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Some recent achievements and relevant ongoing studies in ITU-T SG13 with focus on NGN evolution and Internet of Things/Machine-to-Machine developments

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Outline

- Brief introduction to ITU-T SG13 and some recent directions of its standardization activity
- Information elements of few ongoing key studies in SG13
- Focus on NGN evolution (NGN-e) and Internet of Things/Machine to Machine (IoT/M2M): achievements and ongoing studies in SG13

Brief introduction to ITU-T SG13 and some recent directions of its standardization activity

ITU-T Study Group 13 (Study Period 2013-2016)

"Future networks including cloud computing, mobile and NGN"

Responsible for studies relating to:

- requirements, architectures, capabilities and mechanisms of future networks including studies relating to service awareness, data awareness, environmental awareness and socio-economic awareness of future networks.
- cloud computing technologies such as virtualization, resource management, reliability and security.
- **network aspects of Internet of Things (IoT)**.
- network aspects of mobile telecommunication networks, including International Mobile Telecommunications (IMT) and IMT-Advanced, wireless Internet, mobility management, mobile multimedia network functions, internetworking and enhancements to existing ITU T Recommendations on IMT.
- NGN/IPTV enhancements, including requirements, capabilities, architectures and implementation scenarios, deployment models, coordination across SGs.

Lead Study Group roles:

- **Future networks (FN)**
- **Mobility Management and Next Generation Networks (NGN)**
- **Cloud computing (CC)**
- **Software-Defined Networking (SDN)**

SG13 organizational structure

SG13RG-AFR	Regional Group for Africa
WP1/13	**NGN evolution and IMT**
Q1/13	Service scenarios, deployment models and migration issues based on convergence services
Q2/13	Requirements for NGN evolution and its capabilities including support of IoT and use of SDN
Q3/13	Functional architecture for NGN evolution including support of IoT and use of SDN
Q4/13	Identification of evolving IMT systems and beyond
Q5/13	Applying IMS and IMT in developing country mobile telecom networks
WP2/13	**Cloud Computing and Common Capabilities**
Q6/13	Requirements and mechanisms for network QoS enablement (including support for SDN)
Q7/13	Deep packet inspection in support of service/application awareness in evolving networks
Q8/13	Security and identity management in evolving managed networks (including SDN)
Q9/13	Mobility management (including support for SDN)
Q10/13	Coordination and management for multiple access technologies (Multi-connection)
Q17/13	Cloud computing ecosystem, general requirements, and capabilities
Q18/13	Cloud functional architecture, infrastructure and networking
Q19/13	End-to-end Cloud computing service and resource management
WP3/13	**Software-Defined Networking and Networks of Future**
Q11/13	Evolution of user-centric networking, services, and interworking with networks of the future including SDN
Q12/13	Distributed service networking
Q13/13	Requirements, mechanisms and frameworks for packet data network evolution
Q14/13	Software-Defined Networking and Service-aware networking of future networks
Q15/13	Data-aware networking in future networks
Q16/13	Environmental and socio-economic sustainability in future networks and early realization of FN

Some recent directions of SG13 standardization activity (1/2)

NGN evolution (NGN-e)

- Enhancements of network intelligence capabilities and functions (with/without SDN usage); virtualization of control functions; support of advanced/emerging services (incl. IoT, converged services etc.); support of Oauth and OpenID prot.

Network aspects of Internet of Things (IoT)

- Overview; services scenarios; "common" requirements and capabilities; "specific" requirements and capabilities; functional framework; web framework

IMT and IMS in developing countries

- Scenarios and requirements in terms of services and deployments

Common capabilities

- Resource control for virtual networks for cloud services; Deep Packet Inspection (requirements, framework and mechanisms); cloud security (use cases, requirements, framework, inter-cloud); framework for emergency service support; mobility management framework and architecture for diverse scenarios; multi-connection capabilities for diverse scenarios and services

Interworking

- Interworking for Streaming and IPTV VoD services

Energy measurement and energy management

- Measurement in networks; management for Home Networks and Web of Things

Some recent directions of SG13 standardization activity (2/2)

PTDN and DSN extensions

- Public packet Telecom Data Network (PTDN) extensions (mechanisms for interworking, OAM and QoS; interfaces); Distributed Service Networking (DSN) extensions (m-media telephony, service routing, content distribution, security)

Cloud computing (CC)

- Framework and high level requirements; reference architecture; requirements for infrastructure, DaaS, NaaS (and funct. arch. for NaaS), IaaS and inter-cloud; Big Data capabilities; end-to-end resource and service lifecycle mgt

Future Networks (FN)

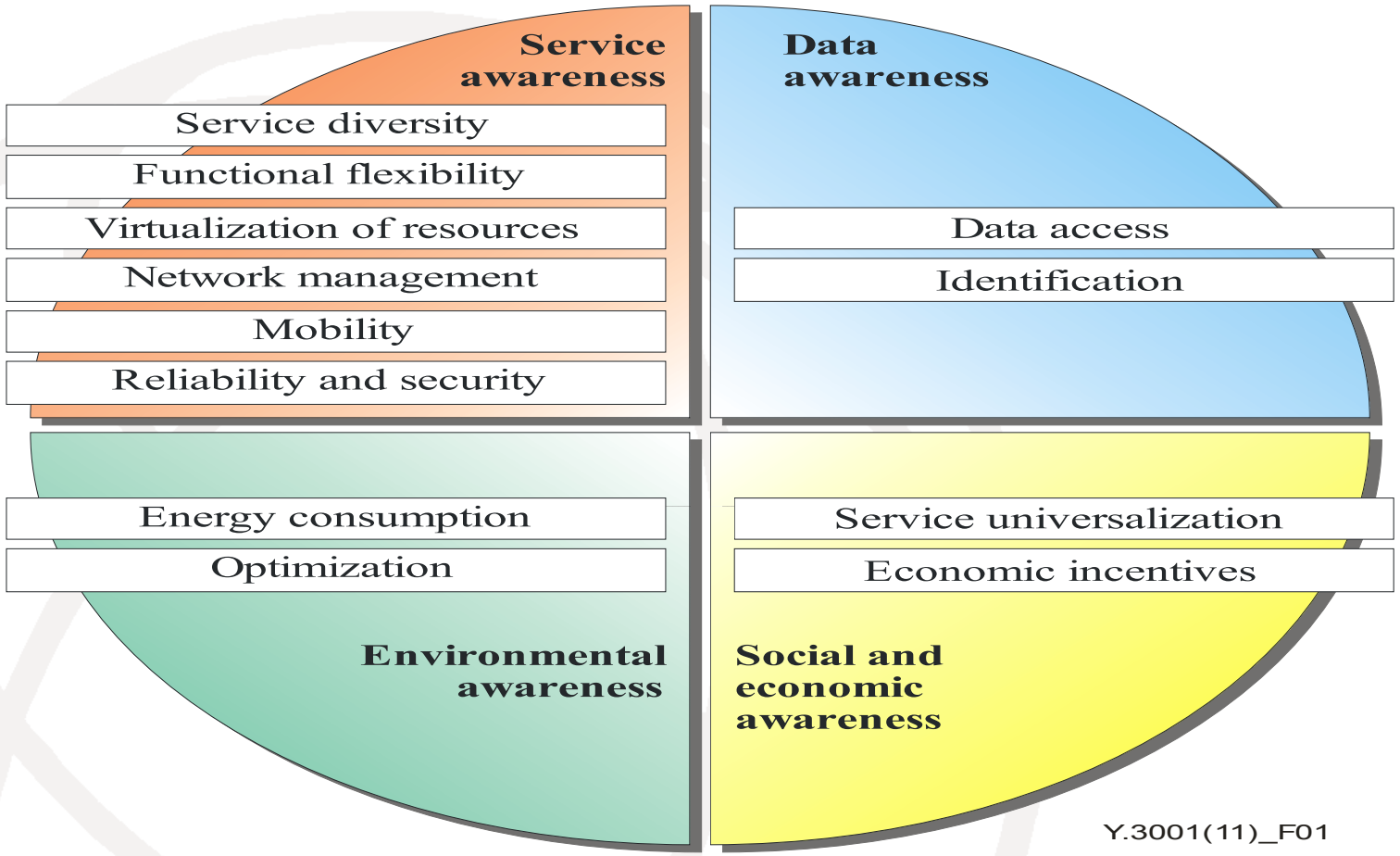
- FN objectives and design goals; FN framework and requirements; frameworks for energy saving, identification, data aware-networking and auto-manageability; framework, requirements and functional architecture for network virtualization; interworking mechanisms; FN socio-economic assessment; service universalization
- Smart Ubiquitous Networks (overview, resource management, content and context awareness, content delivery)

