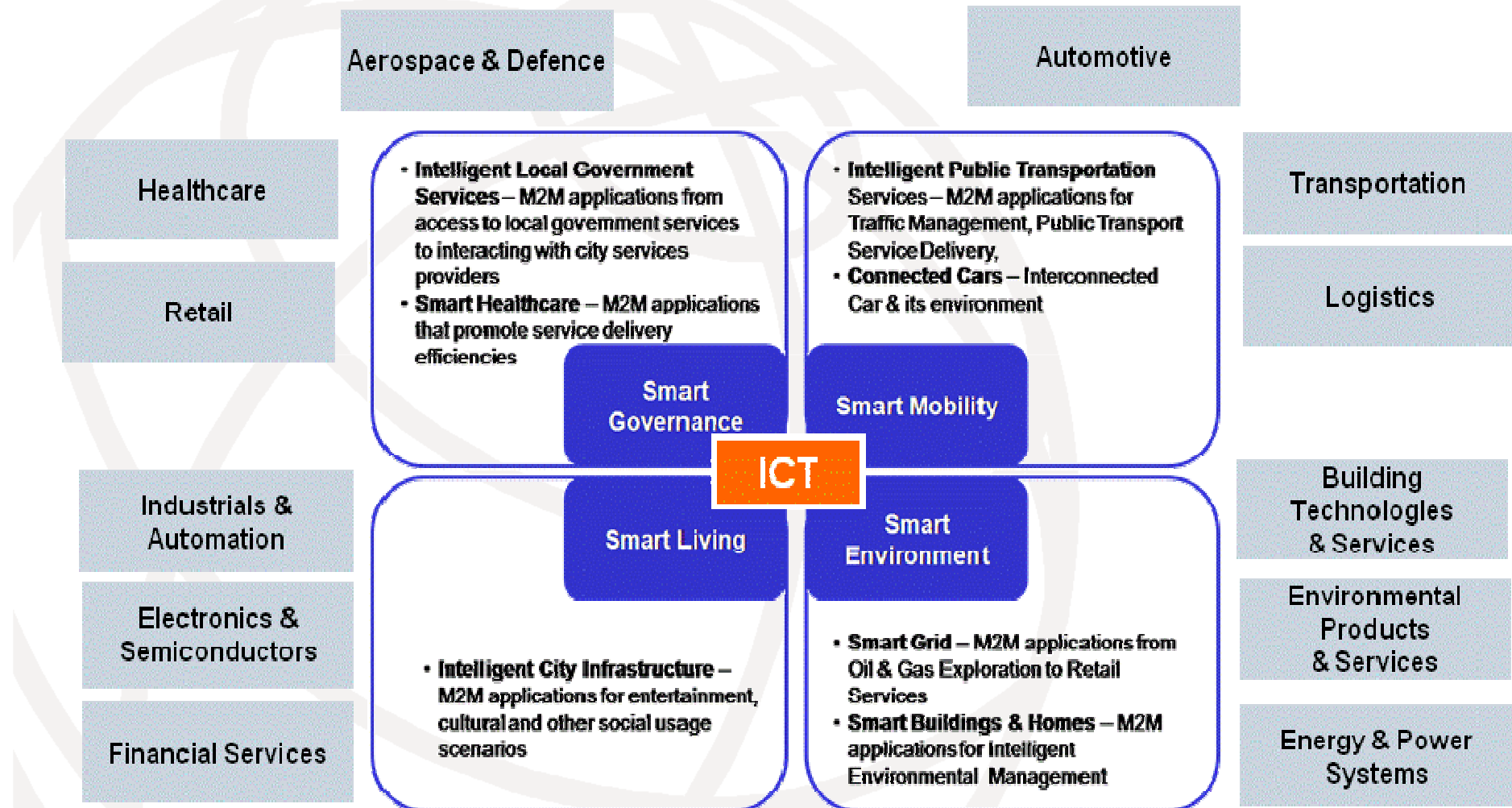


**More and more smart services:** agriculture, surveillance, public safety, ads, smart home, smart grid, fleet management, ...



**“Machine to Machine” technologies: a key enabler of IoT infrastructure**

# M2M technologies becoming pervasive in various Industries (driving convergence between ICT and Industries)



Source: Frost & Sullivan (2012)

