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 , Marco.carugi@gmail.com

Outline

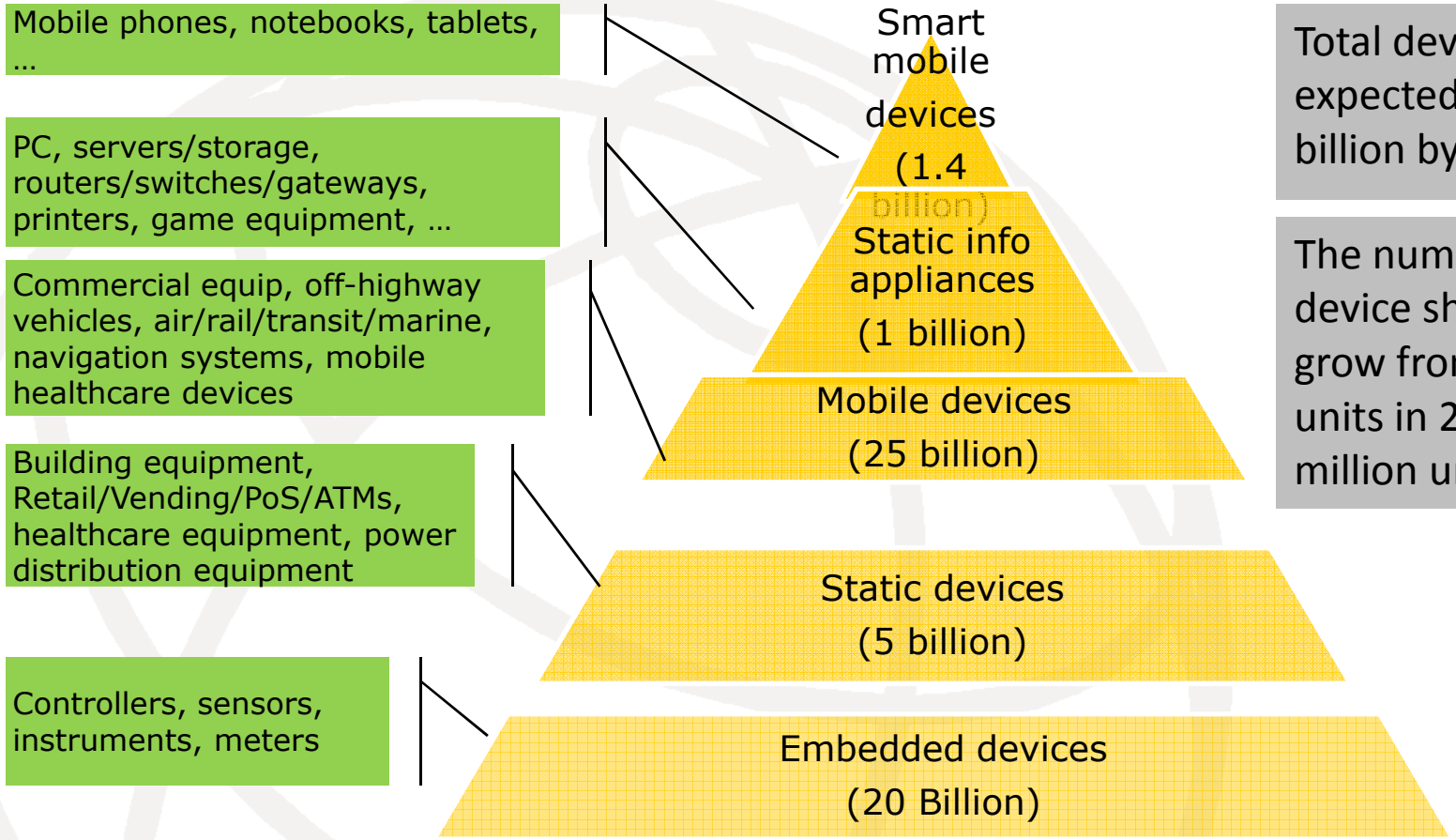
- Internet of Things (IoT) and Machine to Machine (M2M) communications
  - Introduction to market, technology and applications
- Advances in ITU-T standardization of IoT
  - Few organizational details
  - Some key achievements
  - Information on relevant ongoing work

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



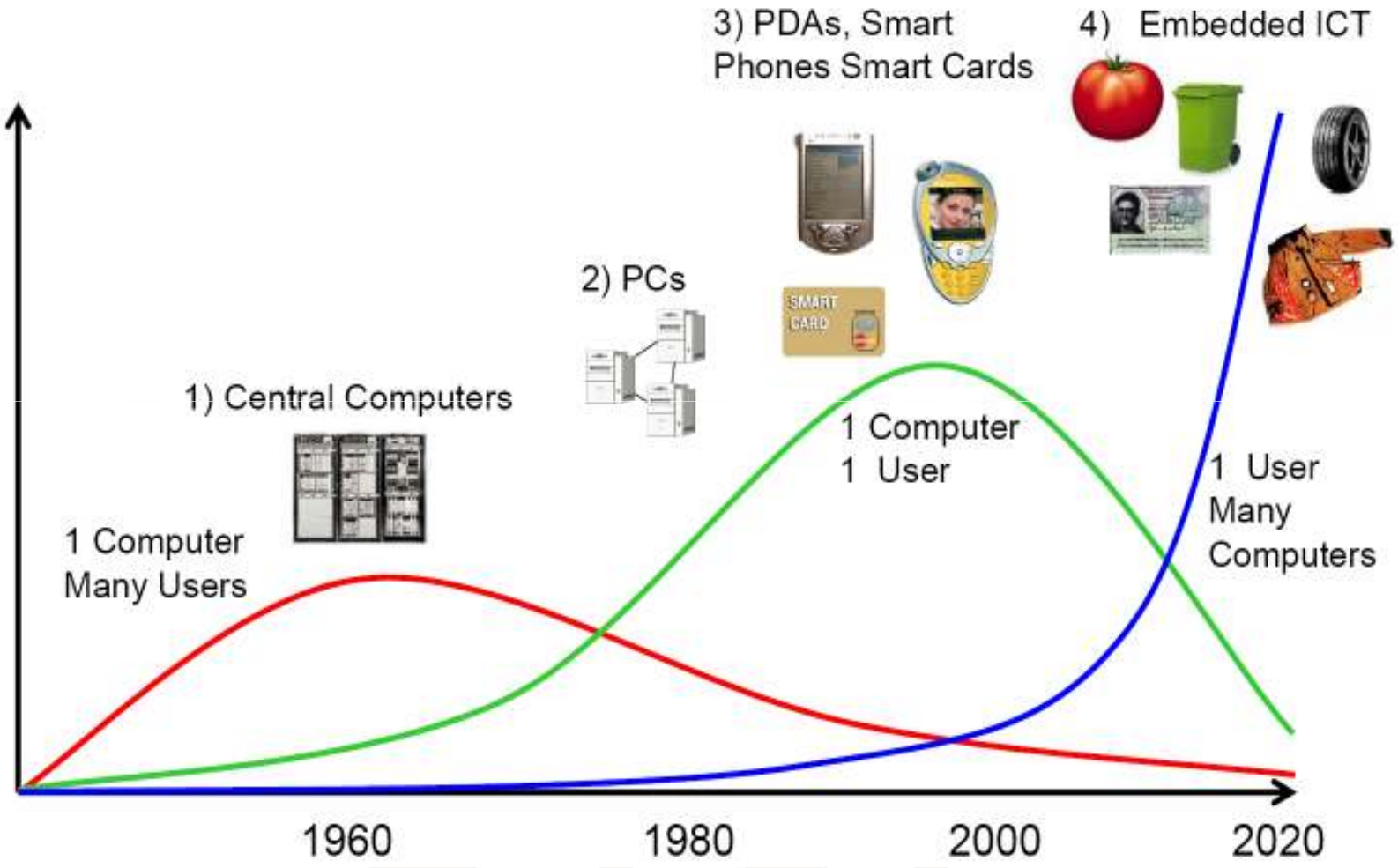
Total device revenue is expected to exceed $12 billion by 2013

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



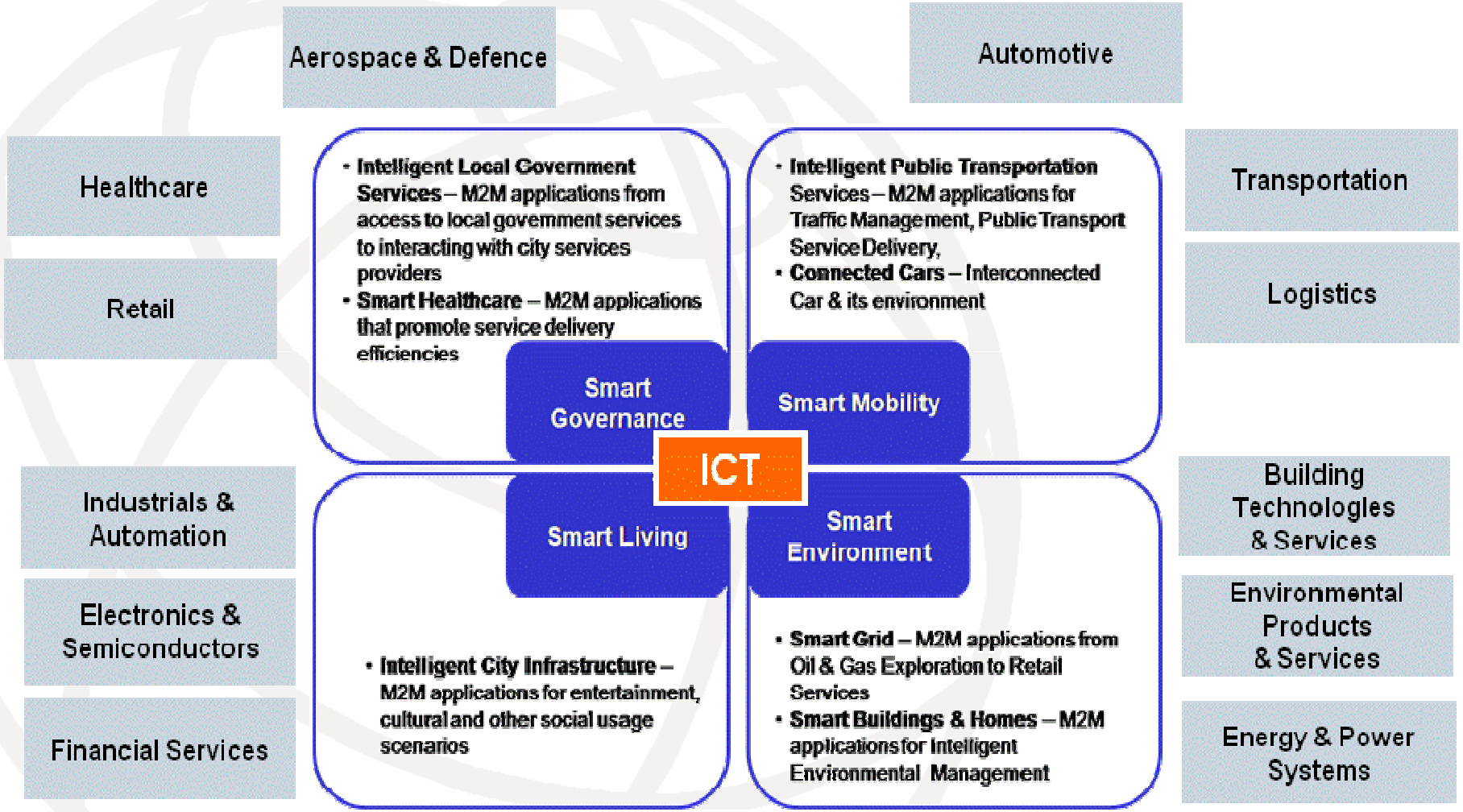
Source: DFKI, German Research Center for Artificial Intelligence