Software-Defined Networking (SDN)

- Framework; requirements for formal methods; telecom SDN use cases; functional requirements and functional architecture

Information elements of few ongoing key studies in SG13

Future Networks studies are progressing



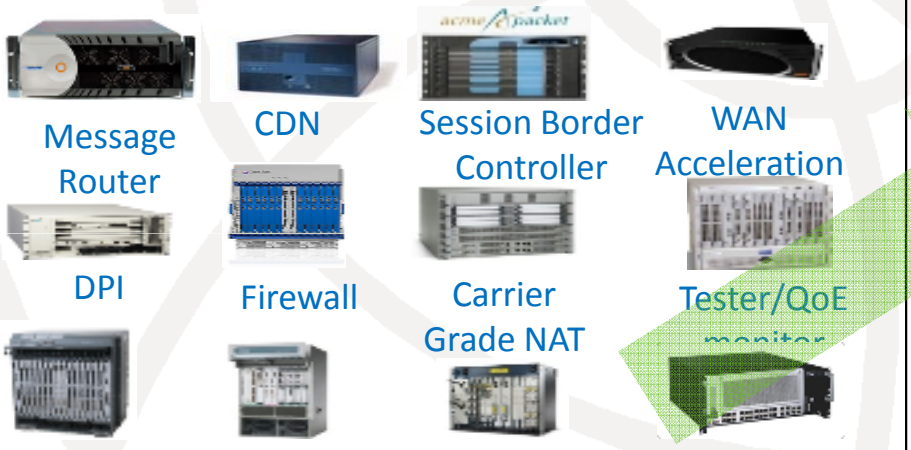
The 4 objectives and 12 design goals of Future Networks (FNs)

Source: ITU-T Y.3001 "Future networks: Objectives and design goals" (2011)

Emerging hot topic: Network Functions Virtualization (NFV)

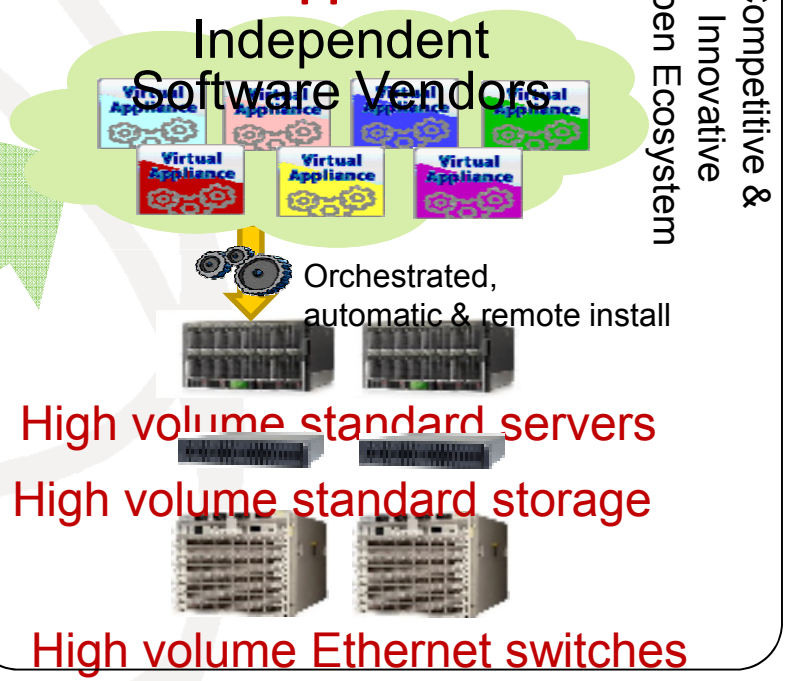
NFV is about implementing network functions in software (running today on proprietary hardware), leveraging (high volume) standard equipment and IT virtualization

Classical Network Appliance Approach



- Fragmented, purpose-built hardware
- Physical install per appliance per site
- Hardware development: large barrier to entry for new vendors, constraining innovation & competition

Network Functions Virtualisation Approach

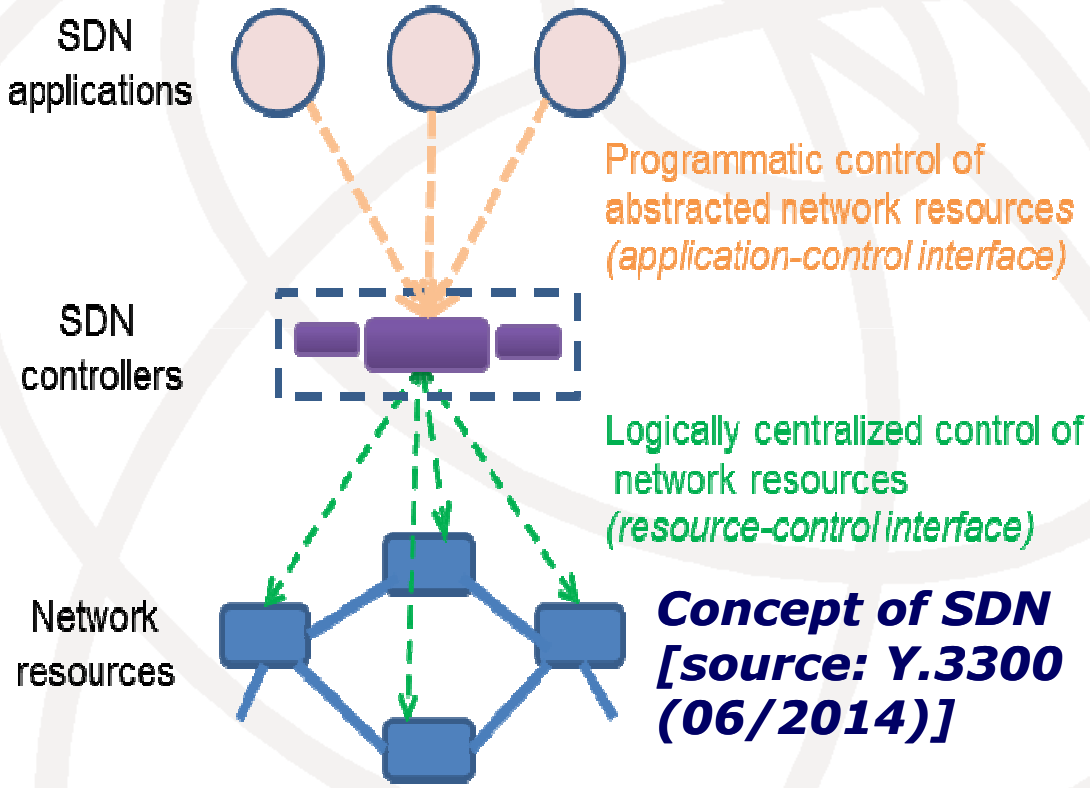


NFV is expected to be disruptive for telecom industry over next 2-5 years. A trend for all telecom networks (certainly FN, but also applicable to NGN)

As general study, SG13 has focused till now on "network virtualization": Y.3011 (framework), Y.3012 (requirements), Y.Fnvirtarch (funct. arch.)

