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Quality of Service for Next Generation Networks

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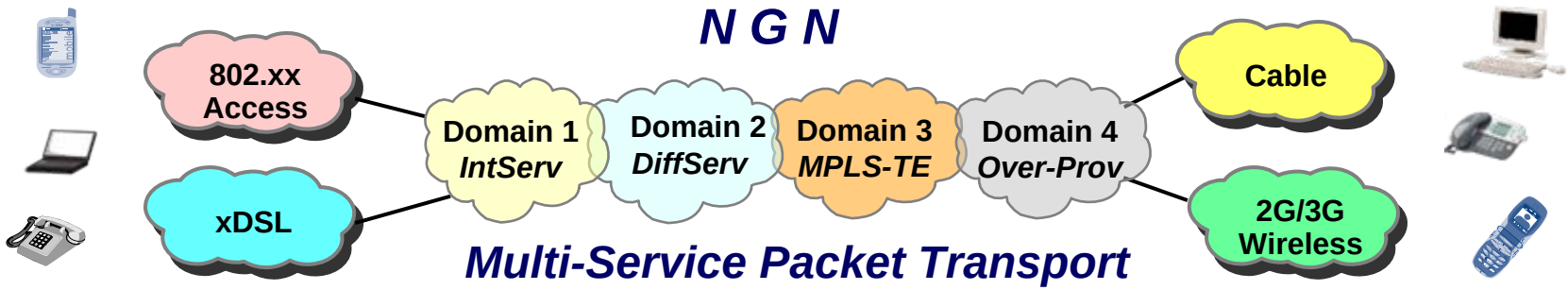
Outline

- Complexity of NGN QoS
- Key QoS topics under study in ITU-T
- Active NGN QoS work items in Q4/13
- Resource and admission control
- Inter-domain performance measurement and management
- Summary

Complexity of NGN QoS



- User-perceived QoS is end-to-end (cf. E.800)
- NGN QoS is complex because
  - NGN applications have *diverse* performance needs
  - IP is *not* designed for consistent application performance
    - Various mechanisms have been introduced with specific applicability
  - *Diversity* in an end-to-end path is common owing to
    - Different levels of QoS support in *endpoints*
    - Varying types of QoS support in the *transport*
    - Multiple *provider domains*

Effective management of resource contention is an important aspect of NGN QoS support

Key QoS Topics under Study in ITU

- Performance objectives, including
  - Network performance classes
  - Network performance allocation

  → SG 12, SG 16, FGNGN
- Dynamic QoS controls, including
  - Signaling of performance requirements
  - Resource and admission control
  - Interworking of QoS mechanisms
  - Inter-domain considerations
  - Frameworks and guidelines

  → SG 11, SG 13, FGNGN
- Performance measurement and management

  → SG 4, SG 12, SG 13, FGNGN
- Performance assessment

  → SG 12

ATIS has been a key contributor

A major goal is to develop an end-to-end QoS solution that allows incremental deployment