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, …

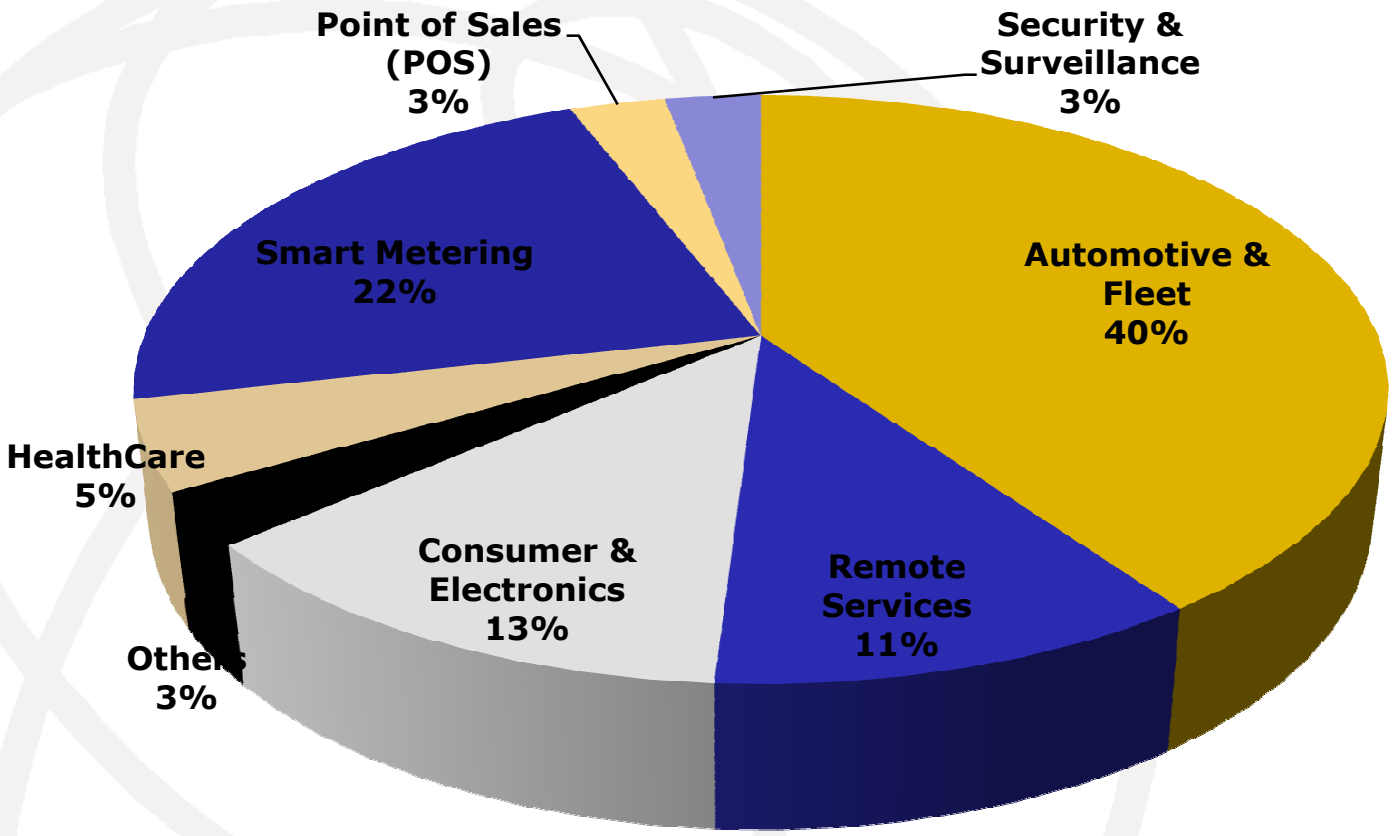
"Machine to Machine" technologies: a key enabler of IoT infrastructure

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



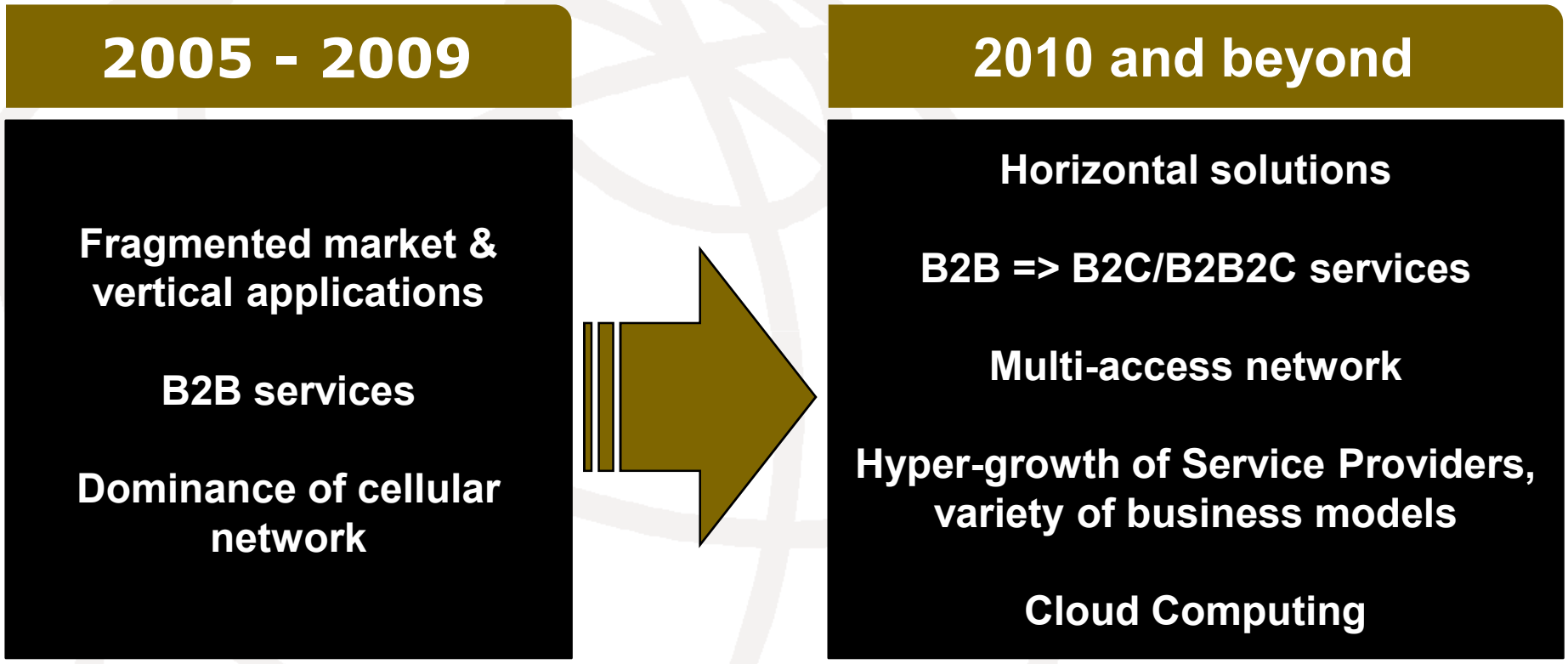
Source: Frost & Sullivan (2012)

M2M service deployment by Industry (Vertical)