Consolidated hot topic: Software-Defined Networking (SDN)

SDN is a set of techniques enabling to directly program, control and manage network resources, which facilitates design, delivery and operation of network services in a dynamic and scalable manner.



Concept of SDN [source: Y.3300 (06/2014)]

SDN objectives

- *Faster network business cycle*
- *Acceleration of innovation*
- *Rapid adaptation to demand*
- *Increase in resource availability and usage efficiency*
- ***Customization of network resources** including **service-aware networking***

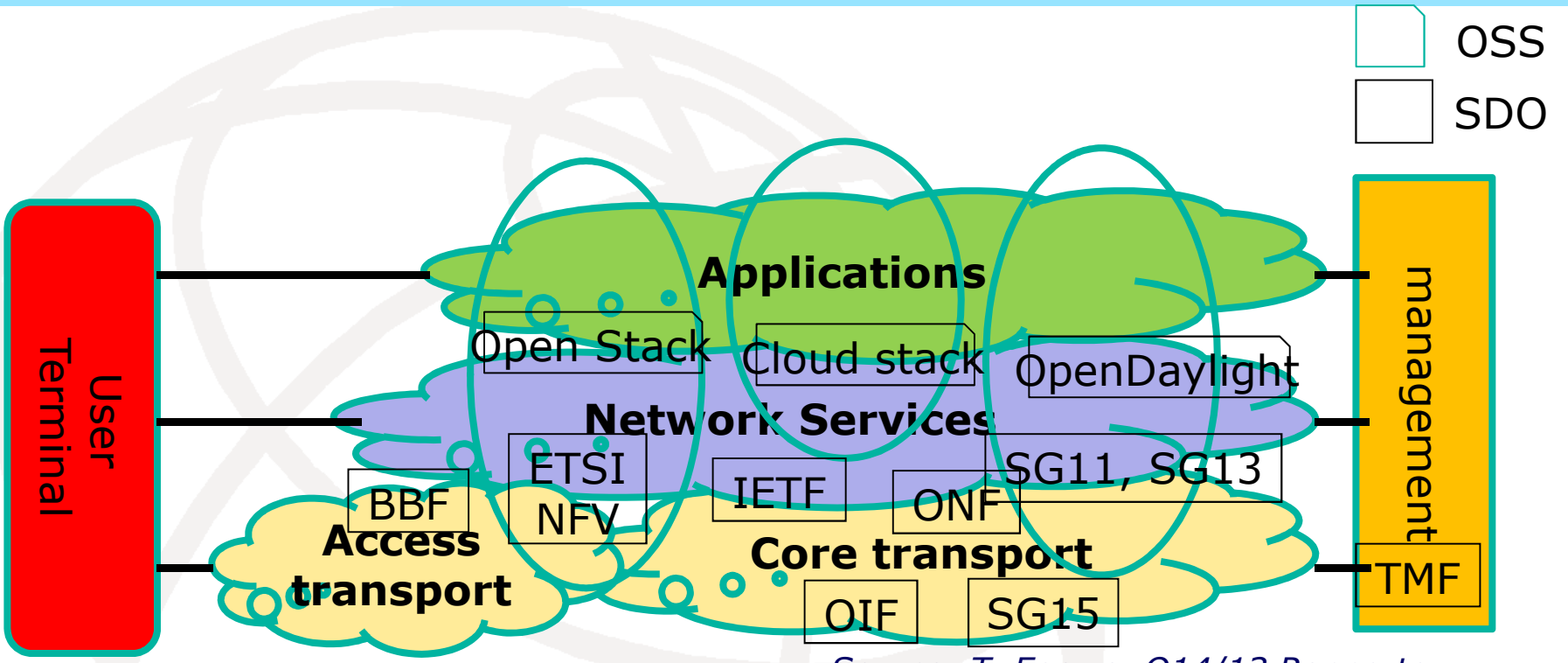
Basic SDN capabilities

- ***Programmability** (customized behavior of network resources)*
- ***Resource abstraction** (easy management and control of network resources)*

NOTE - SDN and NFV can be complementary

SDN applications may require virtual partitioning of network element's resources or virtually aggregated resources from multiple network elements

SDN for telecommunication networks is the focus of ITU-T SDN standardization



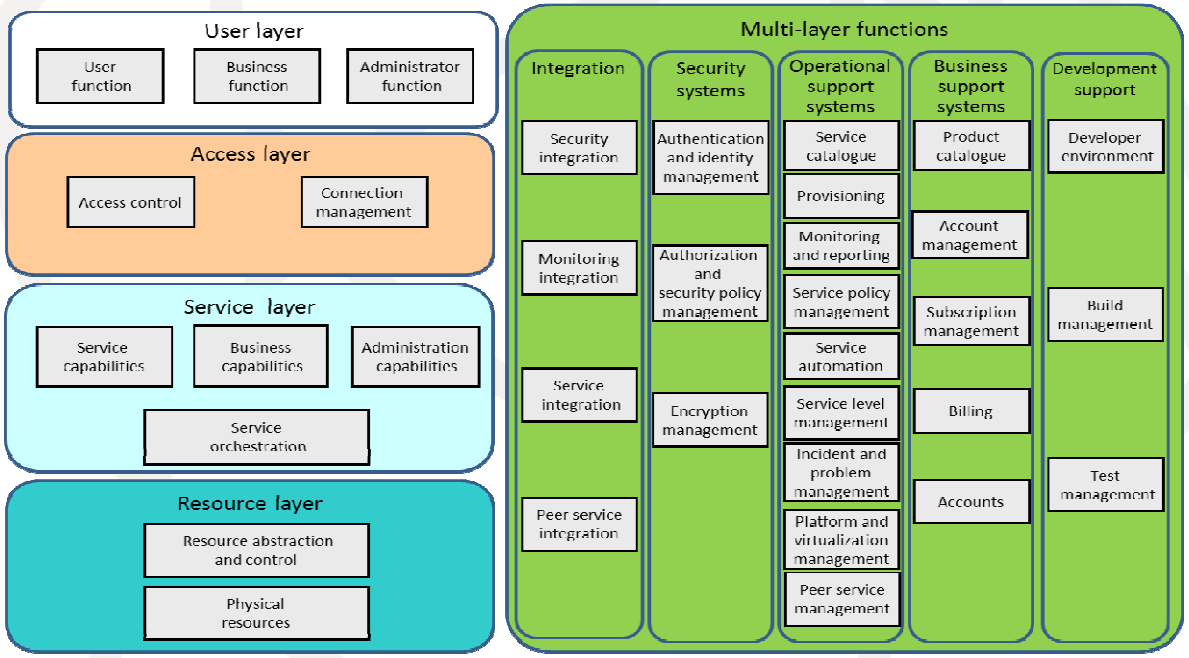
Source: T. Egawa, Q14/13 Rapporteur

ITU-T is progressing work on SDN from various perspectives

- ITU-T JCA-SDN (general coordination and SDN standards roadmap)
- Future Networks use SDN (and Network Virtualization) (SG13)
- iSCP (independent Scalable Control Plane) for control/data separation [Y.2621, Y.2622] (SG13)
- "Framework of SDN" [Y.3300] and new items on functional requirements and arch. (SG13)
- Other SDN related studies, incl. SDN signalling (SG11), the application of SDN to NGN (SG13), transport SDN (SG15)

Cloud computing (CC) studies are progressing

Cloud computing definition [Y.3500=ISO/IEC 17788]:
Paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand. NOTE – Examples of resources include servers, operating systems, networks, software, applications and storage equipment.



