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Introduction to NGN, its architectural aspects and relevant directions of its evolution

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Outline

- Introduction to NGN and its architectural aspects
- Some key areas of NGN
- Highlights on relevant directions of the evolution of NGN

NOTE – the presentation follows an approach based on the developments of the ITU-T standardization of NGN

Introduction to NGN and its architectural aspects

Chronology of NGN standardization in ITU-T

- **First ITU-T NGN workshop in July 2003**, first JRG-NGN meeting in Oct 2003 (4 draft Recommendations generated)
- **NGN Focus Group formed in May 2004 and Study Group 13 established by WTSA-04 as the lead SG for NGN studies**
- **JCA-NGN, NGN GSI(Global Standards Initiative) started in 2006**
- 13 ITU-T Recs on NGN basic concepts published at July 2006
- **ITU-T NGN Release 1 practically completed in Jan 2008**
- More advanced services and features (IPTV, FMC etc.) progressed in following years, but Release approach finally abandoned (although Rel.2 Scope and Rev.1 NGN Requirements published in Sep 2008 and Sep 2009)
- **Rev.1 of NGN Functional Reference Architecture in Apr 2010** (Content Delivery, Mobility Management and Control, IdM, other functions)
- **NGN open service platform: NGN-OSE in 2008, NGN-SIDE 2011/12**
- **IoT/M2M over NGN from 2011 to 2013**: Tag-based identification, USN, MOC, Ubiquitous Networking, Web of Things, Networked Vehicle, SCN
- Various other NGN related topics developed along the years (DSN, Multi-connection, IPv6-based NGN, VPN, Multicast, DPI etc.)
- **JCA-NGN and NGN GSI ended in July 2012**
- **NGN evolution (NGNe) agreed in SG13 for ITU-T 2013-2016 Study Period (as enhancements to NGN, hopefully an evolutionary path towards Future Networks)**
- **First NGNe Rec. in Aug 2013 (NICE Reqts), others ongoing - NGN(e)**

NGN definition and basic features

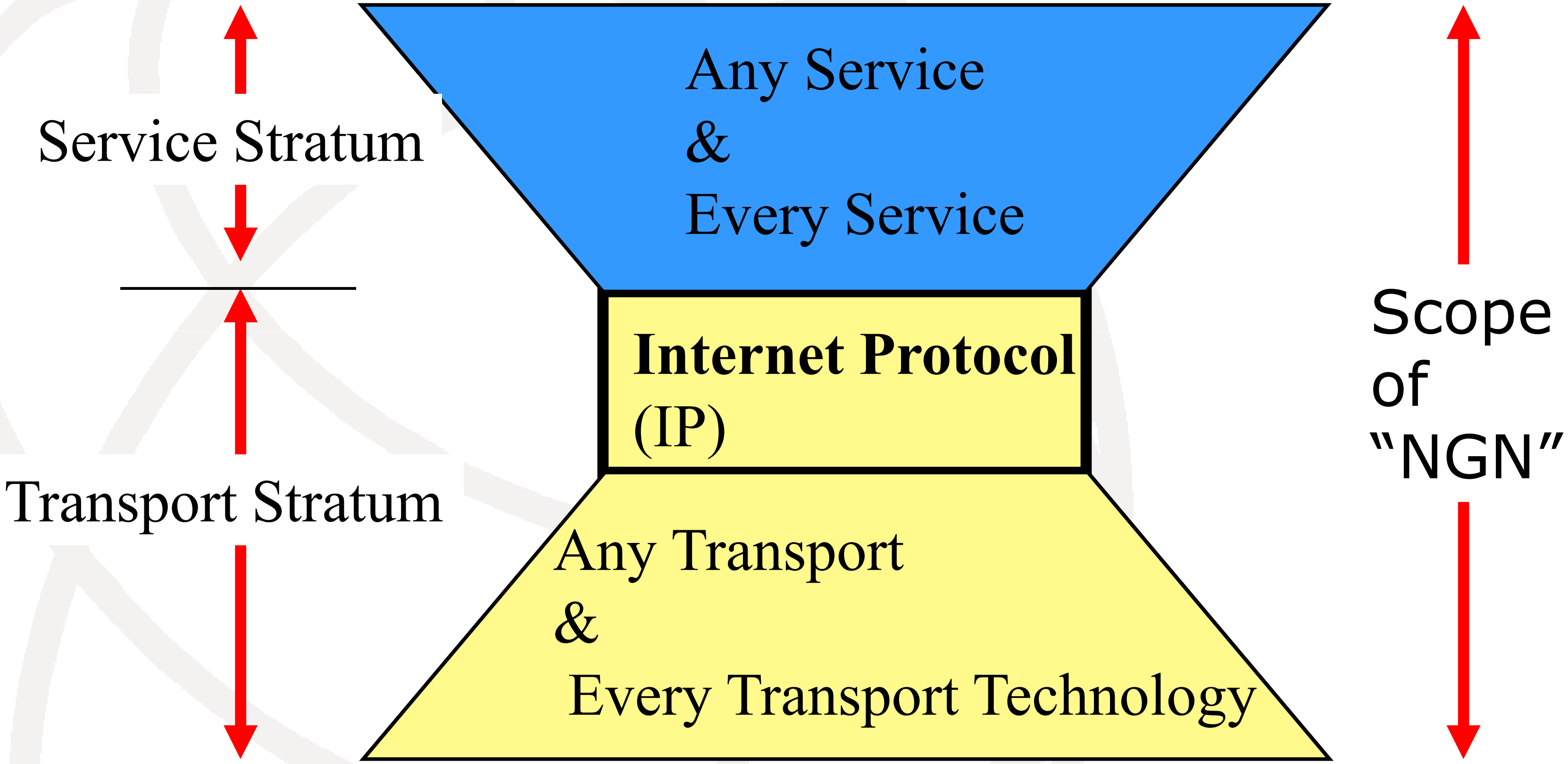
Definition of NGN (Rec. Y.2001)

A NGN is a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

Target Standards areas

- Generalized Mobility → Fixed/Mobile Convergence
- Unrestricted Access → Open Access Interfaces
- Service-Transport Independence → Architecture and Open APIs
- QoS-enabled Transport → Manageable Broadband
- Multiple Broadband → Manageable Broadband

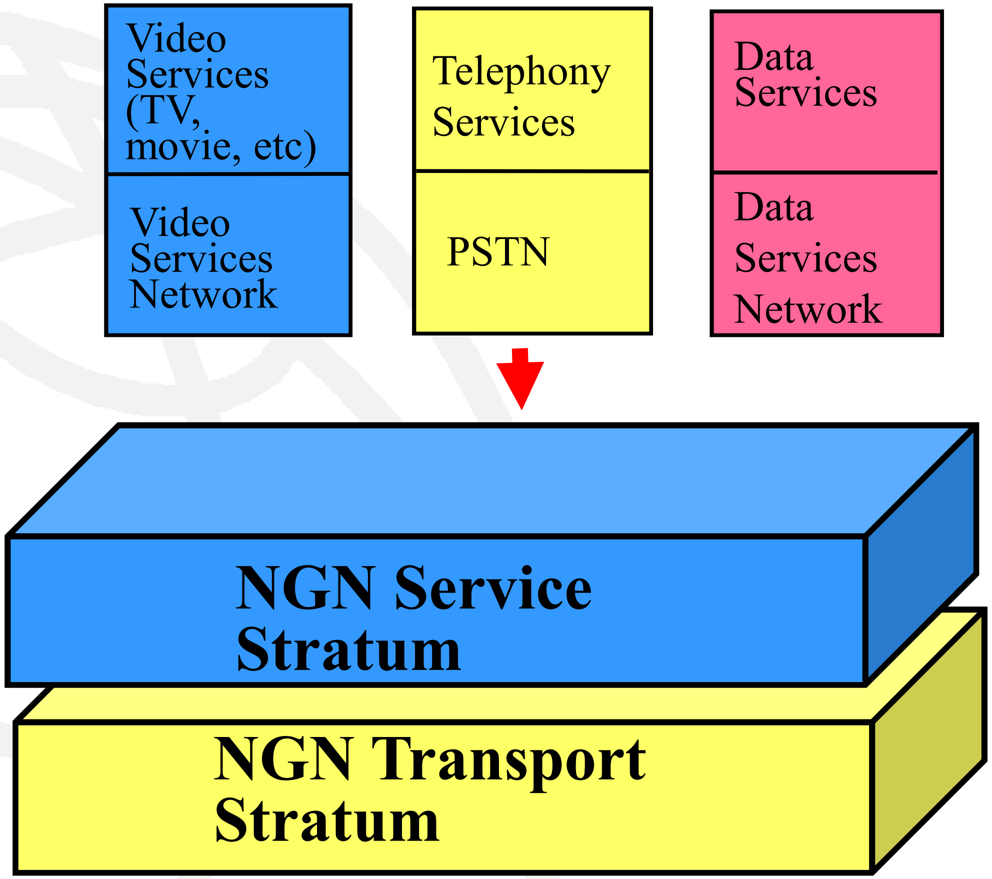
The unifying IP convergence layer



NGN separation of services from transport [Y.2011]