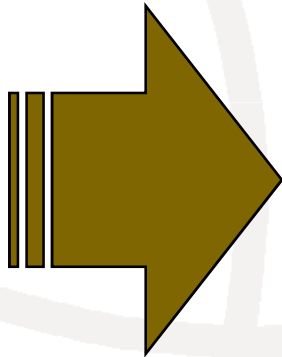
# Some trends in IoT/M2M

**2005 - 2009**

**Fragmented market &  
vertical applications**

**B2B services**

**Dominance of cellular  
network**



**2010 and beyond**

**Horizontal solutions**

**B2B => B2C/B2B2C services**

**Multi-access network**

**Hyper-growth of Service Providers,  
variety of business models**

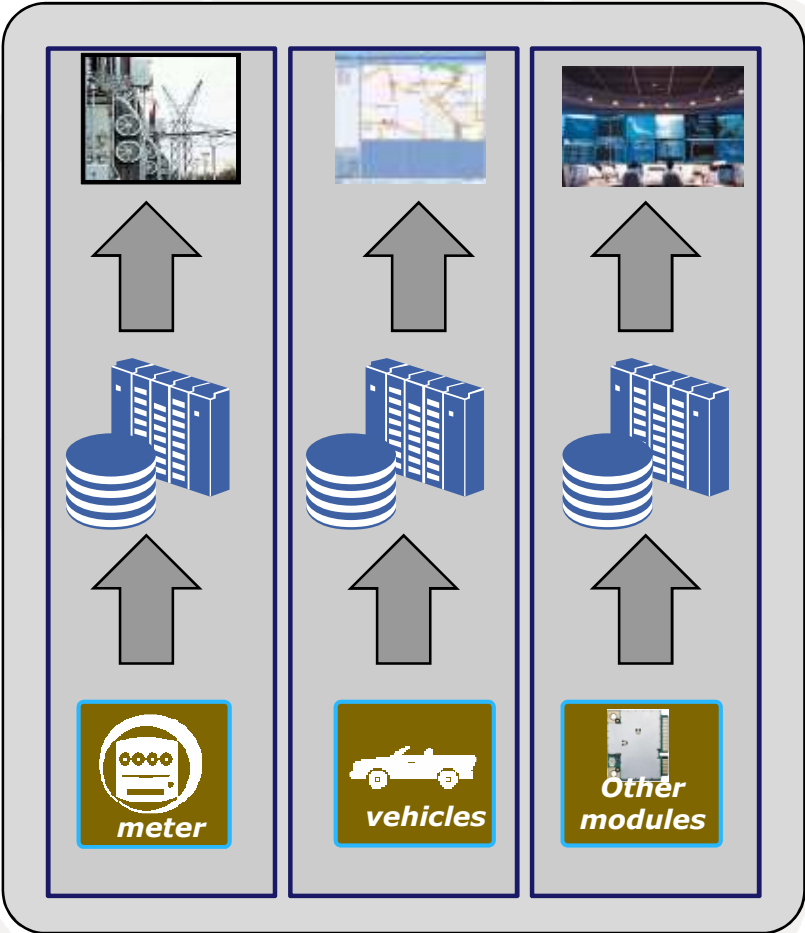
**Cloud Computing**

**From business market to mass market**



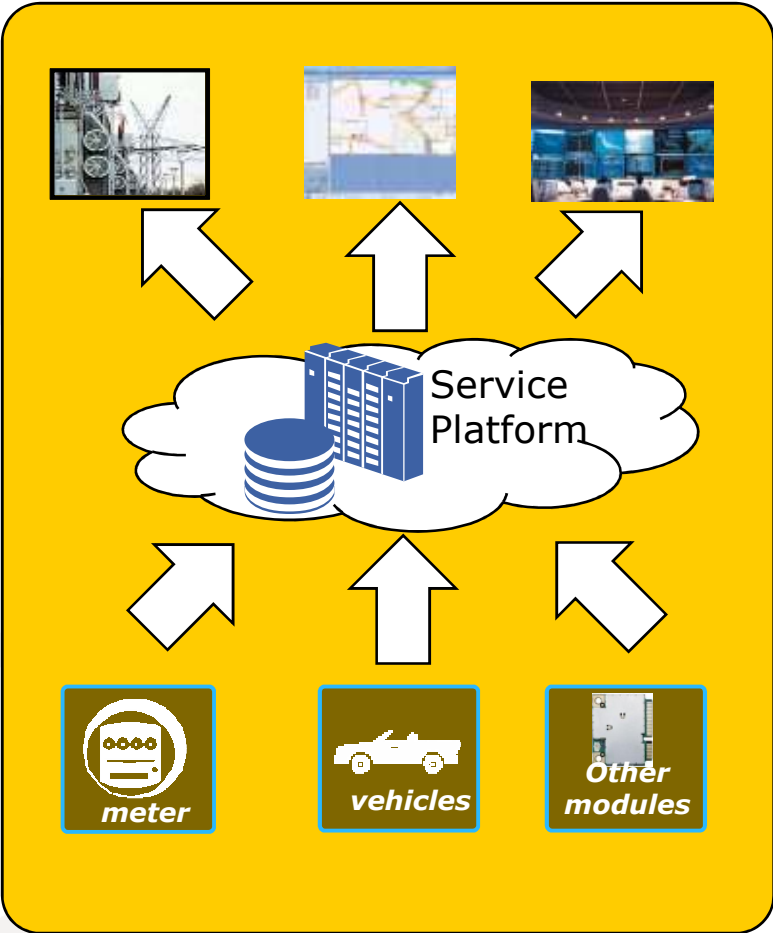
# From vertical to horizontal integration model

