ITU-D Workshop on NGN and Regulation for the Philippines

NGN Architecture and main Elements

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Oscar González Soto
ITU Consultant Expert
Spain
oscar.gonzalez-soto@ties.itu.int

NGN Concepts and Elements

- Motivation and concept
- NGN Architecture
- Network Elements

Motivation: Premises

- Strategic Trends
  - data traffic (bandwidth) will become 2 to 5 times higher than the voice traffic.
  - IP is becoming the universal transport protocol used by all services
- How PSTN should evolve ?
  - as before, with its dedicated optimised technology (TDM) ?
  - or move to packet IP networks, telephony being a service among others ?
- Background reasons to evolve
  - service merge and new services
  - DSL and other broadband access penetration
  - cost of ownership: unique instead of separated networks

Motivation: *NGN concept*

- A **multi-service network** able to support voice, data and video
- A network with a control plane (signaling, control) **separated** from the transport/switching plane
- A network with **open interfaces** between transport, control and applications
- A network using **packet mode technology** to transport of all kind of information
- A network with **guaranteed QoS** for different traffic types and SLAs

Motivation: Why

- **Flexibility** for service building and offering
- Expectation of **cost reductions** by sharing infrastructure and systems
- **Simplification of O&M**, thus lowering OPEX.
- Use of **open interfaces** leads for:
  - quick deployment of services and applications
  - new services (third parties)