Pre-NGN: Vertically Integrated Networks

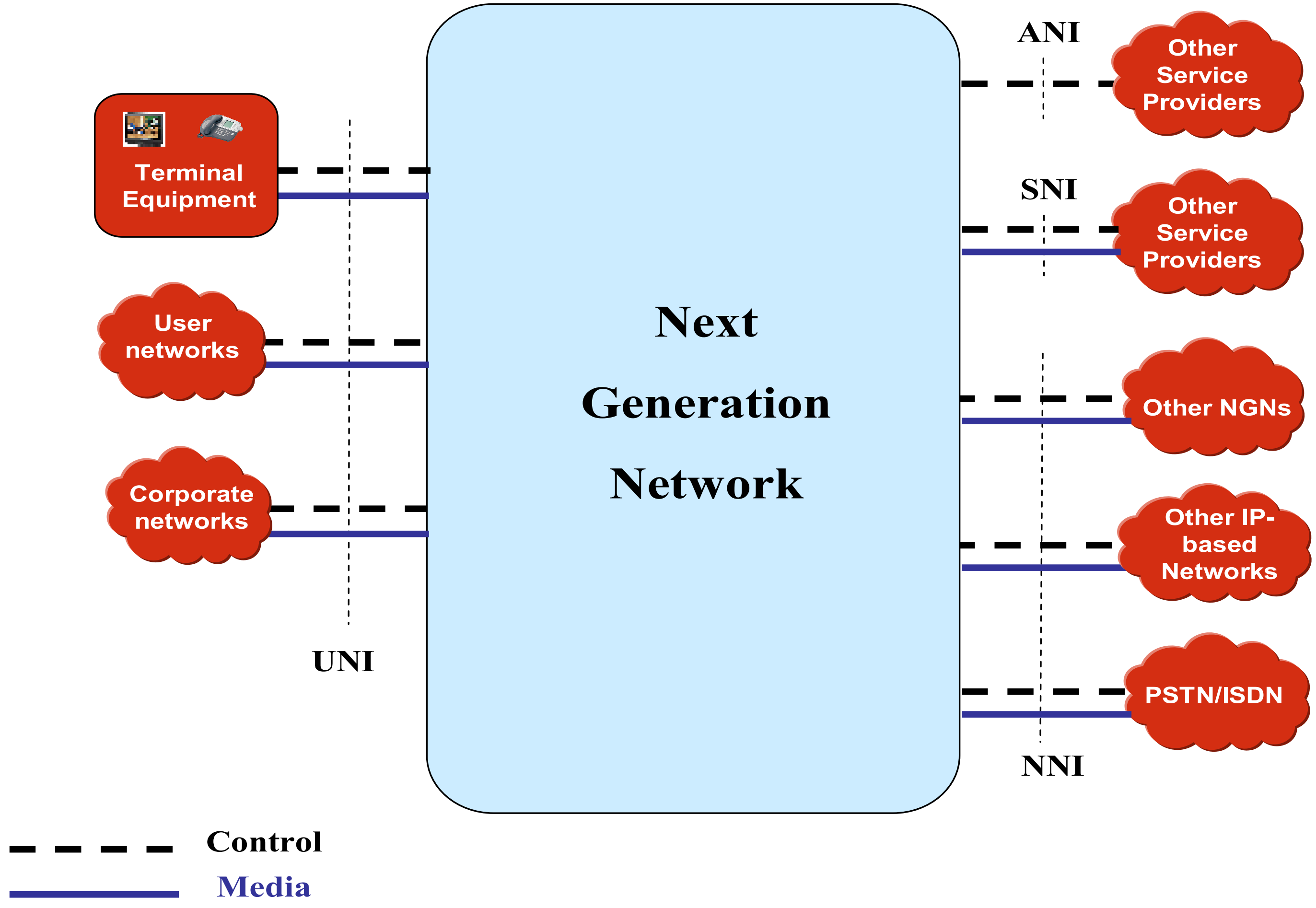
NGN: Horizontally Integrated Networks



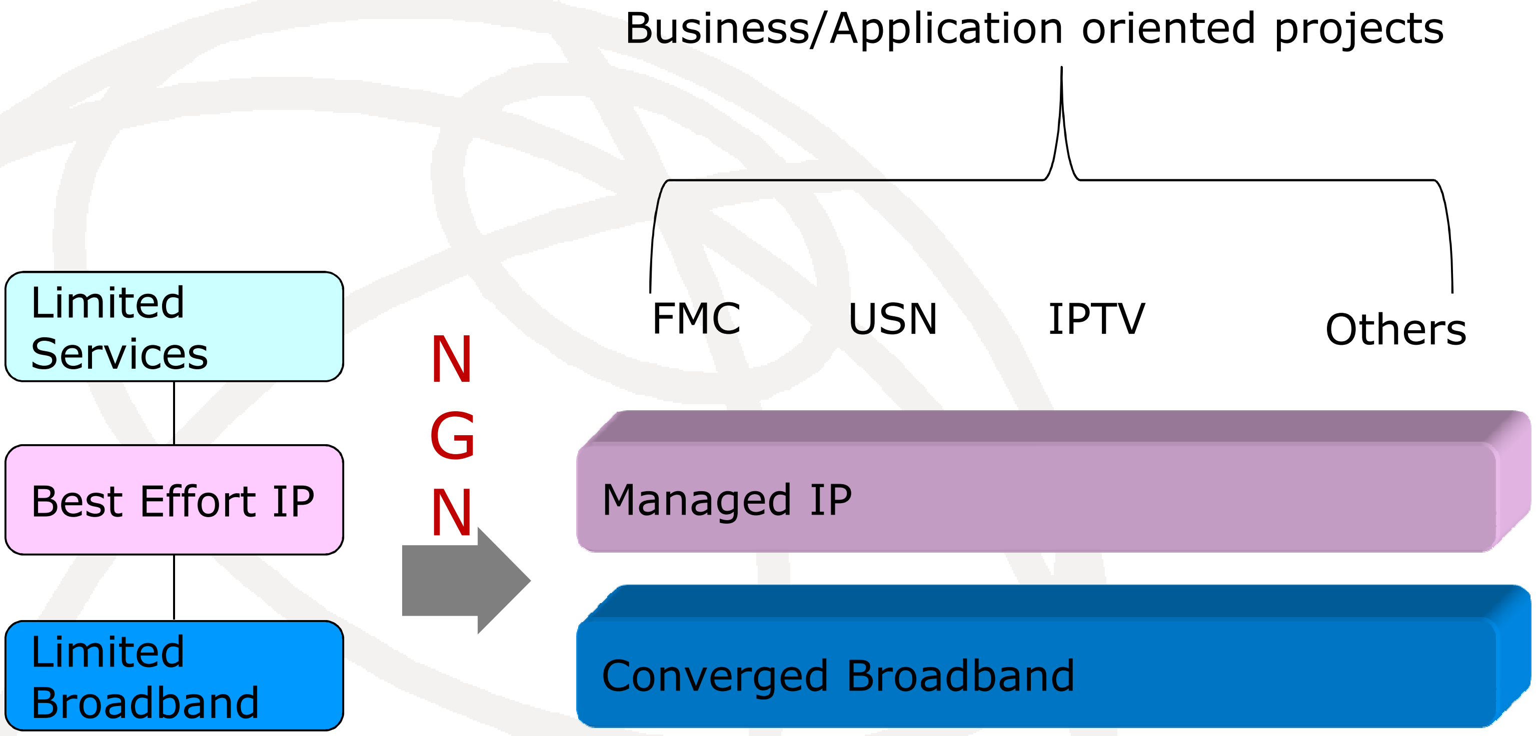
"NGN Service Stratum" versus "**NGN Transport Stratum**"

Each stratum comprises one or more layers, where each layer is conceptually composed of a **data (or user) plane**, a **control plane**, and a **management plane**