Functional components of CC Ref. Architecture [source: Y.3502= ISO/IEC 17789]

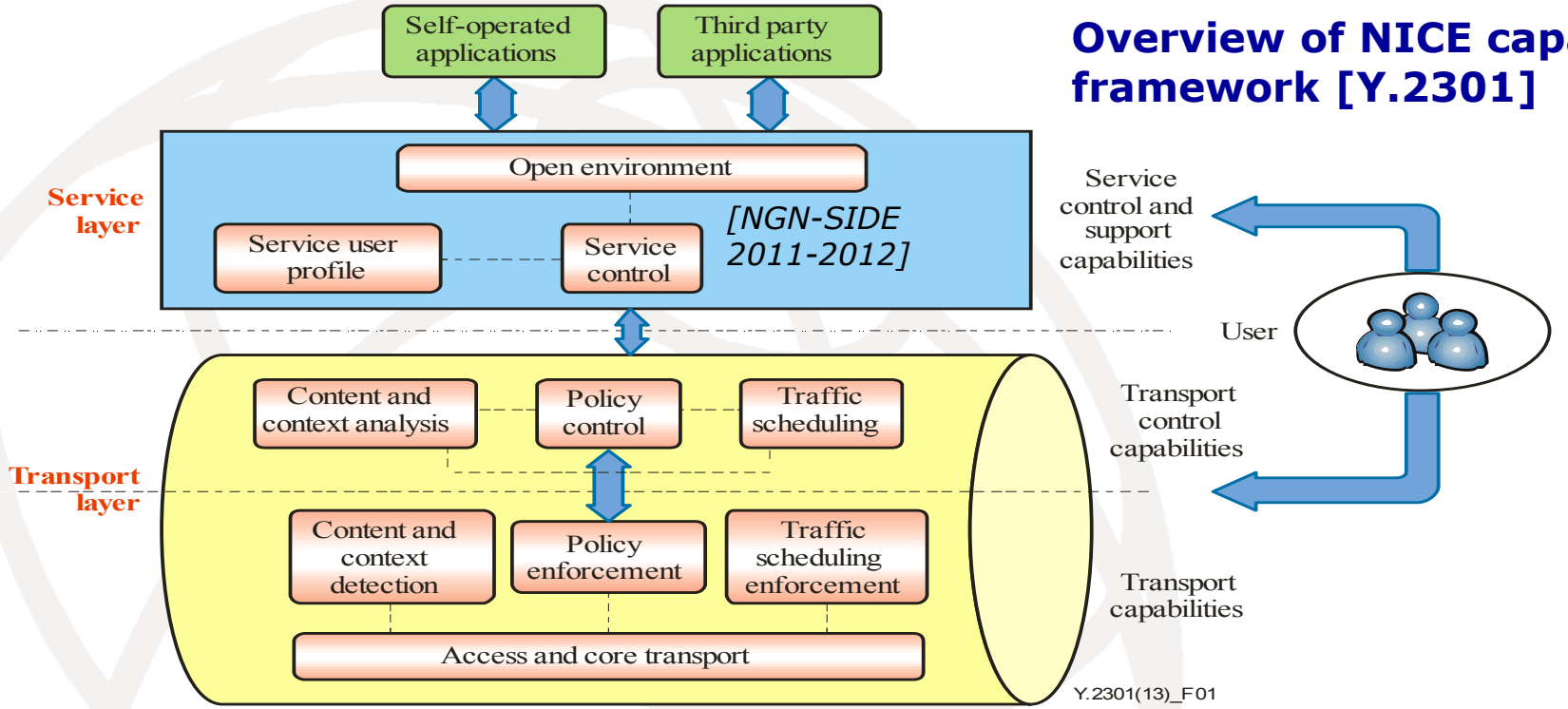
Key ITU-T CC achievements (SG13)

- Y.3500 (overview and vocab.), 3501 (framework and high level reqts), 3502 (ref. arch.)
- Y.3503 (DaaS reqts), 3510 (infrastructure reqts), 3512 (Naas reqts) [AAP], 3513 (IaaS reqts) [AAP]
- Y.3511 (inter-cloud framework), 3520 (end-to-end resource management)

From NGN to NGN evolution (NGN-e): achievements and ongoing studies in SG13

NICE [Y.2301 (8/2013), Y.2302 (AAP)]: enhancing the NGN with network intelligence capabilities for service provisioning

Overview of NICE capability framework [Y.2301]



NICE capabilities enable operators to assign and dynamically adjust specific network resources based on the requirements, as well as supporting interfaces for users and applications enabling on-demand resource and service provision

NICE supports the following features:

1) **awareness features**
2) **on-demand provision features**
3) **optimization features**
4) **openness features**
5) **cooperation features**

NICE stands for "Network Intelligence Capability Enhancement"

Application of Network Functions Virtualisation to NGN – work in progress

The application of virtualization techniques in NGN evolution will enable the deployment of **virtualized network functions** (implementation of network functions in virtualized hardware/software environment, that is software running in Virtual Machines inside Physical Servers).

Claims:

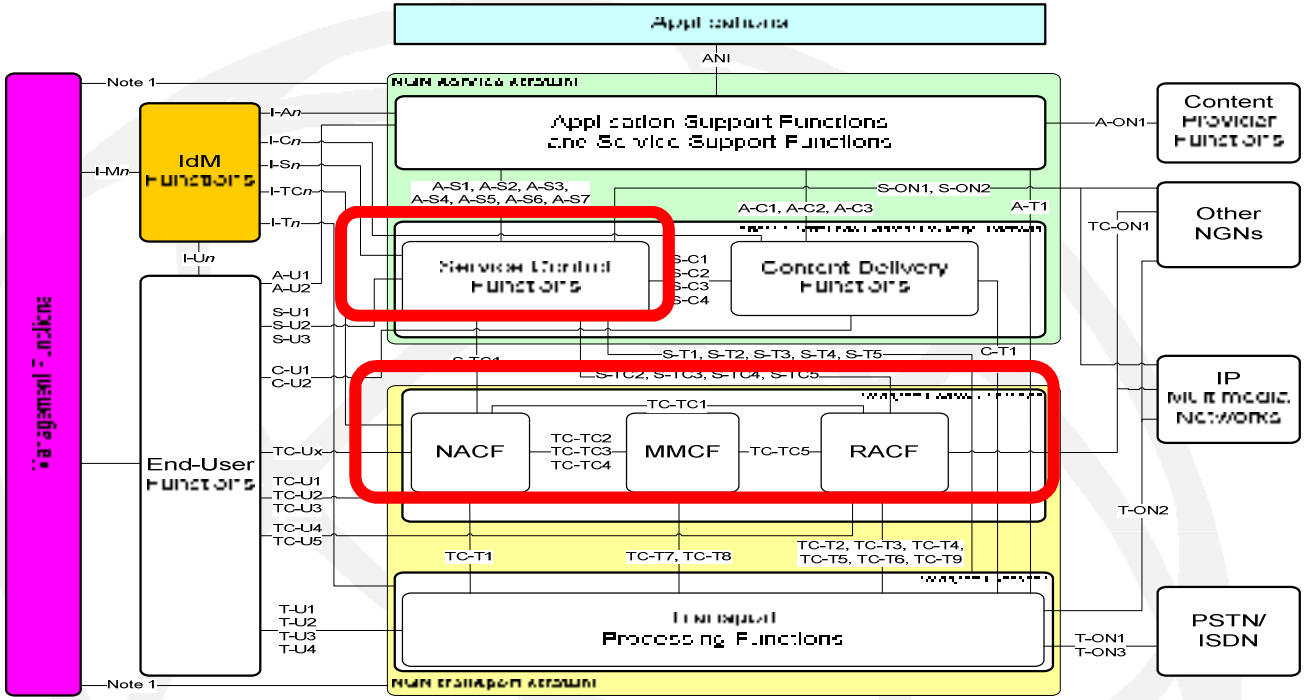
- **Elasticity, scalability, automation** because of abstraction of underlying hardware
- **Significant CAPEX/OPEX benefits (TCO)**, leveraging economies of scale
- **Application field spanning all domains (fixed and mobile networks)**
- Aiming to transform the way network operators architect and operate their networks (though changes are expected to be incremental)