VERTICAL MODEL



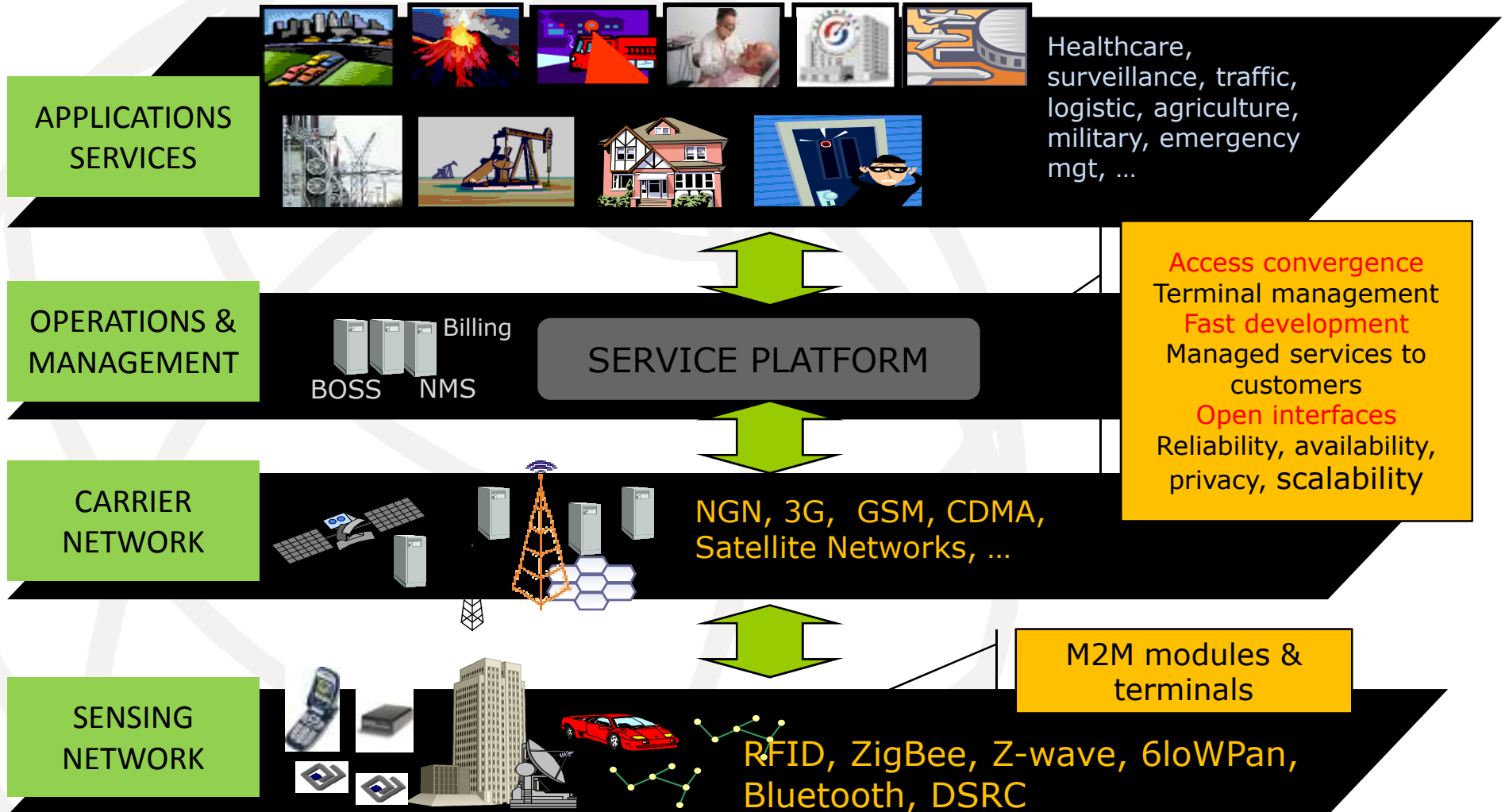
Platform configured per service

HORIZONTAL MODEL

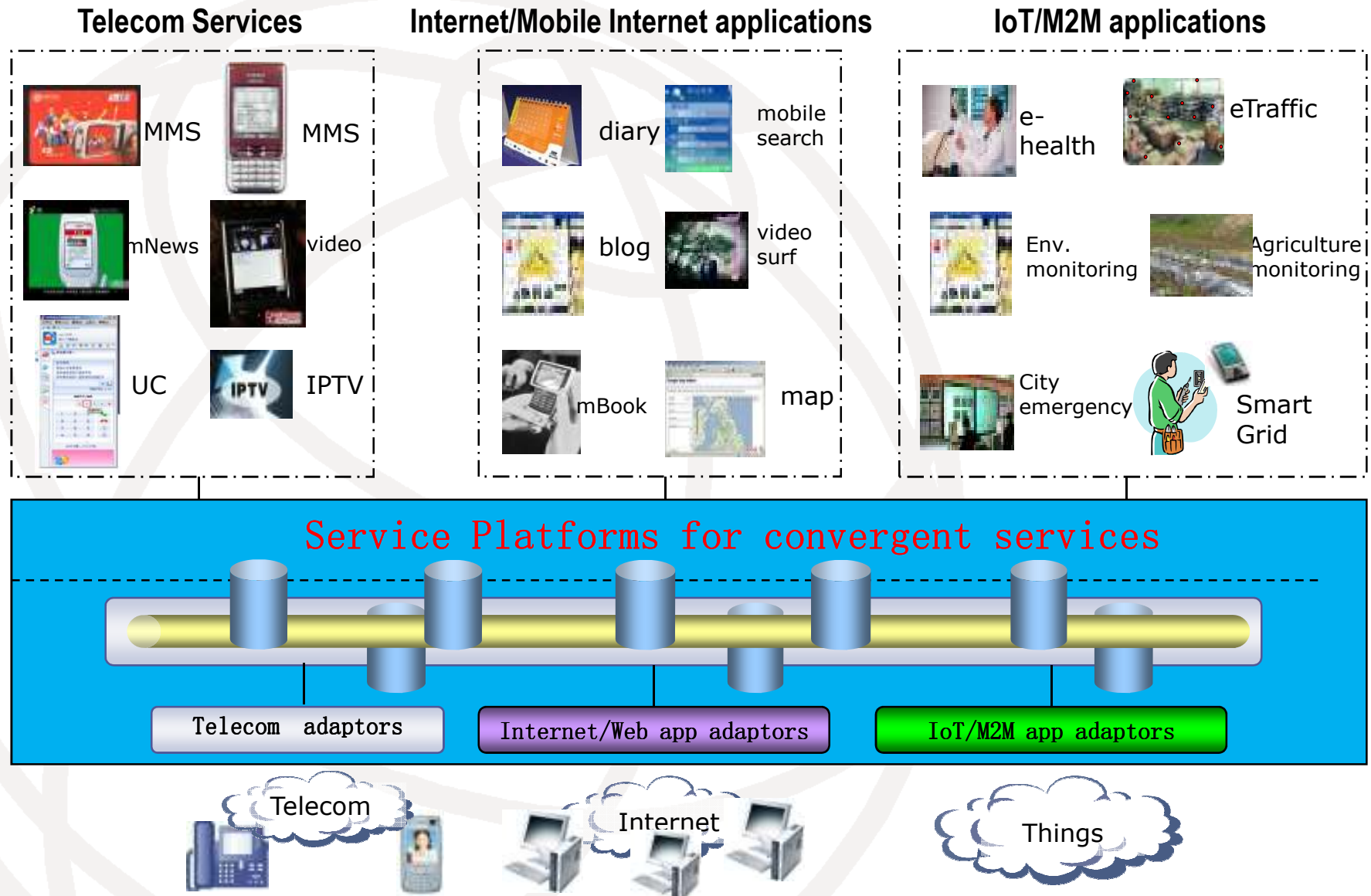


Integration of services in the platform  
Adaptation to different terminals  
Componentization of service platform

# Service platforms: towards smarter systems



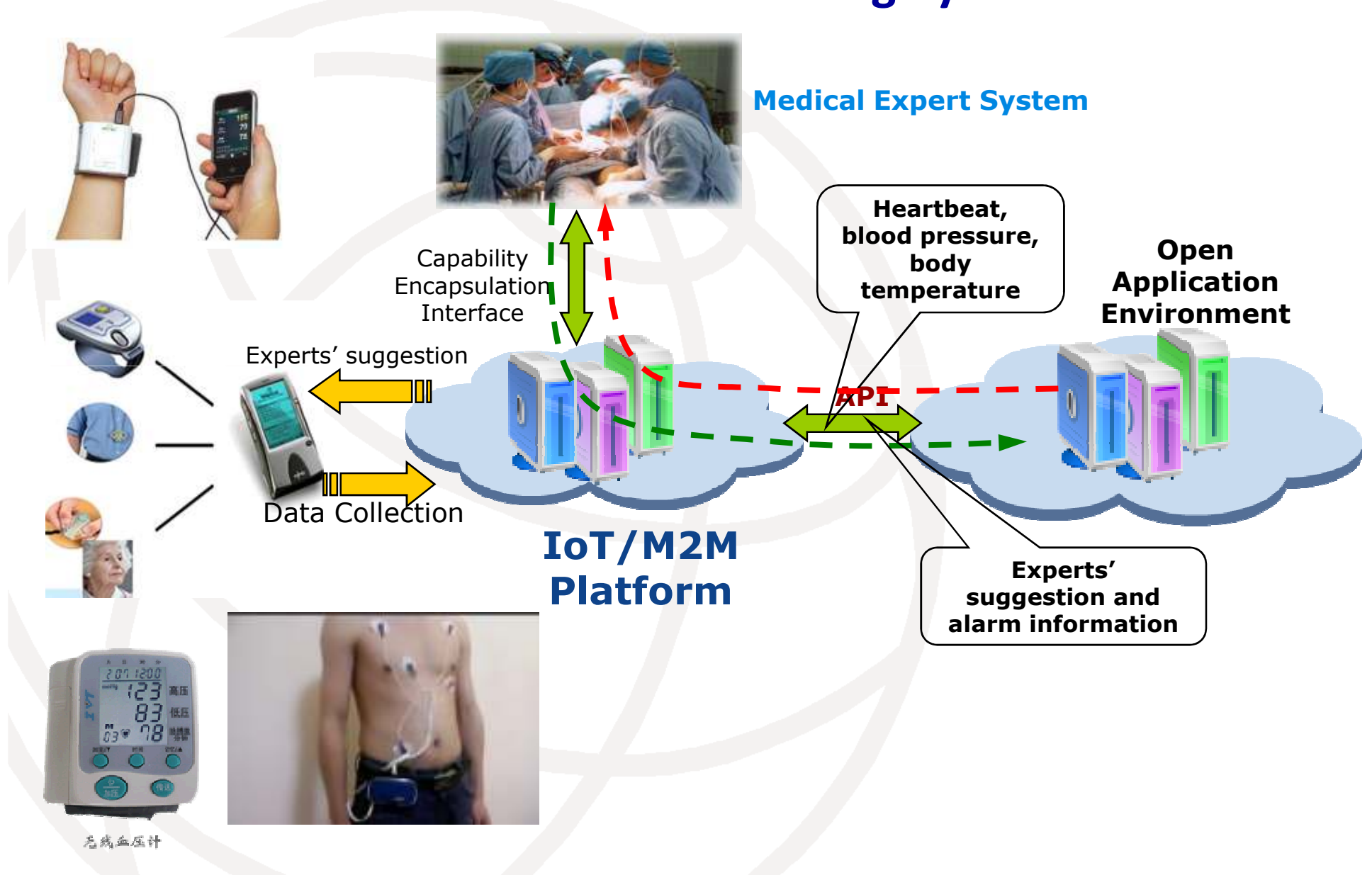
# Service Platforms in longer term: modular platforms for convergent services ?