Connectivity to NGN



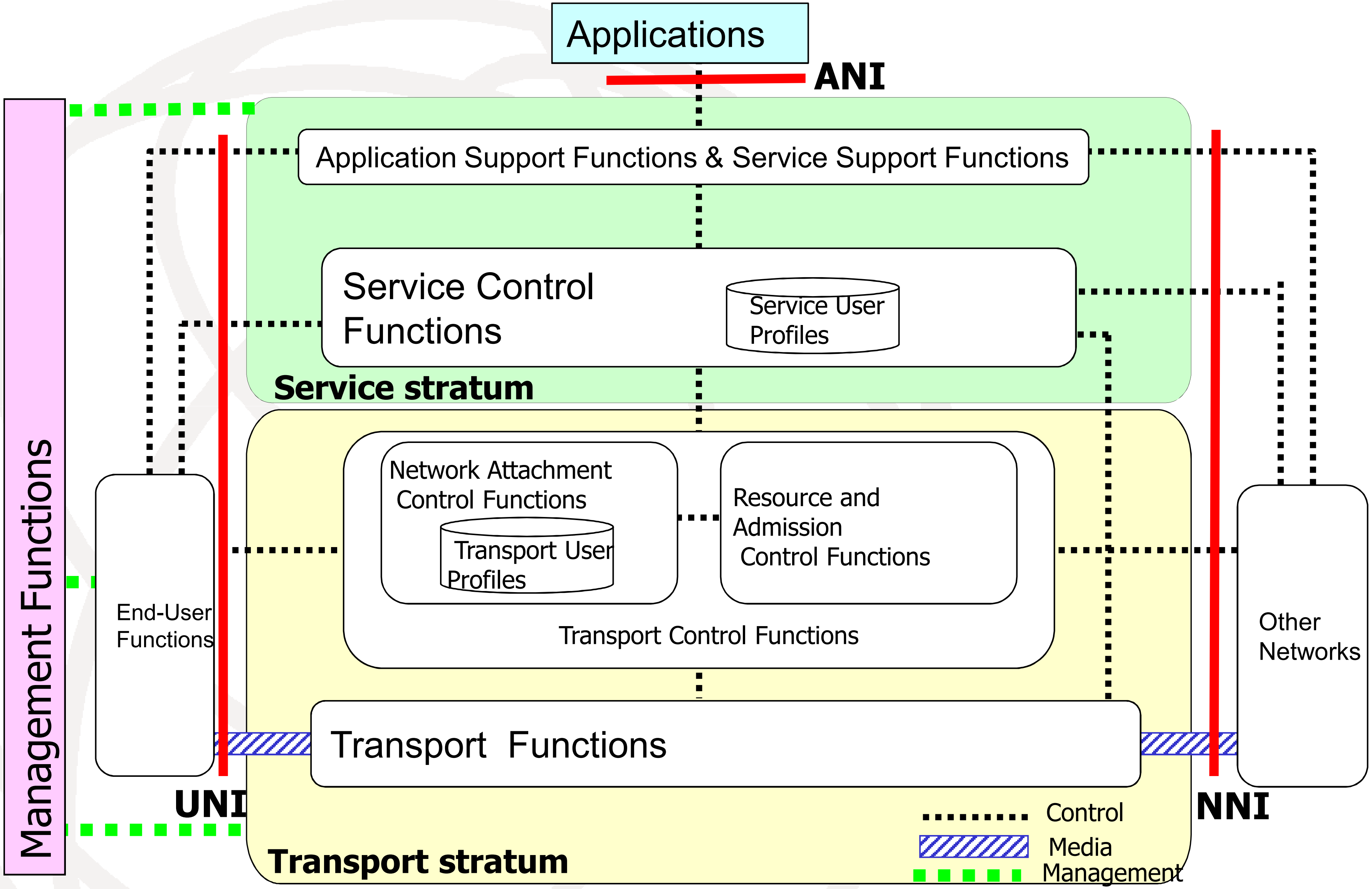
NGN: enabler for Convergence



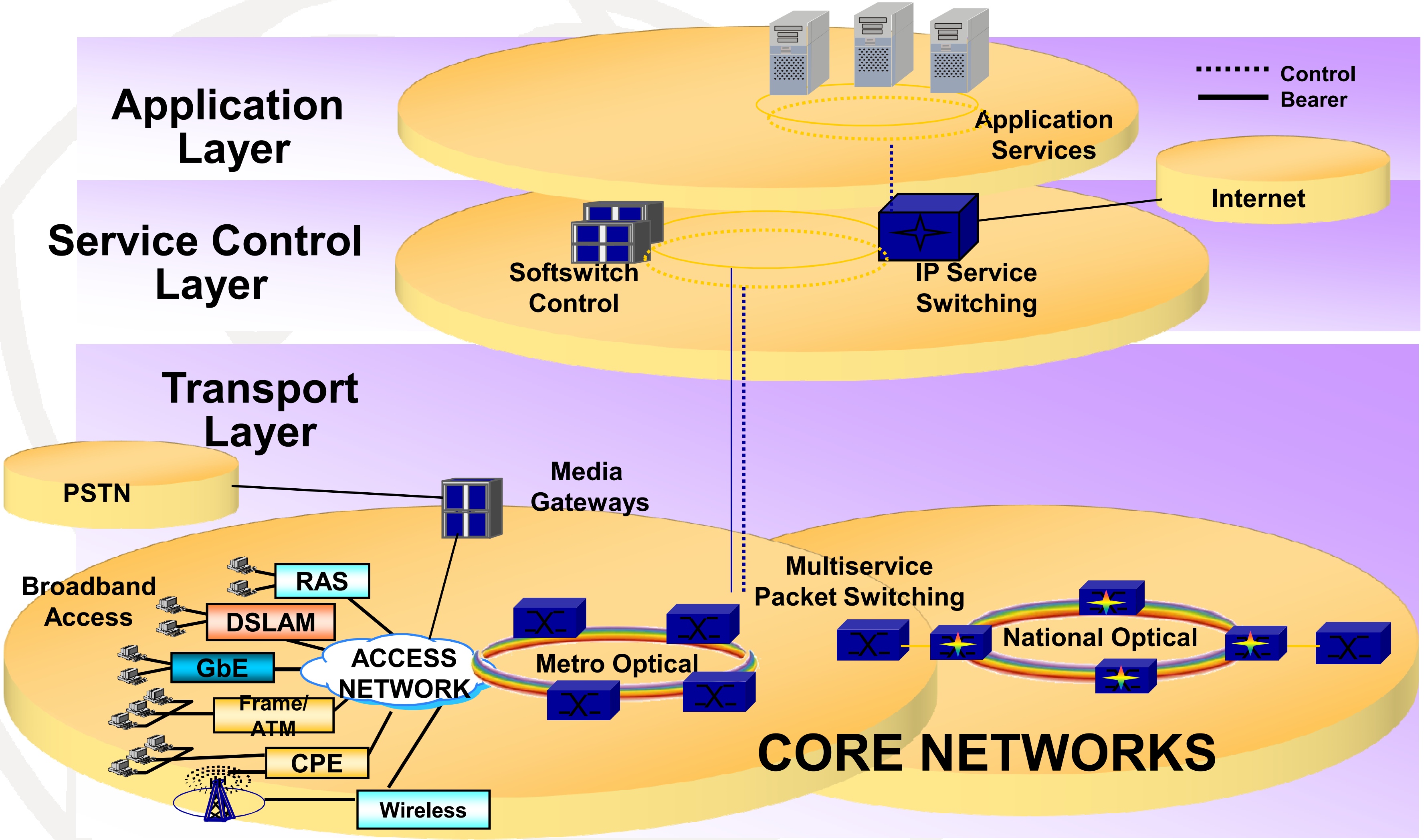
- Simple linkage between layers
- Simple business relationships and simple players

- Simple linkage between layers with dynamics
- Diverse business models and players, diverse and flexible business relationships

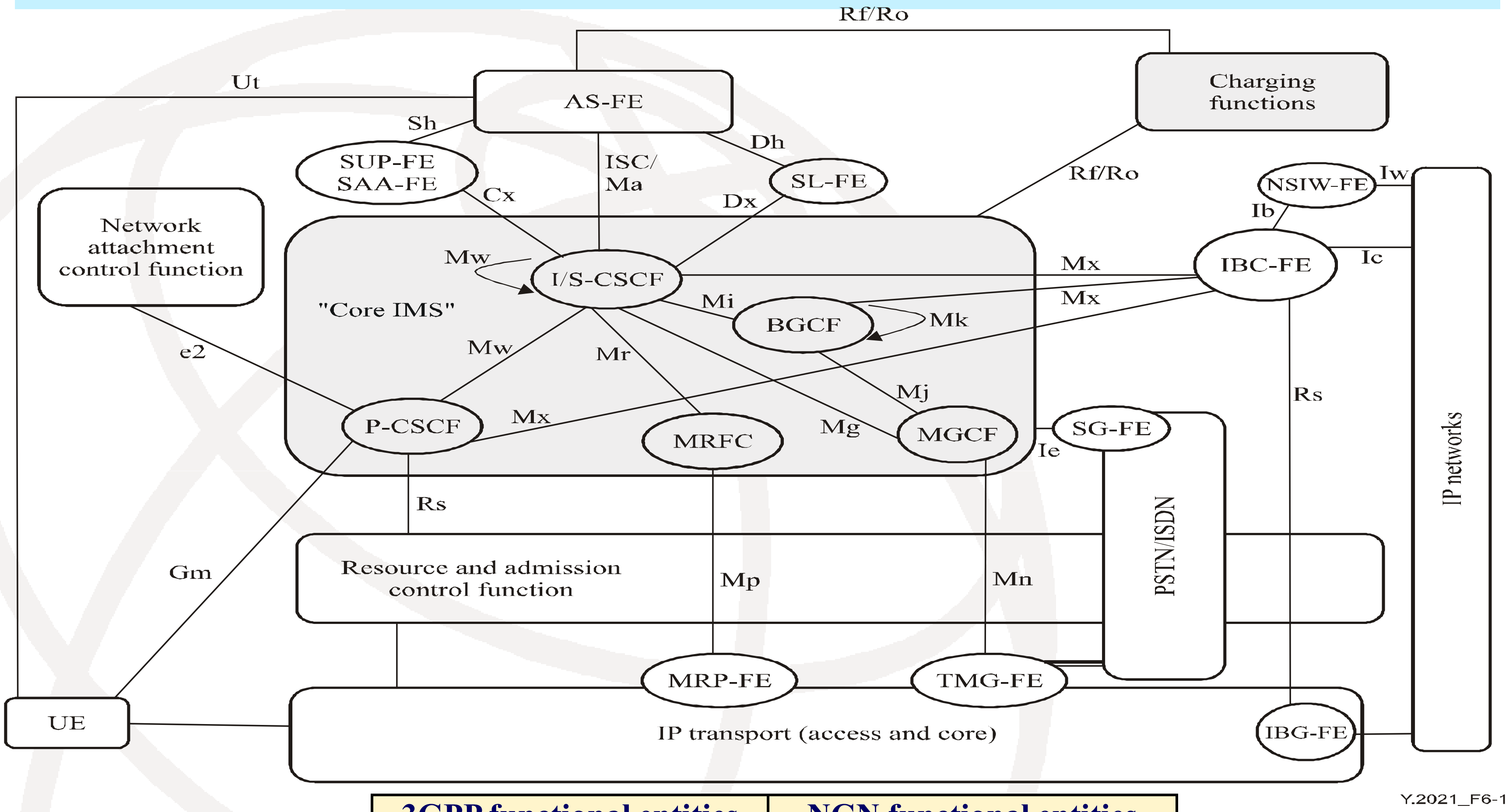
First version of NGN functional reference architecture (NGN Release 1) [Y.2012, 09/2006]



An example of NGN implementation (Layered Architecture)



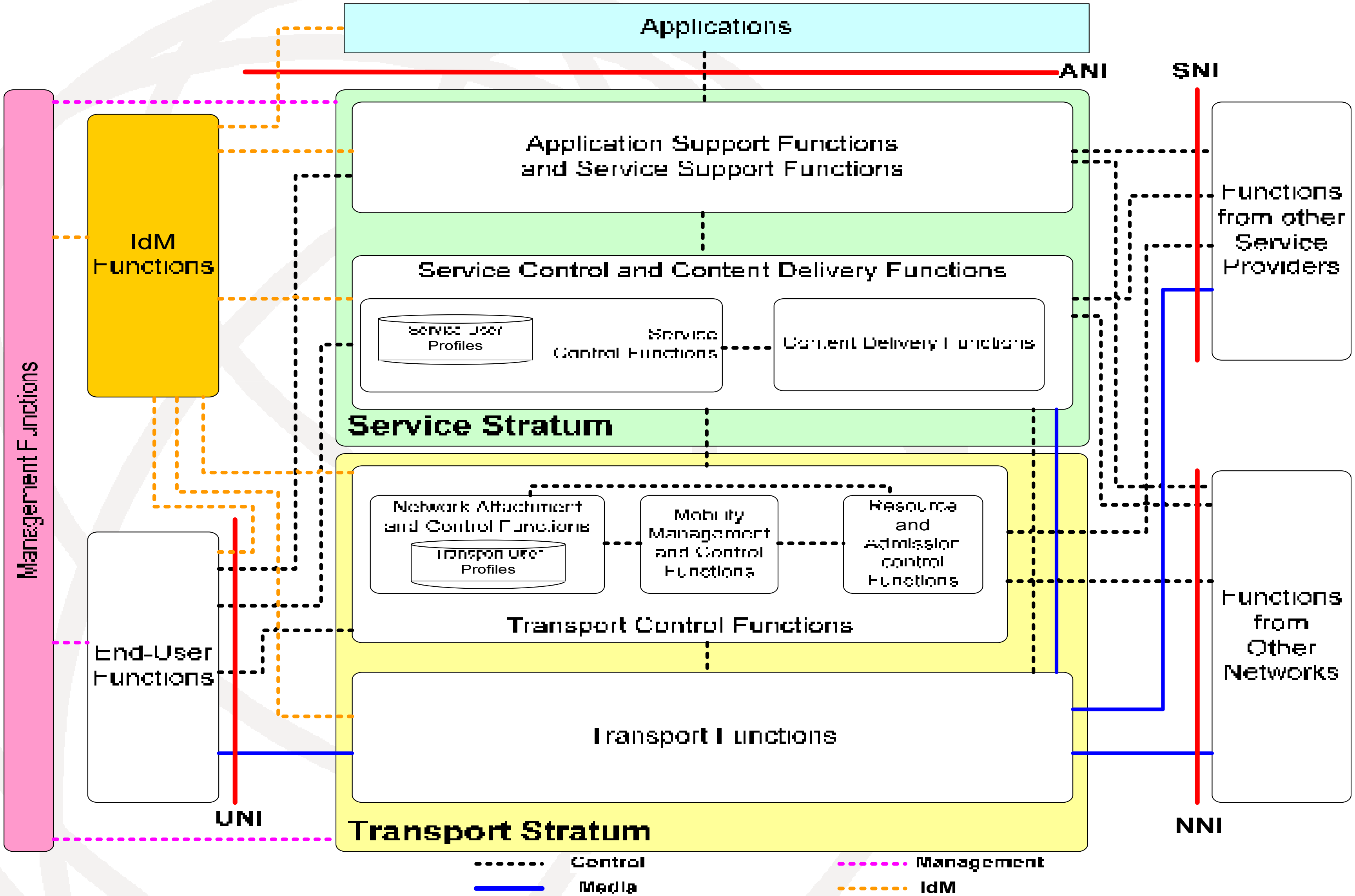
IMS for NGN [Y.2021]



