ITU-D Regional Development Forums 2010 on NGN and Broadband for the Arab Region
"NGN and Broadband, Opportunities and Challenges"
Cairo, Egypt

The model network methodology for NGN testing. Approach of service and QoS Testing

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Contents

- Conformance and interoperability testing
- Model networks as an instrument for providing testing
- New approach of Service testing
- QoS and NP testing & monitoring as a central task for operator activity

Conformance and interoperability testing

Features of NGN implementation

- Increase in the number of manufacturers due to increased share of software in implementing the technical means of telecommunication
- Reducing the period of the development and introduction of new technologies and services
- lag standardization process from the process of development and implementation, increase the share of corporate regulatory documents
- The increasing complexity of the compatibility problems of equipment from different manufacturers

"NGN and Broadband, Opportunities and Challenges"
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Features of NGN implementation

- Testing procedure play an important role
- Changing the testing methodology – creation Model network – as common measurement instrument
- Centralization and cooperative activities in the analysis and evaluation of different solutions

(Knowledge DataBase)

The approach of NGN testing

- Functional Interop. testing – verification the functionality on TM (EUT) and system-network solutions (NUT) different vendors for compatibility in accordance with basic ITU-T Recs.
- Service testing – testing the services on "end-to-end" scenarios including call flow testing and testing with existent provider's operation systems (Billing, OSS/BSS and etc.)
- QoS testing – testing the QoS parameters and RACF functionality

Current situation in testing standardization area in ITU-T

Present time

Conformance testing which includes protocols and interfaces testing *(TTCN 1 (X.292-1995), TTCN 2 (X.292-1998), TTCN 3 (Z.140-2003) TSS&TP, PICS/PIXIT proformas for different protocols testing)*

Future

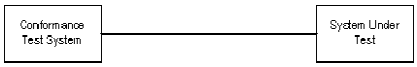
NGN based on the functional entity which interworks using some protocols

Interoperability testing

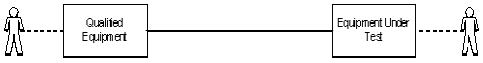
(Q.3901 for NGN, Q.3904 for IMS)

NGN testing methods

- **Conformance testing or type testing**
  - The purpose of conformance testing is to determine to what extent a single implementation of a particular standard conforms to the individual requirements of that standard



- **Interoperability testing**
  - Interoperability testing is the activity of proving that end-to-end functionality between (at least) two communicating systems is as required by those base systems' standards



*Note: Martin Brand, Test creation principles, International training seminar 'Testing of System and Network Solutions' ZNIIS, Moscow December 10-11 2009

Key deficiency of Interoperability and Conformance Testing

- **Conformance and Interoperability**
  - both important and useful approaches to the testing of standardized protocol implementations
  - each of these testing approaches does not cover all network problem points and can not replace the other
- **Conformance testing**
  - able to show that a particular system complies with all of the protocol requirements specified in the associated base standard
  - the different Vendors similar systems which is tested on conformance could not be guarantee to be compatible

Key deficiency of Interoperability and Conformance Testing

- **Interoperability testing**
  - can clearly demonstrate that two systems will interact and provide the specified end-to-end functions
  - the different Vendors similar systems which is tested on interoperability could not be guarantee that the interact protocol is realized on the associated base standard

NGN - Interoperability testing methods

- Network Integration Tests/End-to-End Tests
- Benchmark/Load Tests
- QoS Tests
- Security Tests
- Roaming Tests
- Interconnection Tests
- Functional tests/Real Equipment Tests

ITU-T Rec. Q.3900 as a global approach of testing

Purpose – determination of the Model network as a basic solution for NGN testing

Model network – a network which simulates the capabilities similar to those available in present telecommunication networks, has a similar architecture and functionality and uses the same telecommunication equipment

Contents of Q.3900

- Classification of NGN TM regarding the NGN functionality (Y.2012)
- Determination of testing procedures
- Requirements to the Model network

Basic Methodology of NGN testing
ITU-T Recommendation Q.3900 (09/2006)

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

Q.3900
(09/2006)

SERIES Q: SWITCHING AND SIGNALLING

Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks

CAUTION !
PREPUBLISHED RECOMMENDATION
This prepublication is an unedited version of a recently approved Recommendation. It will be replaced by the published version after editing. Therefore, there will be differences between this prepublication and the published version.

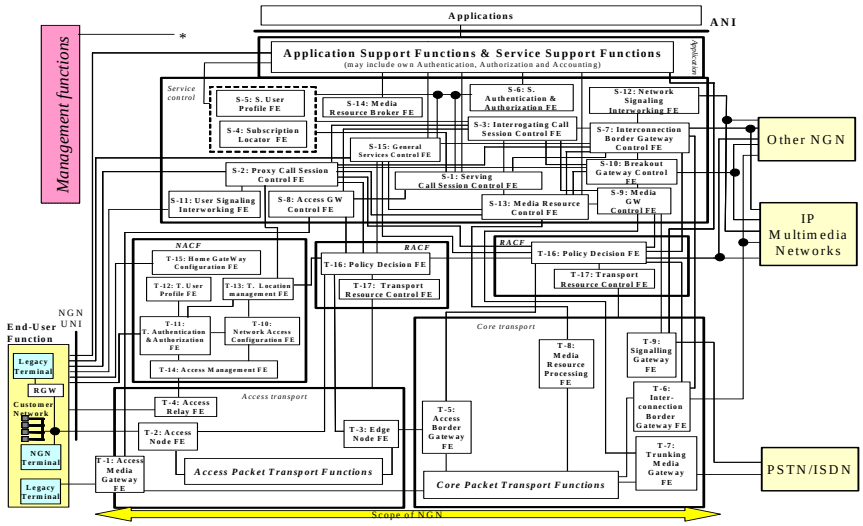
Contents

ITU-T Rec. Q.3900 (09/2006) – Prepublished version

Classification of NGN Technical Means to be tested

- Call Session Control System
  - Media Gateway Controller (MGC)
  - Proxy Server SIP (PS)
  - IP Multimedia Subsystem (IMS)
- Voice and signaling transmit system
  - Media Gateway (GW)
  - Signaling Gateway (SG)
  - Transport Network Environment (TNE)
- Application servers
  - Application Server (AS)
  - Media server (MS)
  - Messaging Server (MeS)
- Management and billing system
  - Management System (MS)
  - Billing system (BS)
- Access Environment
  - NGN Integrated Access Devices (NGN-IAD)
  - Media gateway for Legacy Terminal Equipment (GW-LTE)