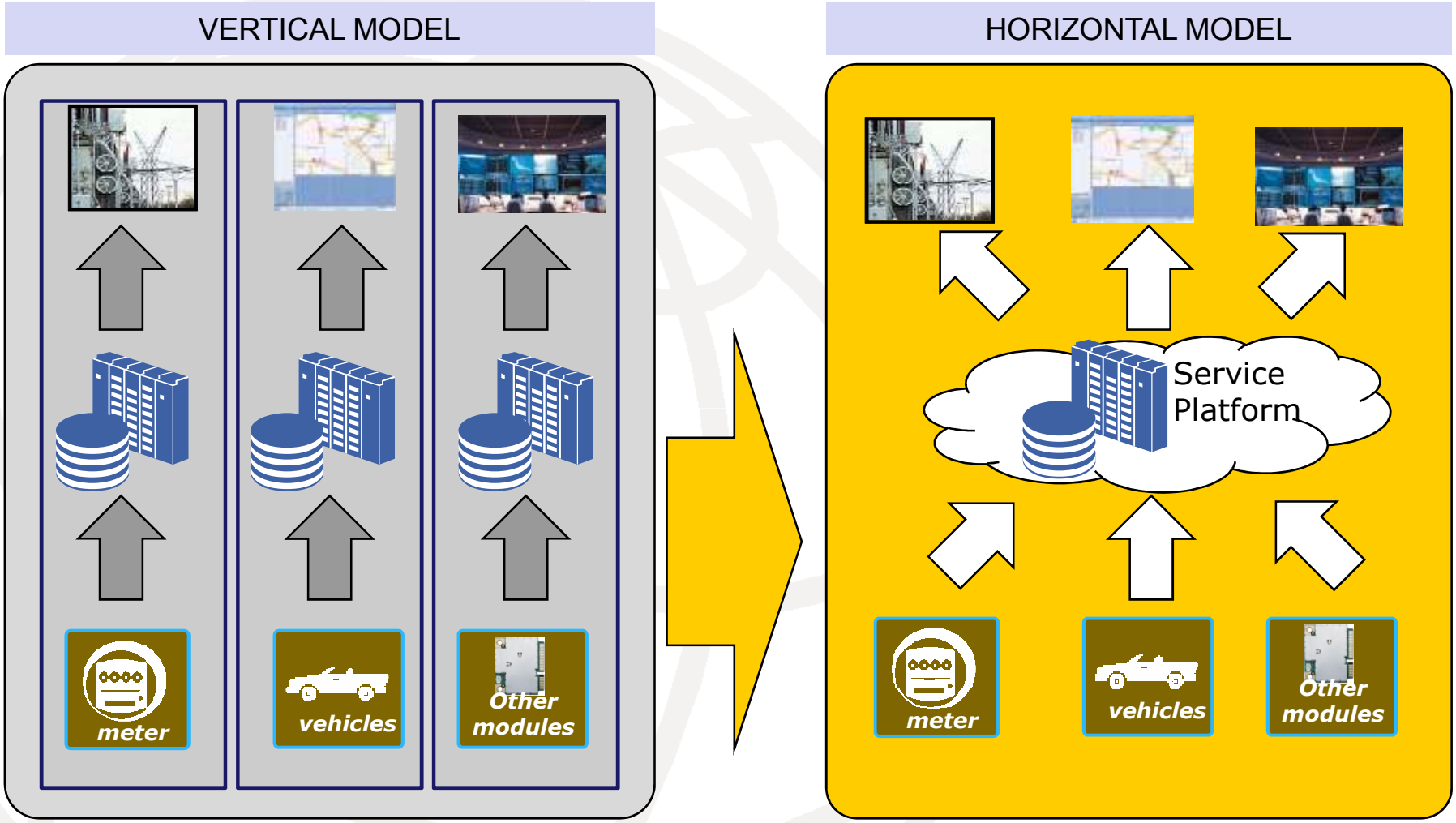
Source: Informa

Some trends in M2M



From business market to mass market

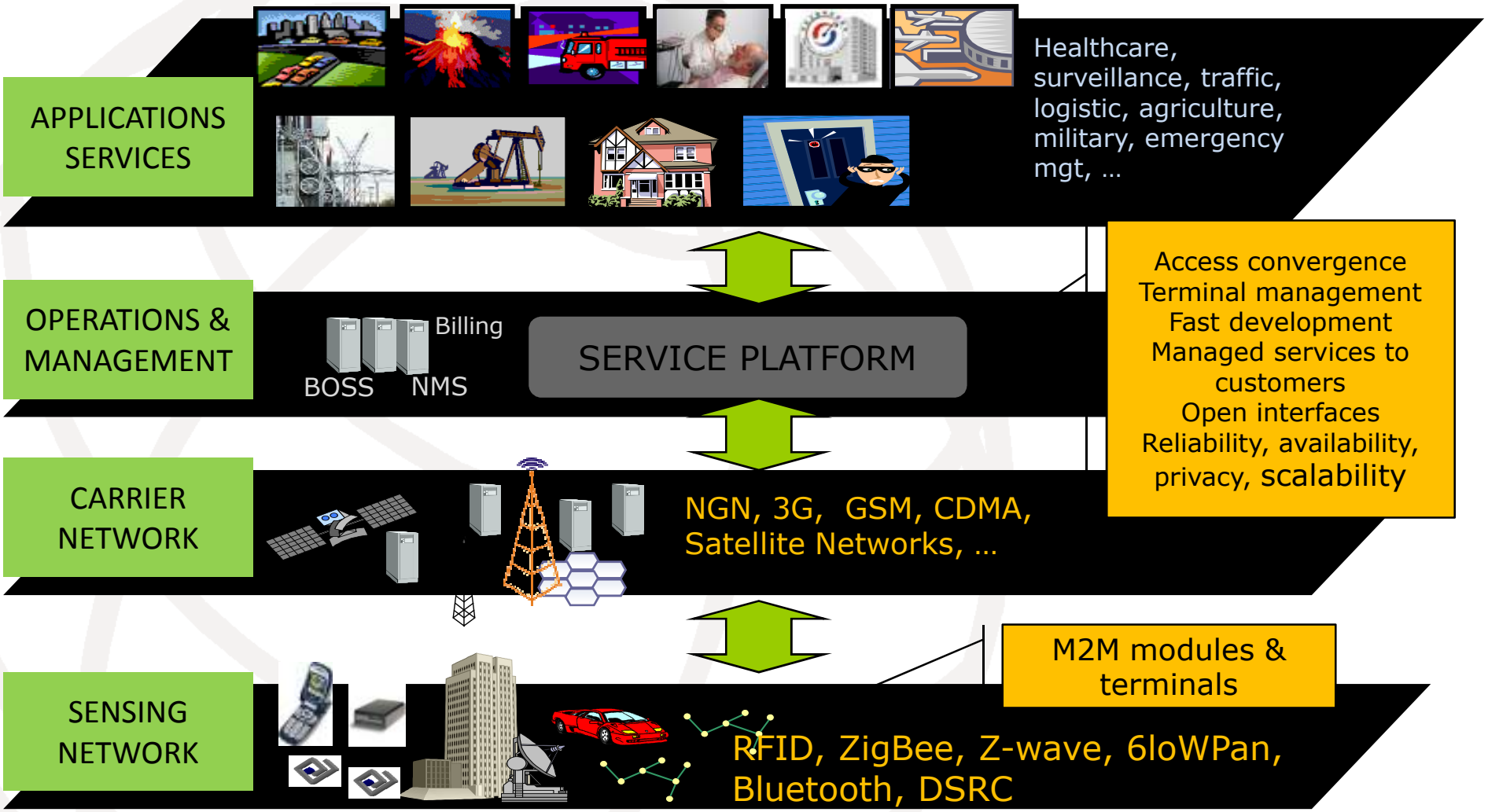
From vertical to horizontal integration model



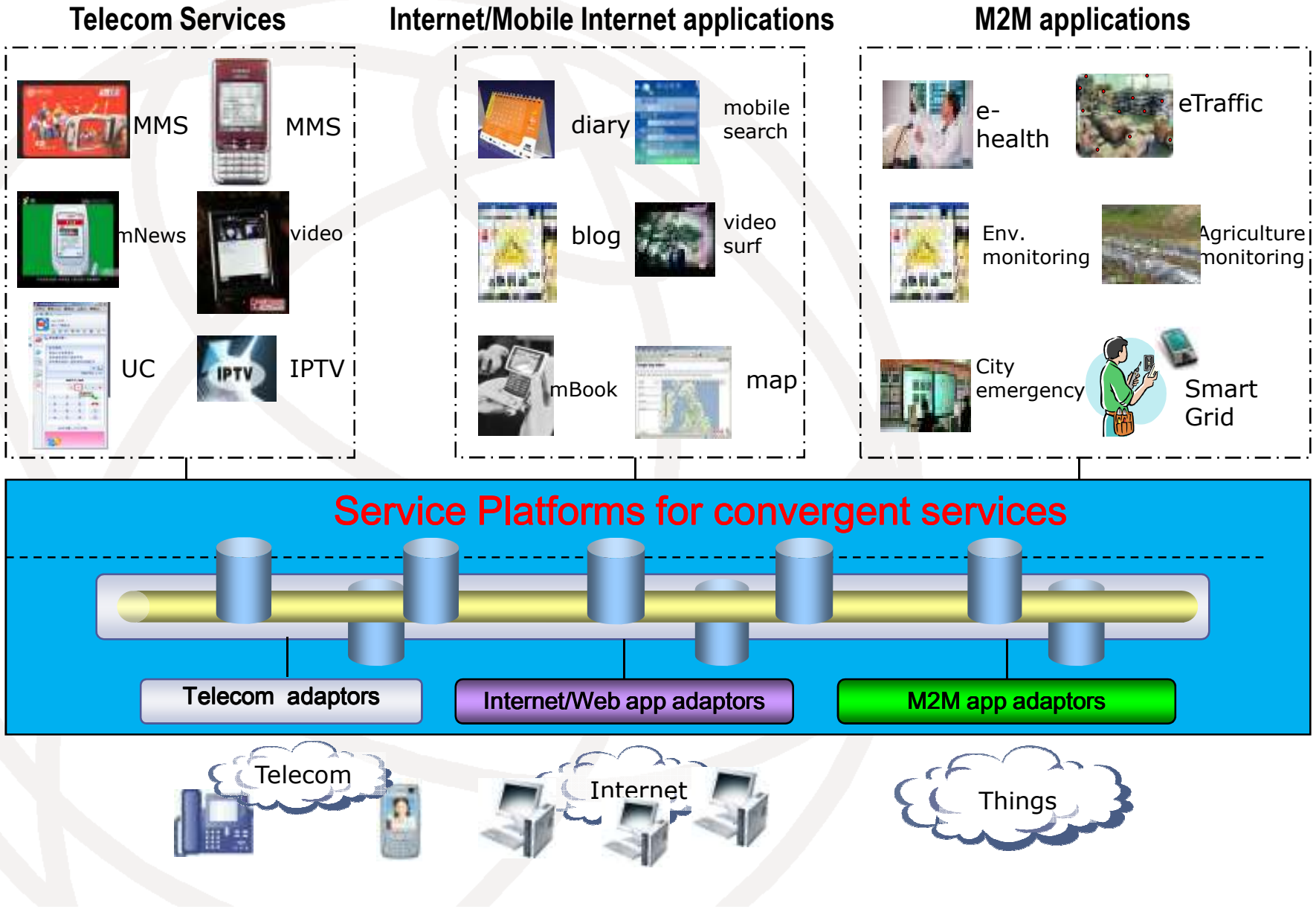
Platform configured per service

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

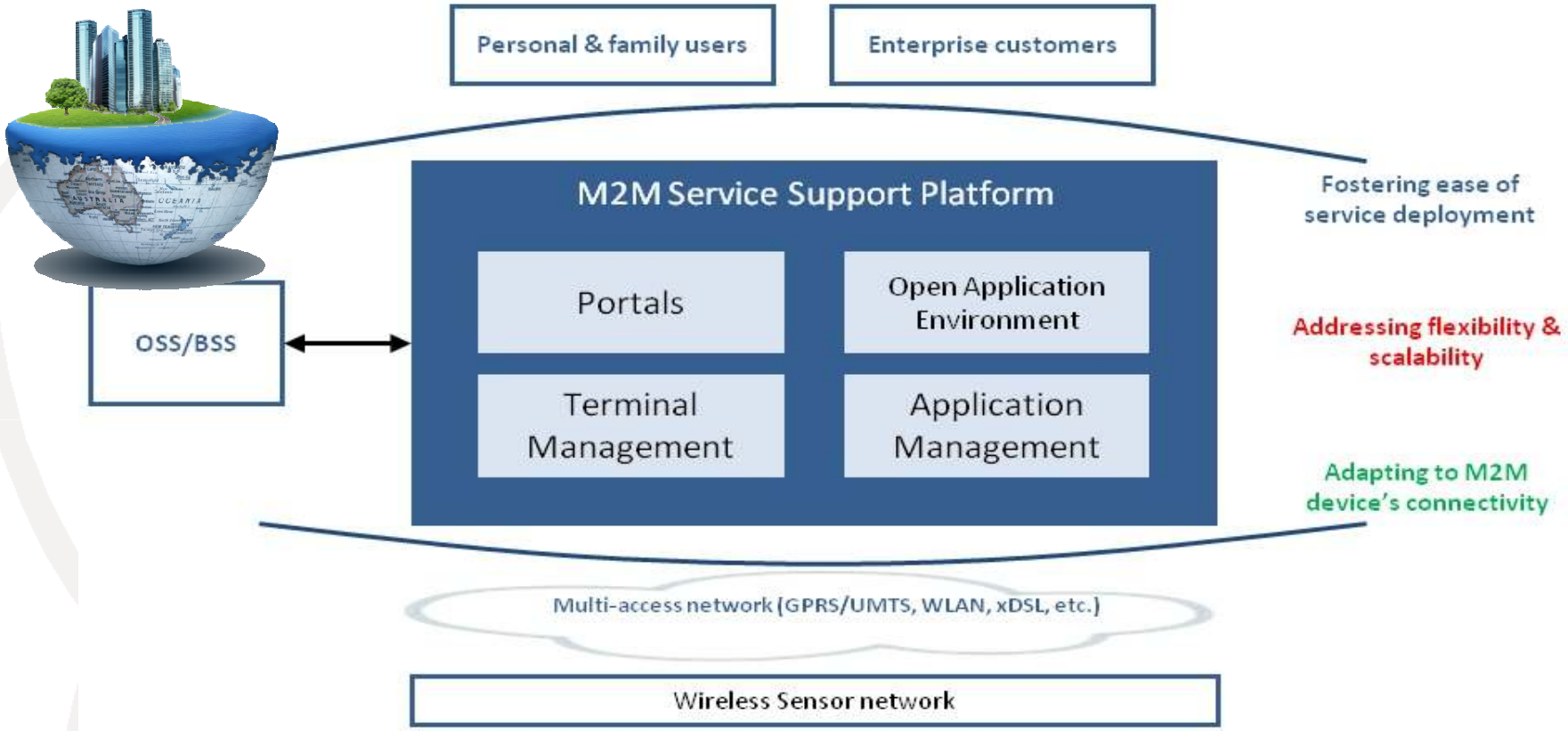
Service platforms: towards smarter systems



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



A market example of Service Platforms for M2M (ZTE)



Some basic features

- Customer-defined service environment (user and 3rd party development tools)
- Unified management of terminals and services
- Integration between services and terminals
- Access Independence and openness via terminal adaptation functions