Testing results:

- Initial NFV tests (e.g. as those reported in last July SG13 meeting by China Mobile) show **feasibility and cost-effective performances**

ITU-T draft Rec. Y.NGNe-VCN-Reqts "Requirements of Virtualization of Control Network (VCN) entities for NGN evolution"

The virtualization study in NGN (Y.NGNe-VCN-reqts)



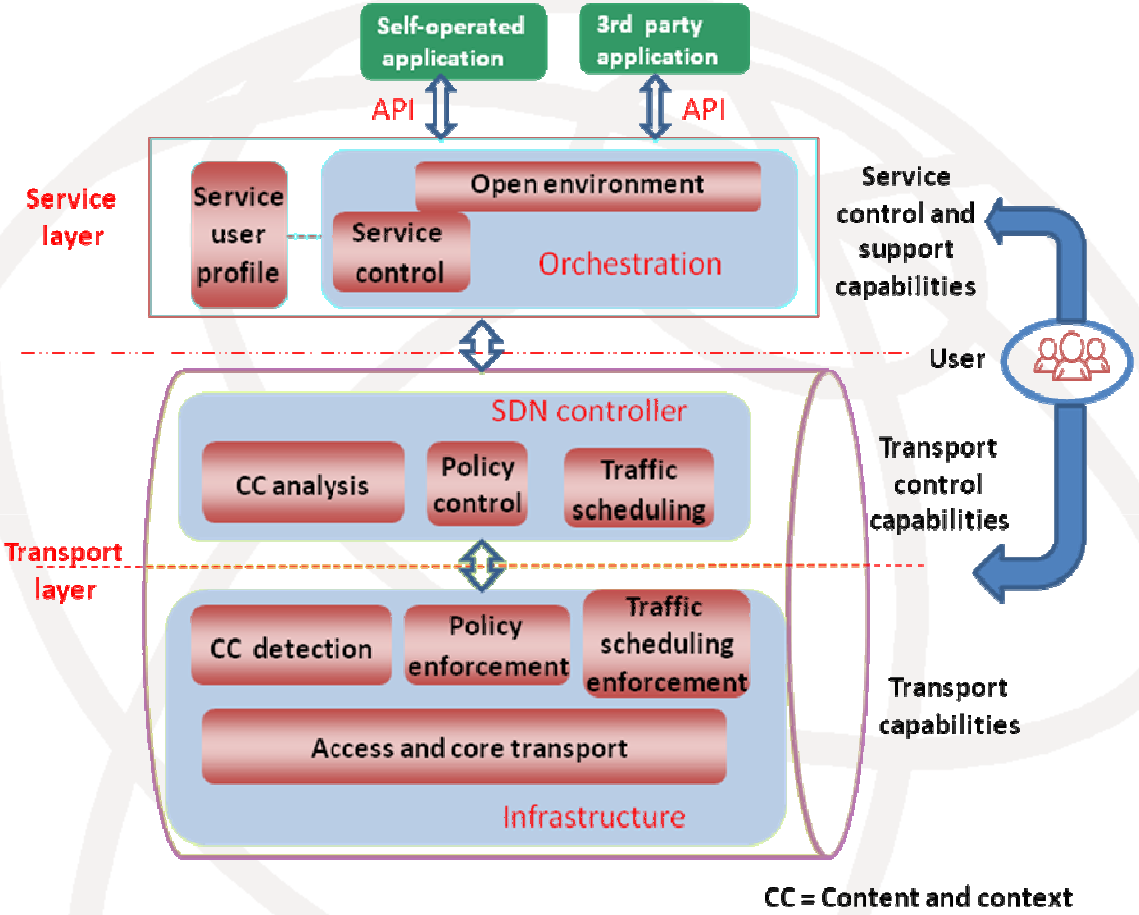
The "Control" functions of NGN are the initial target of this virtualization study in NGN

Focus on scenarios and requirements for virtualization of **Service Control Functions** and **Transport Control Functions** of the NGN

The Control functions of NGN required to be enhanced (e.g. in order to interact with the management system for implementing features such as automatic "scale in/out" of the virtual resources).

NOTE – This virtualization still provides a unified NGN network and not logically isolated separate partitions of the network.

Application of SDN to NGN – work in progress on Software defined NICE (S-NICE)



Overview of S-NICE capability framework
[Source: Y.S-NICE-Reqts "Requirements and capability framework for NICE implementation using SDN]

NOTE- Y.S-NICE-Arch has just been started too

Software defined NICE (S-NICE) is a specific implementation of NICE [Y.2301] [Y.2302] making usage of SDN technologies.

S-NICE supports the intelligent features of NICE, but in the S-NICE framework some NICE capabilities have different implementation approach and some enhancements.

Internet of Things/Machine to Machine (IoT/M2M): achievements and ongoing studies in SG13

The ITU-T definition of IoT

Internet of Things [ITU-T Rec. Y.2060 (06/2012)]:

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.

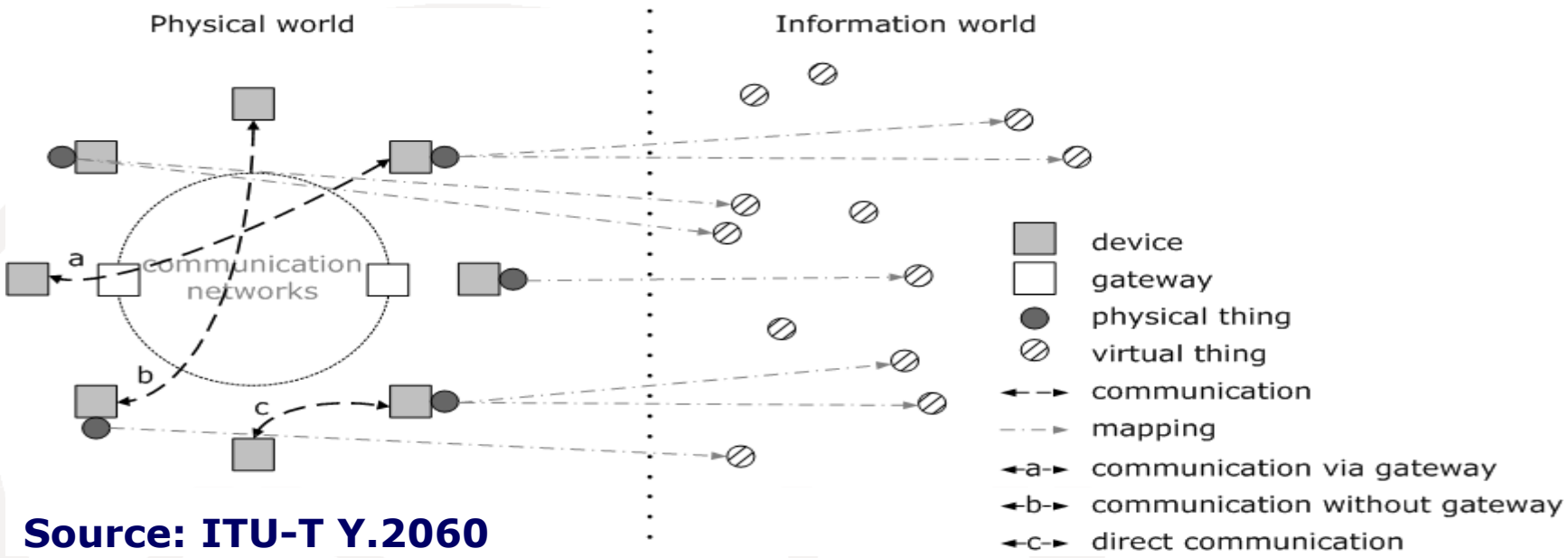
NOTE2 - In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