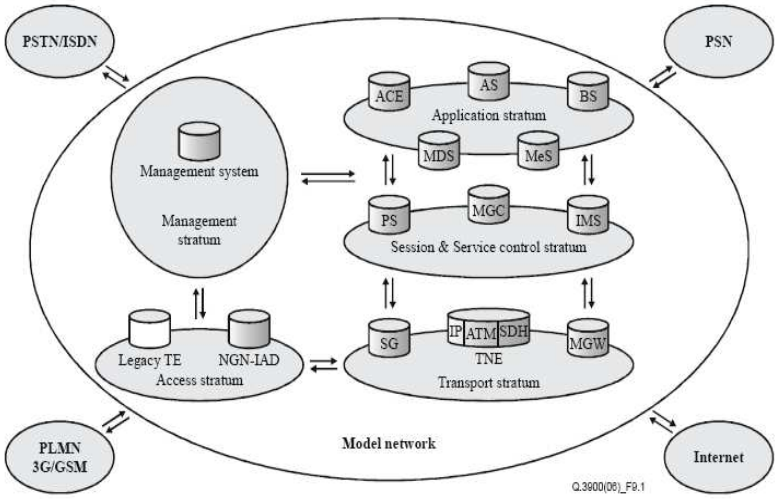
NGN functional architecture Recommendation of ITU-T Y.2012



Conformance of NGN Functions to NGN Technical Means to be tested (Rec. ITU-T Q.3900)

NGN Technical means	NGN Functionality
Call Session Control System	
Media Gateway Controller (MGC)	S3, S7, S9, S10, S12 T10, T11, T12, T13
Proxy Server SIP (PS)	S2, S3, S7, S11, S12 T10, T11, T12, T13
IP Multimedia Subsystem (IMS)	S1, S3, S6, S7, S8, S10, S12, S13 T10, T11, T12, T13, T14, T15, T16, T17
Voice and signaling transmit system	
Media Gateway (GW)	T7, T8
Signaling Gateway (SG)	T8, T9
Transport Network Environment (TNE)	T5, T6, T8
Application servers	
Application Server (AS)	S4, S5, S6, S14, S15
Media server (MS)	S4, S5, S6, S14, S15
Messaging Server (MeS)	S4, S5, S6, S14, S15
Management and billing system	
Management System (MS) Billing system (BS)	- error processing management - equipment configuration management - billing system management - service management - security management
Access Environment	
NGN Integrated Access Devices (NGN-AD)	T2, T4, T3, T5, T15, T14
Media gateway for Legacy Terminal Equipment (GW-LTE)	T1, T2, T3, T4, T5

Architecture of model network



Service testing

"NGN and Broadband, Opportunities and Challenges"
Cairo, Egypt, 13 to 15 December 2010

The relevance of service's standards development (01)

The global problems of service realization

- ✓ Each vendor to realize service base on the functional and technological features of self equipment
- ✓ The similar services to realize on the exist ISP networks by different equipment and different network solutions (for instance – voice: TDM, SSW, IMS, ISP, PS and etc.)
- ✓ Lack of complete service realization in "end to end" scenarios trough the different ISP (roaming of services unavailable)

The relevance of service's standards development (01)

The typical problems of ISP for realizing new services

- ✓ The new technology to form new classes of services which change the typical operation and business process in accordance with achieve the new characteristics and type of parameters of new services based on the new technology
- ✓ The new characteristics require to develop special requirements for quality parameters and network performance which have to be include to SLA and have to be control via providing

International Telecommunication Union
"NGN and Broadband, Opportunities and Challenges"
Cairo, Egypt, 13 to 15 December 2010

General and functional targets of the services conformance testing*

General targets

- Running testbed for network, operation and IT components
- Safeguarding of vendor selection
- Compression of short list
- Analysis of investment and production costs for the offered components

Functional targets

- Compatibility of the call-control with the available terminals (for example TOI-Client, Speedport…)
- Interconnection with PSTN/ISDN through MGC/MG
- Compliancy to regulatory requirements (LI, emergency call)
- End-to-end quality assessment from the customer view
- Proof of general component interoperability in a multivendor environment

The existing international standards for services

- **ITU-T (general principles for services)**
  Y.2006 Description of capability set 1 of NGN release 1
  Y.2007 NGN capability set 2
  F.7xx multimedia service requirements

- **ETSI (requirements for protocol implementation)**
  SIP/ ISUP Interworking conformance Tests (based on the EN 383 001/Q.1912.5) (TSS&TP, PICS, ETS)
  OIP/OIR Conformance Tests (TSS&TP, PICS, ETS) Rel.1
  TIP/TIR Conformance Tests (TSS&TP, PICS, ETS) Rel.1
  HOLD Conformance Tests (TSS&TP, PICS, ETS)
  MCID (TSS&TP and PICS)
  SUB (TSS&TP and PICS)
  ACR-CB (TSS&TP and PICS)
  CUG (TSS&TP and PICS)

Supplementary services mostly

The instance of service standards «Terminating Identification Presentation (TIP) and Terminating Identification Restriction (TIR)» ETSI TS 186 005

- ✓ **PICS** – the set of function to be tested for service (ETSI TS 186 005 01)
- ✓ **TSS/TP** – the list of tests for service functionality testing and common parameters (ETSI TS 186 005 02)
- ✓ **ATS/PIXIT** – the approach of testing, testing scheme, automatic scripts for realizing testing procedure (ETSI TS 186 005 03)

The set of function to be tested for service (ETSI TS 186 005 01 - PICS)

