International Telecommunication Union

Quality of Service Standardization for Next Generation Networks

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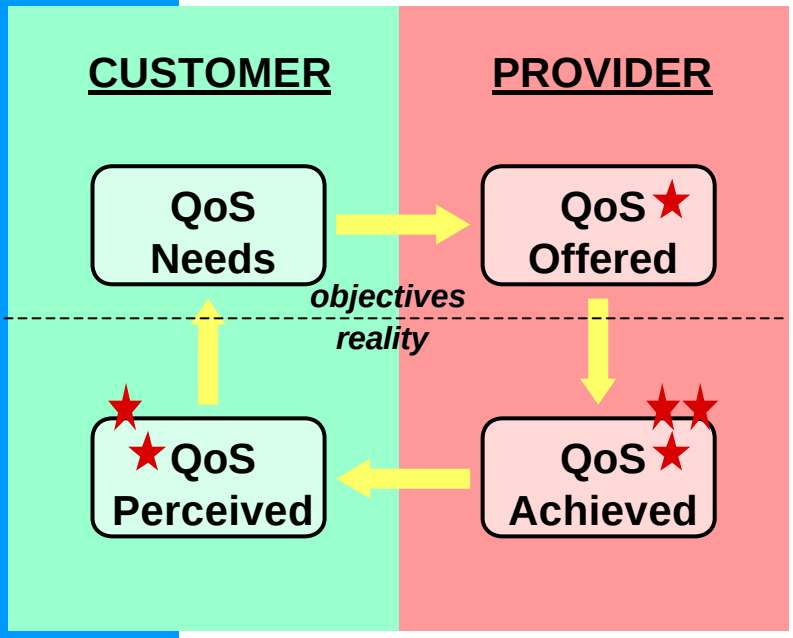
Outline

- QoS and NGN
- Key standardization areas
- ITU-T FGNGN QoS effort
- Summary

QoS and NGN

E.800 QoS: the collective effect of service performance which determines the degree of satisfaction of a user of the service



(Cf. G.1000)

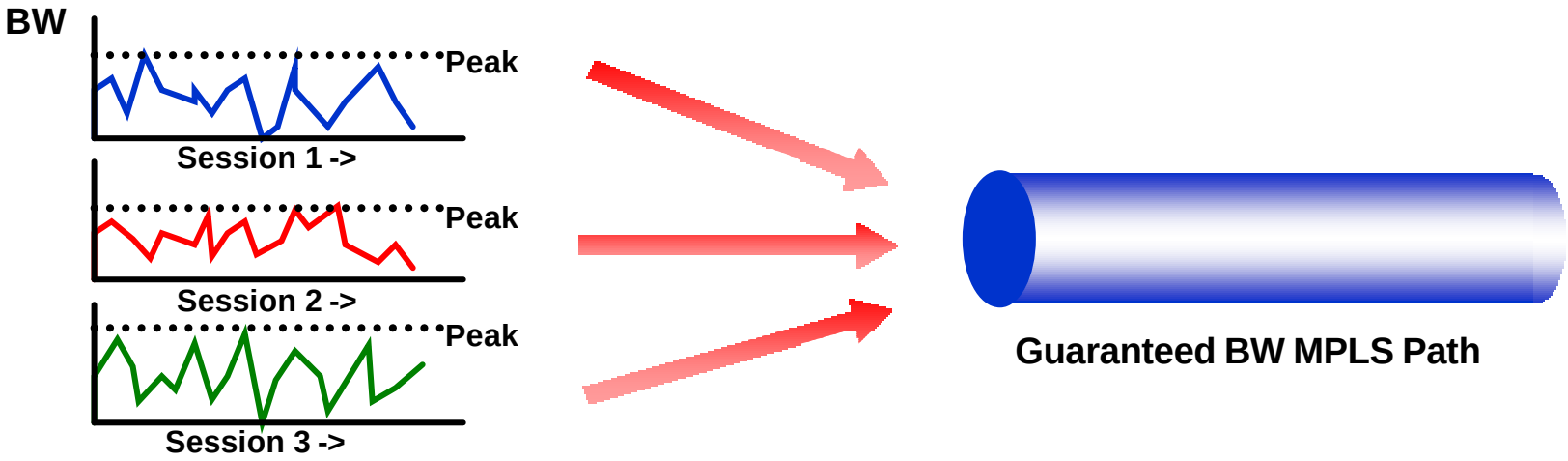
NGN

- *Packet based*
- *No inbuilt QoS*
- *Multi service*

- Customer perceived QoS is end to end
- QoS is related to reliability and security
- QoS in NGN presents complex issues