NGN Concepts and Elements

- Motivation and concept
- NGN Architecture
- Network Elements

General functional model for NGN

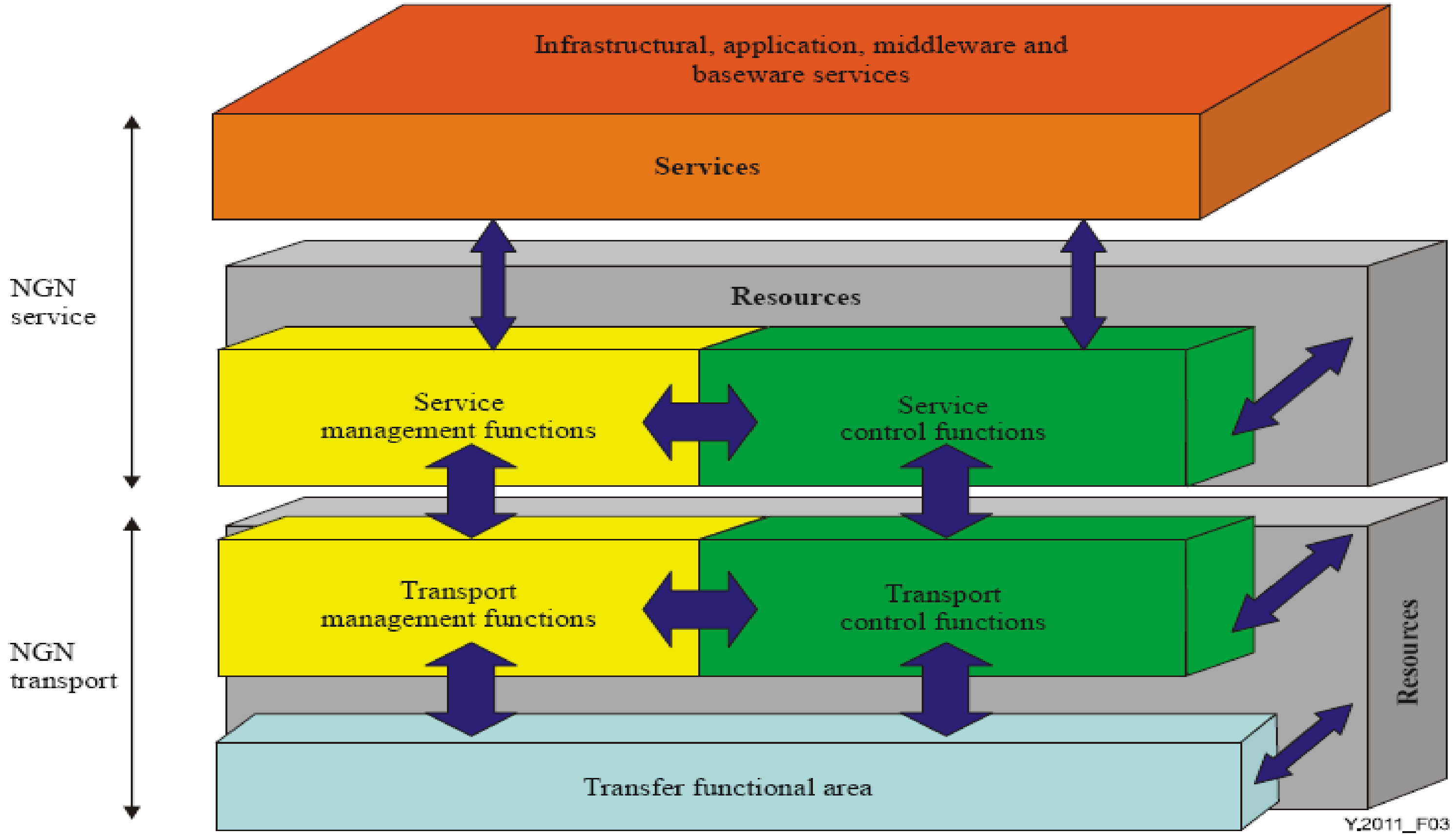
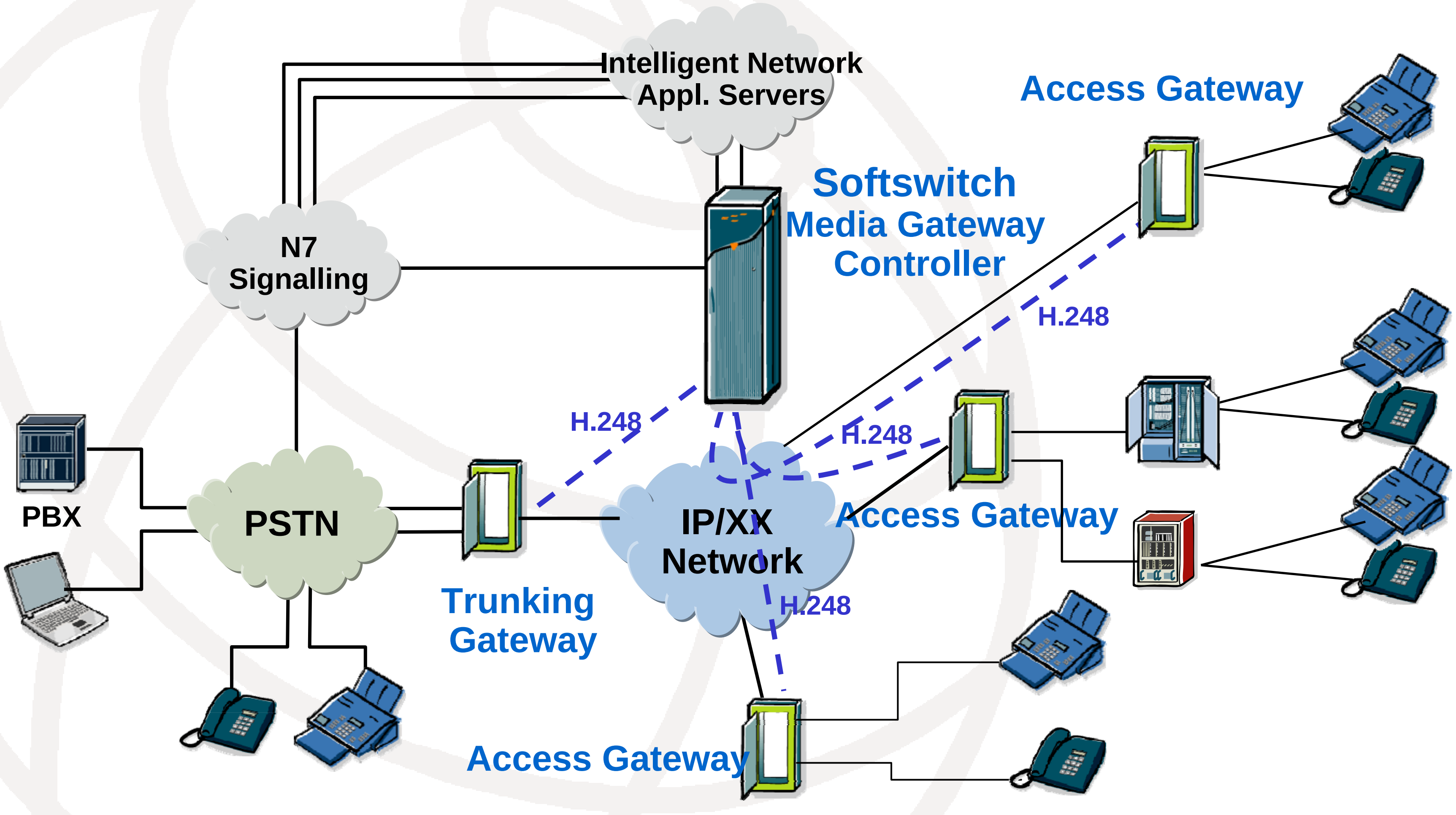
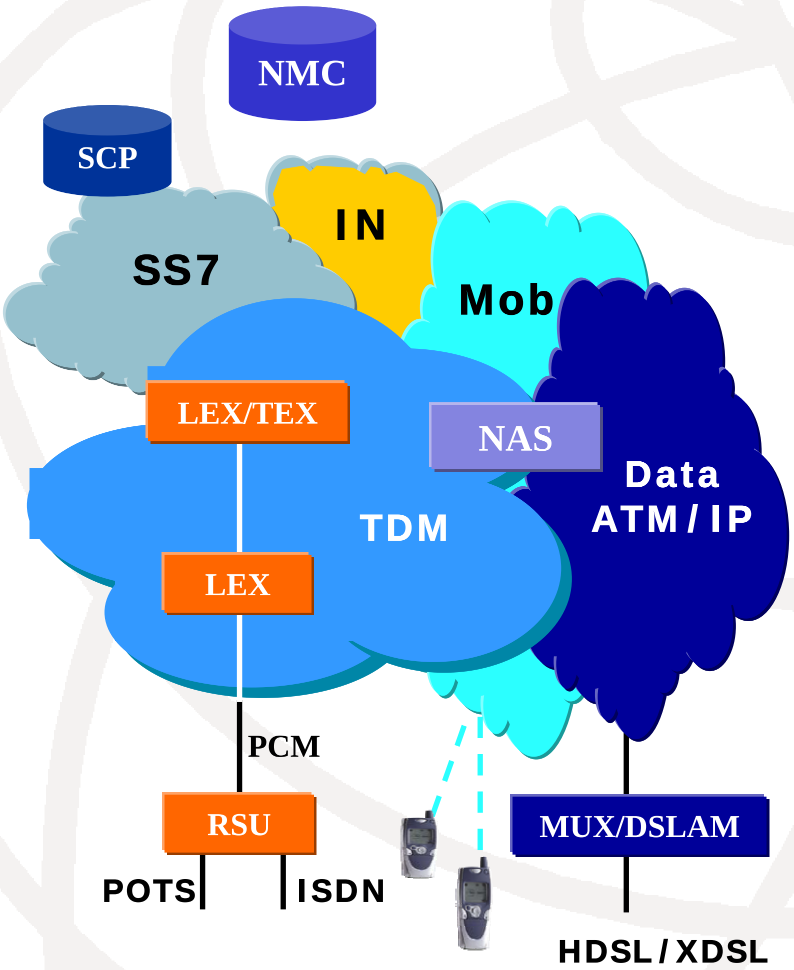