Active NGN QoS Work Items in Q.4/13

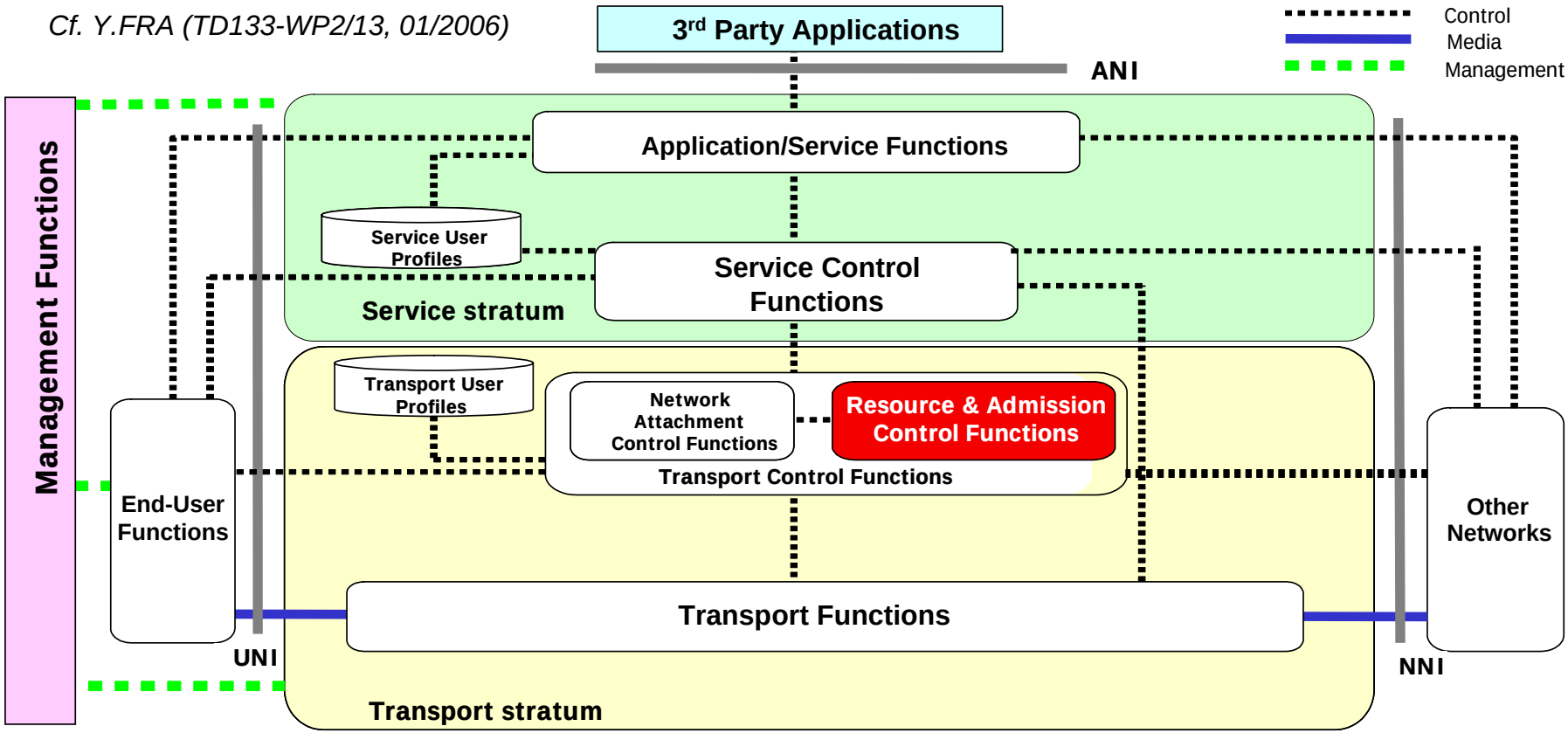
- Requirements and architecture for resource and admission control in NGN (Y.racf)
- A QoS control architecture for Ethernet-based IP access networks (Y.123.qos)
- A QoS architecture for Ethernet networks (Y.enet)
- Performance measurement and management for NGN (Y.pmm)
- Requirements and framework for end-to-end QoS support in NGN (Y.e2eqos.1)
- Priority classification for IP networks and services
- Requirements for flow-aware transport in NGN

Notes:

1. Q.4/13 has inherited most of the FGNGN QoS work as highlighted.
2. Y.pmm is worked jointly with Q17/12, which also is the home of Y.1541 and the FGNGN follow-up work on network performance (including Y.NGN.NHNperf and G.fepo).
3. SG 11 has approved the FGNGN output on IP QoS signalling requirements as Q-Series Supplement 51.