TIP/TIR user capabilities

Table 2: TIP/TIR user capabilities

Item description	Reference	Status	Support
Does the originating user subscribe the TIP service?	4.3.1.1/ [10]	o	
Does the terminating user subscribe the TIR service in permanent mode?	4.3.1.2/ [10]	o	
Does the terminating user subscribe the TIR service in temporary mode with default value "presentation not restricted"?	4.3.1.2/ [10]	o	
Does the terminating user subscribe the TIR service in temporary mode with default value "presentation restricted"?	4.3.1.2/ [10]	o	
Does the originating user subscribe the override category for the TIR service?	4.6.3/ [10]	o	
Does the user equipment supports the "from-change" tag in the Supported header?	4.5.2.12 [10]	o	
[2/6] Does the terminating user equipment send an UPDATE request if a "from-change" tag was received in the initial INVITE?	4.5.2.12 [10]	o	
The terminating user subscribes "special arrangement"?	4.5.2.9 [10]	o	

The list of tests for service functionality testing and common parameters (ETSI TS 186 005 02 - PICS)

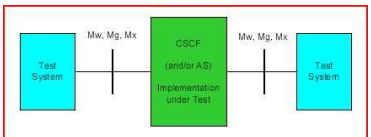


Figure 3: Applicable interfaces for tests using a (generic) NNI interface

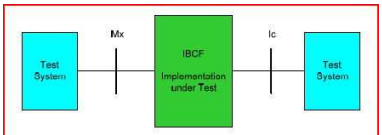


Figure 5: Applicable configuration to test IBCF functionalities

TSS User/TermUserE	TP TIP_U01_002	TIP/TIR reference 4.5.2.12	Selection expression PICS 2/6, 1/2, 2/7
Test purpose: *The Terminating UE sends an UPDATE request with an updated From and To header.* Ensure that the Terminating UE supports the "from-change" tag in the Supported header. If the UE receives a "from-change" tag in a Supported header in an initial INVITE, the user equipment sends an UPDATE request after the ACK for the 200 OK INVITE was received containing a connected identity in the From header.			
SIP messages: INVITE: Supported: from-change 18x/200: Supported: from-change UPDATE: From <identity user equipment>			
Comments: **Test equipment**		**User equipment**	
INVITE with "from-change" tag	→		
180 Ringing	←		
200 OK INVITE	←		
ACK	→		
UPDATE with updated From and To header	←		
200 OK UPDATE	→		

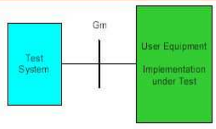


Figure 4: Applicable configuration to test UE functionalities

The approach of testing, testing scheme, automatic scripts for realizing testing procedure (ETSI TS 186 005 03)

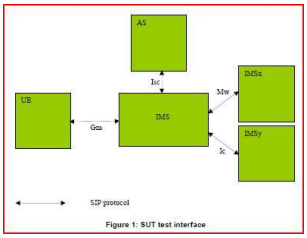


Figure 1: SUT test interface

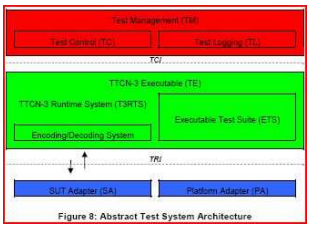


Figure 8: Abstract Test System Architecture

Table 3: Library of modules

Module Class	Module Id	Description
AtsCommon	SS_Ims_PICS	Module Parameter declarations associated with PICS
	SS_Ims_PIXITS	SIP common Module Parameter declarations associated with PIXIT
	SS_Ims_TestConfiguration	Functions which implement the configuration of the SUT adapter and mapping of test components for establishing and tearing down different test configurations
	SS_Ims_TestSystem	TSI components, test system internal ports
	SS_Ims_TestCases	Test case definitions
	SS_Ims_TCFunctions	Test case functions
LibIms	LibIms_PIXITS	IMS specific common Module Parameter (e.g. addresses related to SUT components and TS) declarations associated with PIXIT
	LibIms_Interface	IMS component
	LibIms_SIPTypesAndValues	IMS specific user and interface specific profile data (see note)
	LibIms_Templates	Modified templates with IMS specific header fields
	LibIms_Steps	functions using IMS specific types
LibSip	LibSip_PIXITS	SIP general common Module Parameter (e.g. SDP/SIP procedure options) declarations associated with PIXIT
	LibSip_Interface	SIP component
	LibSip_SIPTypesAndValues	SIP message types and constants, simple user profiles (see note)
	LibSip_SDPTypes	SDP types and constants
	LibSip_Templates	Basic and modified templates with SIP specific header fields
	LibSip_Steps	SIP specific behaviour function library
	LibSip_XMLTypes	XML types for SIP tests
	XSDAUX	Basic types used in XML
LibCommon	LibCommon_AbstractData	Generic data types for a stack and its operations
	LibCommon_BasicTypesAndValues	Basic type and value definitions (integer and Boolean)
	LibCommon_DataStrings	Bit and Octet string types
	LibCommon_Sync	Co-ordination/synchronization of test components
	LibCommon_TextStrings	Basic character and string types with fixed length
	LibCommon_Time	Time handling functions and module parameter
	LibCommon_VerdictControl	Basic functions for setting of test component verdicts
NOTE:	In order to build a comprehensive library all SIP message header (incl. IMS specific) have been defined in LibSip_SIPTypesAndValues only.	

The scenarios of services standardization

- **International standardization ITU-T**

  SG13 Q.14/13 "Service scenarios and deployment models of NGN"

  SG11 WP 4/11 Q.10/11 "Service test specification for NGN"

- **EU ETSI TISPAN WG6**

  Produces manual and automatic test suites to ensure the conformance to TISPAN, 3GPP and ITU standardized protocols. These tests ensure the global interoperability of ISDN, PES and IMS Core NGN R1/R2, QoS between networks and Performance Benchmarking for NGN.