Figure 3/Y.2011 – General functional model

NGN Architecture and Network Elements

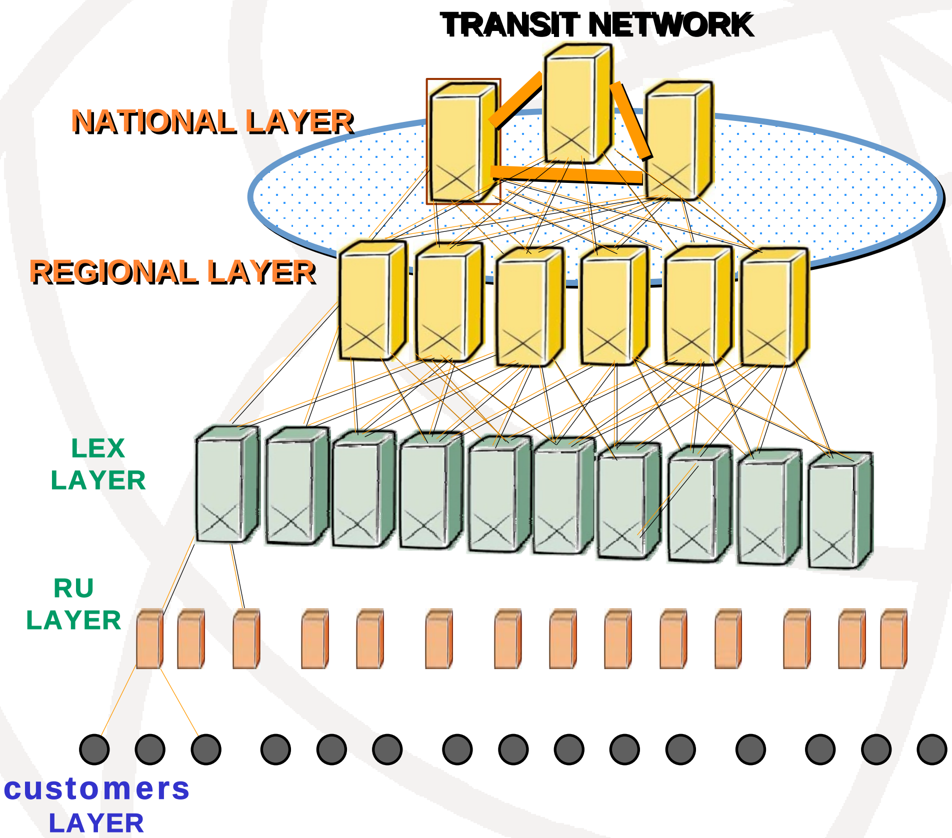


Network Architecture: Existing networks and architecture



- 5 different network types to handle telecom services
- TDM for fixed and mobile networks working in circuit mode with end to end reserved paths
- SS7 and IN network working with message switching mode
- Data network working with leased lines and packet mode with different and conventional IP protocols

Network Architecture
Existing networks and architecture



- Hierarchical topology with 4 to 5 layers, connectivity to the upper next layer and within each layer as a function of economical optimization
- Number of nodes as a function of O/D traffic and nodes capacity
- Service handling for media, signaling and control at all exchange nodes
- Carrier grade quality with well defined QoS criteria and standardized engineering rules