QoS is an enabler
as well as a differentiator
for NGN deployment

QoS Presents Complex Issues
Example – per session QoS



We can ensure QoS for each session by allocating the peak bandwidth needed for each session

- But since the flow rarely uses peak bandwidth, this makes inefficient use of bandwidth

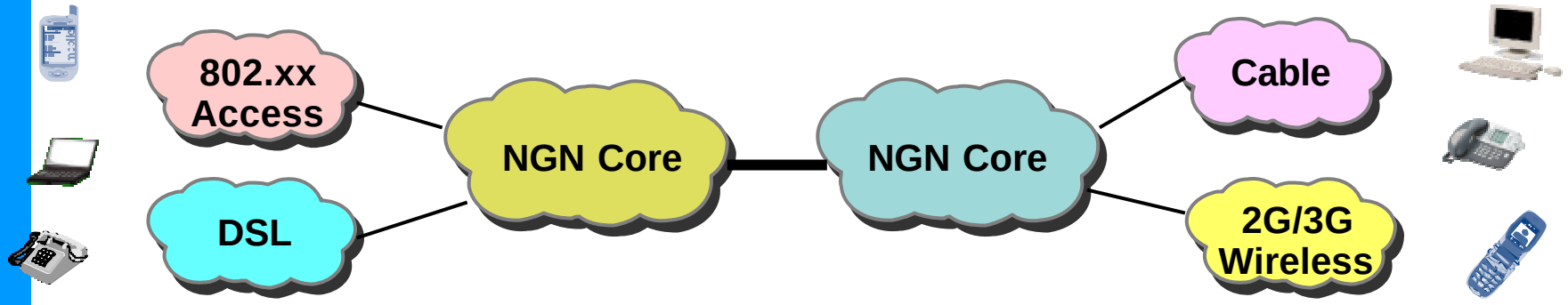
We can make efficient use of bandwidth by allocating some fraction (e.g., the average) bandwidth required by a session

- But this can result in data loss when traffic peaks coincide

How to manage congestion?

Key High-Level NGN QoS Requirements

- Support of diverse CPE QoS capabilities
- Support of diverse access QoS technology
- Support of mobility and nomadicity
- Inter-provider QoS
- End-to-end QoS
- On-demand QoS
- QoS charging
- Flexibility for implementation and deployment
- Scalability
- Operational simplicity



Observations on End-to-End QoS

- At the Application/Session Control Layer
  - The application must understand QoS requirements (BW, delay, packet loss, etc.) for the service offered
  - The application communicates requirements to the Core and Access Network to ensure QoS through standard mechanisms
  - End-to-end QoS involves a variety of control protocols & mechanisms
    - Session control protocols (SIP, HTTP, H.323, RTSP, etc.), QoS solutions (DiffServ, IntServ, etc.) …
- At the Transport Layer
  - Core Network
    - MPLS generally used to provide QoS
    - Local, network specific resource and admission control needed
    - But over-engineering "solving" a lot of issues
  - Access Network
    - Tends to be layer-2 networks that are NOT IP aware
    - Needs local, network specific resource and admission control
    - Tends to be a more likely source of congestion

Key NGN QoS Standardization Areas

1. Performance objectives and classes
   a. Application performance
   b. Network performance

   → SG 12, SG 16

2. Dynamic QoS controls, including
   a. Signaling of performance requirements
   b. Dynamic activation of QoS controls
   c. Inter-provider QoS
   d. Interworking of QoS mechanisms
   e. Framework and guidelines