- **Corporate standards (ISP standards)**

  Additional requirements for equipment, protocols and solutions to service delivery

The instance of service standards «Terminating Identification Presentation (TIP) and Terminating Identification Restriction (TIR)»

Y.2211 Next Generation Networks – Service aspects: Service capabilities and service architecture. IMS based real-time conversational multimedia services over NGN

9.6 Terminating identification presentation (TIP)

9.6.1 Description

The TIP simulation service provides the originating party with the asserted identification information of the terminating party.

9.6.2 TIP service interactions with other ISDN/PSTN simulation services (NGN)

Terminating identification restriction (TIR): TIR shall have precedence over TIP.

Communication DIVersion (CDIV): if forwarding party B chooses to restrict the presentation of the forwarded-to party, i.e., C's identification information, the originating party A does not receive the terminating party C's identification information irrespective of whether the terminating party C has TIR activated or not.

9.6.3 TIP interoperability with PSTN/ISDN networks

The NGN supports the interoperability of the TIP services with the PSTN/ISDN supplementary service COLP and vice-versa. The scope of this interworking may result in a limited service capability.

9.7 Terminating identification restriction (TIR)

9.7.1 Description

The terminating identification restriction (TIR) enables the terminating party to withhold presentation of its asserted identification information to the originating party.

NOTE: The requirements for support of emergency telecommunications may over-ride the user request for suppression.

9.7.2 TIR service interactions with other PSTN/ISDN simulation services

Terminating identification presentation (TIP): TIR shall have precedence over TIP.

9.7.3 TIR interoperability with PSTN/ISDN networks

The NGN supports the interoperability of the TIR services with PSTN/ISDN supplementary service COLR and vice-versa. The scope of this interworking may result in a limited service capability.

In case of limited interoperability, TIR/COLR shall have precedence over TIP/COLP.

Basic requirements to services

Future ITU-T approach of service standardization

Q.14/13

Q.10/11

The structure of ITU-T standard for service

- **Service definition** and it compatibility
- **Network structure** and network elements (equipment, FE) and performance requirements for realizing the service
- **Access network requirements** including AP and TE
- **Service delivery scenarios**
- **Call flows** requirements
- **Protocol requirements** for realizing service (etalon points)

The instance of service which is could be realized via service roaming

UPT – mobility service which to allow customer to connect via different access network (different operators networks) to the traditional set of services which is available on home network

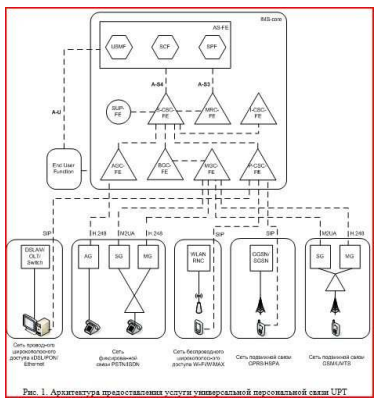


Рис. 1. Архитектура предоставления услуги универсальной персональной связи UPT

Рис. 2. Диаграмма установления сеанса связи при сценарии параллельного вызова

Рис. 4. Диаграмма установления сеанса связи при сценарии с проигрыванием персональной мелодии контроля посылки вызова

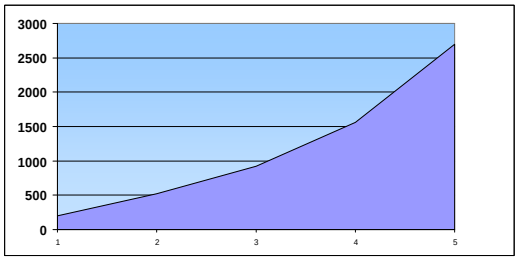
The service testing approaches

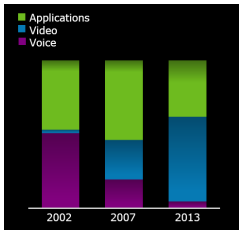
- Protocol and call flow testing under simulator based on TTCN-3
- Functional testing ("end-to-end")
- Emulation critical parameters of networks for determine require parameter of quality for service (benchmarking testing)
- Testing procedure of control QoS on the network for this service
- Testing interaction with ISP network systems for providing this service:
  - Billing system
  - Statistic system
  - OSS/BSS and control system

QoS and NP testing

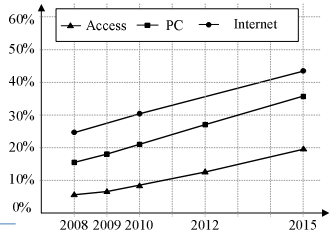
Forecast in telecommunication

The total performance of transit IP-networks





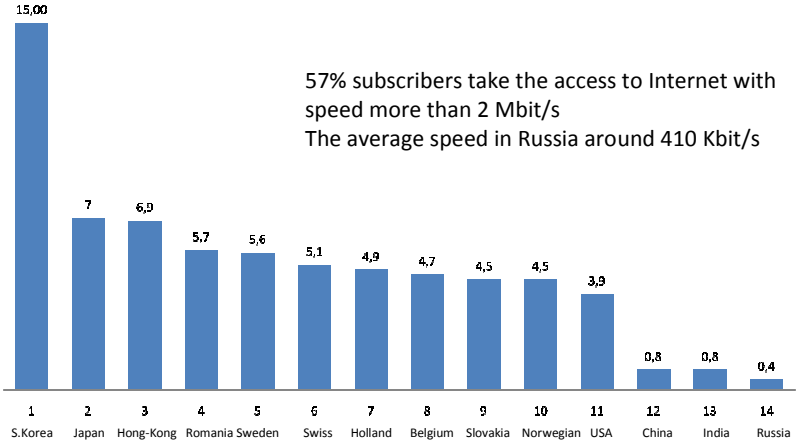
The level BBA in Russia



In the near feature all of operators will have a problem of accessible broadband on transit and access networks which will be conducted with technology lag and traffic raising

World trends on Broadband development (access to Internet)