# Integration of IoT and Cloud Computing

- Combining IoT and clouds
  - To support resources required to increasingly heterogeneous things
  - To meet the dynamic computational needs of various apps (e.g. environmental ones)
- Benefits
  - The cloud can work on behalf of things for increasing availability, maintaining performance and scalability
  - The cloud can support resource continuity so that objects move freely changing access technologies while using resources from the same cloud
- Cloud based IoT
  - Data stored in the Cloud
  - Data follow user and its devices
  - Data accessible anywhere
  - Data can be shared with others

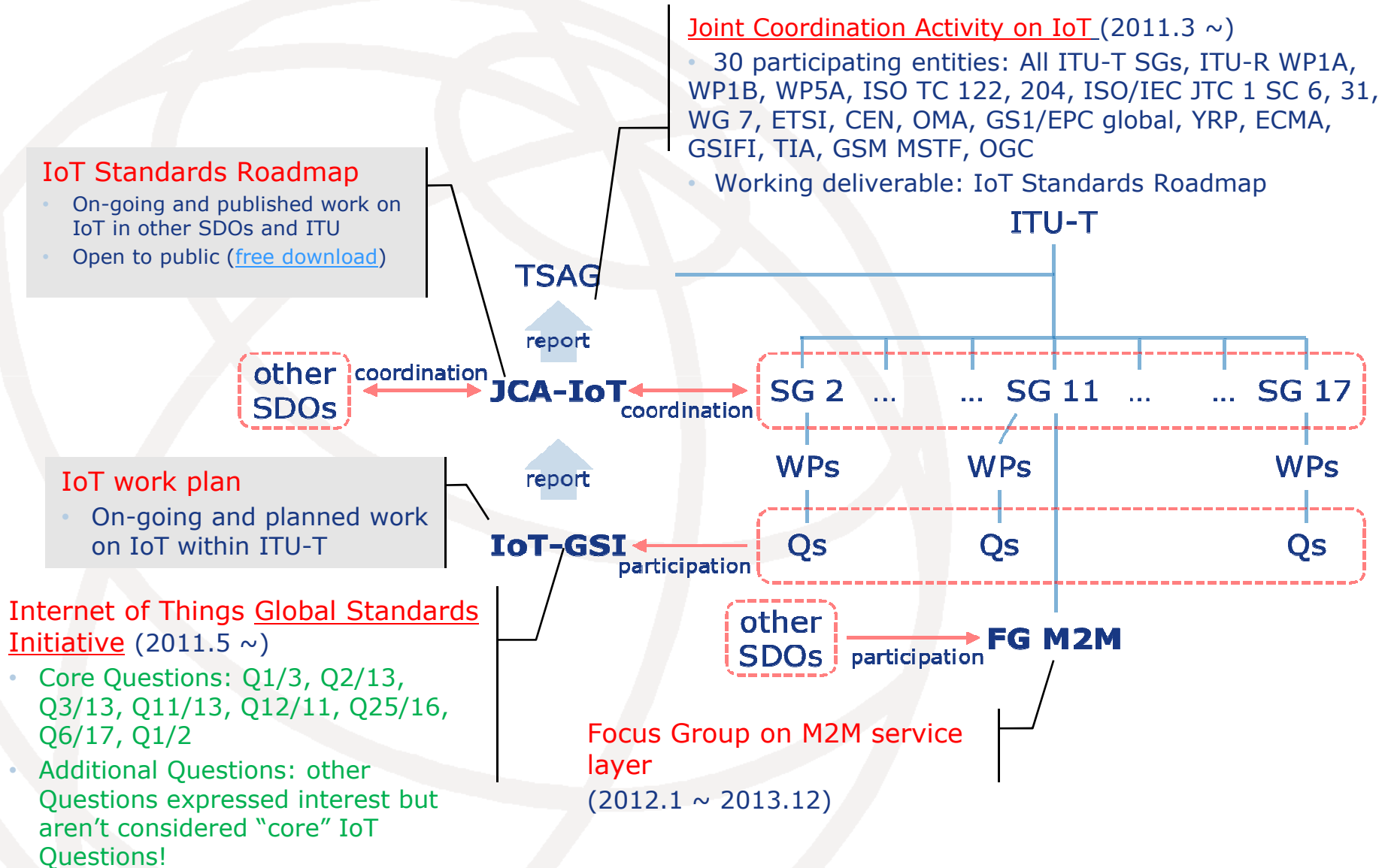
# Smart Governance - E-health: Remote Patient Monitoring System





# **Advances in ITU-T standardization of IoT**

# ITU-T organizational structure for IoT/M2M standardization activity



# JCA-IoT

## IoT Joint Coordination Activity

- Established in March 2011, replacing and continuing the work performed by JCA-NID (Network aspects of Identification of things, USN) since 2006
- High level coordination of ITU-T work related to IoT, taking into account the work done in other SDOs
- Maintenance of a list of cross-SDO IoT standardization items and associated roadmap (**IoT Standards Roadmap**)
- External coordination role with other relevant SDOs, acting as single point of contact within ITU-T to avoid duplication of work

[www.itu.int/itu-t/jca/iot](http://www.itu.int/itu-t/jca/iot)



# IoT-GSI

## IoT Global Standards Initiative

- Established in May 2011
- The banner for the effective IoT standardization work
- Visible single location for information on/development of IoT standards
- Participation from: industry, government entities, SDOs  
Initial key efforts have included:
  - ***IoT terminology*** (including definition of IoT)
  - ***IoT overview (ITU-T Rec Y.2060 "Overview of IoT" - approved in June 2012 )***
  - ***IoT work plan*** (candidate study items – as input to the cross-SDO JCA-IoT Roadmap)

**The success of the Internet of Things in business and social communities will depend strongly on the existence and effective operation of global standards**

**[www.itu.int/itu-t/gsi/iot](http://www.itu.int/itu-t/gsi/iot)**

# ITU-T definition of IoT

## **Internet of Things [ITU-T Recommendation Y.2060]:**

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.