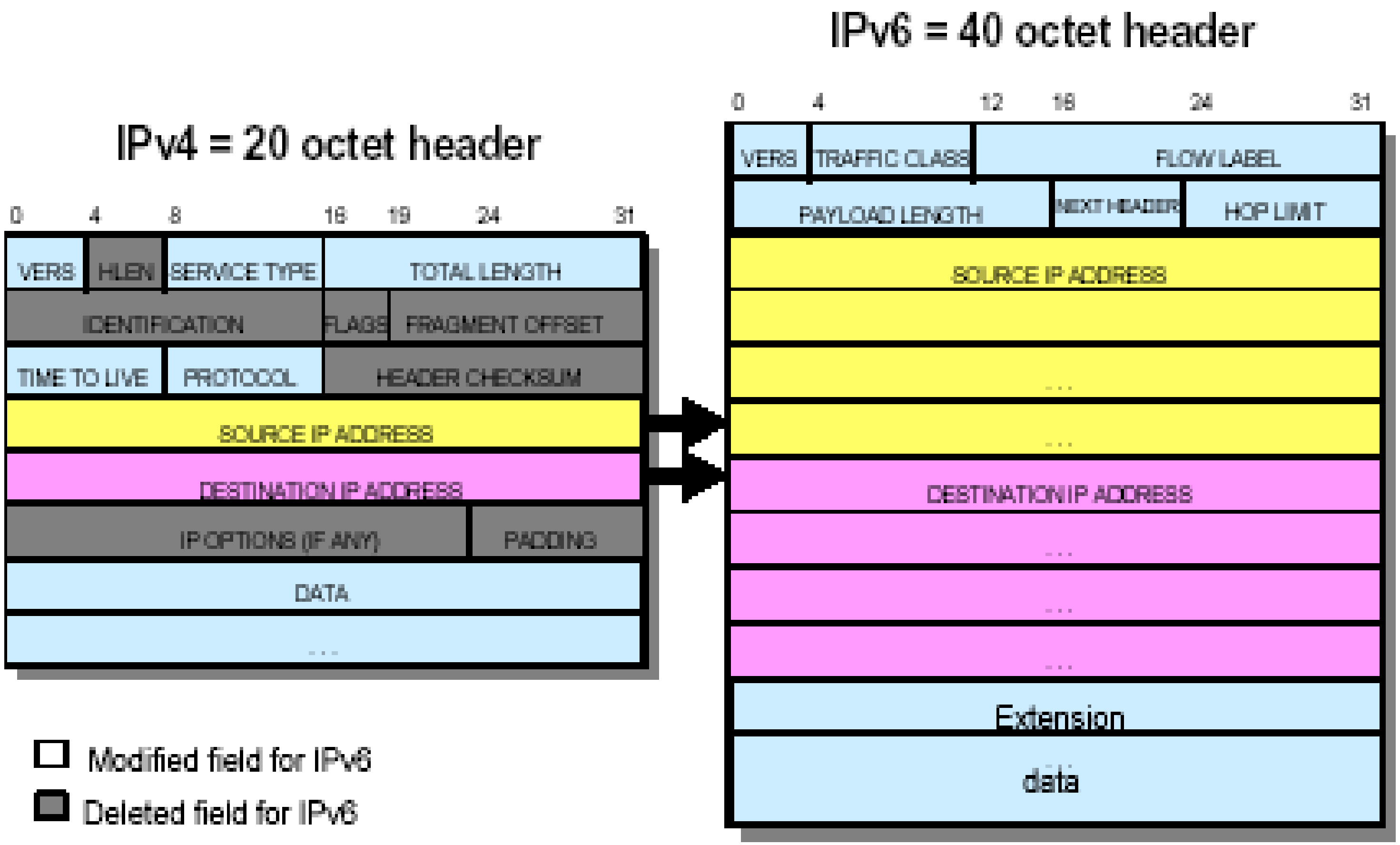
NGN Architecture and Elements

- Motivation and concept
- NGN Architecture
- Network Elements

NGN Network Elements

- **Packet networks**
  - Information is packetized in variable packet sizes with control headers to allow appropriate routing and delivery
  - trend is to use IP based networks over various transport possibilities (ATM, SDH, WDM…)
  - IP networks must offer guarantees of Quality of Service (QoS) regarding the real time characteristics of voice
- **IPv4**
  - Internet Protocol at network level that insert headers for each packet in order to allow end to end packet flows: v4 is the first widely used version with 20 octet header
- **IPv6**
  - Internet Protocol at network level that insert headers for each packet in order to allow end to end packet flows: v6 is the latest version with 40 octet header and adding capabilities for current requirements in addressing and routing

NGN Network Elements



NGN Network Elements

- **Access Gateways**
  - allows the connection of subscriber lines to the packet network
  - converts the traffic flows of analogue access (Pots) or 2 Mb/s access devices into packets
  - provides subscriber access to NGN network and services
- **Trunking Gateways**
  - allows interworking between classical TDM telephony network and Packet-based NGN networks,
  - converts TDM circuits/ trunks (64kbps) flows into data packets, and vice versa

NGN Network Elements

- **Softswitch / MGC**
  - referred to as the Call Agent or Media Gateway Controller (MGC).
  - provides the "service delivery control" within the network
  - in charge of Call Control and handling of Media Gateways control (Access and/or Trunking) via H.248 protocol
  - performs signalling gateway functionality or uses a signalling gateway for interworking with PSTN N7 signalling network
  - provides connection to Intelligent Network /applications servers to offer the same services as those available to TDM subscribers
- **Application Server (AS)**:
  - A unit that supports service execution, e.g. to control Call Servers and NGN special resources (e.g. media server, message server).

NGN Network Elements

- **H.248 Protocol**
  - Known also as MEGACO: standard protocol, defined by ITU-T, for signalling and session management needed during a communication between a media gateway, and the media gateway controller managing it
  - H.248/MEGACO allows to set up, keep, and terminate calls between multiple endpoints as between telephone subscribers using the TDM

- **SIP**
  - Session Initiation Protocol in order to handle communication signalling and negotiation like call establishment, maintenance and termination from packet mode terminals. Has a distributed peer to peer implementation

NGN Network Elements

- **Signaling Gateway (SG):**
  - A unit that provides signaling conversion between the NGN and the other networks (e.g. STP in SS7).

- **ENUM**
  - Electronic NUMbering: Protocol that allows to establish a correspondence between the traditional telephone numbering (E.164) and the network addresses related to the packet mode networks (RFC 2916 "E.164 number and DNS" IETF).

NGN Network Elements

- **MPLS**
  - Multiprotocol Label Switch or protocol that assigns labels to information packets in order to allow the node routers to treat and route flows in the network paths according to established priority for each category. Establishes a tunnel for an end to end forwarding. A label is a short, fixed length, locally significant identifier which is used to identify a "Forwarding Equivalence Class" (FEC) to which that packet is assigned."