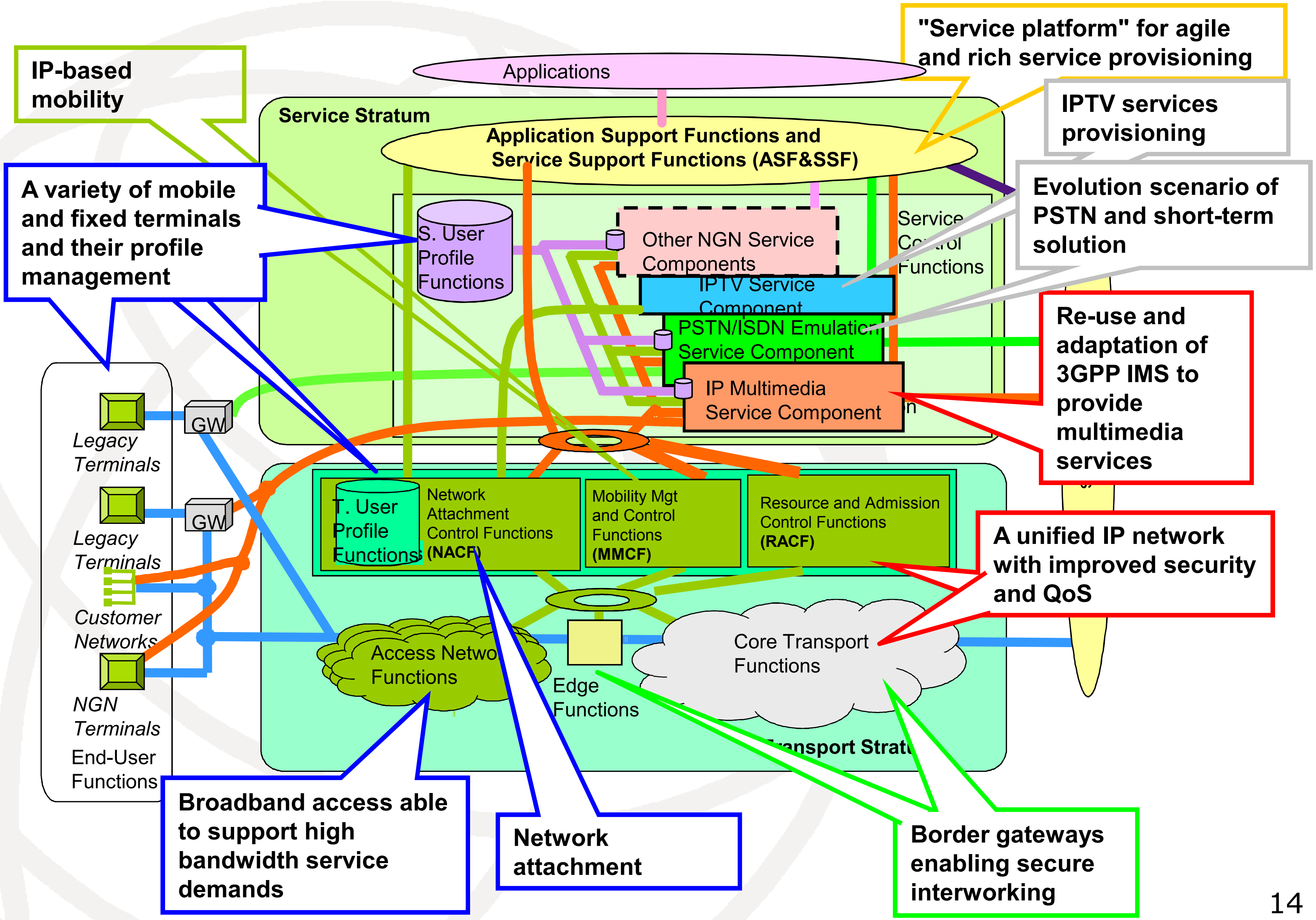
Correspondence between 3GPP IMS FEs and ITU-T NGN FEs

3GPP functional entities	NGN functional entities
S-CSCF	S-CSC-FE
P-CSCF	P-CSC-FE
I-CSCF	I-CSC-FE
MGCF	MGC-FE
MRFC	MRC-FE
BGCF	BGC-FE

The revised NGN functional reference architecture [Y.2012, 04/2010]

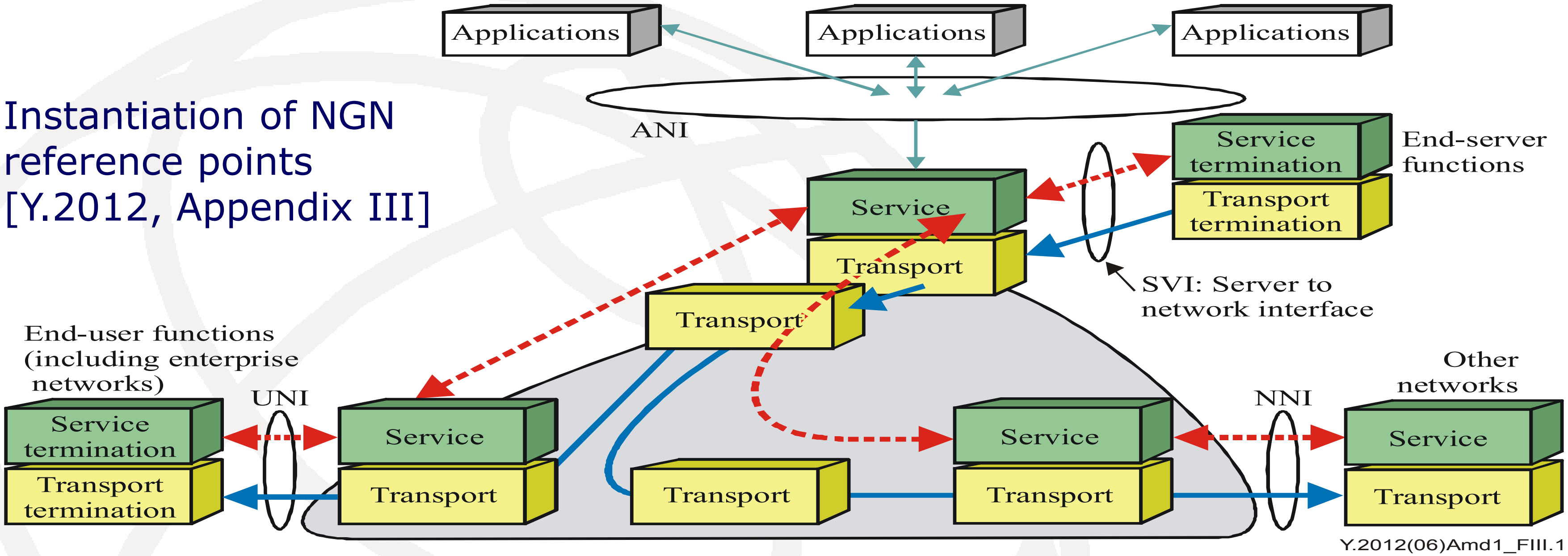


“NGN components” (functional view) [Y.2012, 4/2010]



Reference points in the NGN architecture

Instantiation of NGN reference points [Y.2012, Appendix III]



- **ANI provides control-level interaction**
  - No media flows across ANI
- **SNI introduced in Rev1 as access interface for service partners (content providers, data information providers, application service providers)**
  - Support of special requirements (transport and signalling resource capacity, customized policy, multicast injection of media flows etc.)
  - Exchange of transport-level media flows and service-level signalling flows

NGN Capabilities: Rel.1 [Y.2201] and Rel.2 [Y.2201 Rev.1]

- Transport connectivity and network components
- Communication modes
- Multicast
- Media handling (resource management and codecs)
- Access networks and network attachments
- User networks including enterprise networks
- Interconnection, Interoperability and Interworking
- Numbering, naming, addressing
- Identific., authentic., authoriz.
- Identity management
- Security
- Critical infrastructure protection
- Routing
- Quality of Service
- OAM and Survivability
- Accounting and Charging
- Management
- Mobility handling
- Service enablers
- Context awareness
- Open service environment
- Profile management
- Policy management
- Content management
- IPV6 support
- Non disclosure of info across NNI and ANI
- Inter-provider exchange of user-related information
- Public Interest Services support capabilities
- *Capabilities for service specific requirements*

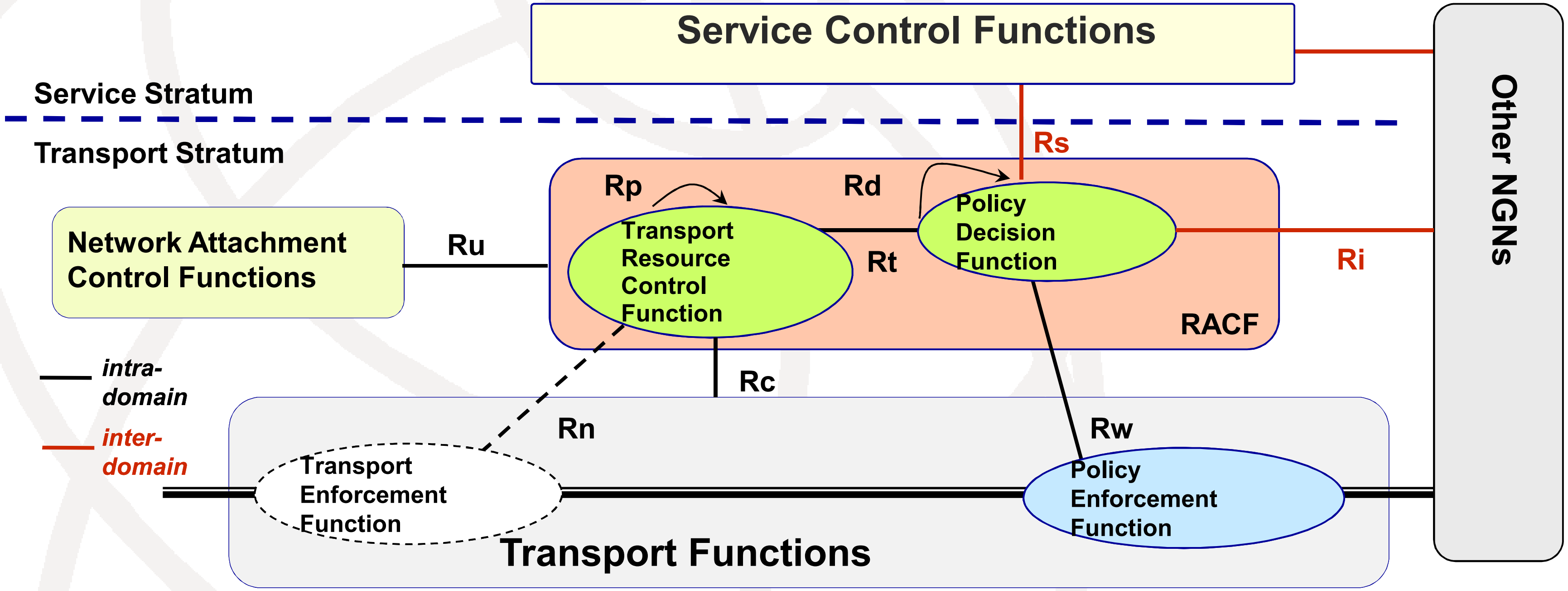
Some key NGN architectural challenges

- Application-driven QoS:
  - QoS classes
  - Explicit bandwidth selection
  - Mapping & control from Service to Transport
  - Flow awareness (monitoring, accounting)
- Mobility
  - Seamless handover
  - Fixed Mobile Convergence (FMC)
- Scalability
  - Multicast
  - Ubiquitous networking
- Flexibility
  - Support of new services and business models