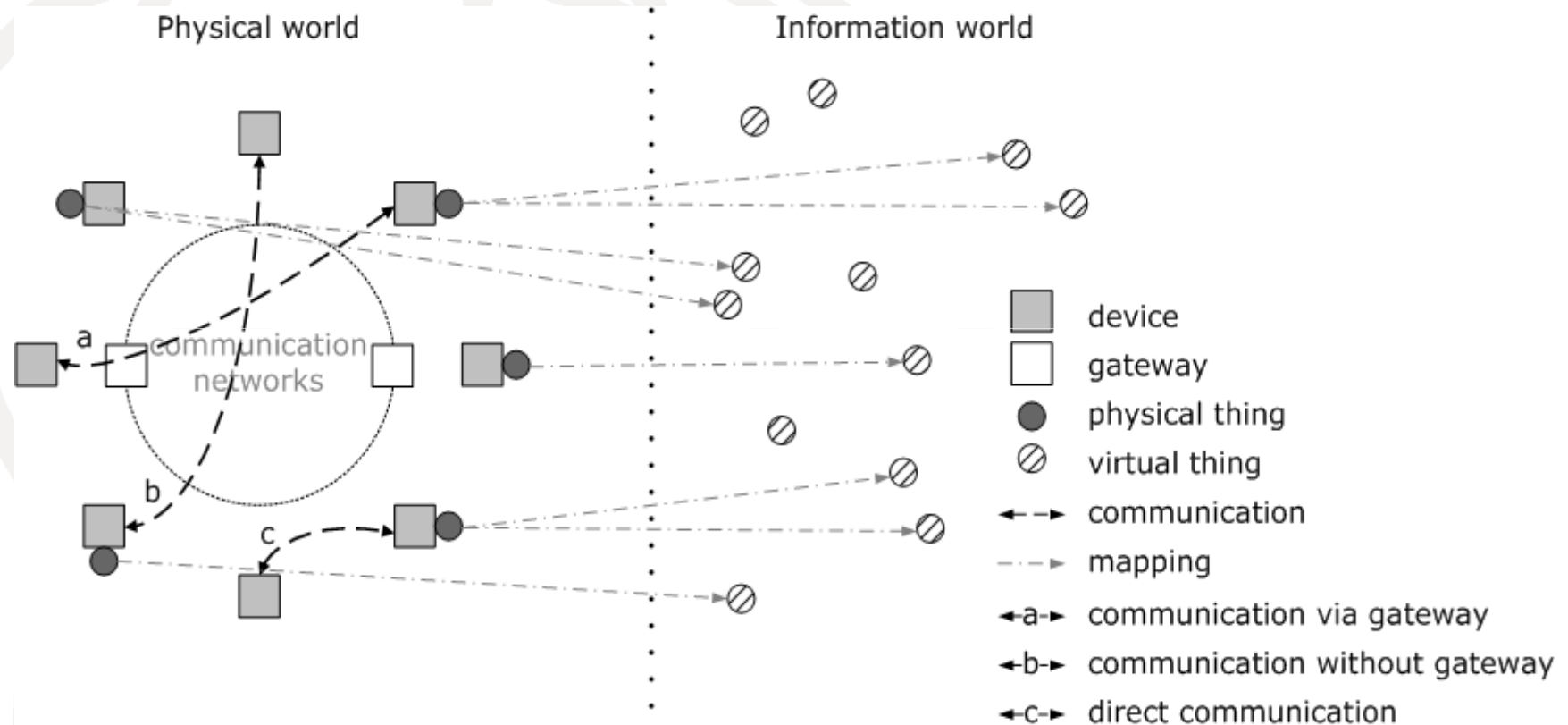
NOTE2 - In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

***This definition is fundamentally aligned with the IoT concepts and terminology developed in other key SDOs and communities***

***Thing:*** *In the Internet of Things, object of the physical world (physical things) or of the information world (virtual things), which is capable of being identified and integrated into the communication networks.*