- **LSP**
  - Label-switched paths: An LSP is a specific traffic path that using convenient protocols will establish a path through an MPLS network and will reserve necessary resources to meet pre-defined service requirements for the data path.

NGN Network Elements

- **OSPF**
  - **O**pen **S**hortest **P**ath **F**irst: A routing protocol that determines the best path for routing IP traffic over a TCP/IP network based on distance between nodes and several quality parameters. OSPF is an interior gateway protocol (IGP), which is designed to work within an autonomous system
- **BGP**
  - Border Gateway Protocol: performs inter-domain routing in TCP/IP networks, handling routing between multiple autonomous domains. Routers use BGP to maintain a consistent view of the internetwork topology

NGN Network Elements

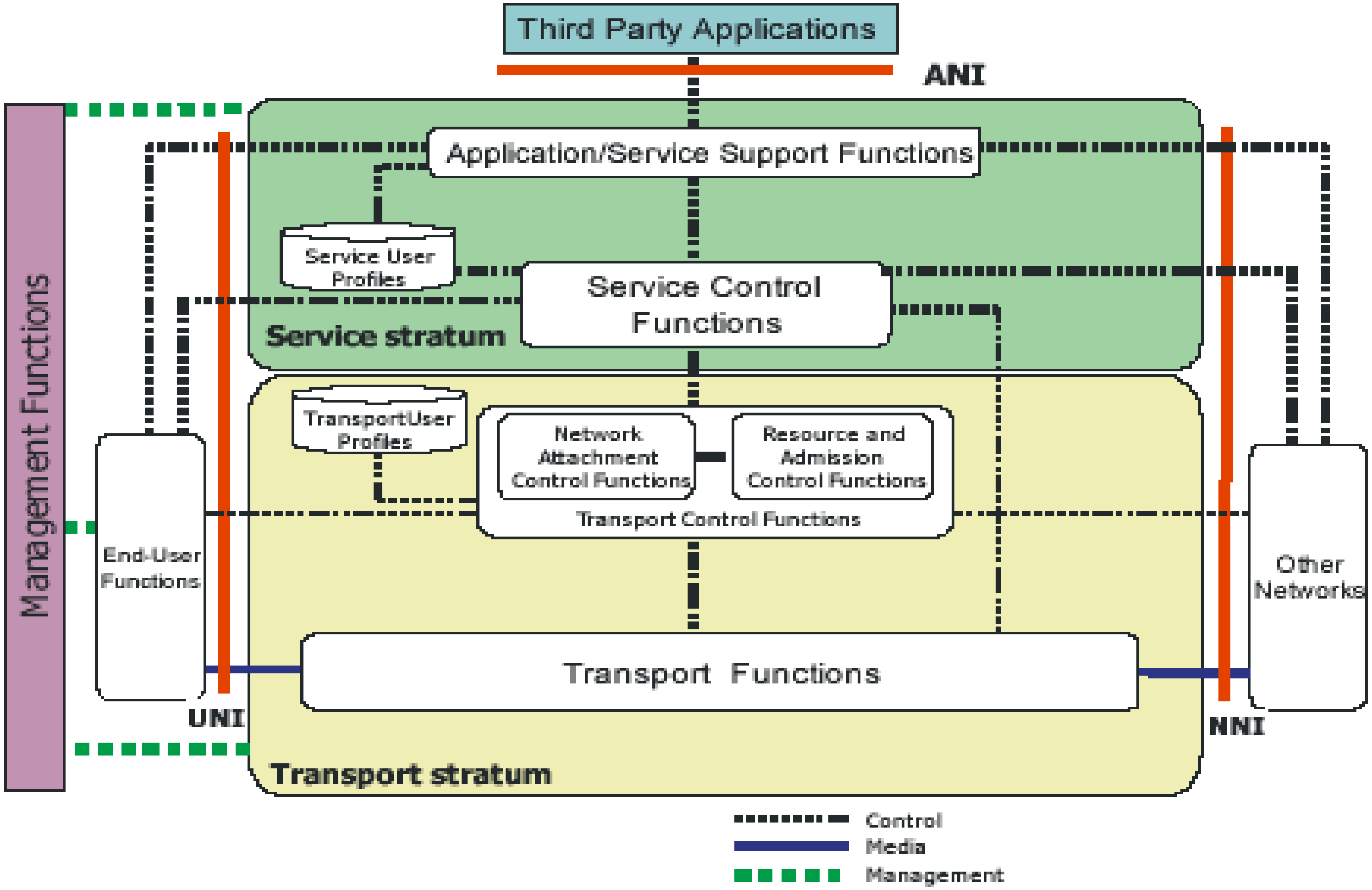
- **Traffic Engineering Module**
  - Traffic Engineering refers to the process of selecting the paths (LSPs) in order to balance the traffic load on the various links, routers, and switches in the network. A major goal of Traffic Engineering is to facilitate efficient and reliable network operations with guarantee of QoS while simultaneously optimizing network resource utilization and traffic performance
- **CAC**
  - Call Acceptance Control function in order to accept/reject traffic in the network that allows guarantee of QoS for services with a given Service Level Agreement