Some key areas of NGN

Resource and Admission Control Functions (RACF) [Y.2111]

RACF provides real-time application-driven and policy-based transport resource management [in support of end-to-end quality of service (QoS), gate control and other]

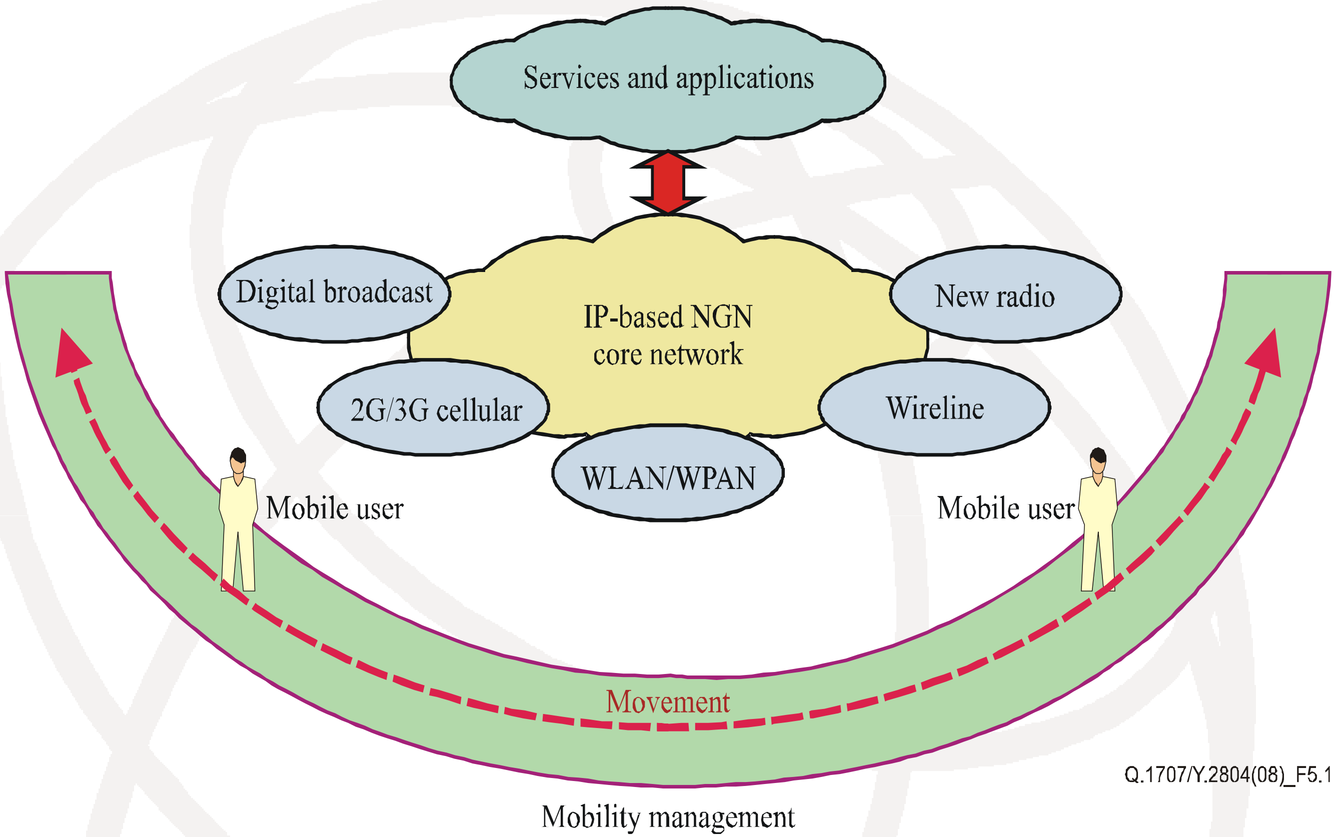


- Policy Decision Function
  service facing, transport independent
- Transport Resource Control Function
  service independent, transport dependent, network segment specific
- Policy Enforcement Function
  typically part of border transport elements

RACF augments native transport QoS support

- Preempting transport congestion at the service control layer
- Protecting ongoing premium traffic

Mobility: fundamental enabler of NGN



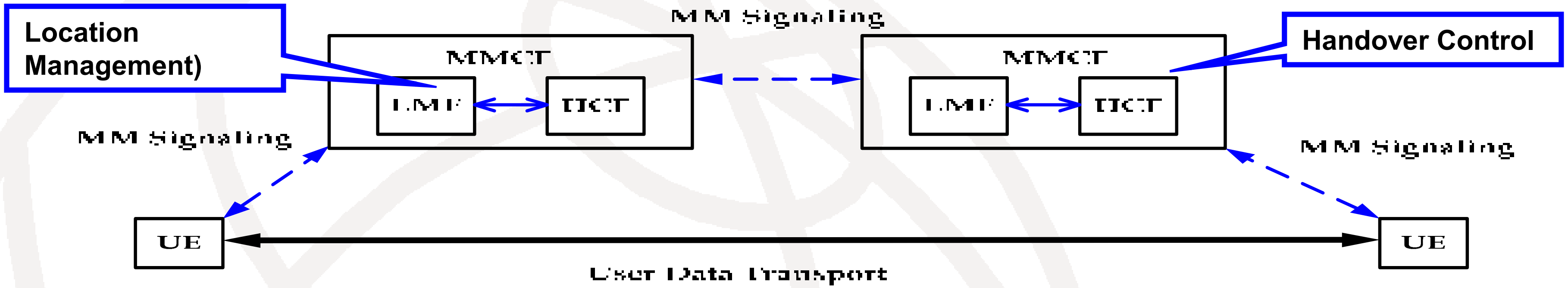
A complex and heterogeneous environment

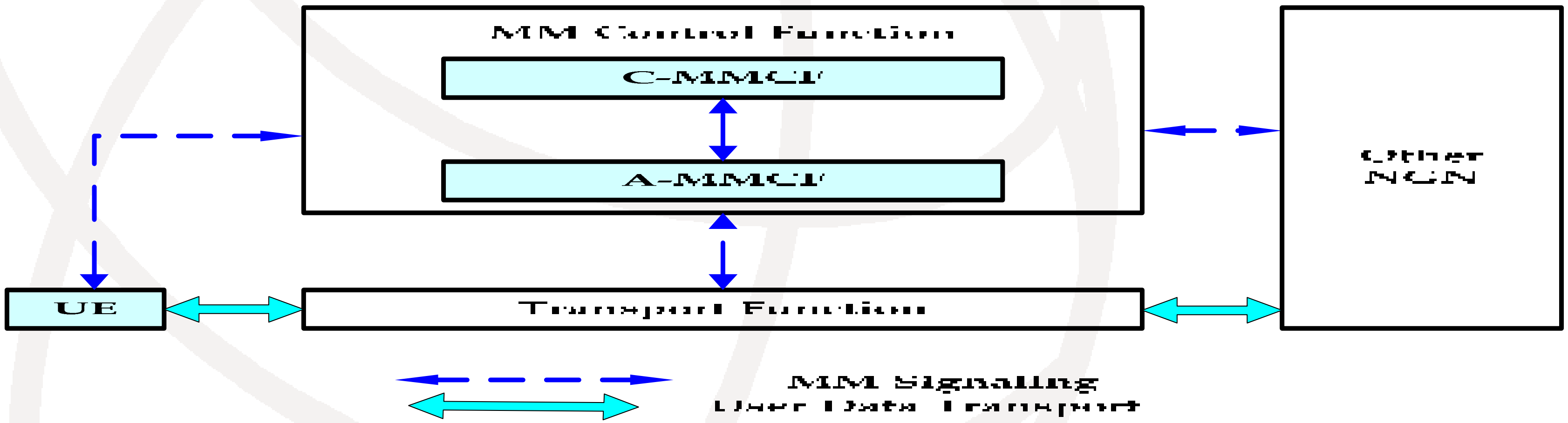
Basic requirements from User

- Access from a variety of environments (access technology independence) via variety of terminals with varying capabilities
- Global roaming, ubiquitous and seamless solutions

Mobility Management (MM)

Signalling and control operations for IP-based MM to ensure seamless service continuity