# IoT in ITU-T Y.2060 (1/6)

## ■ Technical overview

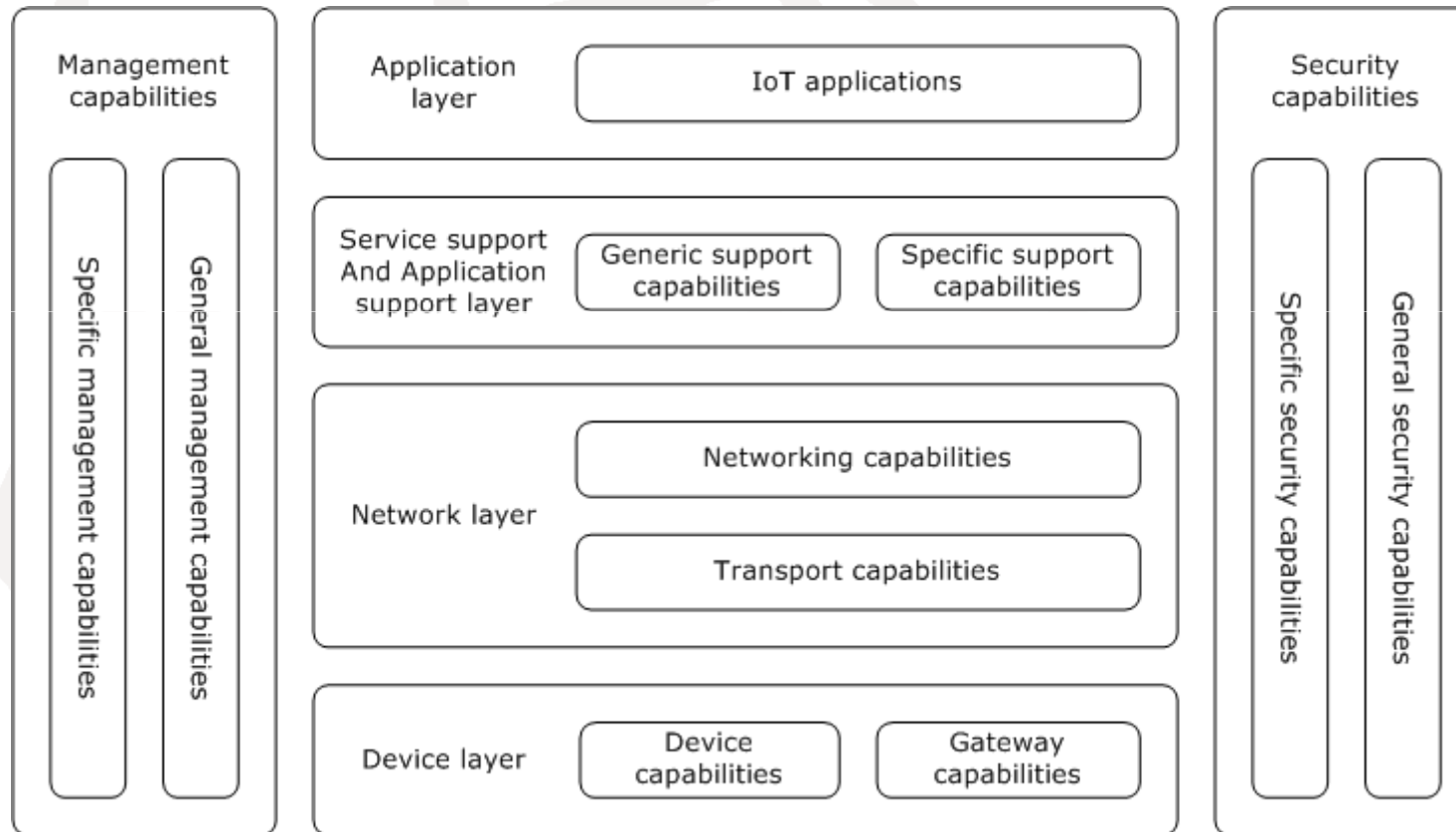


Source: ITU-T Y.2060, 2012

**Device:** In the Internet of Things, a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing

# IoT in ITU-T Y.2060 (3/6)

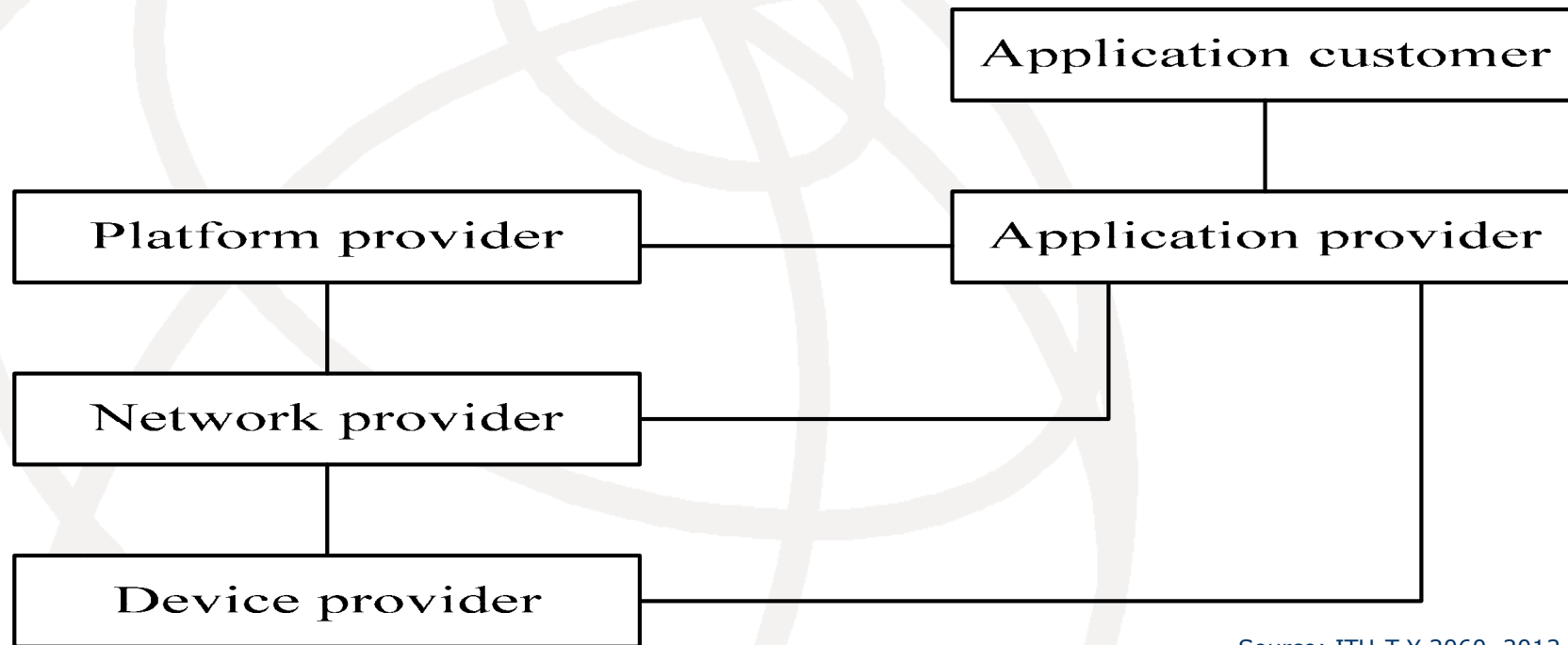
## ■ Reference model



Source: ITU-T Y.2060, 2012

# IoT in ITU-T Y.2060 (4/6)

## ■ IoT Ecosystem

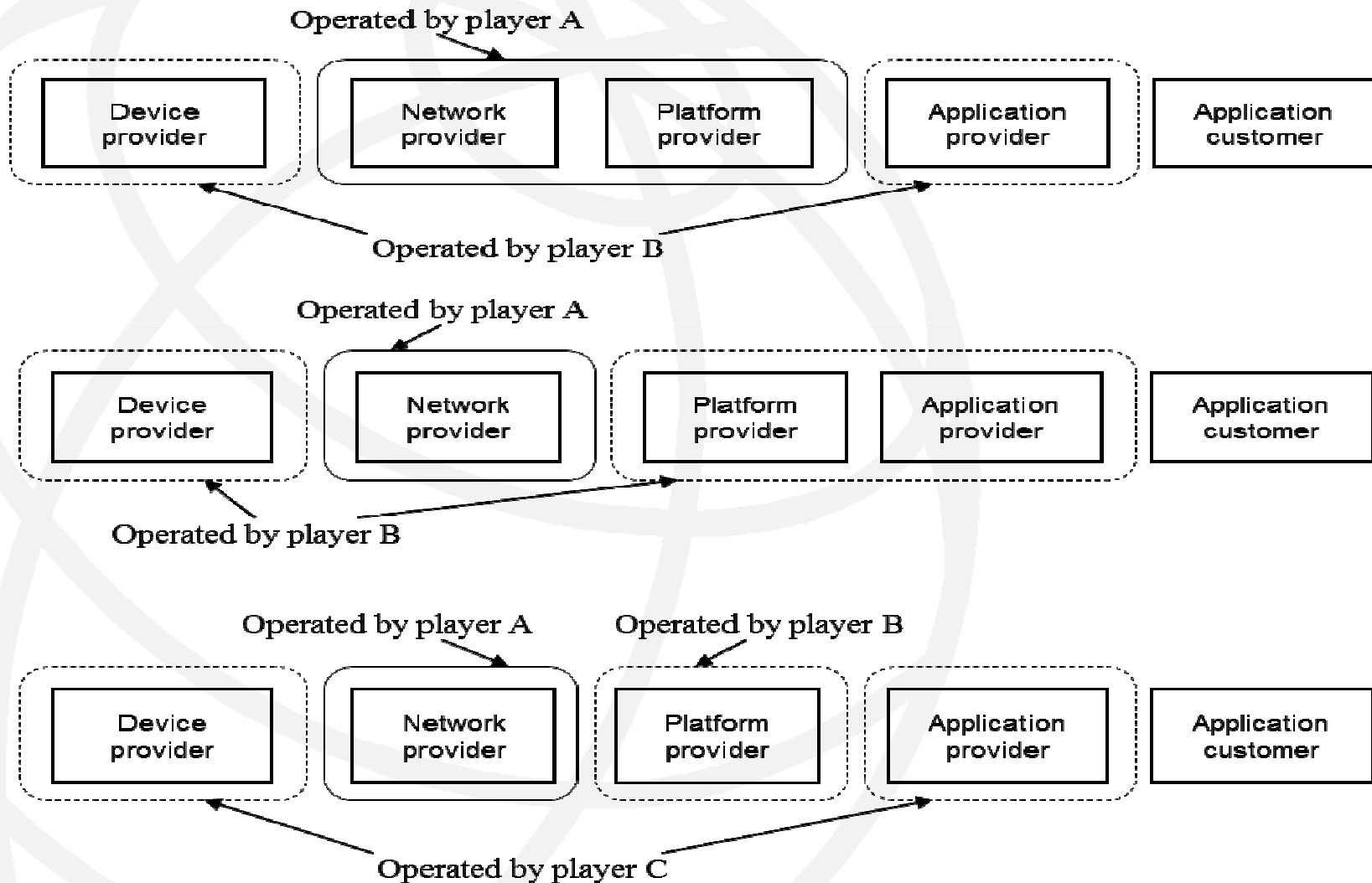


Source: ITU-T Y.2060, 2012

NOTE - The identified business roles and their relationships do not represent all possible roles and relationships which can be found across IoT business deployments.

# IoT in ITU-T Y.2060 (5/6)

## IoT Business Models – examples



# IoT in ITU-T Y.2060 (6/6)

- Fundamental characteristics and high level requirements

## Characteristics

- Interconnectivity
- Things-related services
- Heterogeneity
- Dynamic changes
- Enormous scale

## Requirements

- Identification-based connectivity
- Interoperability
- Autonomic networking
- Autonomic services provisioning
- Location-based capabilities
- Security
- Privacy protection
- High quality and highly secure human body related services
- Plug and play
- Manageability

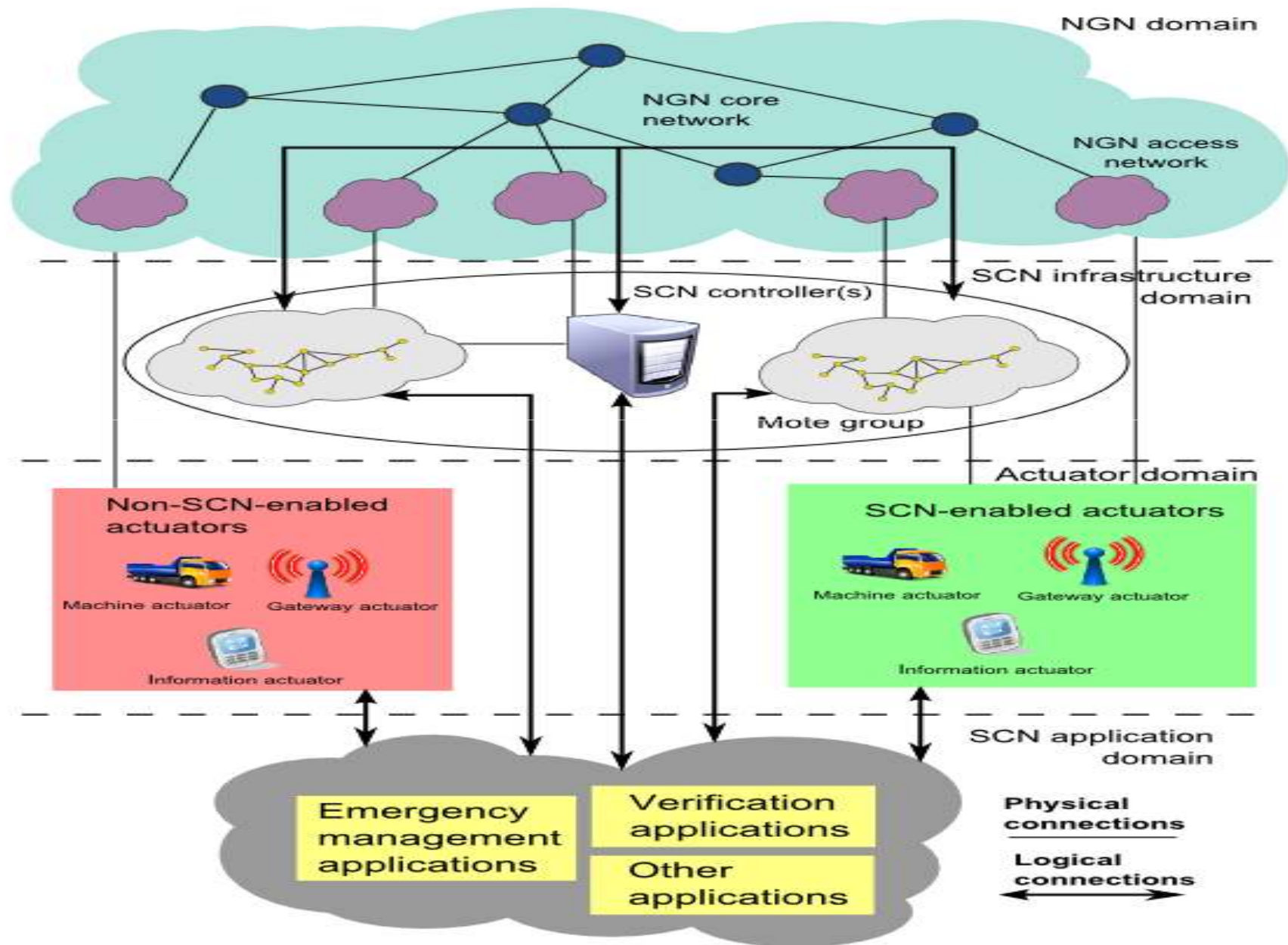