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

IoT versus M2M (Machine to Machine):

the M2M communication technologies are "a key enabler of the IoT"

"Things" and "Internet" (communication networks)



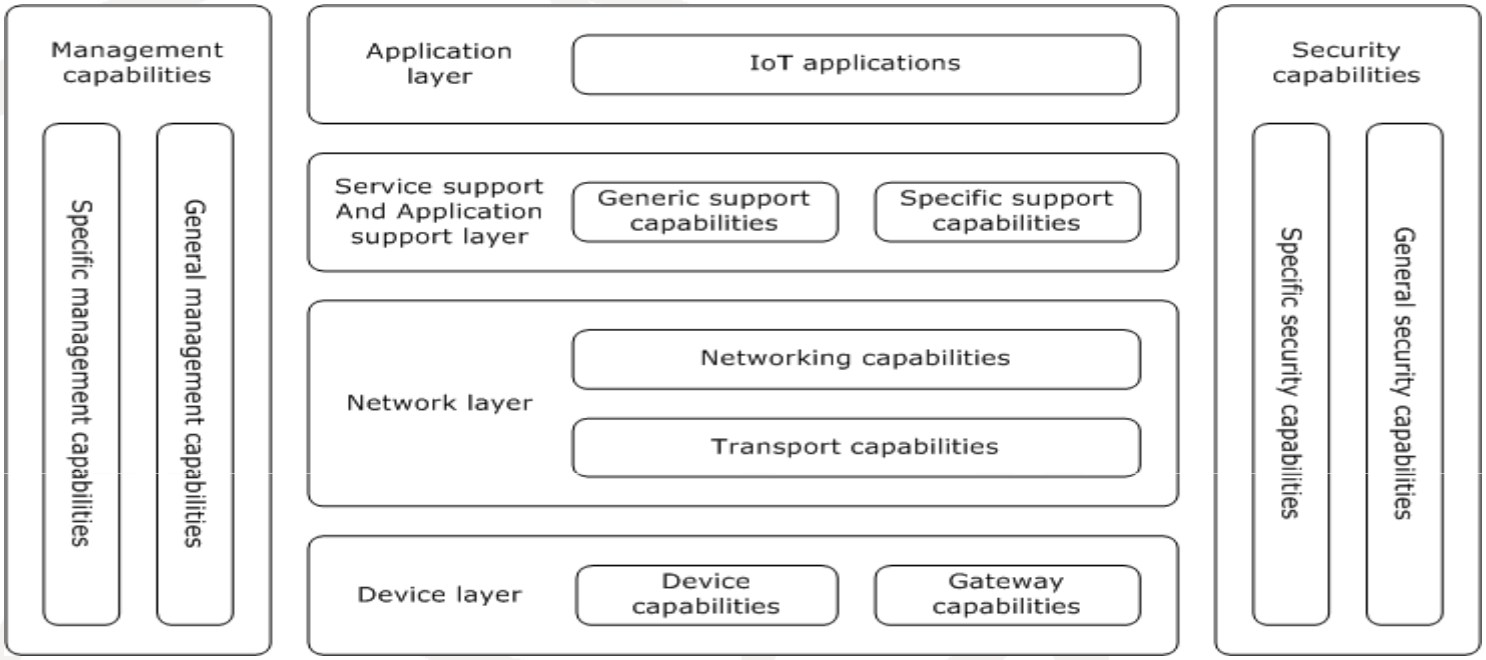
Source: ITU-T Y.2060

Thing: In the Internet of Things, object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into the communication networks.
Physical and Virtual Thing: a physical thing may be represented in the info world via one or more virtual thing, but a virtual thing can also exist without associated physical thing. All types of exchanges (P-P, P-V, V-V) are possible.
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
Communication networks: they may be realized via existing networks (IP based networks) and/or evolving networks (e.g. NGN)

IoT in Y.2060 (1/3)

- IoT reference model

Source: ITU-T Y.2060, 2012



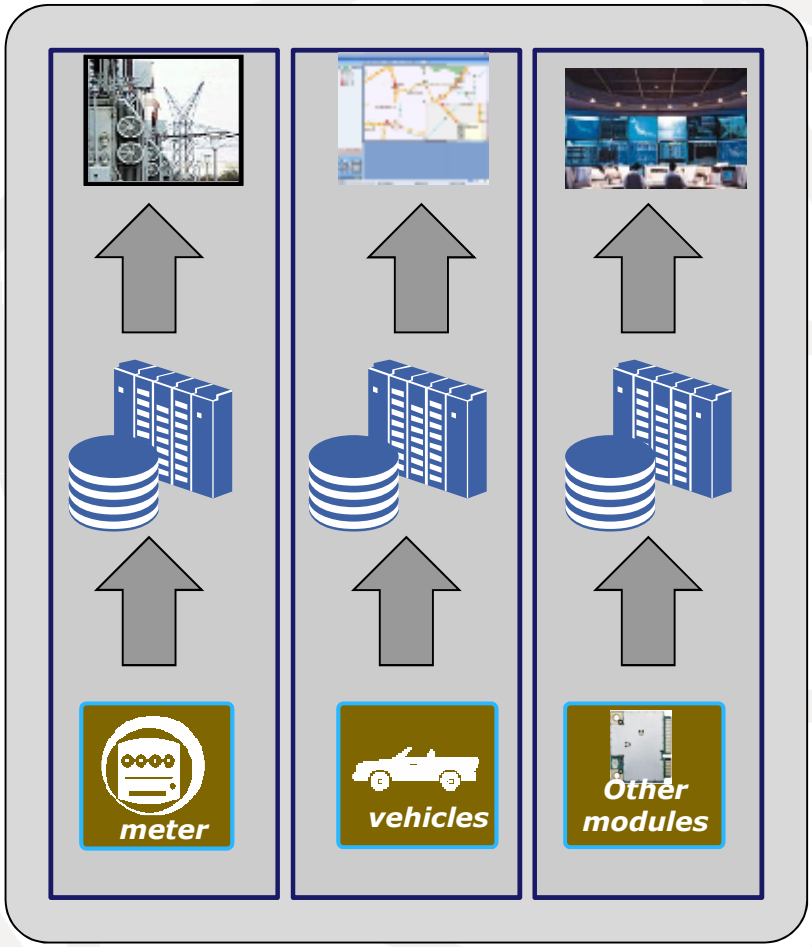
The IoT (ecosystem) is expected to benefit from the integration of leading technologies such as those for

- Machine to Machine communication
- Autonomic Networking
- Data Mining, Data Reasoning (and other Big Data related technologies)
- Security and privacy protection
- Cloud Computing
- Service Delivery Platforms