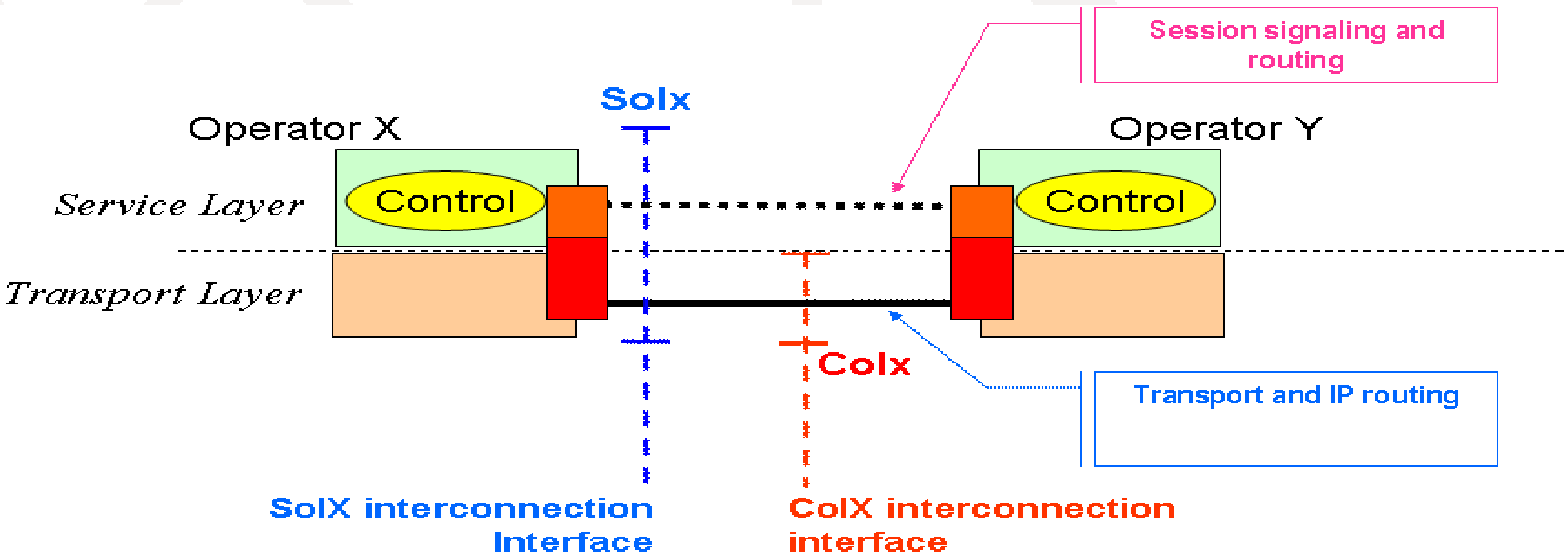




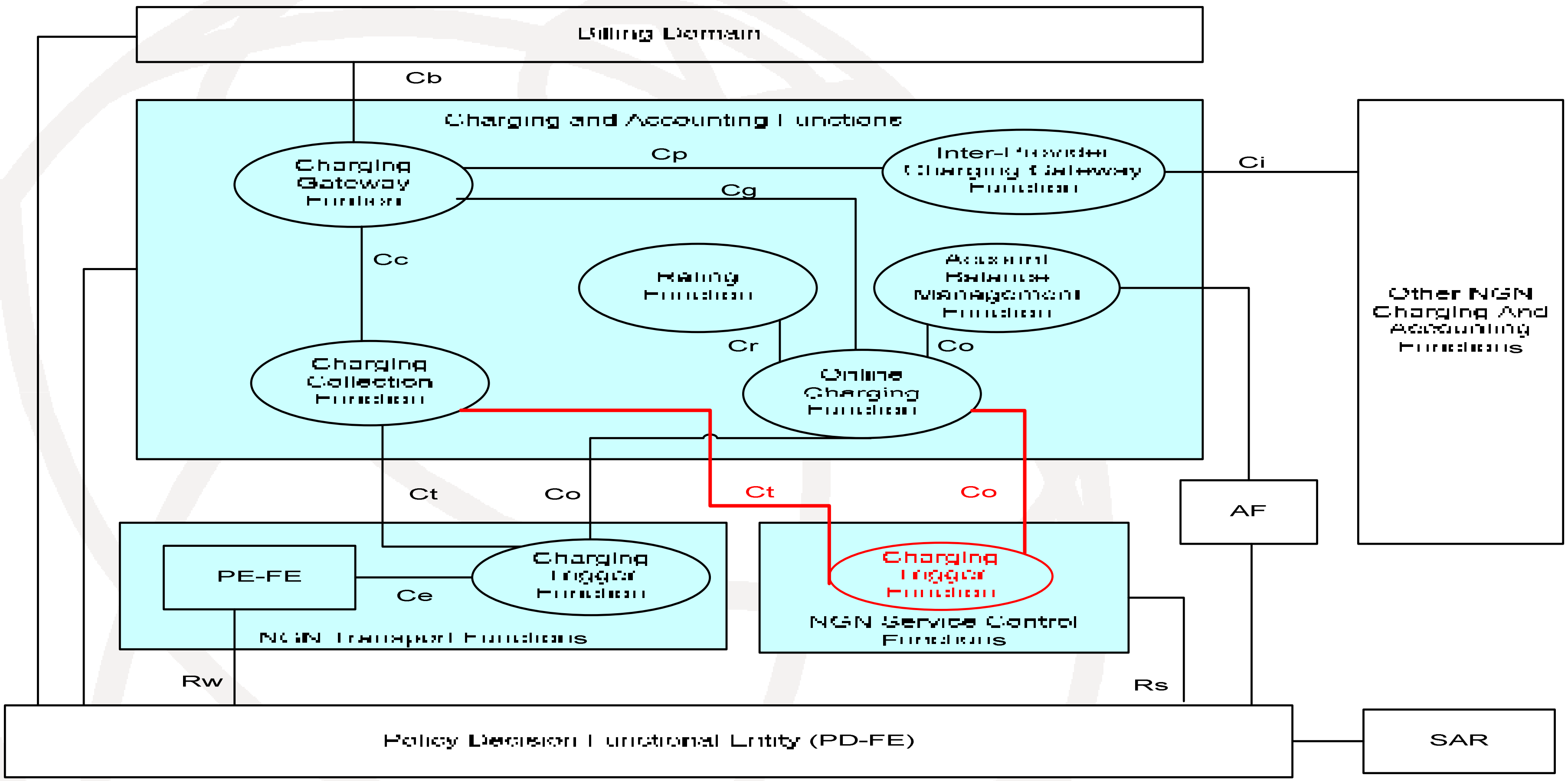
Functional architecture-level view of Mobility Management Control Function (MMCF) in NGN [Y.2804/Q.1707] - MMCF is located in NGN Transport Control

Interconnection

- **Interconnection at Network to Network Interface**
  - Between multiple NGN domains, between NGN and other networks
- **Two types of Interconnection between NGN domains**
  - **Connectivity-oriented Interconnect (CoIx) is required** [Y.2201]
    - Simple IP connectivity, irrespective of interoperability levels
    - No service awareness, no specific requirements assurance
  - **Service-oriented Interconnect (SoIx) is required** [Y.2201Rev1]
    - **Services offered with defined levels of interoperability**



NGN policy-enabled Accounting & Charging capabilities [Y.2233 Rev1]



- CAF interaction with RACF (RACF accesses and transfers charging policies to CTF, and makes admission decisions (PD-FE))
- Policy enablement based on multiple attributes

PSTN/ISDN and the migration to NGN: preserving the existing services

In evolution path to NGN, NGN shall support:

- legacy terminal equipment (e.g. PSTN/ISDN phones)
- PSTN/ISDN-like capabilities

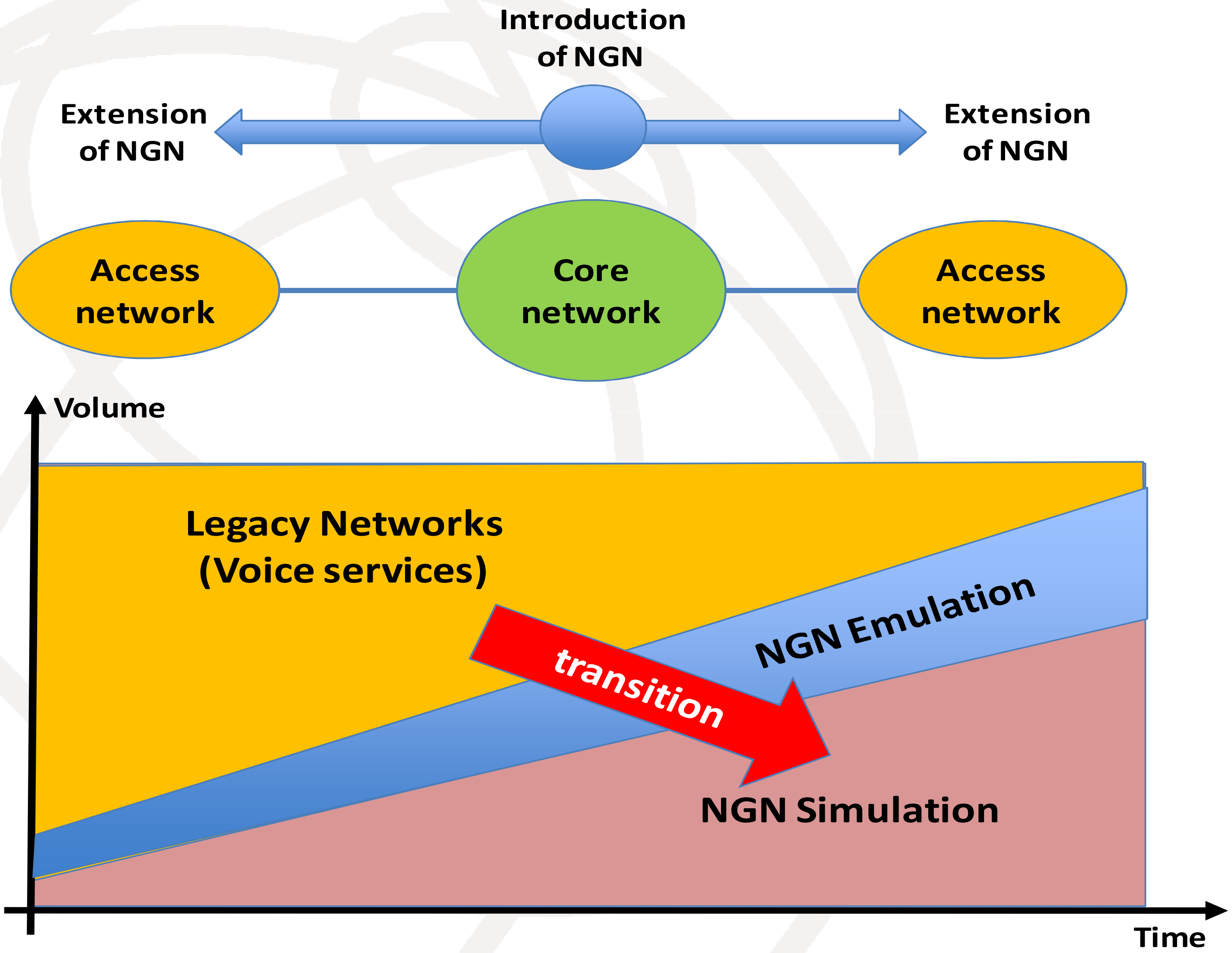
PSTN/ISDN Emulation

- From the end user perspective, the NGN “appears” supporting the same types of services offered by the existing PSTN/ISDN
- Legacy terminals are enabled to continue to use existing telecommunication services while connected to NGN
- Implemented via adaptation to an IP infrastructure