# The “ITU-T IoT work plan” from IoT-GSI

Goal: to identify potential IoT study items to be analysed and possibly launched as new IoT standardization work items within ITU-T (cooperation with other SDOs not excluded); once a new work item is launched, it is moved to IoT standards roadmap

Item number	Item title - 25th June 2013 version
1	Identification and addressing aspects in IoT
2	Requirements and capabilities for energy saving using smart objects
3	APIs for IoT
4	IoT functional architecture
5	Data centric capabilities for IoT
6	IoT and general Service Delivery Platforms (SDP) (common SDP capabilities for support of multiple IoT applications) - <i>Note: this item could be combined with the item on IoT requirements and capabilities.</i>
7	IoT application domains and related use cases
8	Support of Inter- provider application scenarios <i>Note: it is for consideration to combine this item with the IoT application domains and related use cases item.</i>
9	IoT management and provisioning
10	Quality of Service for IoT <i>Note: this item could be combined (and, at least, requires coordination) with the item on IoT requirements and capabilities.</i>
11	Security and privacy protection in IoT
12	IoT and Cloud
13	IoT and Peer2Peer/DSN
14	Conformance and interoperability testing in IoT
15	IoT Governance
16	IoT terminology (incl. update of last version of IoT terminology Recommendation)
17	Plug and Play for IoT