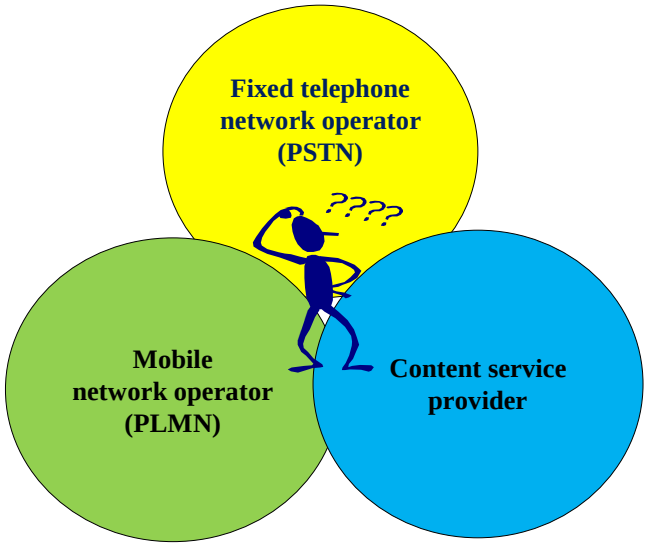
Access Internet (Mbit/s) December 2008



57% subscribers take the access to Internet with speed more than 2 Mbit/s
The average speed in Russia around 410 Kbit/s

Akamai report

Whom will this customer be belong?



Definition

- **Quality of service (QoS)** - Totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service
- **QoS experienced/perceived by customer/user (QoSE)** - A statement expressing the level of quality that customers/users believe they have experienced
- **Network performance (NP)** - The ability of a network or network portion to provide the functions related to communications between users

(Rec. ITU-T E.800)

Customer's requirements to QoS

From the customer's point of view, quality of service is expressed by parameters, which:

- ✓ focus on user-perceived effects, rather than their causes within the network
- ✓ do not depend, in their definition, on assumptions about the internal design of the network
- ✓ take into account all aspects of the service from the customer's point of view
- ✓ may be assured to a user by the service providers, sometimes in contractual terms
- ✓ are described in network-independent terms and create a common language understandable by both the user and the service provider

Common ITU-T Recs. on QoS

Rec. E.800 Terms and definitions related to quality of service and network performance including dependability

Rec. G.1000 Communications quality of service: A framework and definitions

Rec. G.1010 End-user multimedia QoS categories

Rec. I.350 General aspects of quality of service and network performance in digital networks, including ISDNs

Rec. I.356 B-ISDN ATM layer cell transfer performance

Rec. X.800 Security Architecture for Open Systems Interconnection for CCITT applications

Rec. X.805 Security Architecture for systems providing end-to-end communications

Rec.Y.1540 Internet protocol data communication service - IP packet transfer and availability performance parameters

Rec.Y.1541 Network performance objectives for IP-based services

Rec. Y.1560 Parameters for TCP connection performance in the presence of middleboxes

Rec. Y.1561 Performance and Availability Parameters for MPLS Networks

Rec. Y.2011 General principles and general reference model for NGNs

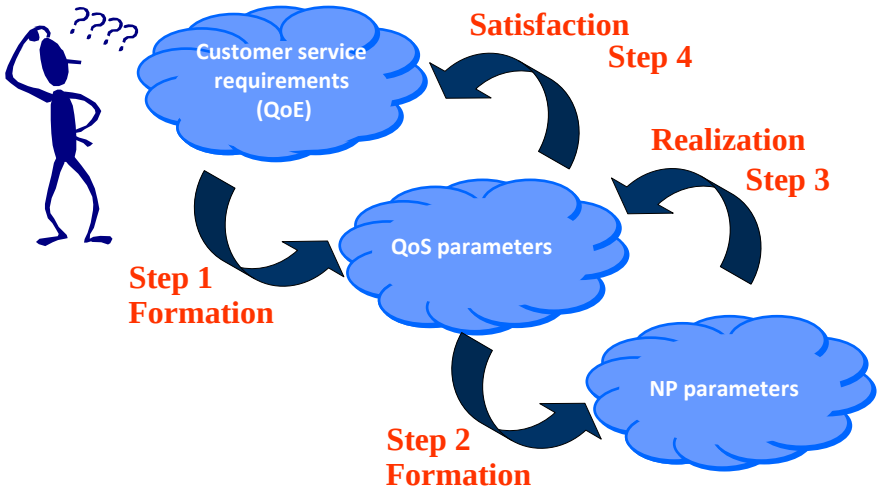
Common ITU-T Recs. on NP

ITU-T Home : Study groups : ITU-T Recommendations : Study Group 12 treeview

General search | Specific search | Treeview search | Roadmap search

- Y1000-Y1999: Internet protocol aspects
- Y1200-Y1299: Architecture, access, network capabilities and resource management
- Y1500-Y1599: Quality of service and network performance
  - Y.1501/G.820/I.351: Relationships among ISDN, IP-based network and physical layer performance Recommendations
  - Y.1530: Call processing performance for voice service in hybrid IP networks
  - Y.1531: SIP-based call processing performance
  - Y.1540: Internet protocol data communication service – IP packet transfer and availability performance parameters
  - Y.1541: Network performance objectives for IP-based services
  - Y.1542: Framework for achieving end-to-end IP performance objectives
  - Y.1543: Measurements in IP networks for inter-domain performance assessment
  - Y.1544: Multicast IP performance parameters
  - Y.1560: Parameters for TCP connection performance in the presence of middleboxes
  - Y.1561: Performance and availability parameters for MPLS networks
  - Y.1562: Framework for higher-layer protocol performance parameters and their measurement
  - Y.1563: Ethernet frame transfer and availability performance

Connectivity of Quality-of-experience, Quality-of-service, Network Performance



IP network QoS class definitions and network performance objectives

Network performance parameter	Nature of network performance objective	QoS Classes					
		Class 0	Class 1	Class 2	Class 3	Class 4	Class 5 Unspecified
IPTD	Upper bound on the mean IPTD (Note 1)	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 (Note 2)	50 ms (Note 3)	50 ms (Note 3)	U	U	U	U
IPLR	Upper bound on the packet loss probability	1×10^{-3} (Note 4)	1×10^{-3} (Note 4)	1×10^{-3}	1×10^{-3}	1×10^{-3}	U
IPER	Upper bound	1×10^{-4} (Note 5)					U