NGN Network Elements

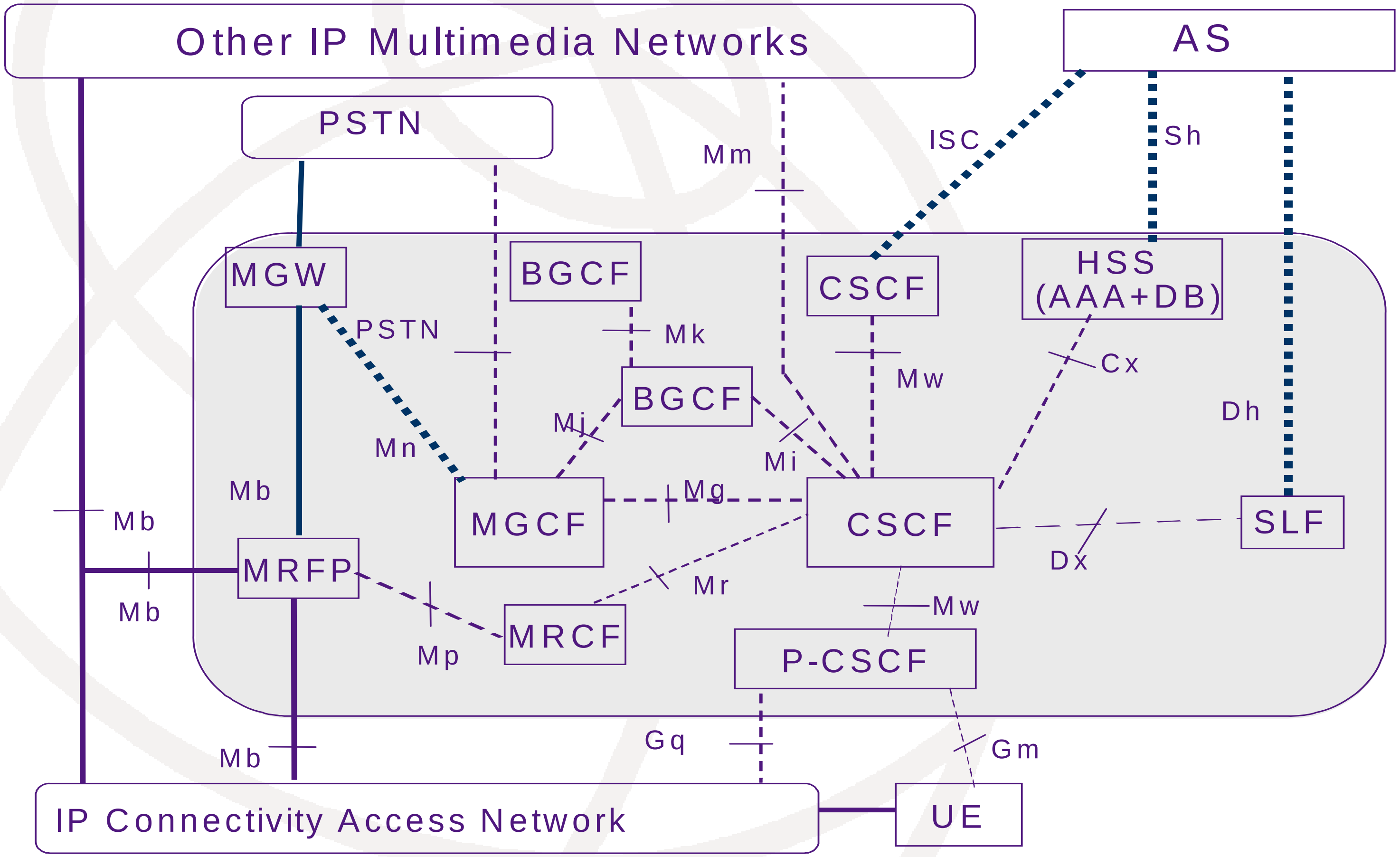
- **IMS**
  - IP Multimedia Subsystem: architectural framework for delivering IP multimedia services. It was originally designed by the wireless standards body 3rd Generation Partnership Project (3GPP) for mobile services and later extended to all types of networks.
  - It has a multilayer structure with a transport stratum and a service stratum containing all transport, control and application functions as well as defined interfaces to external 3rd party applications, OSS, BSS, NM and other networks.

NGN Network Elements

IMS Architecture



NGN Network Elements
IMS Functional Structure and Interfaces



NGN Network Elements
IMS Architecture

IMS functional elements:

- •Application Server (AS)
- •Home Subscriber Server (HSS)
- •Call Session Control Function (CSCF)
- •Breakout Gateway Control Function (BGCF)
- •Media Gateway Function (MGW)
- •Media Gateway Control Function (MGCF)
- •Multimedia Resource Function Controller (MRFC)
- •Multimedia Resource Function Processor (MRFP)

NGN Network Elements
IMS Architecture

Application Server (AS)

- Contains Call Related Application Logic
- Facilitates a Service Creation Environment
- Queried by S-CSCF in Real Time to Execute Logic
- Generally Specialized for Each Service
- May Provide Gateway to Legacy Applications (e.g. AIN)