Schematic View of ITU-T NGN Framework Architecture

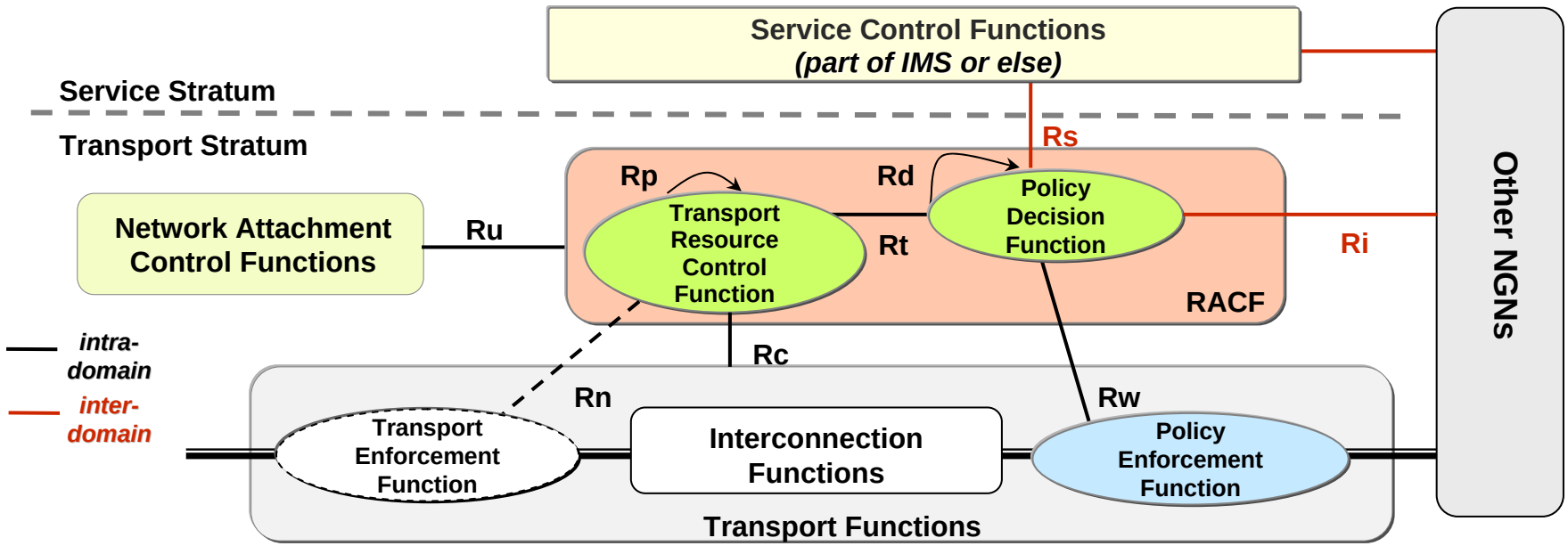
Cf. Y.FRA (TD133-WP2/13, 01/2006)



Resource and Admission Control Functions (RACF)

- Preserve the separation of services and transport
- Bridge services and transport to enable *dynamic application-driven* support for *performance assurance* and *network border control*

ITU-T RACF Architecture



- **Policy Decision Function**
  service facing, transport independent
- **Transport Resource Control Function**
  service independent, transport dependent, possibly 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*
- All applications (VoIP, IPTV, etc.) involving network-based control can make use of RACF via Rs

Roles of RACF and Related Entities

Policy Decision Function

- Makes the overall admission decision based on policy and resource availability
- Applies resource controls to the transport for bandwidth reservation, packet marking, gating, NAPT, etc.