Y.1541 ITU-T (2006)

Methods of service quality measurements

Type of media	Subjective parameter	Intrusive monitoring	None-Intrusive monitoring	Network planning
Voice	One -way (Listening quality)	P.862/P.862.1 (Telephone-band) P.862.2/P/862.3 (Wideband)	P.563, P.564 (Telephone-band)	
	Two -way (Conversational quality)	P.CQO (Telephone-band)		G.107 (Telephone-band) G.WBEM (Wideband)
Audio	One -way (Listening quality)	BS.1387 -1		
Video	One -way (Viewing quality)	J.144 (Cable TV) J.247 (Multimedia)	?.YYY (Cable TV) ?.ZZZ (Multimedia)	
Voice/Audio and video	One –way Two -way	J.148 (Multimedia)		G.OMVAS (Videophone)
Data	One -way	G.Chirp (Web -browsing)		G.1030 Annex A (Web -browsing)

Approach of guarantee QoS parameters

1. More resource allocation, taking broadband more than require for traffic transit
2. Resource reservation, offer by customer requirement QoS and reservation it for customer traffic for complete call scenariou for requested quality level
3. Traffic prioritization and profiling, traffic shaping for different classes with different prioritization of serving and dropping
4. Load forwarding, traffic redirection on reserve route in real time in case overload common route
5. Route optimization dependent on QoS
6. Integration analyze facilities for traffic control (TE)

Future research development on QoS and NP control model

The alternative complex system of network resource control for support guarantee QoS during migration to NGN with conception "All over IP" is required*

*The Article Elctorsvyaz, Russia, Andreev, D. Shalaginov. V "**RESEARCHING OF NETWORK RESOURCE CONTROL SYSTEM FOR DELIVERING QOS OF INFOCOMMUNICATION SERVICES IN NGN**", 2009

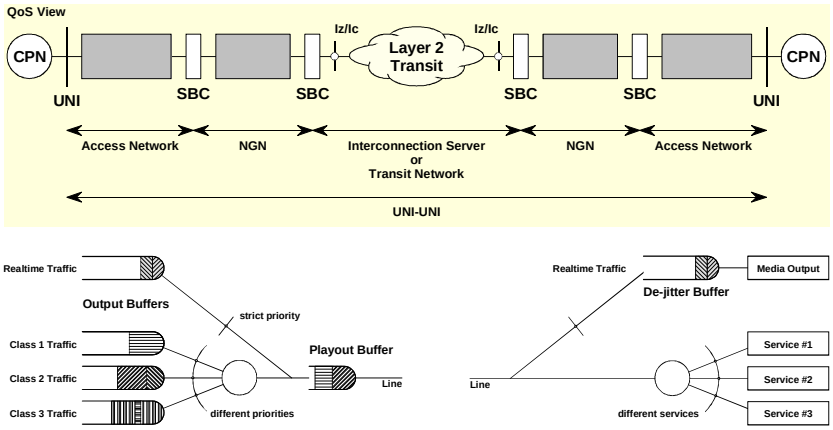
Benchmarking Purpose

The exist operator network technical audit for real maximum NP parameters determination for supporting QoS parameters in case of overload (BHCA)

Common parameters of NP

- ✓ Bandwidth (BW)
- ✓ Codec
- ✓ VAD (Voice Active Detection)
- ✓ Echo cancellation (ITU-T G.168)
- ✓ De-jitter buffer
- ✓ Routing and traffic prioritization
- ✓ Packetization time & packet formation time

de-jitter buffer – one of common NP parameter



QoE

QoE (Quality of expierence)

- ✓ Network Effectiveness Ratio (NER)
- ✓ Service providing latency (Latency)
- ✓ Service quality providing (MOS/R-фактор)

Satisfaction level

R Value	MOS CQEN Value	Categories of User Satisfaction
94	4,42	Very satisfied (Best)
93	4,40	
92	4,38	
91	4,36	
90	4,34	
87	4,195	Satisfied (High)
85	4,18	
82	4,09	
81	4,06	
80	4,03	Some users dissatisfied (Medium)
77	3,85	
73	3,74	
70	3,60	
68	3,50	Many users dissatisfied (Low)
60	3,10	
50	2,58	Nearly all users dissatisfied (Poor)

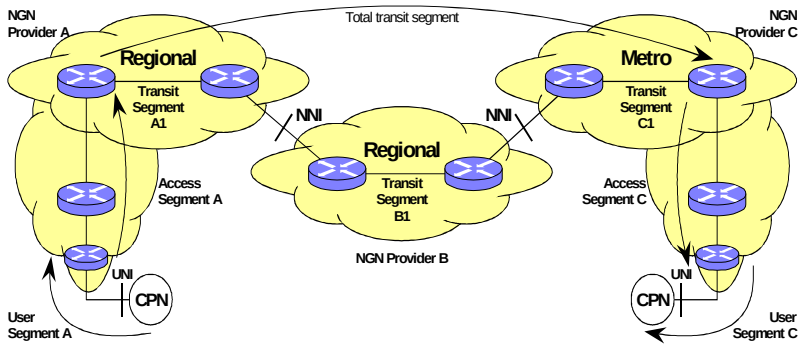
MOS = 1 + (0,035) × R + (000 007) × R (R - 60) (100 - R)

NOTE 1: Connections with R-values below 50 are not recommended.
NOTE 2: Although the trend in transmission planning is to use R-values, equations to convert R-values into other metrics e.g. MOS, % GoB, % PoW, can be found in ITU-T Recommendation G.107 [i.4], annex B.