   → SG 11, SG 13, FGNGN

3. Performance measurement and monitoring

   → SG 4, SG 13, FGNGN

4. Performance assessment

   → SG 12

Other key SDOs involved in NGN QoS standardization include:
3GPP, 3GPP2, ATIS, IETF, ETSI TISPAN, MFA

Objectives of QoS Controls

- To provide consistent and predictable response to a QoS request
- To respond to a QoS request at or above a guaranteed minimum
- To establish in advance the response to a QoS request that can or will be obtained
- To control network resource contention such that a QoS request can be responded with a superior level of network resource
- To control network resource contention such that a QoS request does not obtain an unfair allocation of resources
- To allow for efficient total utilization of network resources while providing a spectrum of QoS responses

(Cf. IETF RFC 2990)

Classification of Controls

- **Time scale of response**
  - **Packet**
  - **Round-trip-time**
  - **Session**
  - **Long term**
- **Granularity of control**
  - **Per flow**
  - **Aggregate**
- **Location of control**
  - **Terminal**
  - **Edge**
  - **Core**
  - **Control plane**
  - **Data plane**
  - **Management plane**
- **Location of control state**
  - **Network entities**
  - **Packet headers**

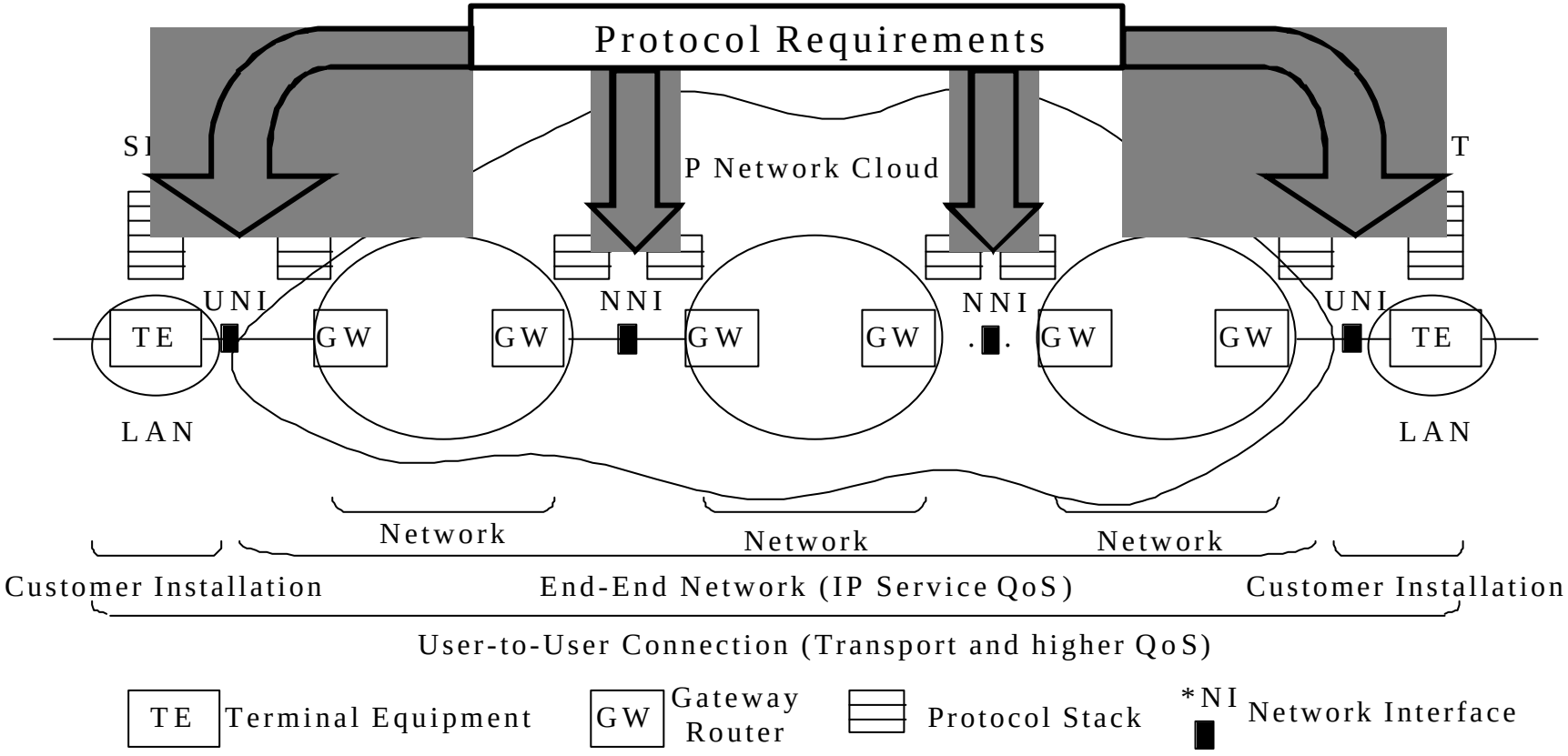
A particularly active work item is on resource and admission control and its interaction with application control