# Overview of SCNs - Y.2222 "Sensor Control Networks and related applications in NGN environment" (04/2013)



# **A not exhaustive list of ongoing ITU-T work items on IoT**

## **Requirements of IoT**

- Y.IoT-common-reqts "Common requirements of Internet of Things"

## **Capabilities of IoT**

- Y.IoT-funct-framework "IoT functional framework and capabilities"

## **Application support models of IoT**

- Y. IoT-app-models "IoT application support models"

## **Gateway for IoT applications**

- Y.gw-IoT-reqts "Common requirements and capabilities of gateways for IoT applications"

## **IoT Device Management**

- Y.DM-IoT-reqts "*Common requirements and capabilities of device management in IoT*"

## **E-health**

- Y.EHM-Reqts "Requirements and network capabilities for E-Health Monitoring services"

## **Plug and play**

- Y.IoT-PnP-reqts "Requirements of the Plug and Play Capability of the IoT"

## **Identification**

- H.IoT-ID "Requirements and Common Characteristics of IoT Identifier for IoT Service"

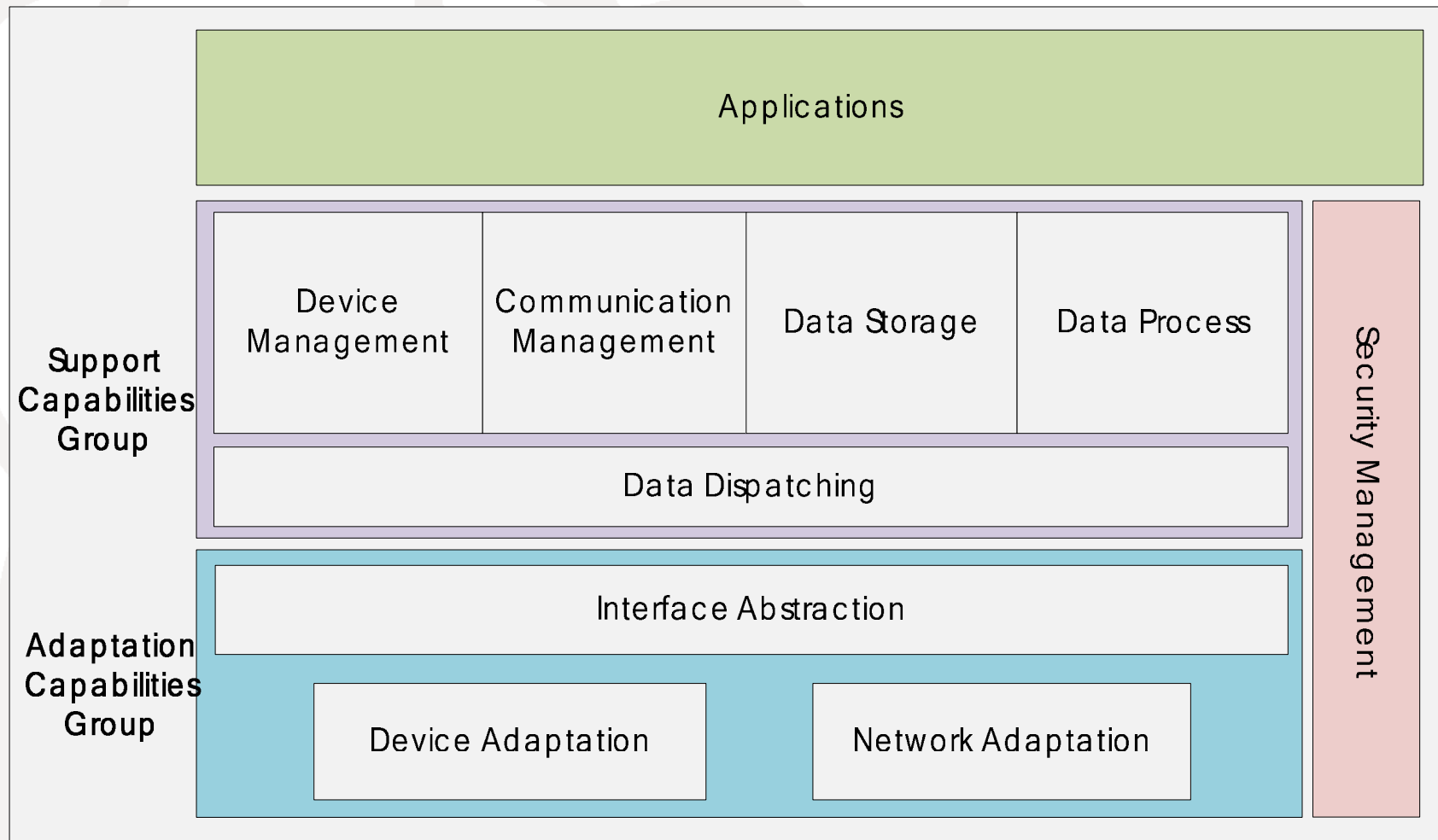
***Detailed information on the ITU-T ongoing items can be provided upon request***

# Requirements of IoT [Y.IoT-common-reqts]

- The scope of the Recommendation includes:
  - Abstracted use cases
  - Cross-domain use cases
  - Common requirements of the IoT
- Abstracted use cases are derived from definition and characteristics of the IoT, or from application use cases
- Cross-domain use cases refer to use cases covering multiple application domains (e.g. e-health, ITS, Smart Home, etc.)
- Launched in May 2012, the item builds on Y.2060, developing common requirements based on the IoT reference model

# Gateway for IoT applications [Y.gw-IoT-reqts]

Reference technical framework of gateway – in progress



# E-health and IoT/M2M: key results of ITU-WHO April 2012 workshop

- E-health standards and interoperable solutions are important for cost effectiveness, higher efficiency, availability and safety of e-health deployments (versus current fragmentation of solutions)
- Strong relevance for e-health of middleware aspects and M2M communications, criticality of the device market segment
- **A common IoT/M2M service layer** could benefit mobile devices (including portable medical devices) used in pilot projects
- **Joint ITU-WHO work was planned on**
  - ▶ a Roadmap about standards and interoperability adoption – which steps for process, standards vs areas matrix (with more focus, also cooperation in FG M2M)
  - ▶ collaboration with e-health SDOs for a portal on e-health standards and interoperability
  - ▶ papers and events for education on value of standards and interoperability (already: ITU-D-WHO collaboration on National E-health strategy toolkit)
- Follow ups concerning this collaboration: WTSA 2012 (ad-hoc session), WHO Forum (Dec 2012) in which ITU participated as key partner, cooperation within the FG M2M (in 2013)



**Thanks for your attention**