Correlation QoE, NP and QoS

QoE parameters	Value	Fix. QoS и NP value	Variable QoS и NP value	Measurement value
Network Effectiveness Ratio (NER)	Satisfied calls to total calls	IPTD; IPDV; IPLR; IPER.	Bandwidth (maximum)	SAPS (session availability per second)
Service providing latency (latency)	Maximum value of signaling timer	Bandwidth, SAPS	IPTD; IPDV; IPLR; IPER.	Timer value
MOS (R-factor)	MOS (R-фактор), not less than 4,06 (81)	Bandwidth; SAPS	1. Service features: Codecs; VAD; G.168; Packetization time. 2. Equipment parameters: De-jitter buffer 3. Network parameters: IPTD; IPDV; IPLR; IPER.	MOS (R-фактор)

Model network
ETSI TR 102 717 V1.1.1

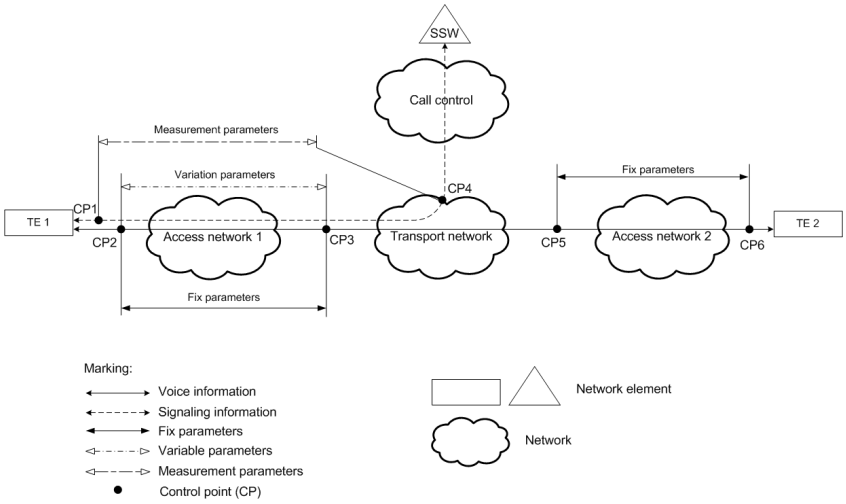


- ✓ User segment A/C
- ✓ UNI A/C - sending/receiving side
- ✓ Access segment A/C
- ✓ Segment-connection Point
- ✓ Total transit segment

Instance of table where the NP parameters are determine on the different network segment

№	Service title	QoE parameter	NP value for different network segment			Signaling segment (Access – Call control)	Network segment for voice transfer (access – transport – access)
			A1	T	A2		
1	Услуга VoIP	Network Effectiveness Ratio (NER)	BW IPTD, IPDV, IPLR, IPER = const	-	BW (IPTD, IPDV, IPLR, IPER = const	+	-
		Service providing latency (latency)	IPTD, IPDV, IPLR, IPER BW, NER= const	-	IPTD, IPDV, IPLR, IPER BW, NER= const	+	-
		MOS (R-factor)	IPTD, IPDV, IPLR, IPER De-jitter buffer MOS=const BW=const			-	+

Common scheme for determination the limit of set NP value



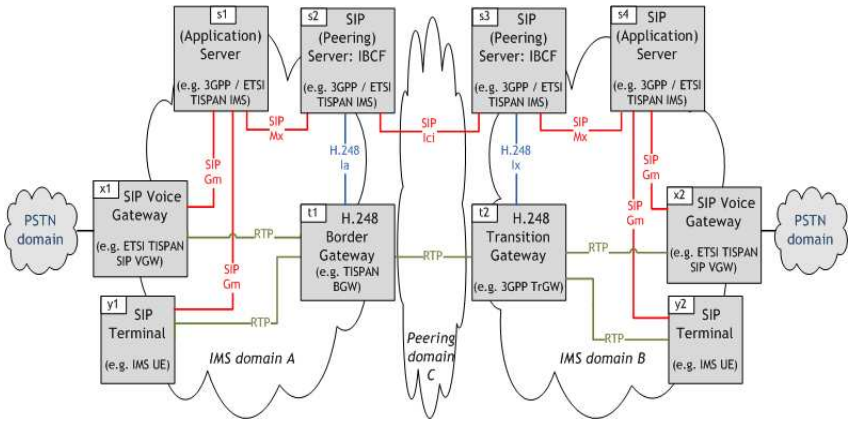
Instance of service QoS testing (ETSI STF392)

Perceptual Impact of End-to-End Delay and End-to-End Delay Variation on Fax-over-IP (FoIP) and Modem-over-IP (MoIP)

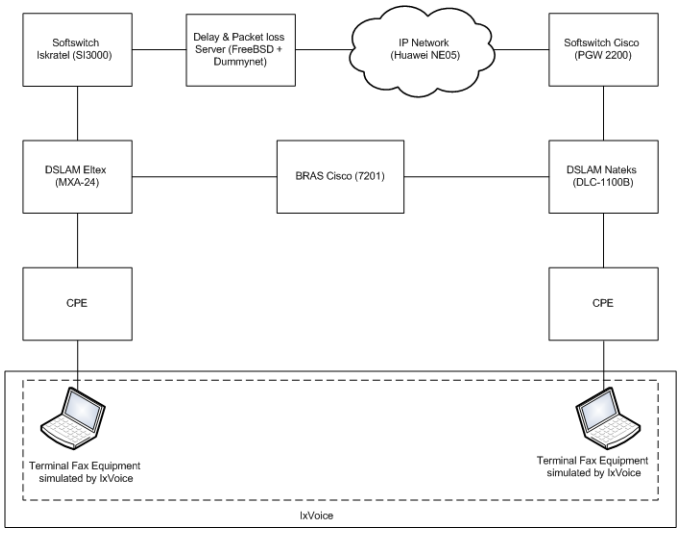
ME: IXIA 400T chassis for Fax-over-IP simulation

Purpose: Emphasis is on the modem/facsimile transmission using different codecs and media gateways and gateways in order to determine the margins of the media gateways and gateway parameters that enable a successful and reliable real-time modem/facsimile transfer over packet-based networks.