FGNGN QoS Deliverables

Title	Area	Latest Draft	Target Date	Status
Signalling requirements for IP QoS (TRQ.IPQoS.sig.cs1)	2.a	FGNGN-OD-00079	Dec. '04	A
A QoS control architecture for Ethernet-based IP access networks (TR-123.qos)	2.b	FGNGN-OD-00010	March '05	D
Multi Service Provider NNI for IP QoS (TR-msnniqos)	2.c	FGNGN-OD-00027	March '05	D
General aspects of QoS and network performance in NGN (TR-NGN.QoS)	1	FGNGN-OD-00045	May '05	D
Network perf. of non-homogeneous networks in NGN (TR-NGN.NHNperf)	1.b	FGNGN-OD-00025	May '05	D
Performance measurement and management for NGN (TR-pmm)	3	FGNGN-OD-00073	May '05	D
A QoS Framework for IP-based access networks (TR-ipaqos)	1, 2	FGNGN-OD-00075	July '05	D
Resource and admission control Function (TR-racs)	2.b-e	FGNGN-OD-00074	July '05	D
A QoS architecture for Ethernet networks (TR-enet)	2.b, 2.d	FGNGN-OD-00077	July '05	D
Requirements and framework for end-to-end QoS in NGN (TR-e2eqos.1)	1, 2	FGNGN-OD-00076	July '05	D

Scope of TRQ-IPQoS.sig.cs1

for signaling IP QoS parameters such as defined in Y.1541 and Y.1221 across network



Outline of IP QoS Signaling Requirements

7.1 User-Network Signalling

- 7.1.1 Attributes of a User QoS Request
- 7.1.2 Omitting Attributes of a User QoS Request
- 7.1.3 Form of a Verifiable User QoS Request
- 7.1.4 Special Case of User QoS Request to support Voiceband Channels
- 7.1.5 Flow Control for User QoS Requests and Re-requests
- 7.1.6 Network Response to User QoS Requests
- 7.1.7 User Answer to Network QoS Response

7.2 QoS Signalling at the Network – Network Interface

- 7.2.1 Attributes of a Network QoS Request
- 7.2.2 Omitting Attributes of a Network QoS Request
- 7.2.3 Performance Requirements for QoS Requests and Re-requests
- 7.2.4 Response to a Network QoS Request
- 7.2.5 Accumulating Performance for Additional Requests