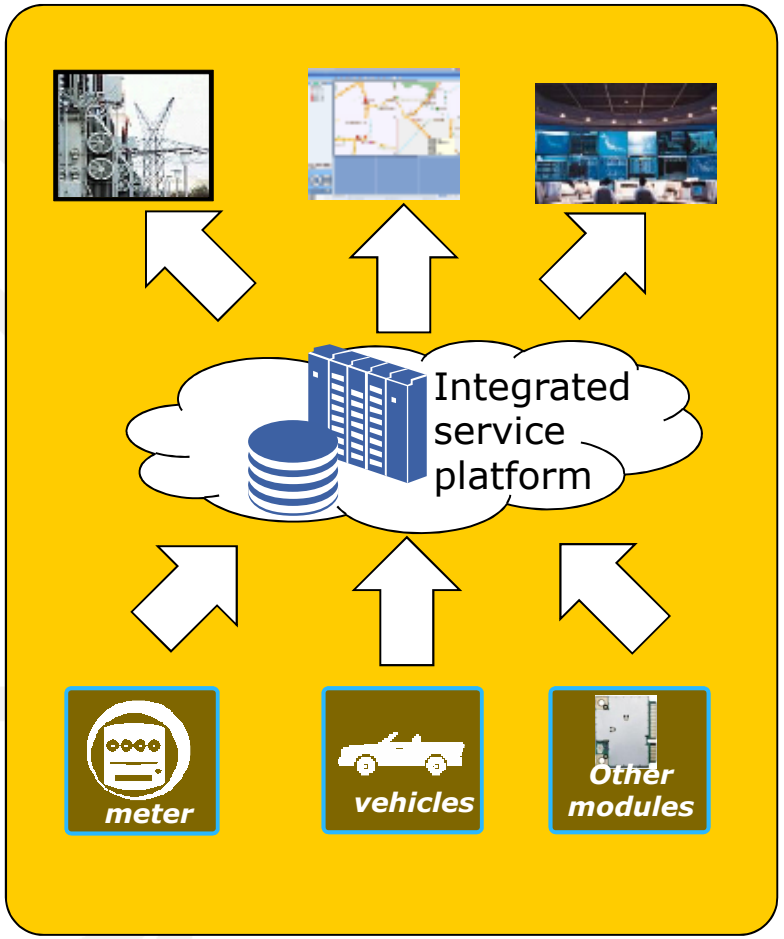
together with technologies for advanced sensing and actuation

From vertical to horizontal integration model

VERTICAL MODEL



HORIZONTAL MODEL

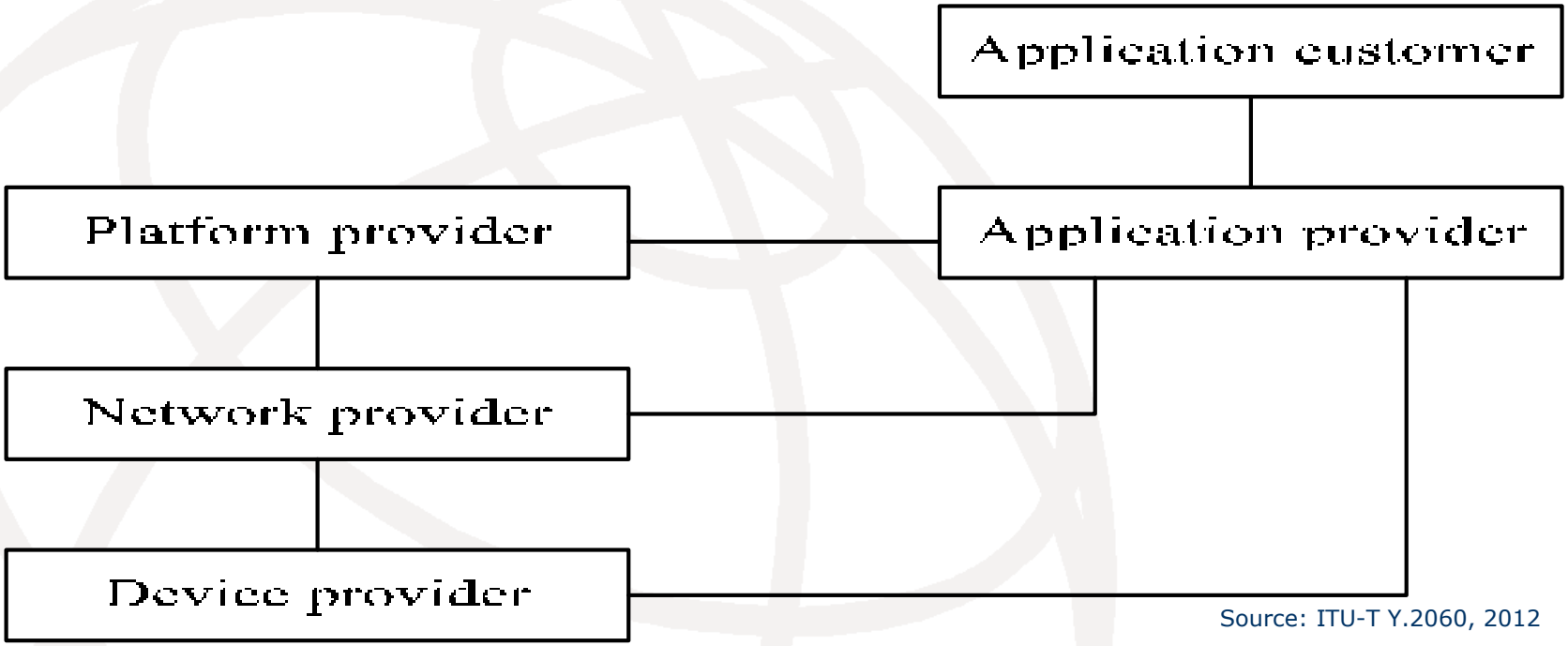


- Service platform configured per vertical application

- Integrated service platform supporting multiple applications
- Generic and application specific components

IoT in Y.2060 (2/3)

- IoT Ecosystem



Source: ITU-T Y.2060, 2012

NOTE - The above business roles and their relationships do not represent all possible roles and relationships which can be found across the real IoT business deployments.
Examples of possible business models (based on the above roles) are provided in Appendix of Y.2060.

IoT in Y.2060 (3/3)

- Fundamental characteristics and high level requirements of the IoT

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

Achievements of SG13 with relevance to IoT (1/2)

Services using tag-based identification

- Y.2213: *NGN service requirements and capabilities for network aspects of applications and services using tag-based identification (2008)*
- Y.2016: *Functional requirements and architecture of the NGN for applications and services using tag-based identification (2009)*

Ubiquitous networking

- Y.2002: *Overview of ubiquitous networking and of its support in NGN (2009)*
- Y.2062: *Framework of object-to-object communication for ubiquitous networking in next generation networks* (03/2012)

Ubiquitous Sensor Networks and Sensor control networks

- Y.2221: *Requirements for support of ubiquitous sensor network (USN) applications and services in the NGN environment* (2010)
- Y.2026: *Functional requirements and architecture of the NGN for support of ubiquitous sensor network applications and services (07/2012)*
- Y.2222: *Sensor control networks and related applications in a NGN environment (04/2013)*

Achievements of SG13 with relevance to IoT (2/2)

Machine-oriented communications

- Y.2061: *Requirements for the support of machine-oriented communication applications in the NGN environment* (06/2012)

Overview and terminology of the IoT

- Y.2060: *Overview of the Internet of things* (06/2012)
- Y.2066: *Common requirements of the IoT (06/2014)*
- Y.2069: *Terms and definitions for the IoT (07/2012)* [NOTE – revision expected]
- Y.2063: *Framework of the web of things* (07/2012)

IoT application or domain specific

- Y.2064: *Energy saving using smart objects in home networks* (01/2014)
- Y.2281: *Framework of networked vehicle services and apps using NGN (2011)*
- Y.2065: *Service and capability requirements for e-health monitoring services (03/2014)*
- Y Suppl. 22 of *ITU-T Y.2200-series: Greenhouse gas monitoring services provided over NGN (06/2013)*

Gateway for IoT applications

- Y.2067: *Common requirements and capabilities of a gateway for IoT applications (06/2014)*

Ongoing IoT work items in SG13

Capabilities of the IoT

- **Y.IoT-funct-framework: *IoT functional framework and capabilities***

Application support models of the IoT

Y. IoT-app-models: *IoT application support models*

Gateway architecture and Device Management capabilities

- Y.gw-IoT-arch: *Functional architecture of a gateway for IoT applications*
- Y.DM-IoT-reqts: *Common requirements and capabilities of device management in IoT*

Detailed network requirements

- Y.IoT-network-reqts: *Network requirements of the IoT*

Plug and play capability

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

Semantic and Big Data related capabilities

- Y.IoT-semantic-reqts-framework: *Semantic requirements and semantic framework for the IoT*
- Y.IoT-BigData-reqts: *Specific requirements and capabilities of the IoT for Big Data*