NGN Network Elements
Flow control at core NGN

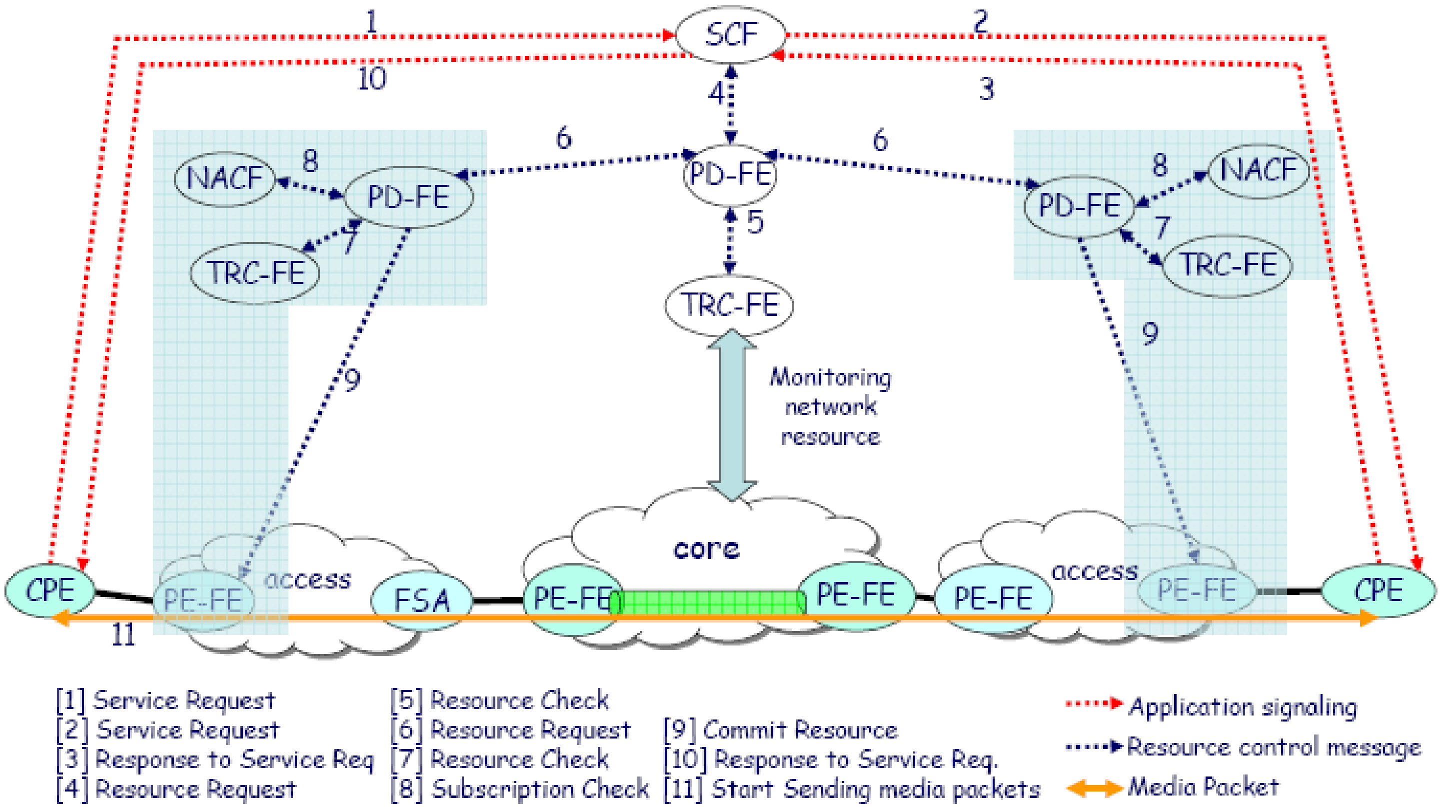


Figure 6.2.12: End-to-End Flow Control Procedure with RACF in MPLS Core Network.