Integration of IoT and Cloud Computing

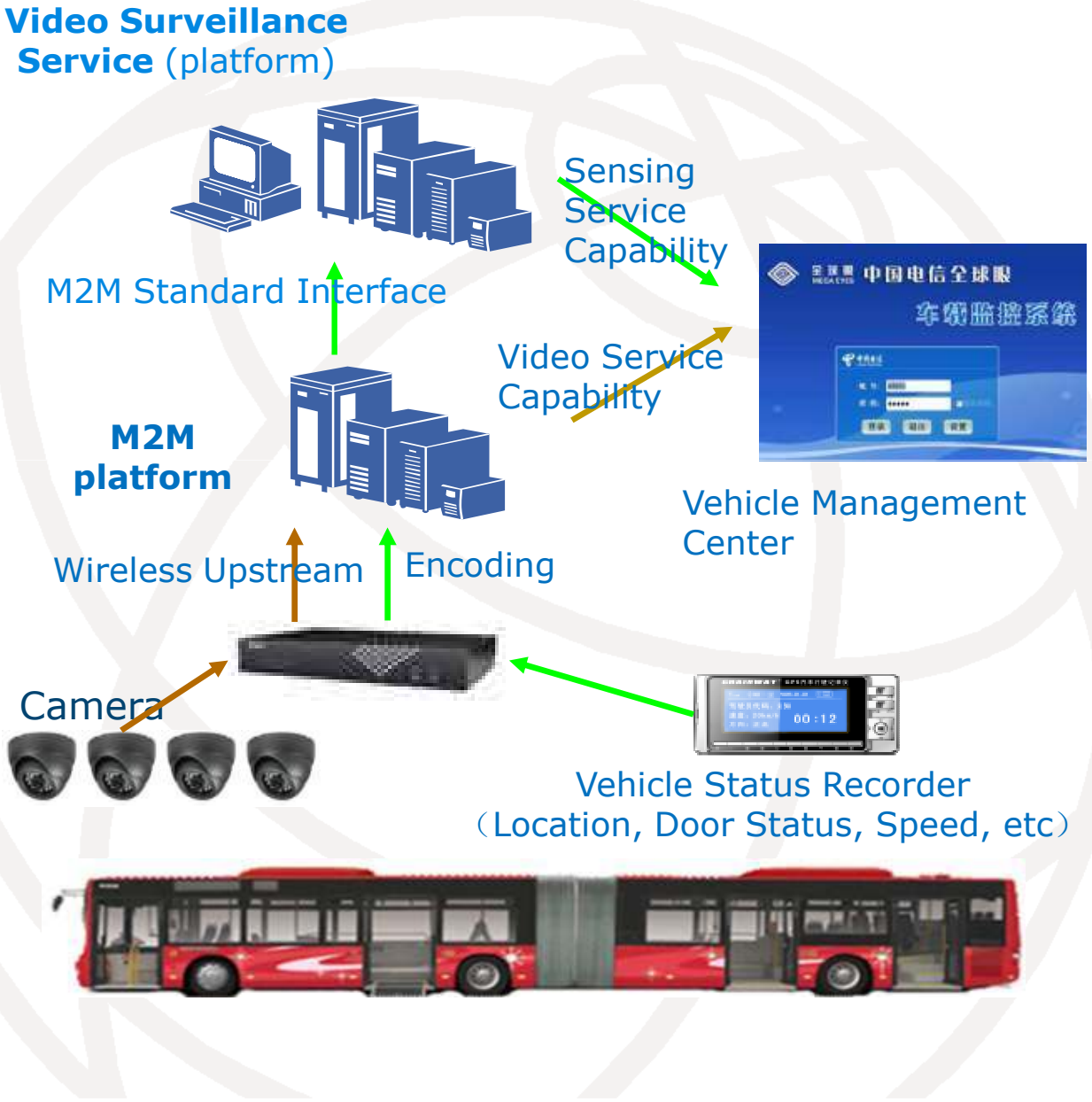
- Combining IoT and clouds
  - To support resources required to increasingly heterogeneous things
  - To meet the dynamic computational needs of various apps (e.g. environmental ones)
- Benefits
  - The cloud can work on behalf of things for increasing availability, maintaining performance and scalability
  - 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

What about the network with the growth of M2M? Optimization

- Some optimization directions
  - To optimize identification and addressing for large number of things
  - To optimize wireless resources management to meet features of low power consumption and low mobility of things
  - To optimize security mechanisms for things

- With the growth of M2M applications, the development of M2M market will be accompanied in the long term by a significant increase of data traffic and improvements of communication networks

Application examples - Smart Mobility: Bus Monitoring (Shanghai Expo - China Telecom)



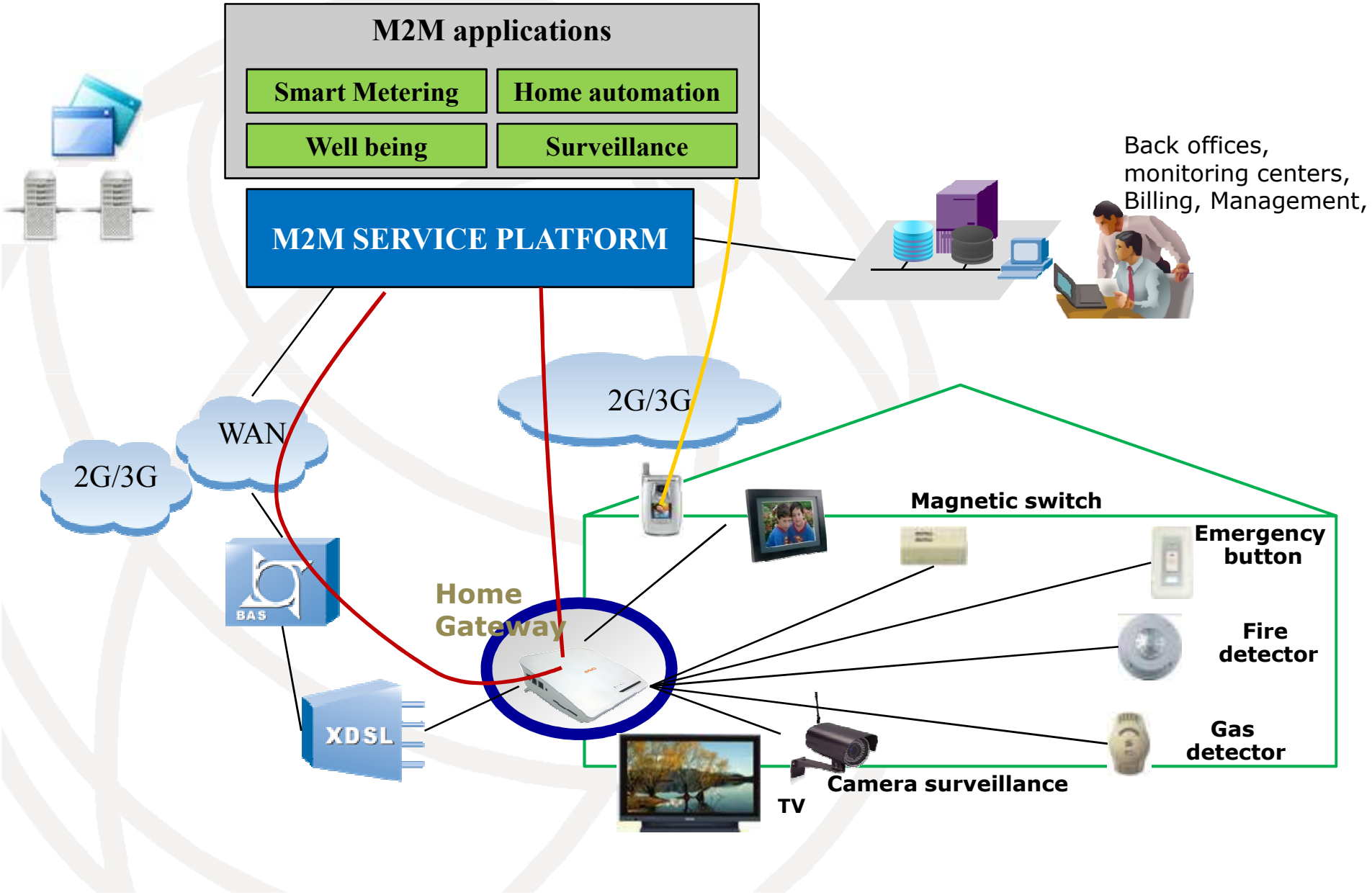
Many services

- SMS Wake UP
- 3G Video Monitoring
- Vehicle Management
- Real Time Location
- Over speed Alarm
- Route Violation/Side turnover/Collision Alarm
- Door Alarm
- Smoke/Fire alarm
- Manual Alarm
- Station automatic announcement
- …

Application examples - Smart Environment and Living: Intelligent home security solution (Turkey Telecom)

Water and smoke detection, infrared detection or motion detection, alarm button, etc.
Home Appliances control: light, door access, appliance power control (DVD, TV, etc.)

Towards a Connected Home solution



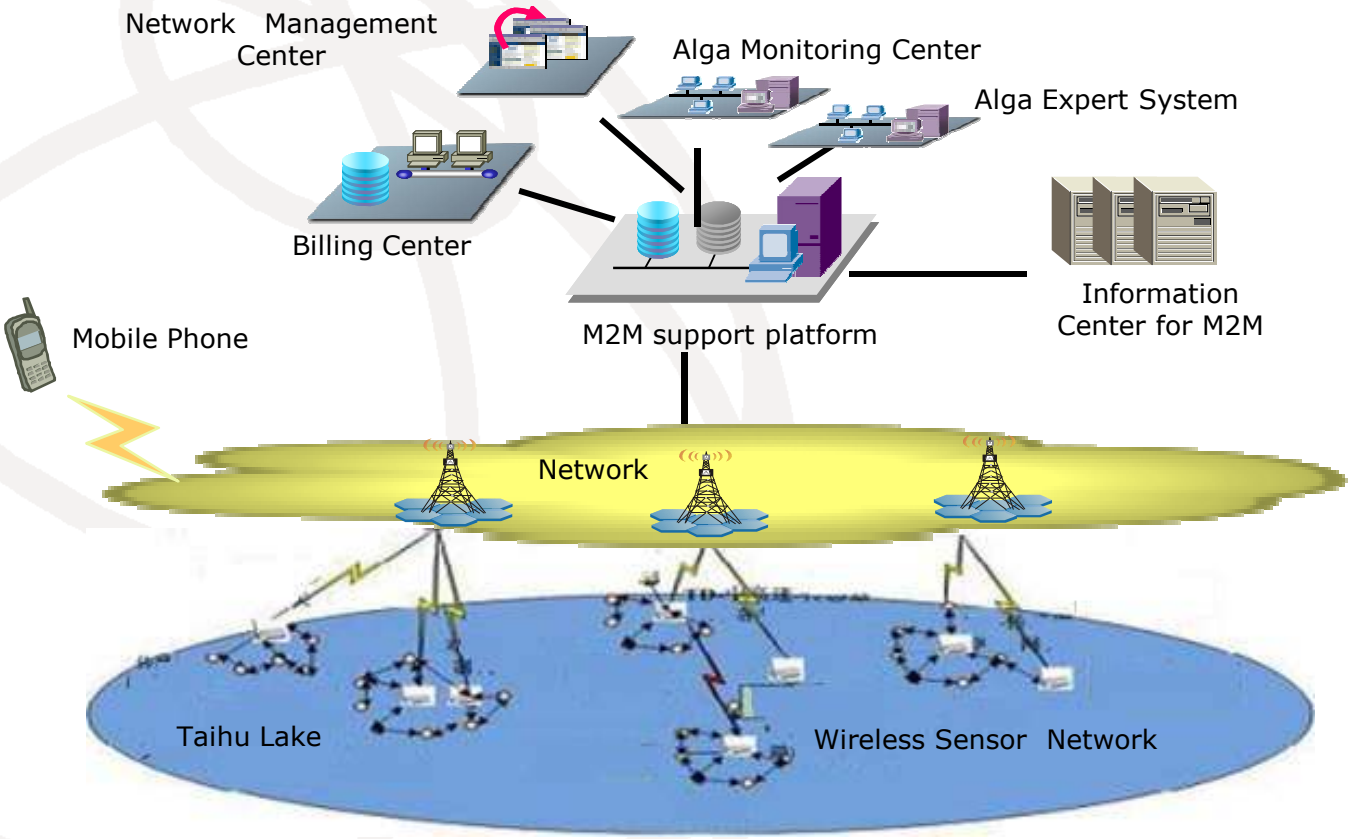
Application examples - Smart Environment: Taihu Lake Blue Alga Monitoring

Blue alga crisis
in Taihu Lake (China)

Water polluted by blue alga

Citizens waiting for fresh water in queue

Network structure of the system



Monitoring of blue alga in a distributed and dynamic mode, so as to avoid the occurrence of water crisis