Constrained node networking

- Y.IoT-cnn: *Framework of constrained node networking in the IoT environments*

Web of Objects

- Y.sfem-WoO: *Service framework of Web of Objects for energy management*

Others

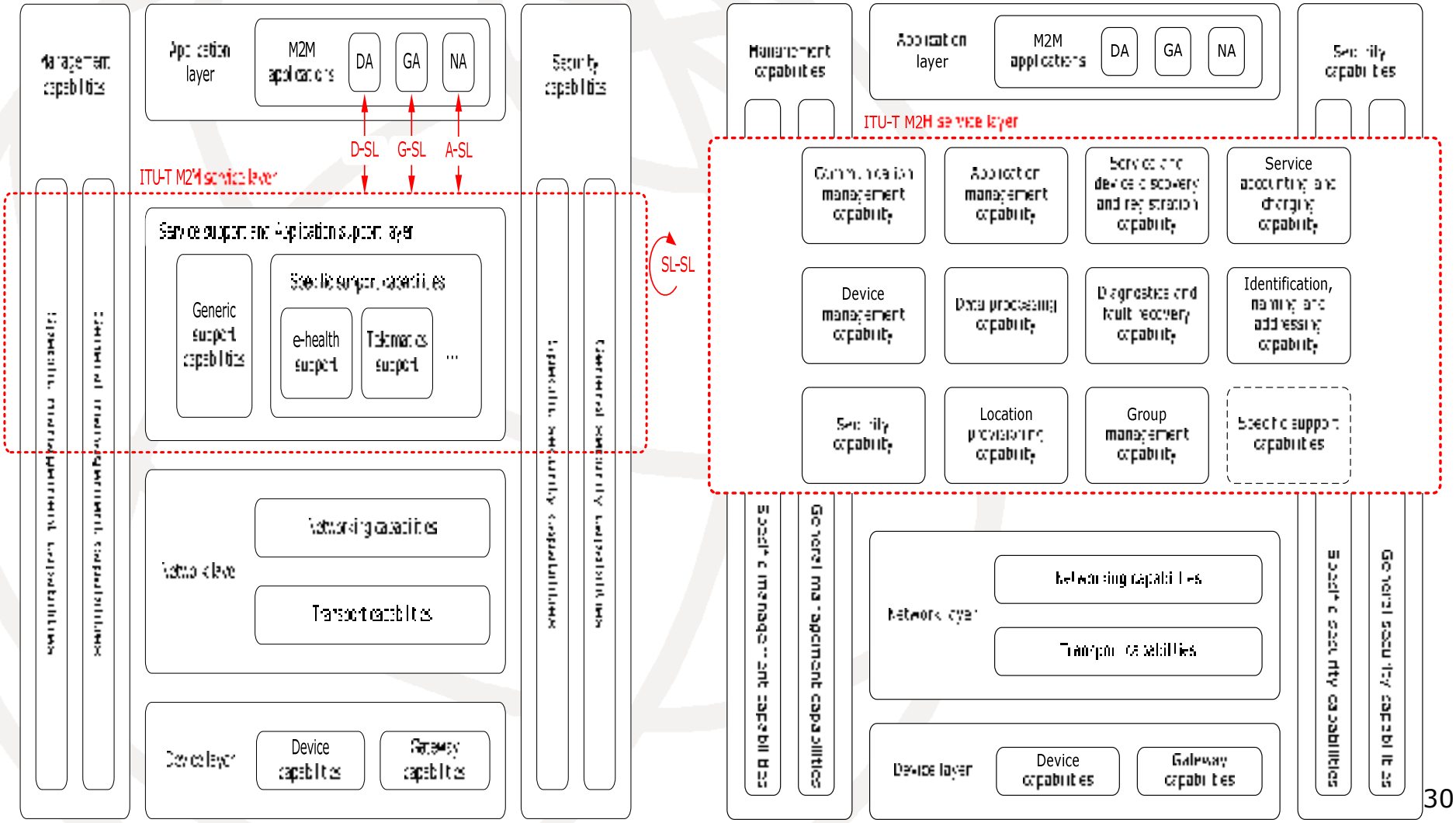
- Y.EHM-cap: *Capability framework for **e-health** monitoring services*
- Y.ufn-sc: *Service model, scenarios for **Ubiquitous Plant Farming** based on networks*
- Y.fsul: *Framework and scenarios for **ubiquitous learning** (u-learning) service*
- Y.social-device: *Framework of the **social device networking***
- Y.meg: *Framework of **micro energy grid***
- Y.IoT-DD-Reqts: *Requirements for **IoT devices and apps' operation during disaster***

ITU-T Focus Group on M2M Service Layer (1/2)

- Established in 2012, closed in March 2014
- **Key goal: study of the requirements and specifications for a common M2M Service Layer**
- **Focused its developments** – from the point of view of use cases and derived requirements for the common M2M service layer – **on the "e-health" application domain** (specifically, remote patient monitoring and assisted living services)
- Targeted the inclusion of vertical market stakeholders not part of the traditional ITU-T membership, such as the World Health Organization (WHO), and the collaboration with M2M and e-health communities and SDOs [and it has actually liaised with various SDOs, fora and consortia, including for the completion of an e-health standards repository]
- Completed 5 deliverables (under transfer to various ITU-T SGs)
  - **E-health use cases**
  - **E-health ecosystem**
  - **M2M service layer requirements and architectural framework**
  - **Overview of M2M service layer APIs and protocols**
  - **E-health standards repository and gap analysis**

ITU-T Focus Group on M2M Service Layer (2/2)

In line with the IoT Reference Model of ITU-T Y.2060, the M2M service layer capabilities include those common to the support of different application domains and the specific ones required for support of each application domain



Thanks much for your attention

Any question ?

Marco Carugi

Marco Carugi works as consultant on telecommunication technologies and associated standardization, currently engaged with China Unicom on requirements and architectures for advanced services and networks.

Marco began his career in Solvay as telecommunication system engineer, worked for 7 years in France Telecom/Orange Labs as research engineer on Broadband Data Services and Network Technologies and then for 8 years in Nortel CTO organization as Senior Advisor on NGN and emerging services. More recently, he has worked for 3 years in ZTE R&D division, Technology Strategy department, as Senior Expert on future service and network technologies and associated standardization.

Marco participates actively since 17 years in several standard development organizations, and has held numerous leadership positions, including ITU-T SG13 vice-chair, Rapporteur for ITU-T Q.3/13 in last three study periods, Rapporteur in ITU-T NGN Focus Group, Cloud Ecosystem working group chair in ITU-T Focus Group on Cloud Computing, OIF Board member, IETF Provider Provisioned VPN working group co-chair. Till its closure in March 2014, he has also acted as vice-chair of the ITU-T Focus Group on M2M Service Layer and co-chair of its working group dealing with requirements and architectural framework of the M2M Service Layer.

Currently, he is Rapporteur for Q.2/13 ("Requirements for NGN evolution (NGN-e) and its capabilities including support of IoT and SDN") inside ITU-T SG13 (Future networks including cloud computing, mobile and NGN). NGN evolution, SDP, SDN, Cloud Computing and IoT/M2M are technical areas in which he is involved at present.

In ITU-T, as Rapporteur for Q.2/13, he is currently participating in the Internet of Things Global Standards Initiative (IoT-GSI) where he leads the development of technical specifications on requirements, capabilities and services for IoT and M2M.

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

Marco holds an Electronic Engineering degree in Telecommunications from the University of Pisa in Italy, a M.S. in Engineering and Management of Telecommunication Networks from the National Institute of Telecommunications (INT) in France and a Master in International Business Development from the ESSEC Business School in Paris.