7.3 QoS Release

7.4 Performance

7.5 Symmetry of information transfer capability

7.6 Contention resolution

7.7 Error reporting

7.8 Unrecoverable failures

7.9 Forward and backward compatibility

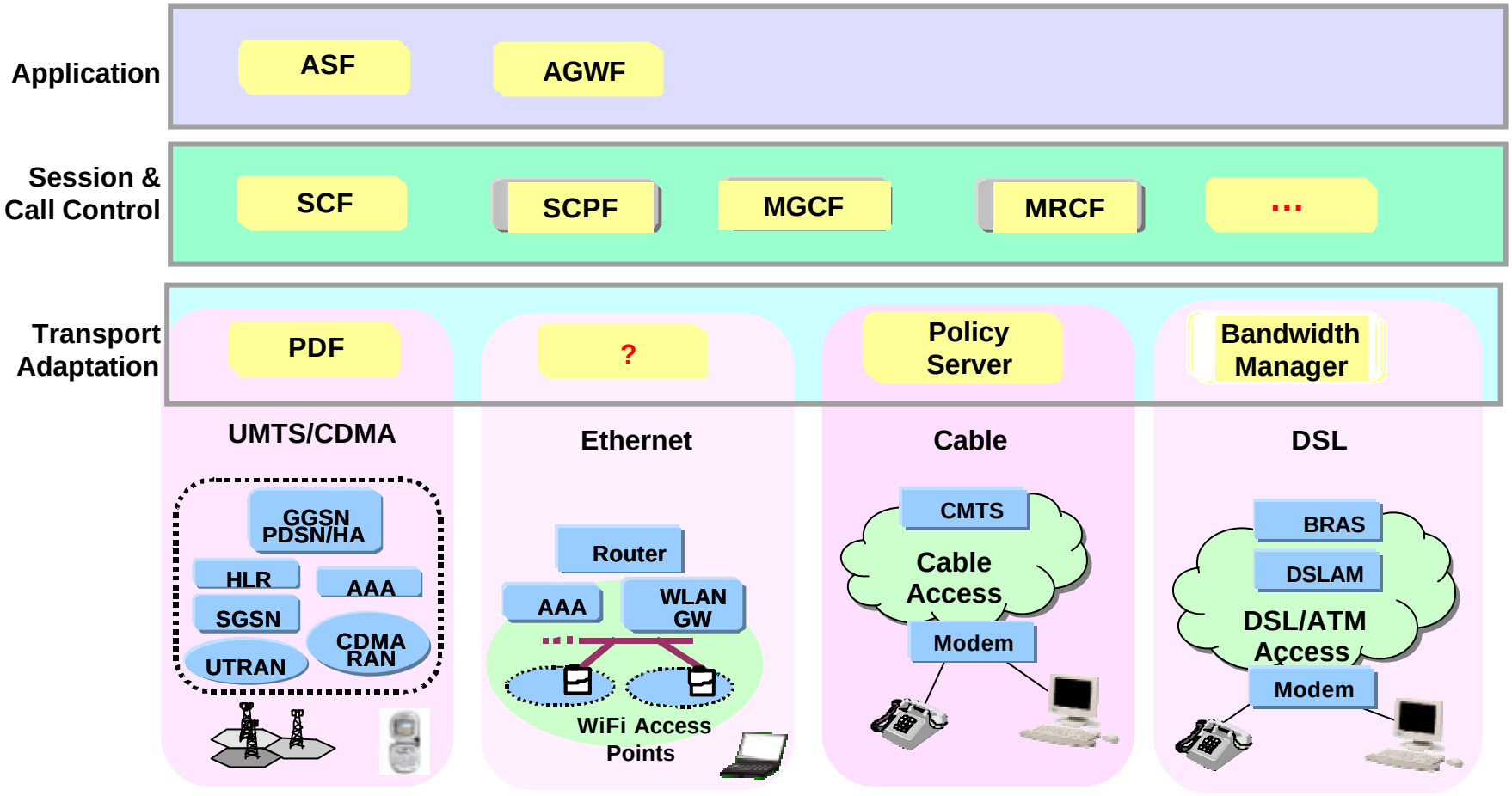
7.10 Parameters and values for Transport connections

7.11 User-Initiated QoS Resource Modification

7.12 Emergency Service

7.13 Reliability/Priority Attributes

Converging Resource and Admission Control for Access and Core networks



Unified resource and admission in support of fixed mobile convergence is desirable