Smart Governance - E-health:
Remote Patient Monitoring System

Medical Expert System

Capability
Encapsulation
Interface

Heartbeat, blood pressure, body temperature

Open Application Environment

Experts' suggestion

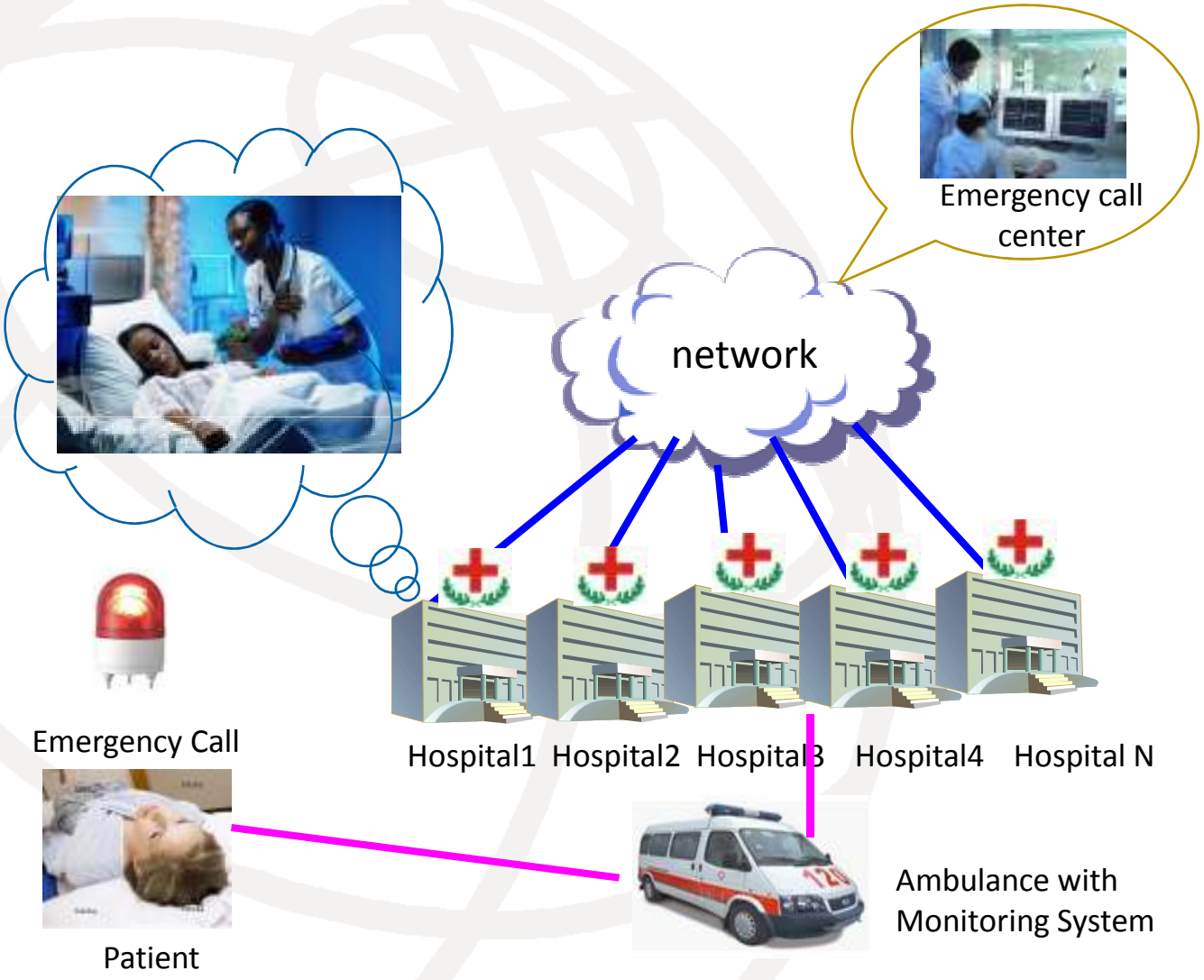
Data Collection

API

M2M Platform

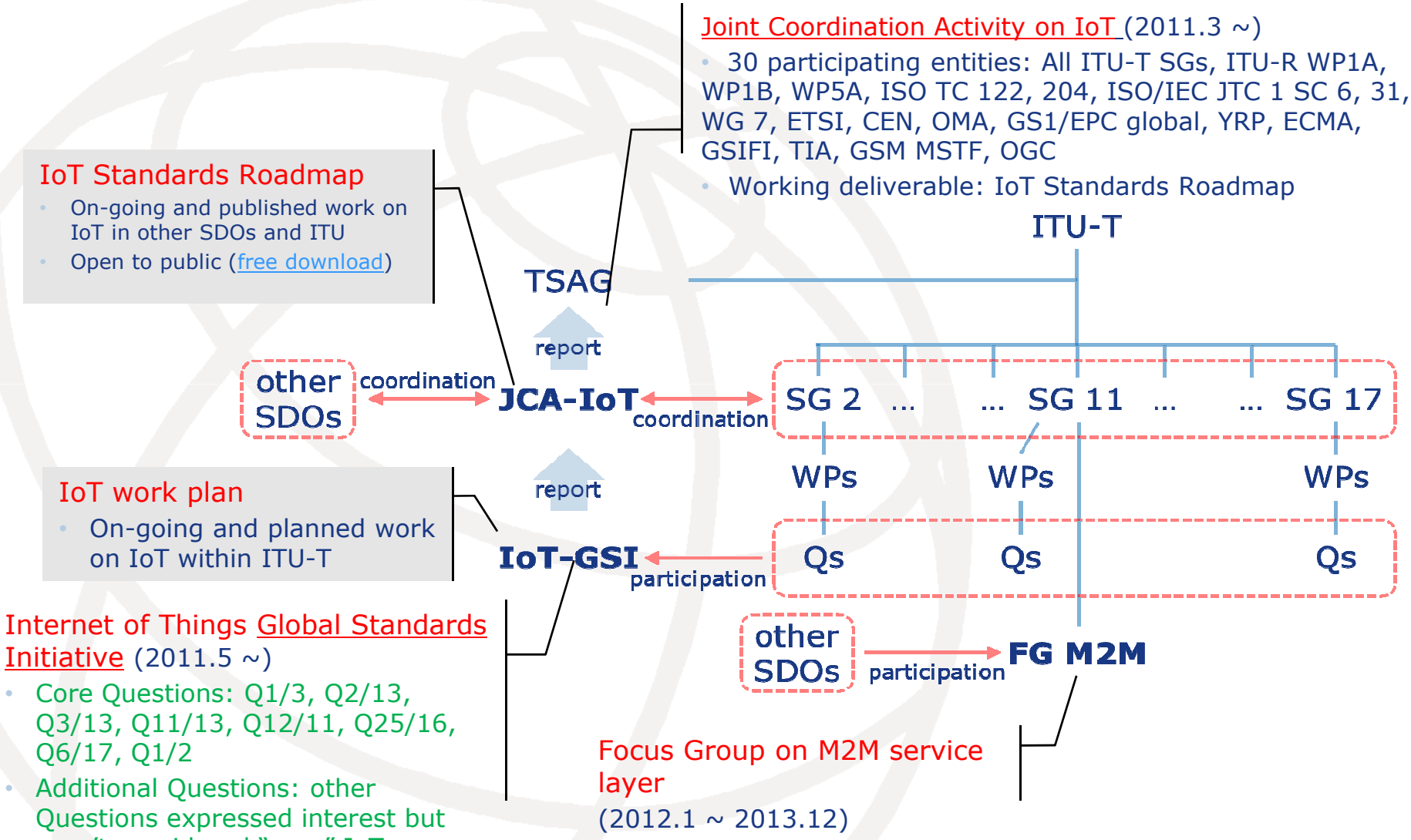
Experts' suggestion and alarm information

Smart Governance - E-health: Emergency Medical care



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

IoT-GSI

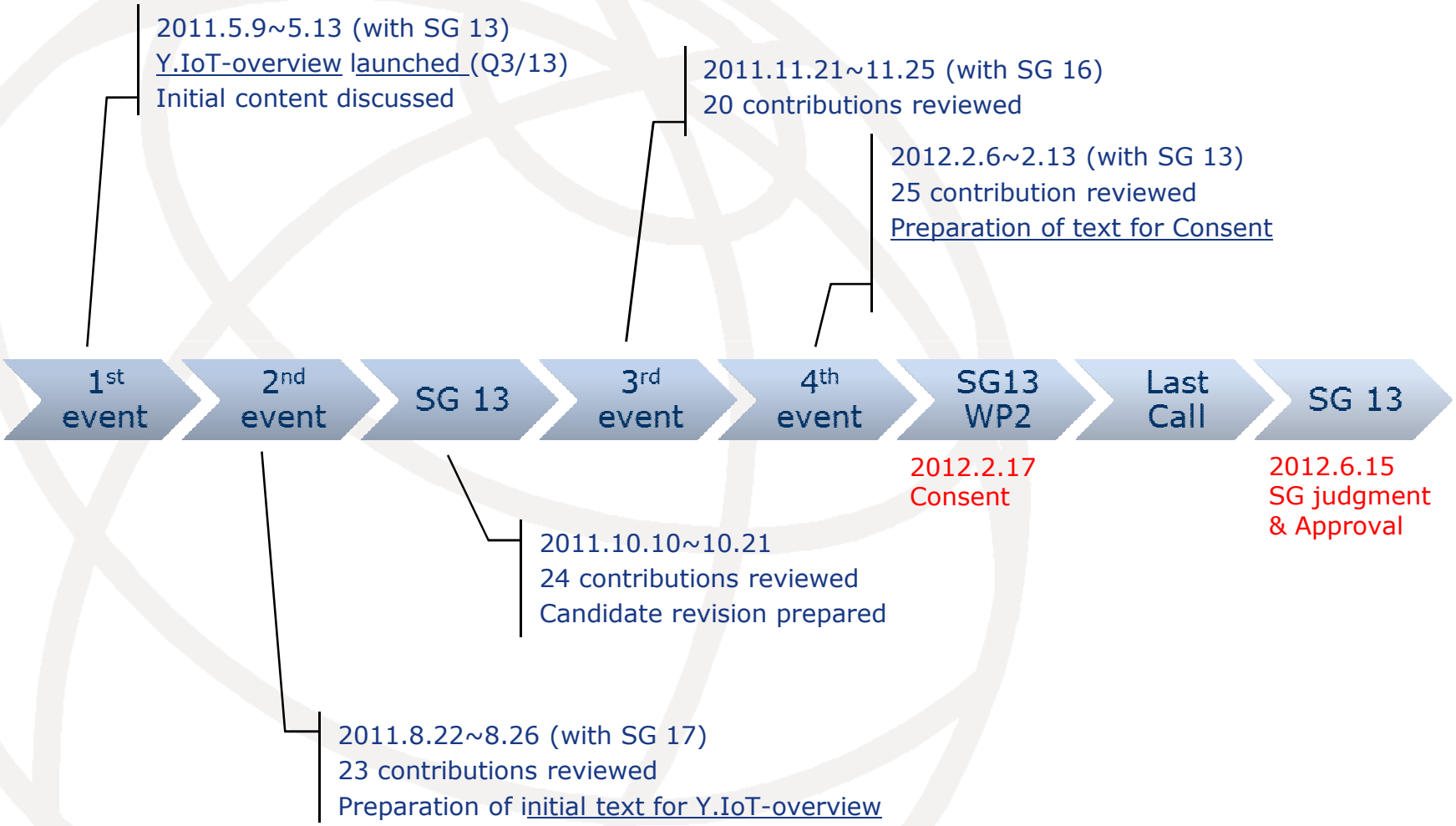
IoT Global Standards Initiative

- 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

Development of ITU-T Y.2060 (Overview of Internet of Things)



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.