NGN Network Elements
Flow control at core NGN

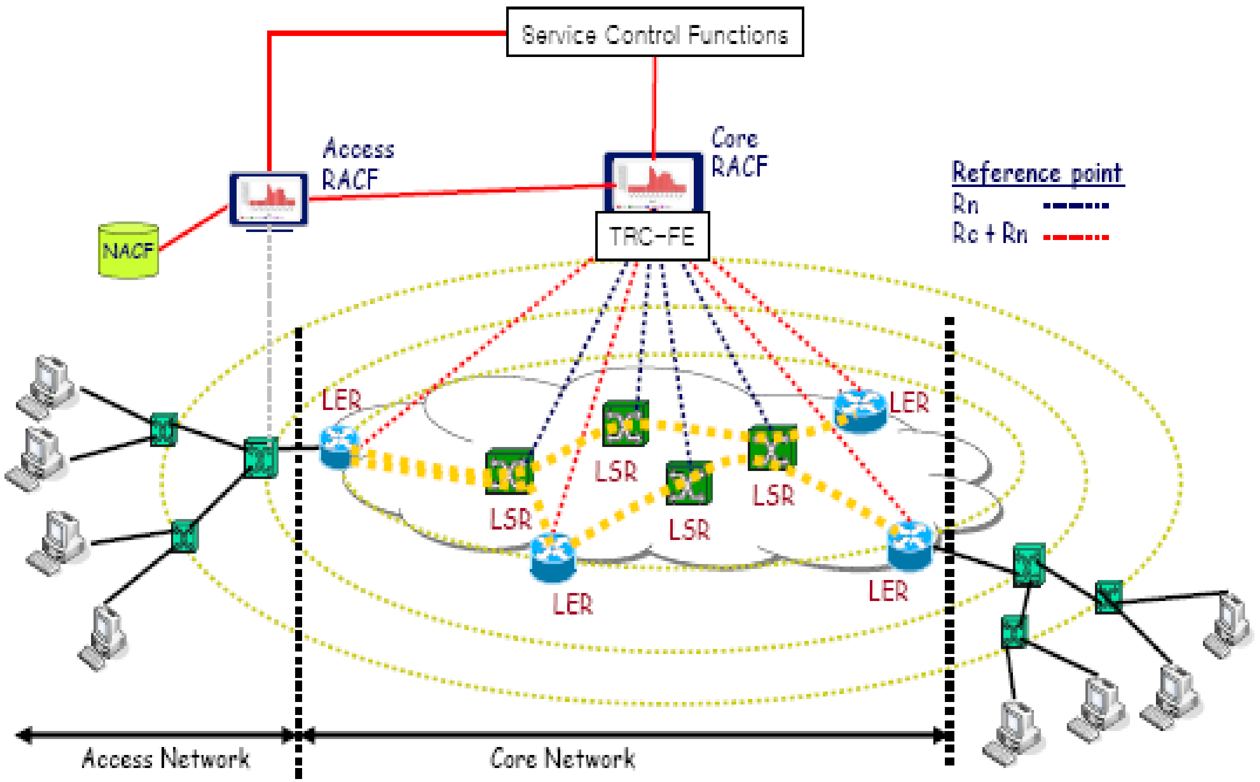


Figure 6.2.13: Centralized RACF Architecture in MPLS Networks.

NGN Network Elements
Flow control at core NGN

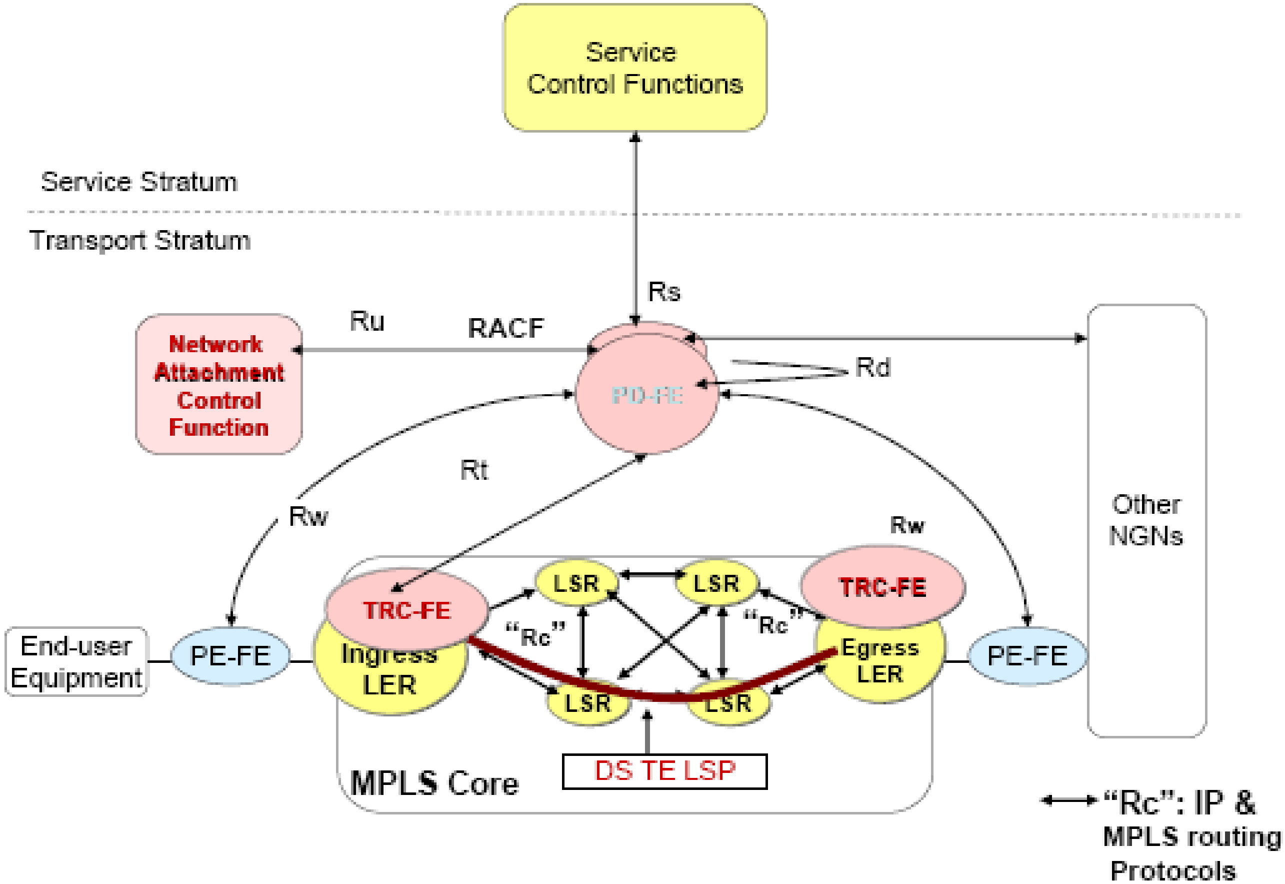


Figure 6.2.14: Distributed TRC-FE Architecture in MPLS Networks.

NGN Concepts and Elements Status today

- Available today for application in many networks fort most elements

- Recently defined functionalities and interoperation standardized and being deployed with adjustments needed

- Careful planning needed for operators with existing infrastructure and operation (migration, profitability, QoS and survivability)

NGN Concepts and Elements
Summary of main factors

- Main advantage of NGN based on IP is the **flexibility for many services**
- NGN for all services with required quality **is not just IP or internet**
- Most functionalities and performance for public networks in operation today. Some multi-domain **interoperation requiring agreements**