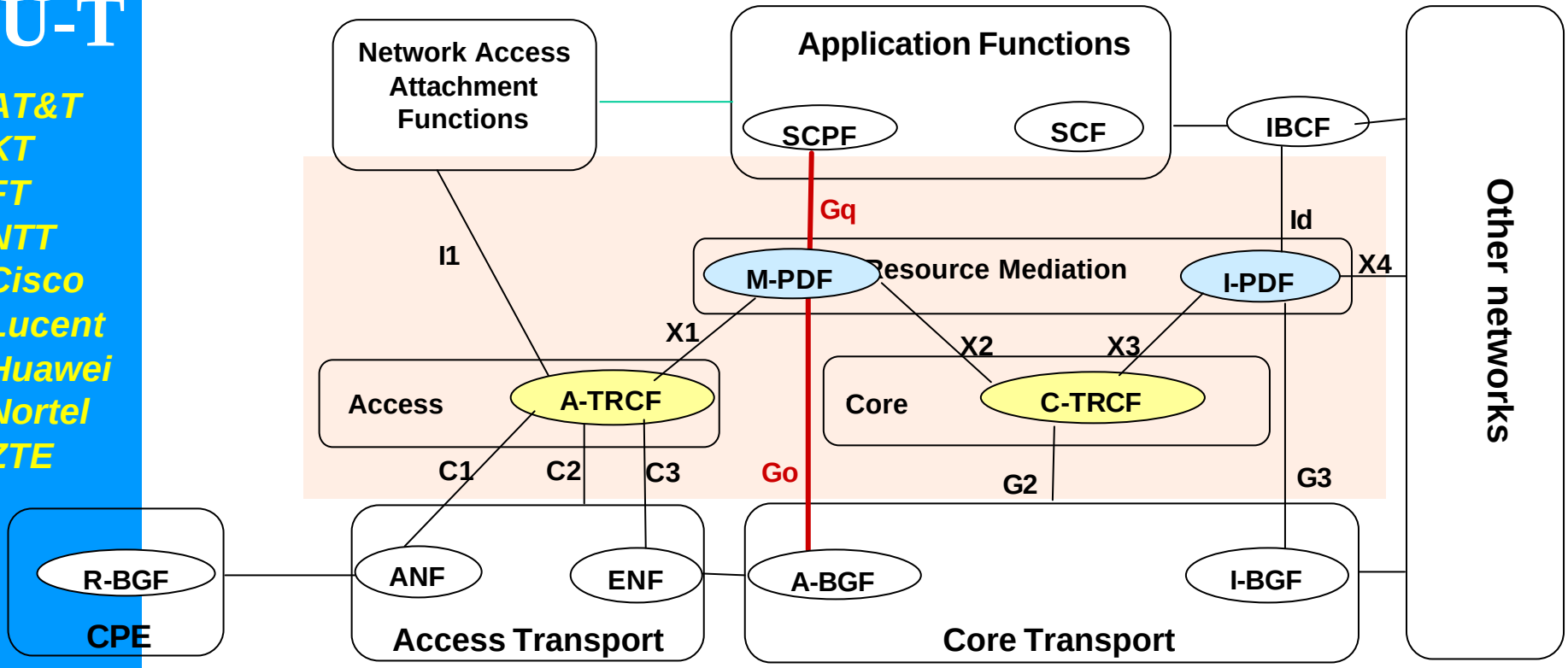
Resource and Admission Control Functional Architecture

ITU-T

AT&T
KT
FT
NTT
Cisco
Lucent
Huawei
Nortel
ZTE

(Cf. FGNGN-OD-00074, Dec. '04)

Work in progress



ANF - Access Node Function
ENF - Edge Node Function
A-BGF - Access Border Gateway Function
I-BGF - Interconnection Border Gateway Function
R-BGF - Residential Border Gateway Function
IBCF - Interconnection Border Control Function

I-PDF - Interconnection Policy Decision Function
M-PDF - Mediation Policy Decision Function
SCF - Service Control Function
SCPF - Service Control Proxy Function
A-TRCF - Access Transport Resource Control Function
C-TRCF - Core Transport Resource Control Function