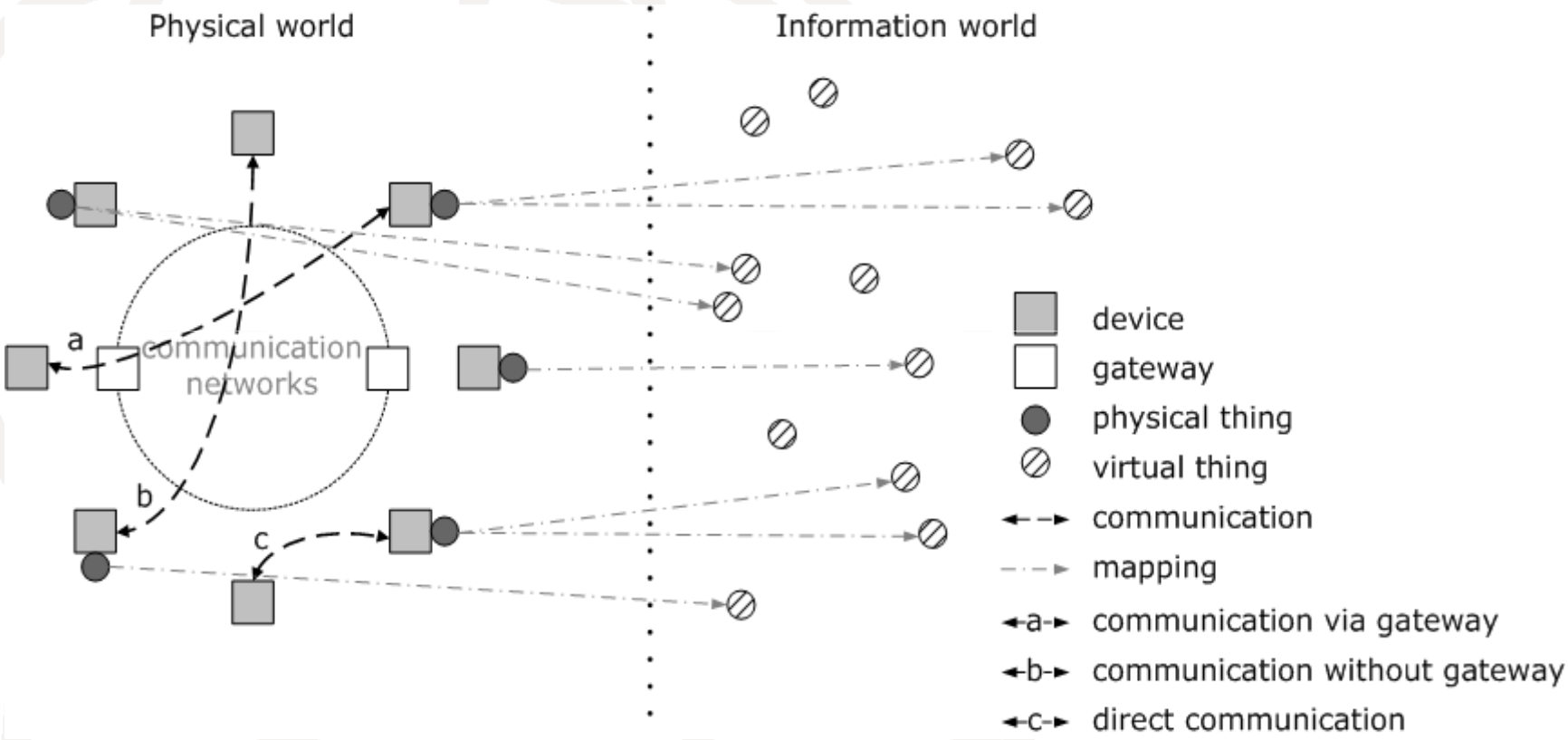
NOTE2 - In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

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

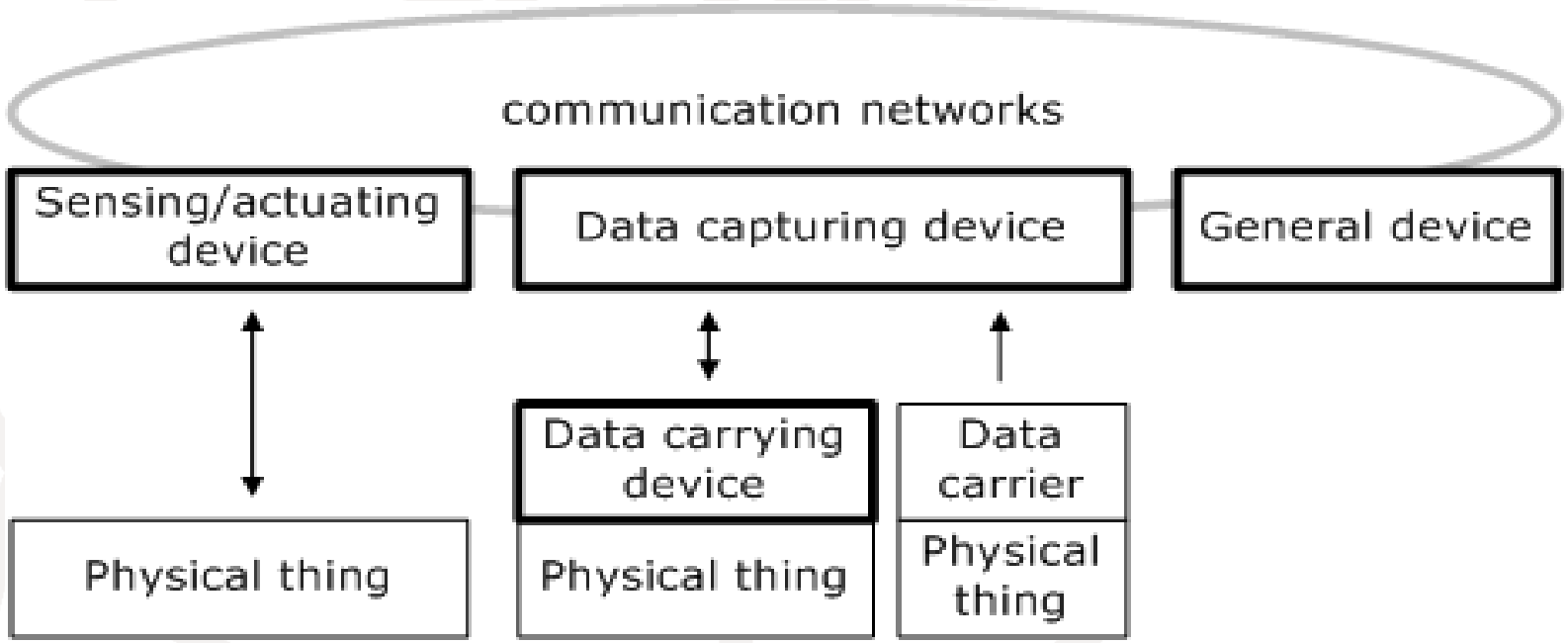


Source: ITU-T Y.2060, 2012

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 (2/6)

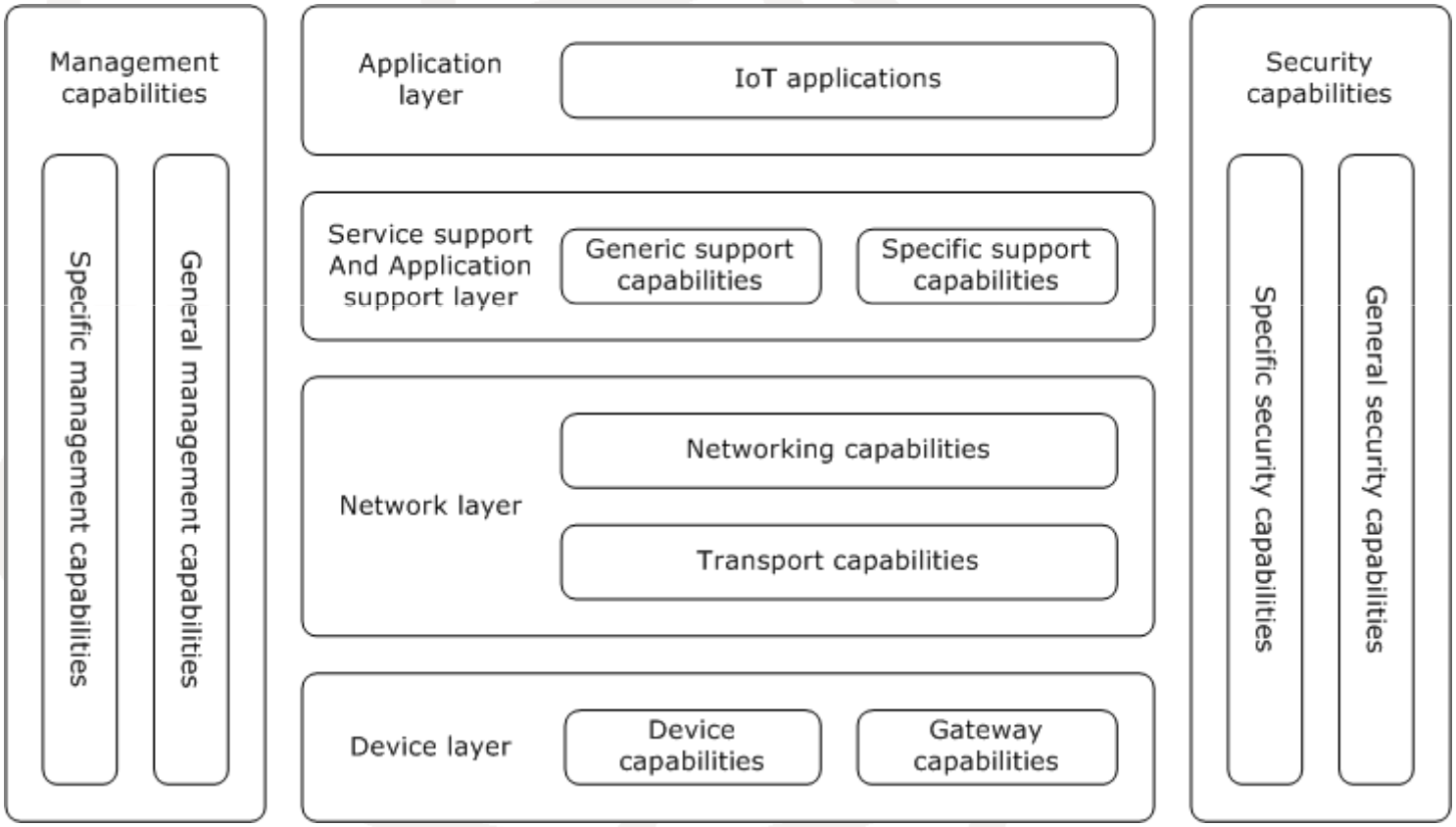
- Types of devices and relation with physical things