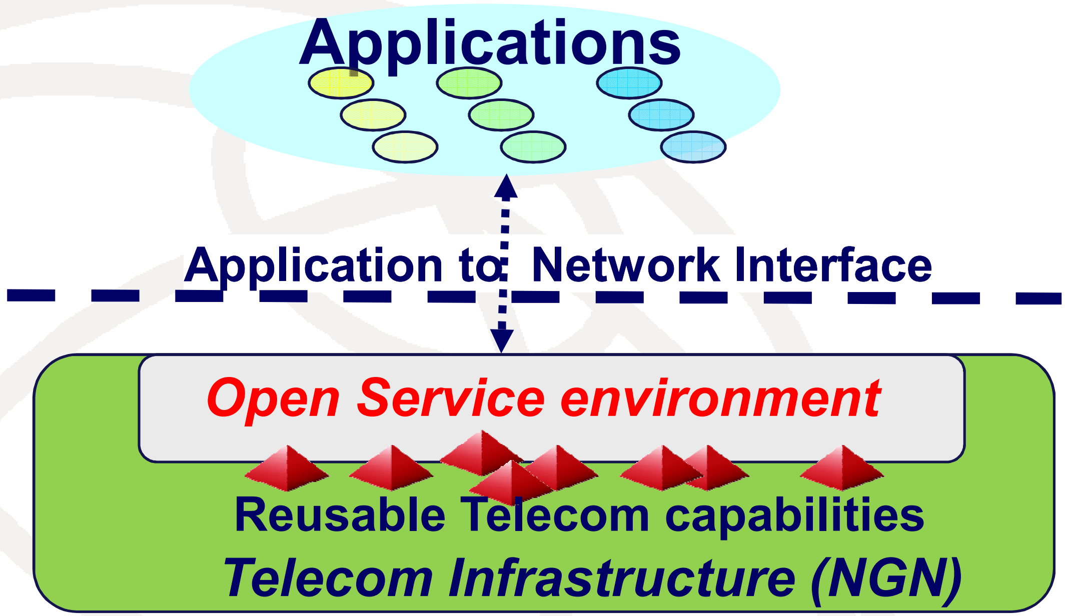
PSTN/ISDN Simulation

- NGN terminals in an NGN network are enabled to use PSTN/ISDN-like service capabilities
- But legacy terminals with terminal adaptations may be used too
- Implemented over IP-based control infrastructure (e.g. using SIP)

General view of migration scenarios to NGN



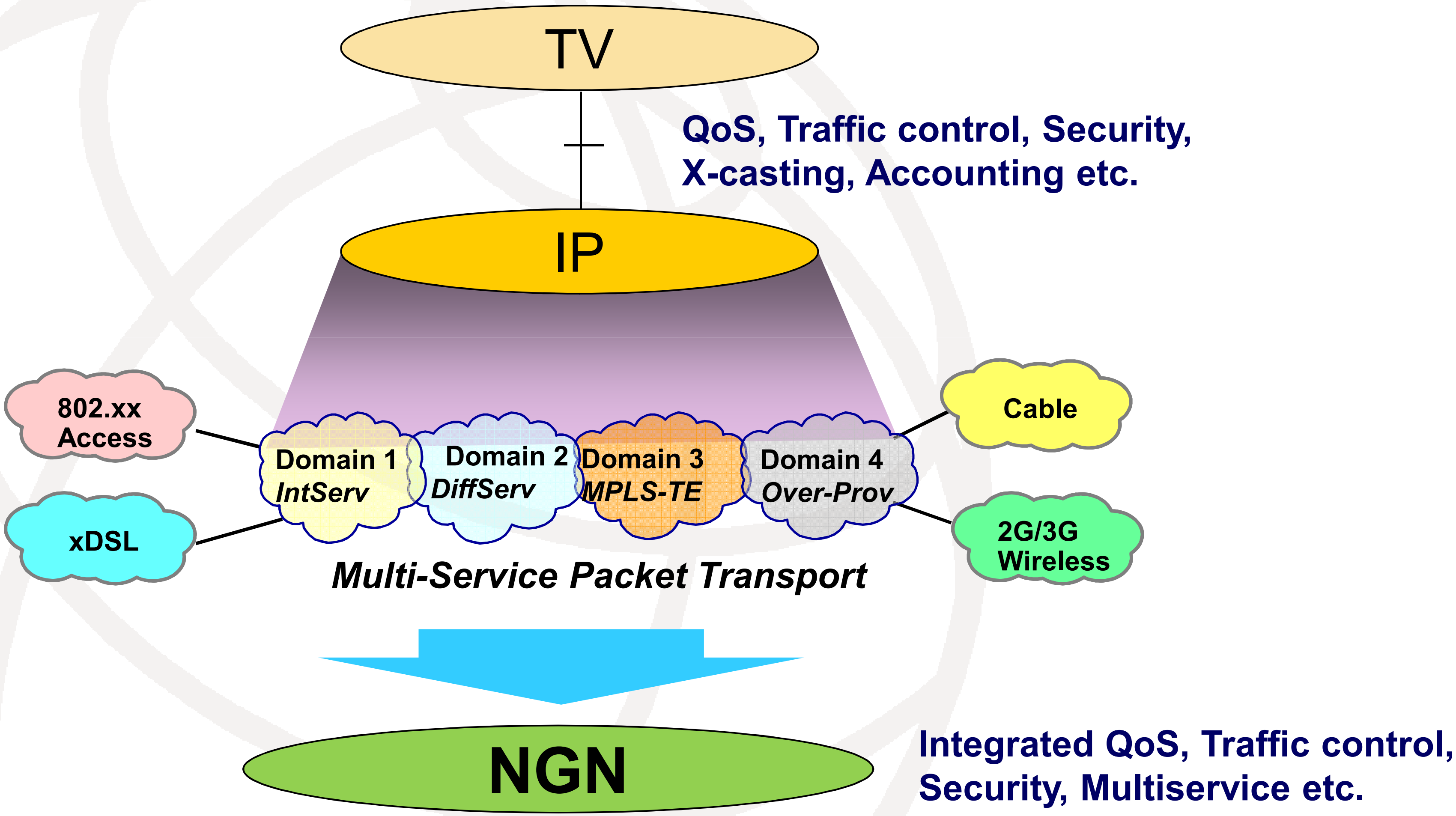
Open service environment for Telecom Infrastructure



- **Reusable Telecom capabilities for reduced service development costs**
  - Applying the development approach from IT industry to telecoms
- **Open service environment** for flexible and agile service creation, execution, management and deployment
  - "Rapid change" is key for satisfying the changing customer needs
  - New business opportunities via an environment integrating applications and telecom infrastructure

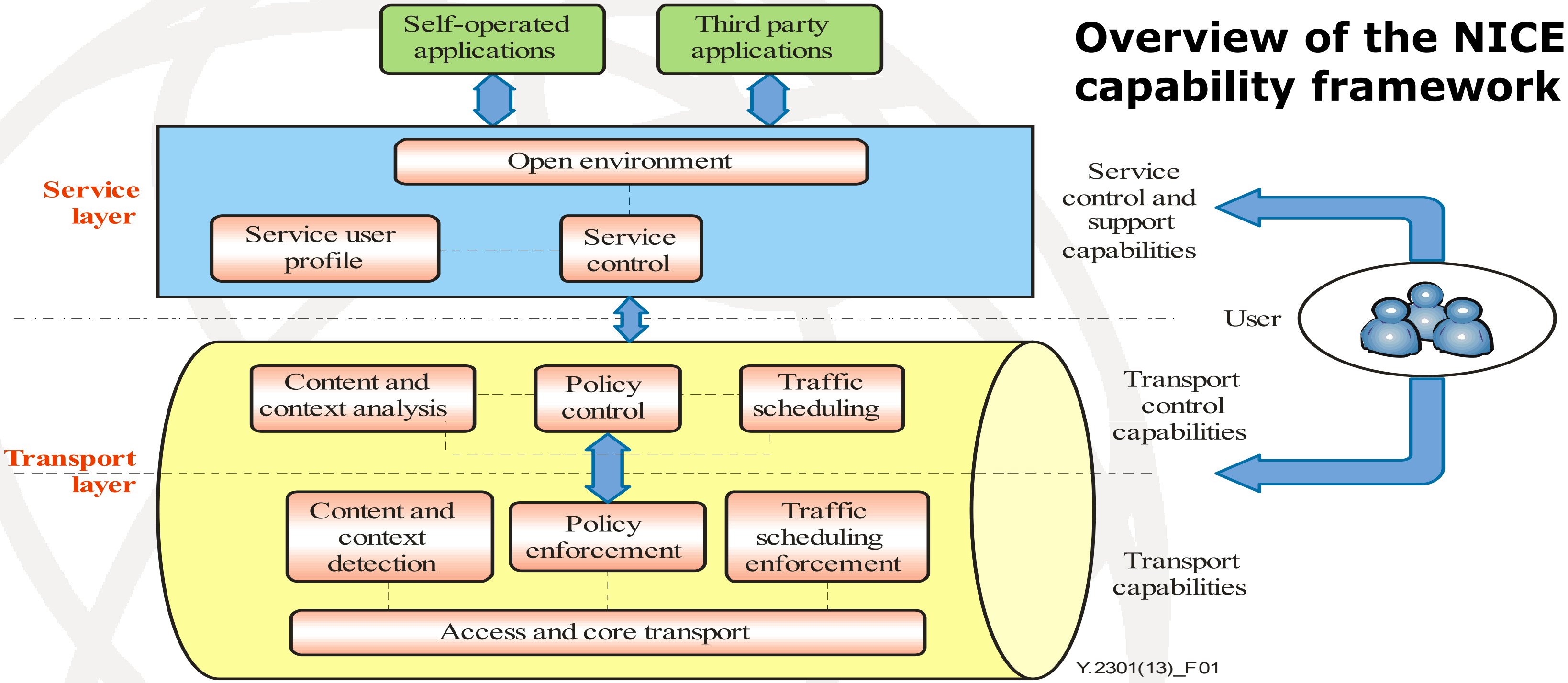
⇨ Telecom "Service Delivery Platform" (Telecom SDP)

NGN as an infrastructure for IPTV



Highlights on relevant directions of the evolution of NGN (NGNe)

NGN enhanced by network intelligence capabilities for service provisioning [NICE - Y.2301]



Overview of the NICE capability framework

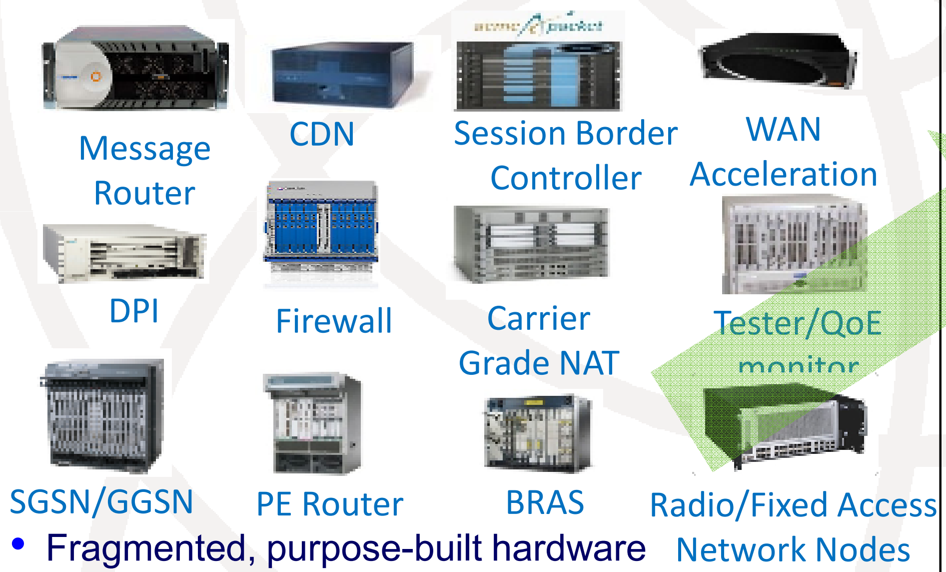
Key business rationale for operators: threats of becoming "pipeline providers", pressure to expand network capacity, disparity between traffic and revenues => need to identify implications of user and service requirements at the network level, and to increase network efficiency and value through intelligent resource scheduling and network traffic management.