Summary / Next Steps

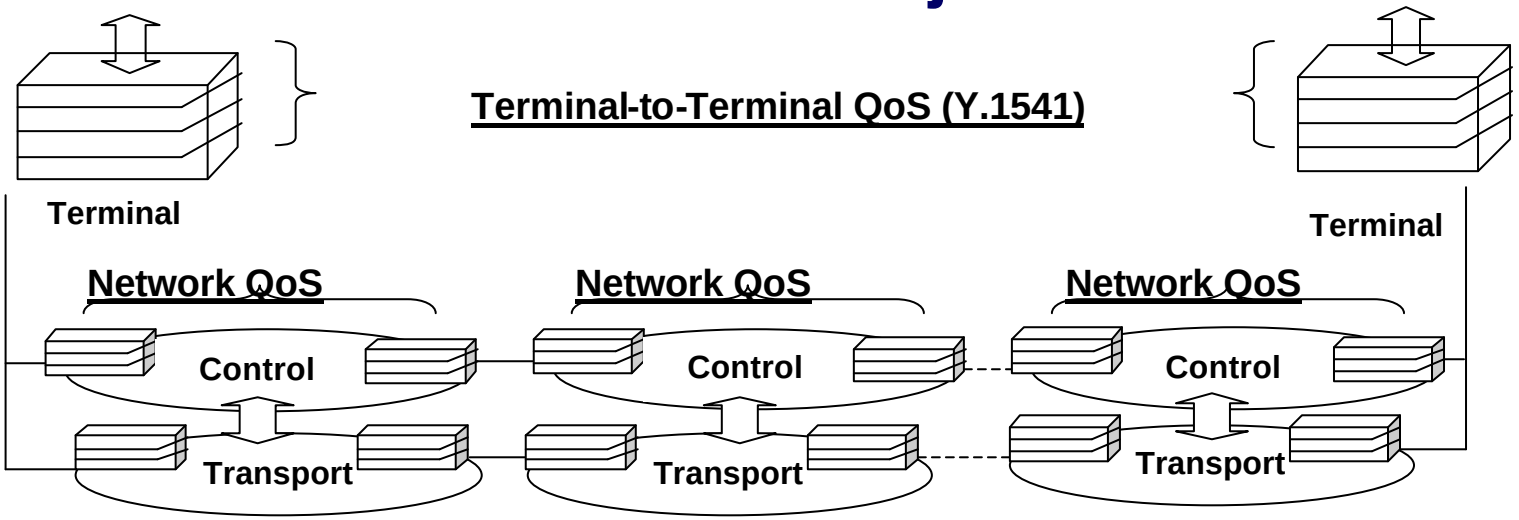
- Multiple drafts under development address various QoS issues with different levels of maturity
  - Continuing rationalization
- Performance objectives and classes and traffic descriptors are relatively well understood as specified in Y.1541 and Y.1221
  - Interworking and harmonization with other QoS class schemes
  - Apportionment of performance parameter values across networks
- Approved IP QoS signaling requirements provides a basis for developing needed protocols
  - Making use of existing or emerging standard protocols?
  - Path-coupled versus path-decoupled signaling
- A consistent approach to resource and admission control in access and core networks and at network boundaries is emerging
  - Check against requirements and alignment with the NGN architecture
- Coordination among related standards efforts is critical to timely development of consistent and interoperable standards
  - Good coordination within ITU-T (led by SG 12)
  - Improving coordination, finding synergies with other SDOs

What are the low hanging fruits? How to reap them?

ITU-T

Backup Slides

Y.1541 IP QoS Classes and Network Performance Objectives



Network Performance Parameter	Nature of Network Performance Objective	Class 0 VoIP	Class 1 VoIP	Class 2 signaling	Class 3	Class 4 low loss	Class 5 (Un-specified)
IPTD	Upper bound on the mean IPTD	100 ms	400 ms	100 ms	400 ms	1 s	U
IPDV	Upper bound on the $1-10^{-3}$ quantile of IPTD minus the minimum IPTD	50 ms	50 ms	U	U	U	U
IPLR	Upper bound on the packet loss probability	$1*10^{-3}$	$1*10^{-3}$	$1*10^{-3}$	$1*10^{-3}$	$1*10^{-3}$	U
IPER	Upper bound	$1*10^{-4}$					U

- Encompass key IP application categories
- Are relatable to practical IP network QoS mechanisms
- Can be achieved in realistic network implementations
- Are verifiable at network boundaries
- Are readily applicable to NGN
- Are being enhanced in ITU-T SG 12