Source: ITU-T Y.2060, 2012

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

- Reference model



Source: ITU-T Y.2060, 2012

Y.2060 IoT ref. model generalized from past studies

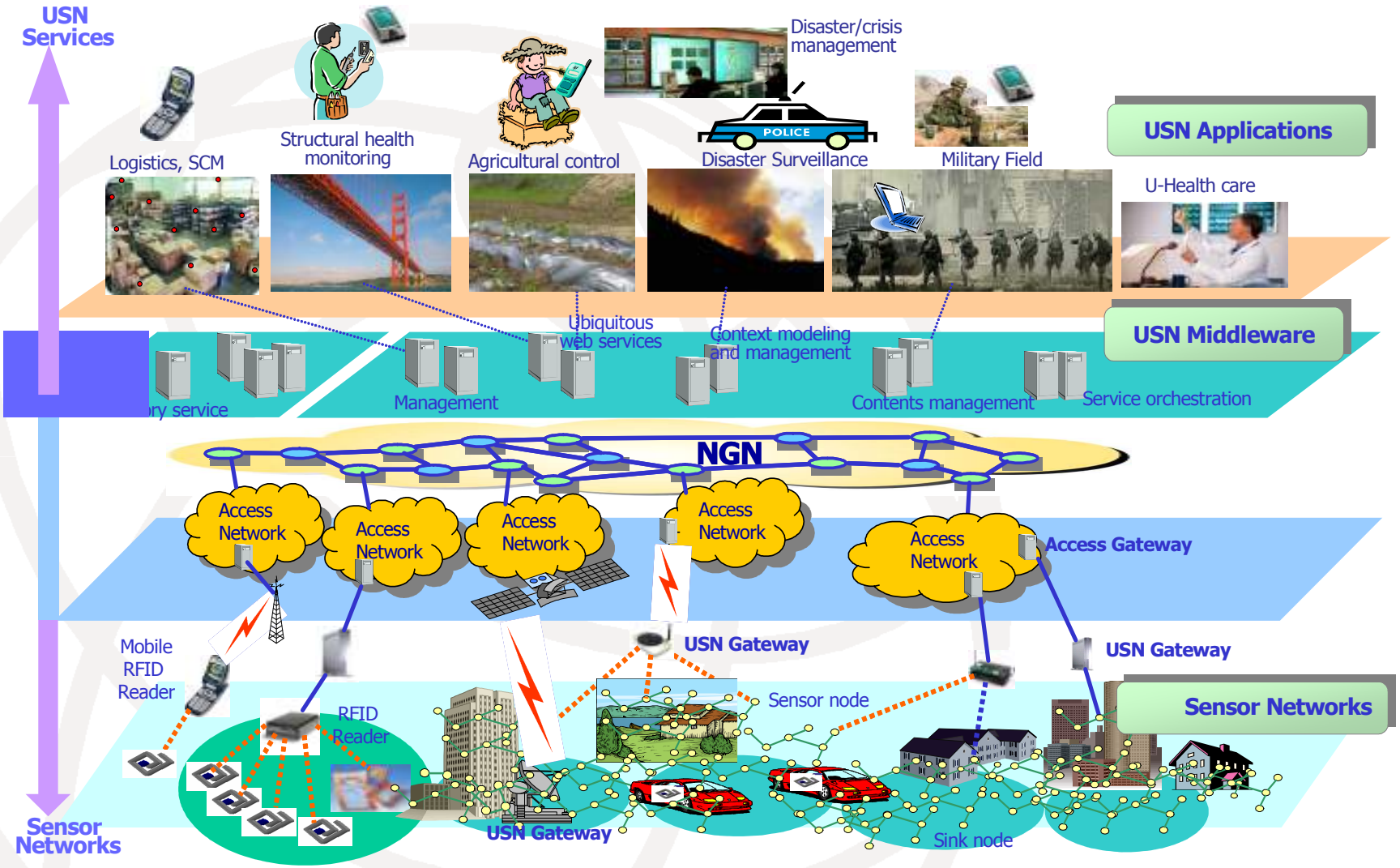
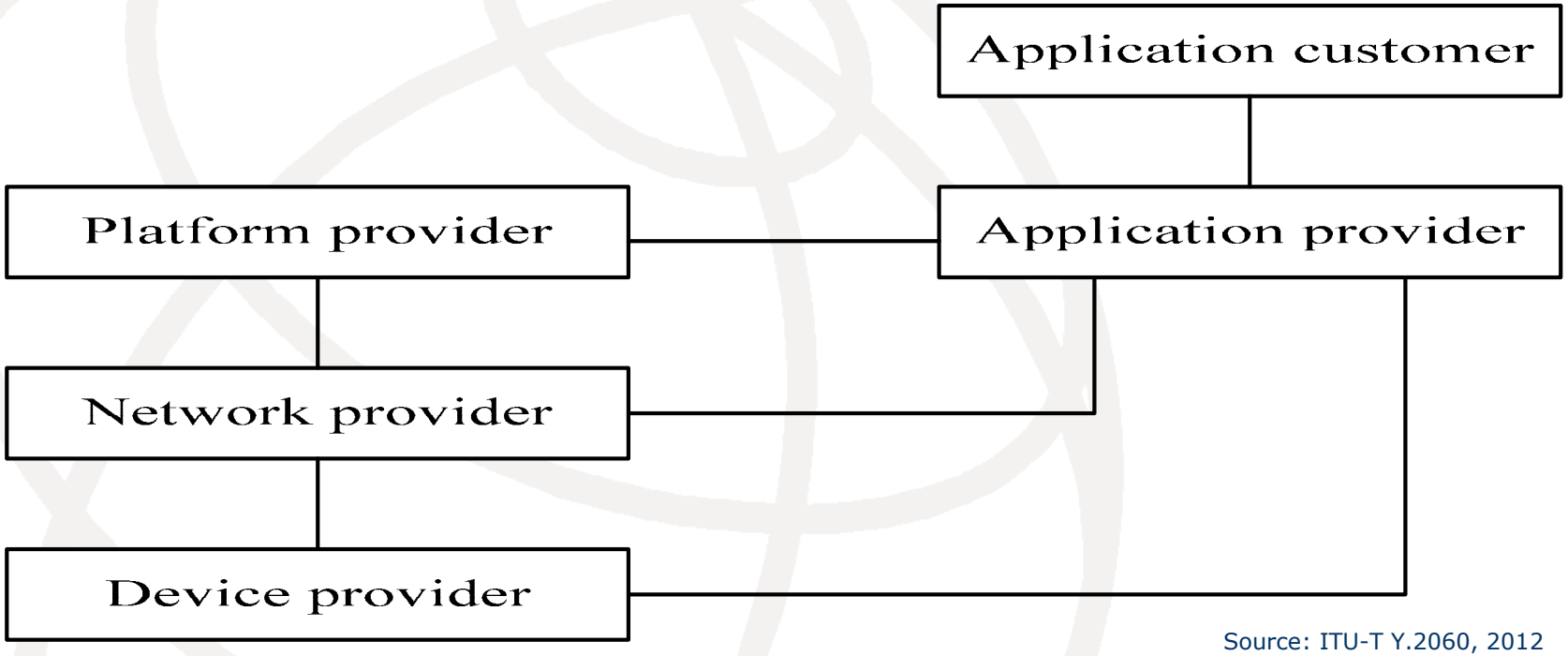


Figure extracted from ITU-T Rec. Y.2211 on "Requirements for support of Ubiquitous Sensor Networks (USN) applications over NGN"

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

- IoT Ecosystem

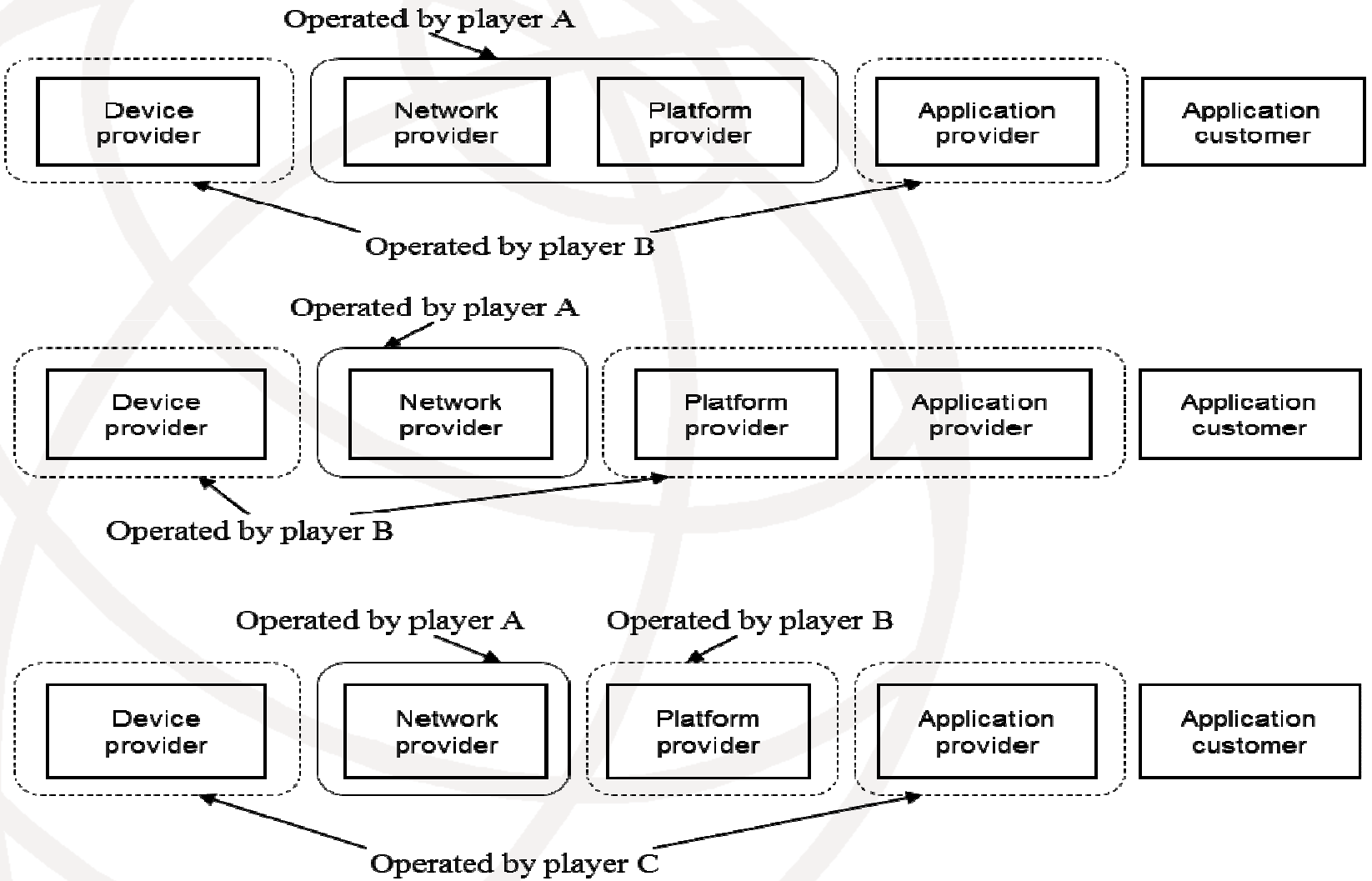


Source: ITU-T Y.2060, 2012

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) - *Note: this item could be combined with the item on IoT requirements and capabilities.*
7	IoT application domains and related use cases
8	Support of Inter- provider application scenarios *Note: it is for consideration to combine this item with the IoT application domains and related use cases item.*
9	IoT management and provisioning
10	Quality of Service for IoT *Note: this item could be combined (and, at least, requires coordination) with the item on IoT requirements and capabilities.*
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