Transport Resource Control Function

- Tracks transport resource usage and network topology
- Checks resource availability
- Applies L2 resource controls to the transport

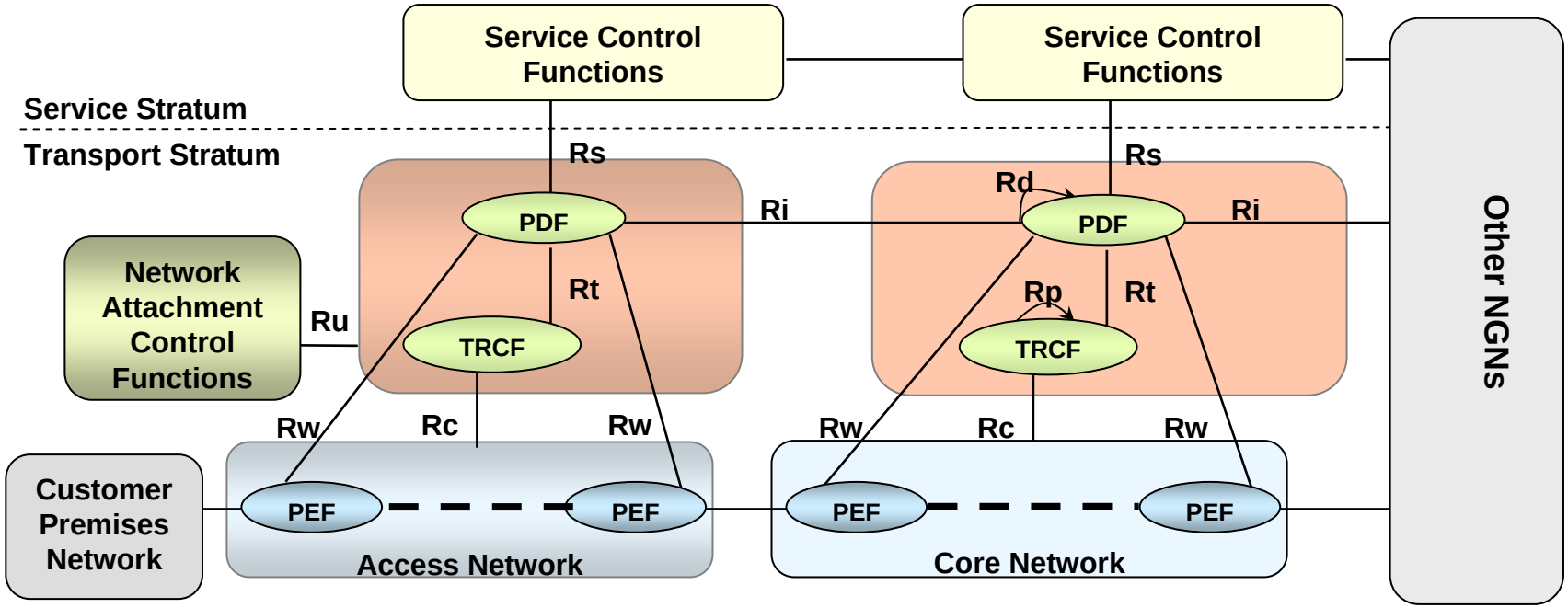
Policy Enforcement Function

- Enforces controls applied by PDF
- Provides resource information to TRCF

Overall, RACF supports

- *Relative* and *absolute* QoS, including *priority*
- Endpoints of varied QoS control capabilities
- *Push* and *pull* models for policy installation
- Multiple transaction models for resource requests
- Various resource management methods based on *accounting*, *measurement* and *reservation*
- *Existing* and *emerging* transport QoS mechanisms