These new capabilities (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 provisioning.

Network Functions Virtualisation (NFV)

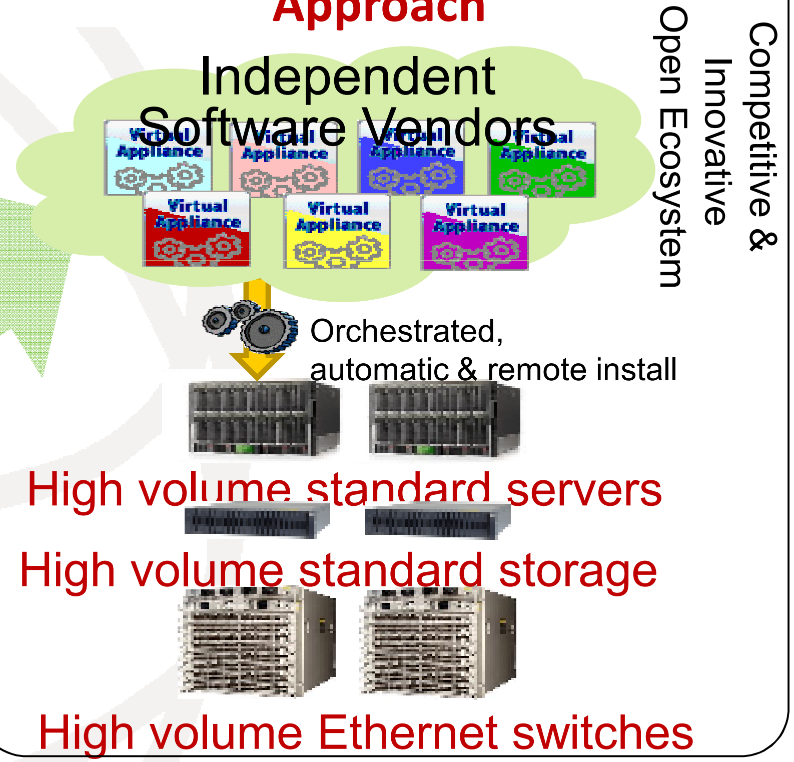
NFV is about implementing network functions in software (running today on proprietary hardware), leveraging (high volume) standard equipment and IT virtualization

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

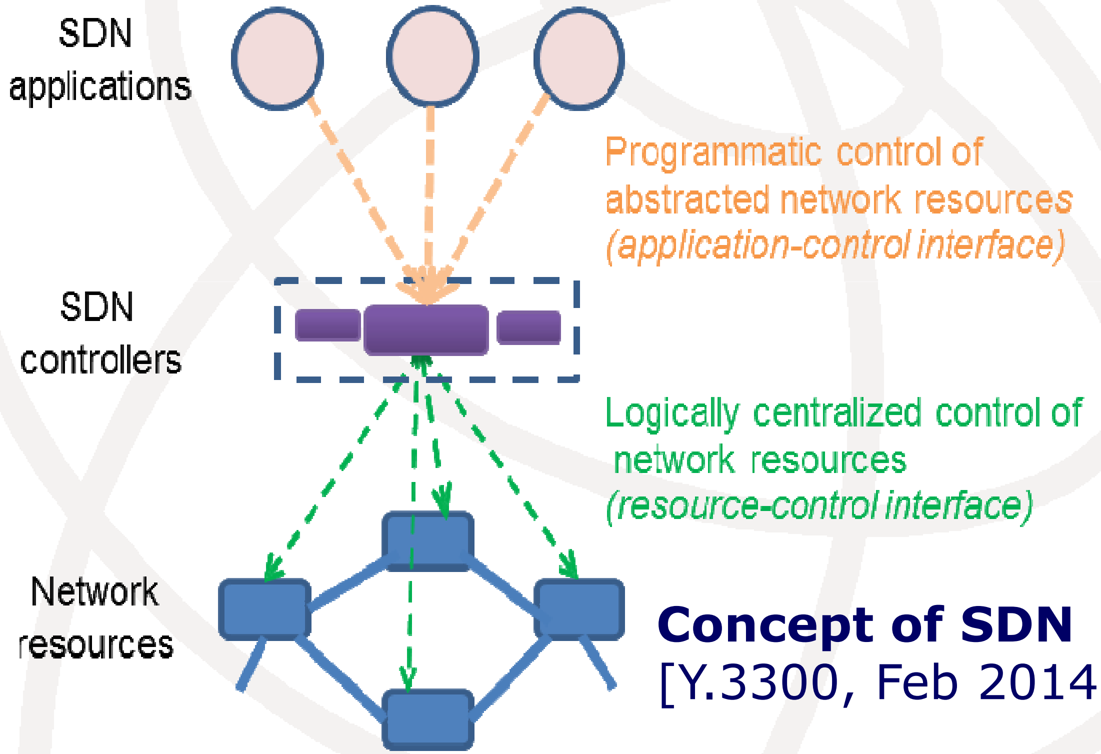
Network Functions Virtualisation Approach



NFV is expected to be disruptive for telecom industry over next 2-5 years. A trend for all telecom networks, applicable to NGN.

Software-defined networking (SDN)

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



Concept of SDN
[Y.3300, Feb 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***

A trend for all telecommunication networks in general, applicable to NGN

Internet of Things (IoT)

IoT is defined in Y.2060 "Overview of Internet of Things" as:

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.

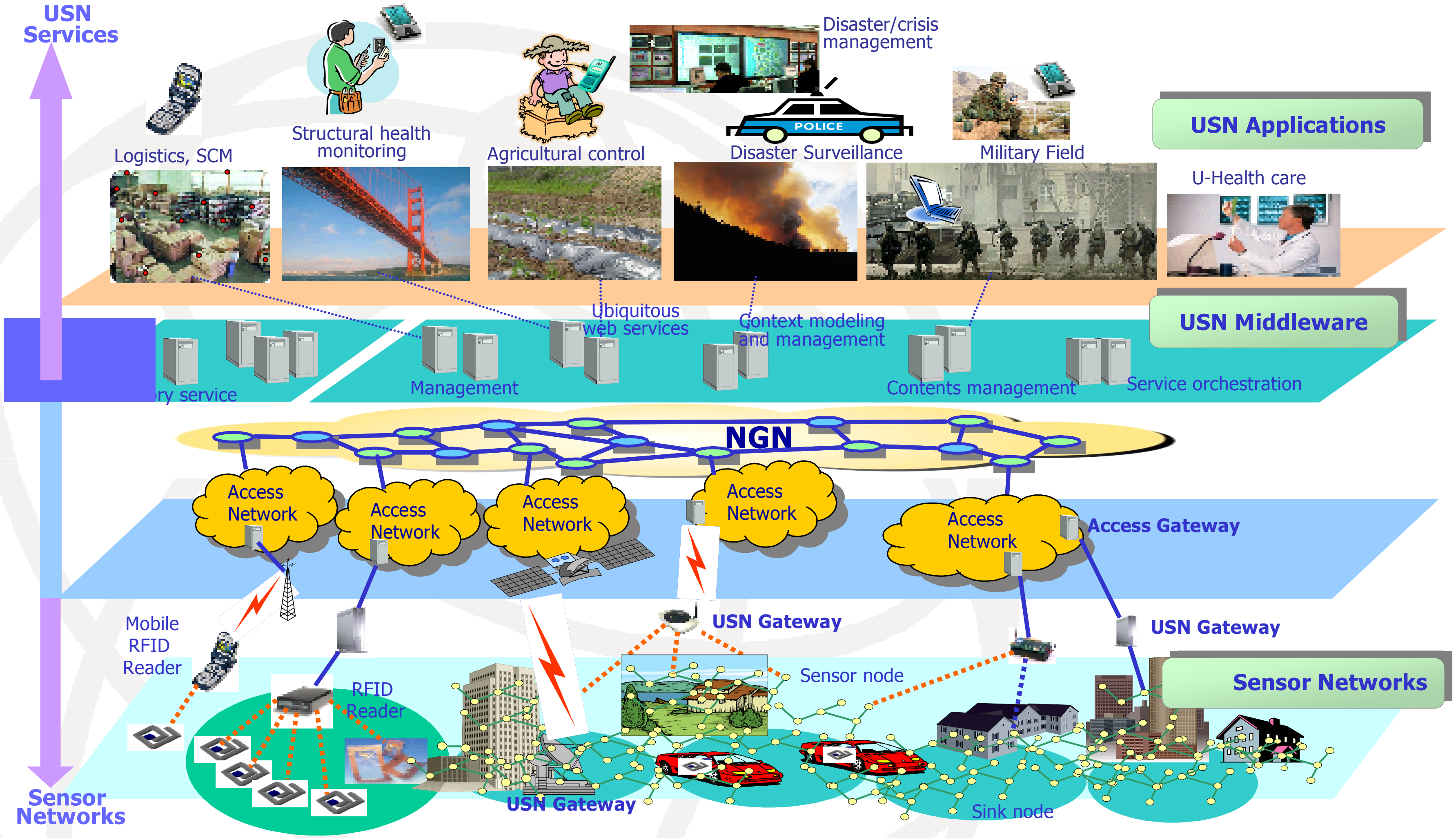
NOTE2 - In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

IoT is expected to integrate leading technologies such as:

- *Advanced Machine to Machine*
- *Autonomic Networking*
- *Data Mining and Data Reasoning (BIG DATA)*
- *Cloud Computing*
- *Service Delivery Platforms*

***with technologies for** advanced sensing and actuation*

NGN support of IoT applications: an example



Source: Y.2221 "Requirements for support of Ubiquitous Sensor Networks (USN) applications over NGN"

Thanks for your attention

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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. 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. He also acts 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.
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.