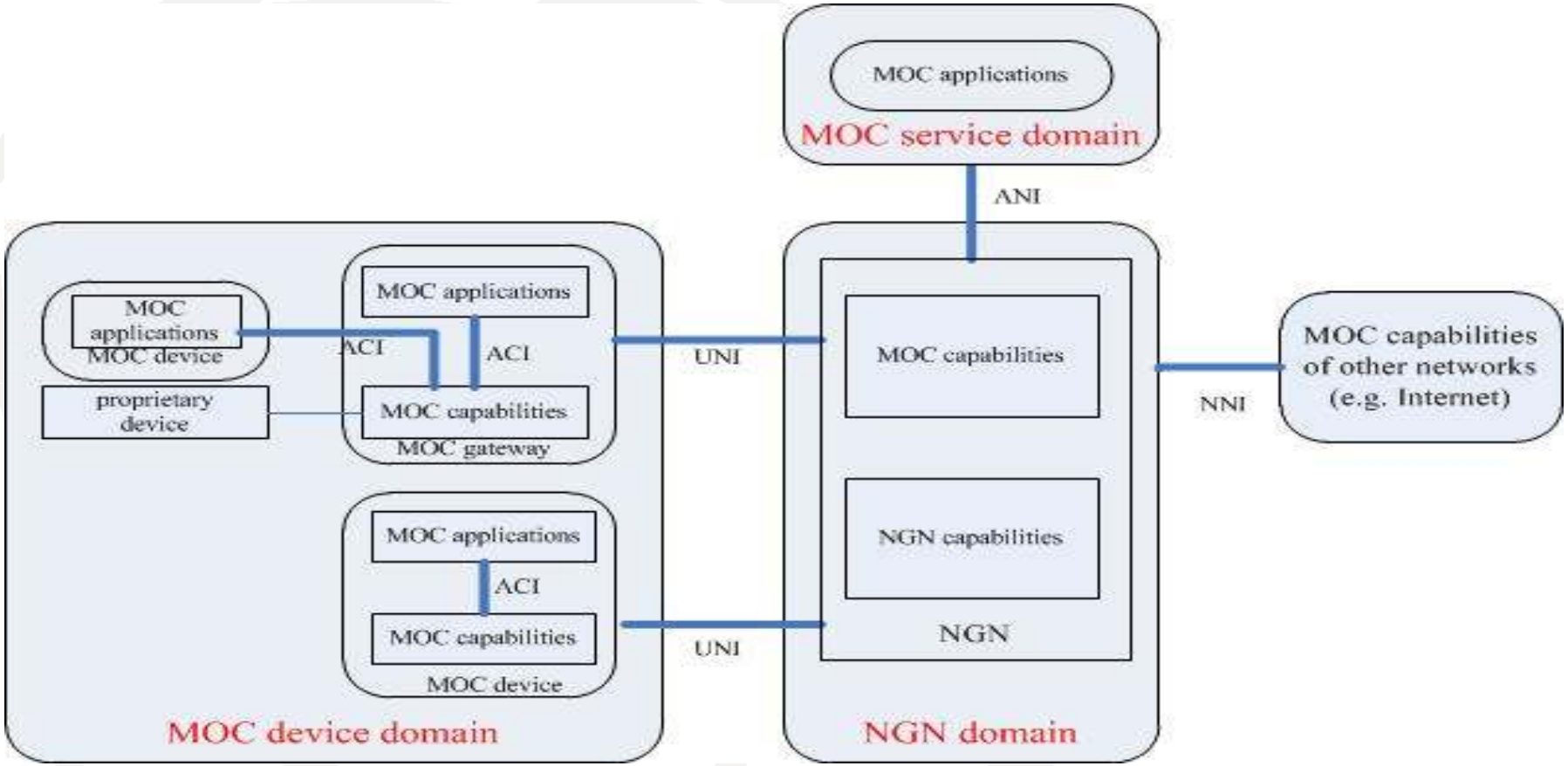
The "IoT Standards Roadmap" from JCA-IoT

- Maintained by JCA-IoT with ITU-T's content extracted from the IoT-GSI work plan and with other SDOs' content based on regular exchanges with other SDOs
- It's a collection of published and under progress IoT deliverables from SDOs

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

- "Activity domains" identified (May 2013) include: general, sensor and actuator, tag-based identification, USN, MOC, FN, Geospatial information, SWE, LBS, AIDC, WASN, supply chain
- http://ifa.itu.int/t/sftp/jcaiot/DELIVERABLES/JCAIoT-D-2r6_IoT_roadmap-20130621.doc

Few examples of other published IoT documents : Machine oriented communication (MOC) applications - requirements for support by NGN



High level view of the reference framework for MOC capabilities

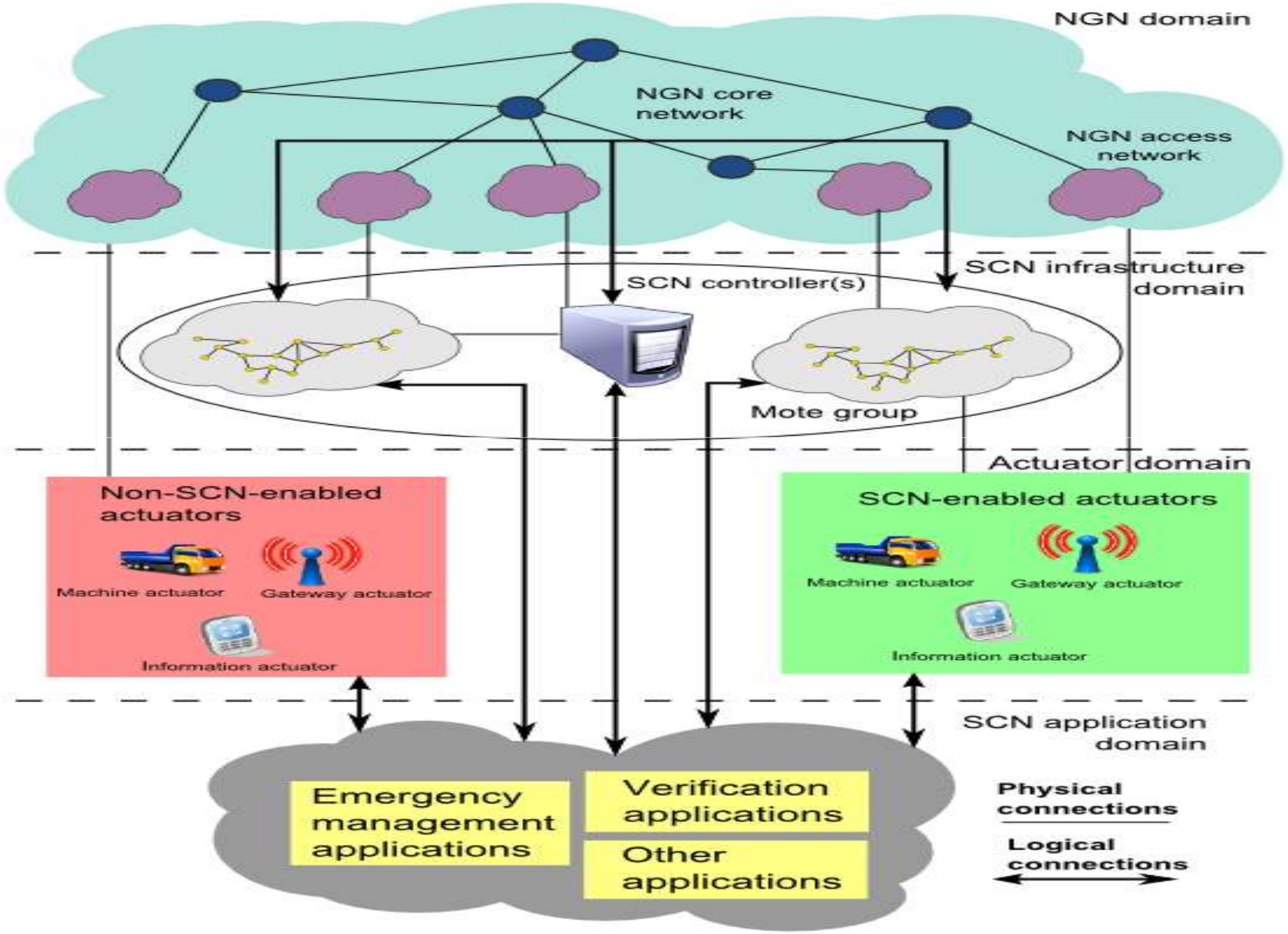
Source: ITU-T Y.2061, 2012

Few examples of other published IoT documents: Sensor Control Networks (SCN)

Y.2222 "Sensor Control Networks and related applications in NGN environment" - 04/2013

- Introduction to SCNs
  - terminology, overview, positioning with respect to NGN
  - configurations for SCN applications, incl. decision making process
- Service requirements of SCN applications
- Use cases of SCNs
  - **Emergency Management**
  - **Decision Verification**

Overview of SCNs



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"

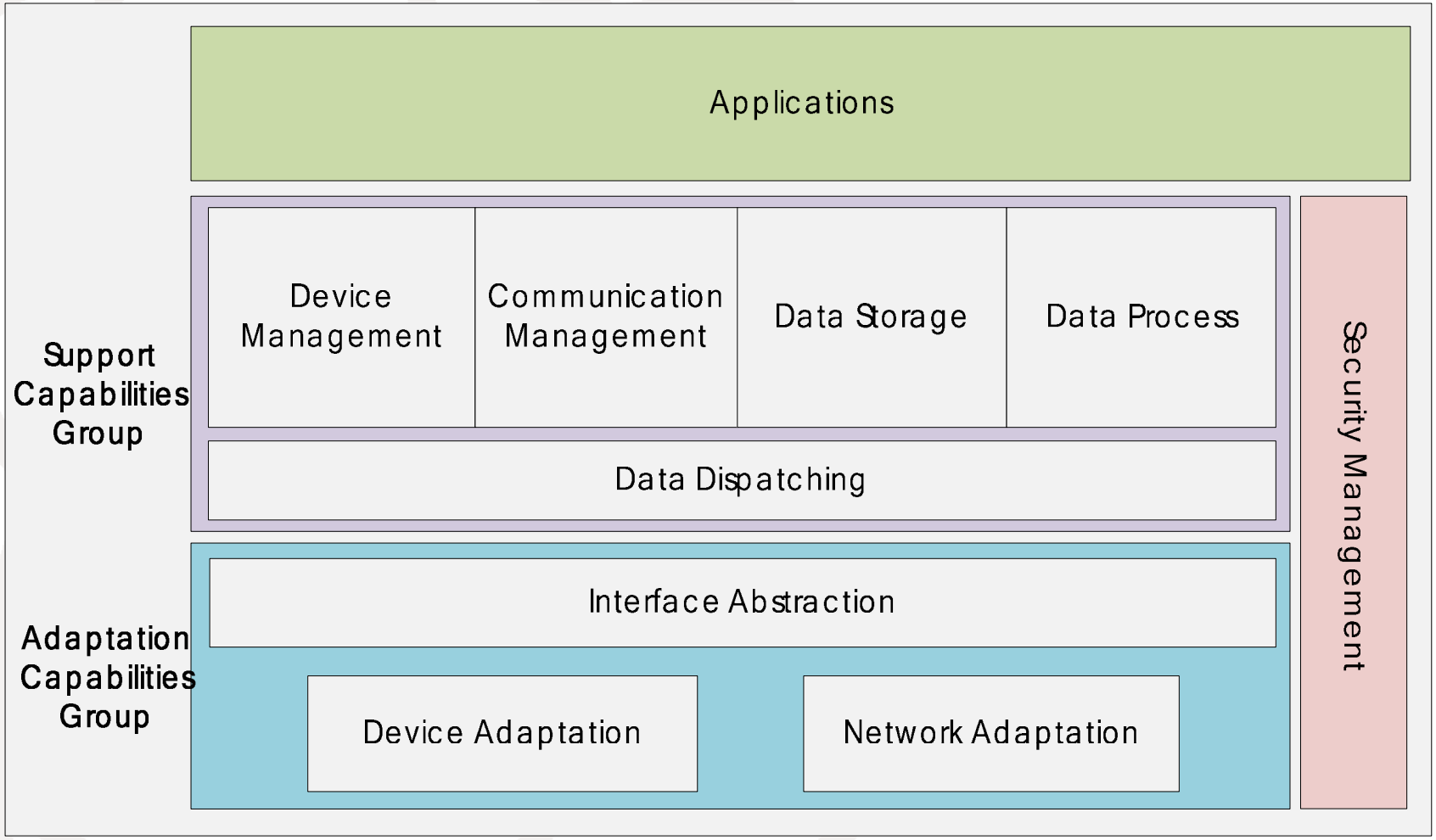
Detailed information on the ITU-T ongoing items can be provided upon request

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

- The scope of the Recommendation includes:
  - Abstracted use cases
  - Cross-domain use cases
  - Key areas of consideration from requirements perspective
- 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)

E-health Monitoring Services [Y.EHM-Reqts]

- Classification of e-health monitoring services (EHM are a subset of the whole e-health services and applications, relevant for the telecommunication market)
- EHM services characteristics from network perspective (general, service specific)
- Requirements for support of EHM services from network perspective
- Capabilities for support of EHM services (at different layers of IoT reference model)
- Service scenarios

- **EHM Healthcare (EHMH)** services: for healthy state
- **EHM Rehabilitation (EHMR)** services: for recovery/sub-healthy state
- **EHM Treatment (EHMT)** services: for illness state

These 3 types of EHM services share some common features but have also distinguished features [e.g. from the perspective of service coverage, target user number, target user mobility, reliability and priority levels of service data transmission, end point – user relationship, special scenarios]

Thanks for your attention