A Configuration Example

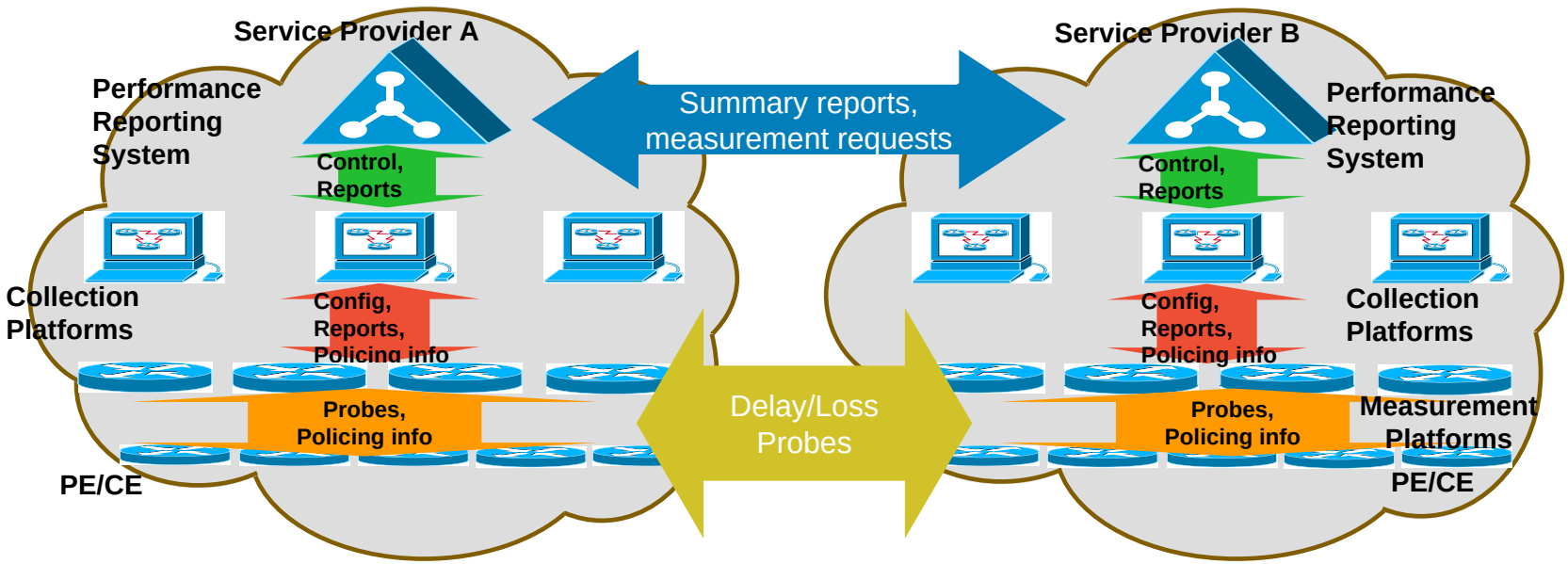


The Policy Enforcement Function can reside in the

- Gateway GPRS Support Node (GGSN)
- Packet Data Serving Node (PDSN)
- Session Border Controller (S/BC)
- Broadband Remote Access Server (BRAS)
- Cable Modem Termination System (CMTS)
- Border gateway

Y.123.qos and Y.enet under way apply RACF to Ethernet-based IP access networks and Ethernet-based NGN, respectively

Inter-Domain Performance Measurement and Management (Y.pmm)



- **Definitions of attributes to be measured**
  - Mean delay, delay variation, packet loss, path unavailability (cf. Y.1541)
- **How attributes are measured, e.g.,**
  - Active or passive measurement (cf. Y.1711 and Y.1731)
  - Active probes tailored to Y.1541 QoS classes
  - Clock synchronization to Coordinated Universal Time through GPS or the like
- **Management requirements for discovery, inter-PRS communication, etc.**

Summary

- NGN QoS has been an active area under study in ITU with active ATIS's involvement
  - A key goal is to develop an end-to-end QoS solution that allows incremental deployment
- Q.4/13 has several related work items ongoing (in collaboration with SGs 4, 11 and 12 as appropriate), including
  - *Y.racf* (targeted for consent in July), which outlines an approach to dynamic application-driven resource and admission control to support performance assurance and network border control
    - Related protocols are under development in Q5/11
    - Draft Recommendations *Y.123.qos* and *Y.enet* apply RACF to specific environments
  - *Y.pmm*, which outlines a basic framework for inter-domain performance measurement and management
  - QoS and *priority*, which has been recently initiated to further support emergency telecommunications services
- Cooperation among related standards efforts across SDOs is critical to the development of consistent and interoperable mechanisms, which are essential for effecting QoS end-to-end