The common scheme of ETSI STF392 FoIP scheme

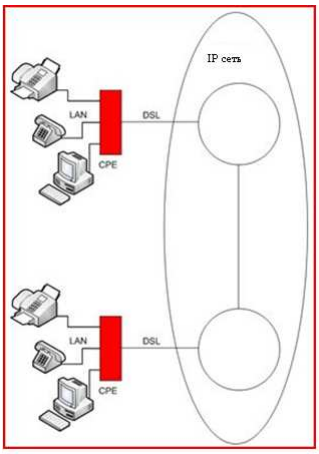


FoIP testing scheme on the ZNIIS Model network



Testing Methods

F_T38_T38_XX	
TSS reference:	**T.38 [i8]_T.38 [i8] FAX G3 Tests**
Preconditions	Bit rate for uplink (side A): **DSL_UP_Rate_A** Bit rate for downlink (side A): **DSL_DOWN_Rate_A** Bit rate for uplink (side B): **DSL_UP_Rate_B** Bit rate for downlink (side B): **DSL_DOWN_Rate_B** T.38 [i8] version (side A): Edition 4 (2005) T.38 [i8] version (side B): Edition 4 (2005) Jitter Buffer Type/Size (side A): **JITTER_BUFF_T_S_A** Jitter Buffer Type/Size (side B): **JITTER_BUFF_T_S_B** Packet Formation Time: 20ms Number of Variation-sensitive channels - Voice (side A): **VA_Channel_Voice_A** Number of Variation-sensitive channels - Data (side A): **VA_Channel_Data_A** Variable for Codecs for Voice: **Codec_Voice_VA** Number of Variation-sensitive channels - Voice (side B): No channel Number of Variation-sensitive channels - Data (side B): No channel Variation-insensitive packet traffic uplink (side A): **VA_Insens_Data_UL_A** Variation-insensitive packet traffic uplink (side B): **VA_Insens_Data_UL_B** Variation-insensitive packet traffic downlink (side A): **VA_Insens_Data_DL_A** Variation-insensitive packet traffic downlink (side B): **VA_Insens_Data_DL_B** Jitter Core: 0 ms End-to-End delay Core: 0 ms Modem Type: V.17 [i12], 14.4 kbit/s FAX Error correction: Redundancy 1
Comments:	



FoIP testing results

Parameters measured for different network segment with different test cases

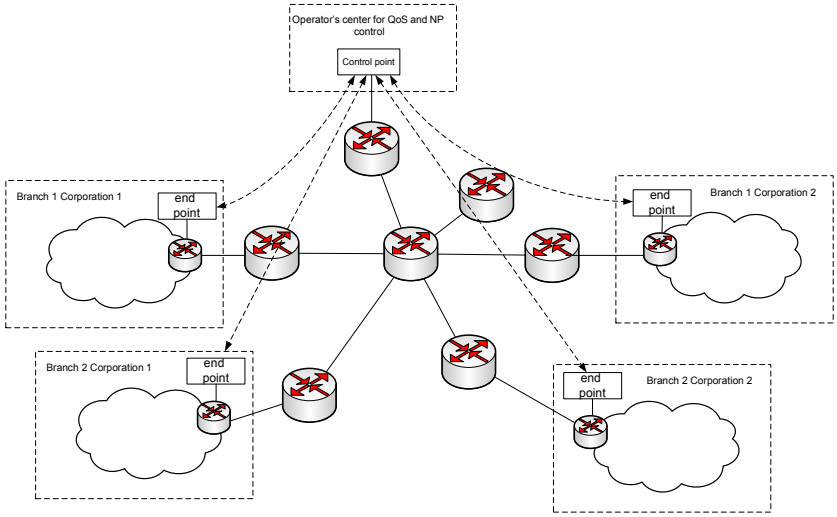
- Delay
- Delay variation
- FOM (Figure of Merrit)
- ECM errored frames
- Total transmission time
- Variances if more than one test run has been achieved for the individual test case
- Duration of transmission of test page in seconds
- Visual inspection of received page for visible errors and missing information.
- In cases with additional voice channels, record the listening quality according to ITU-T P.862.1

QoS monitoring system

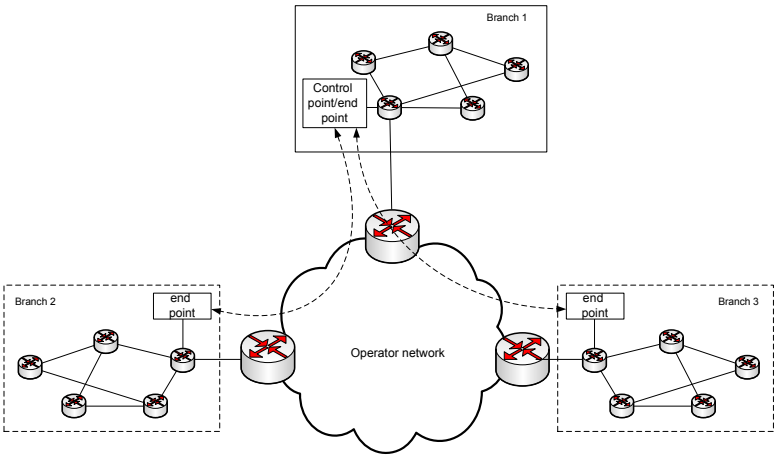
Purpose: SLA implementation control

Task: compare determined NP parameters with parameters included to SLA for supporting requirement QoS parameters

QoS monitoring system architecture for network operator



QoS monitoring system architecture for corporative customer



The set of parameters which under control and monitoring

NP:
Bandwidth (BW)
Codec
VAD (Voice Active Detection)
Echo cancellation (ITU-T G.168)
De-jitter buffer
Packetization time & packet formation time

QoS:
time of call establish
service quality (MOS/R-фактор)
Y.1541 (IPTD, IPDV, IPLR, IPER)

QoE calculation

Параметры качества услуги:
Network Effectiveness Ratio (NER)
Quality of expierience (QoE)
Service availability (SA)

Compare of calculated QoE and values pointed in SLA

SLA

The typical formula for SA calculating

***Service* availability (*SA*)** :

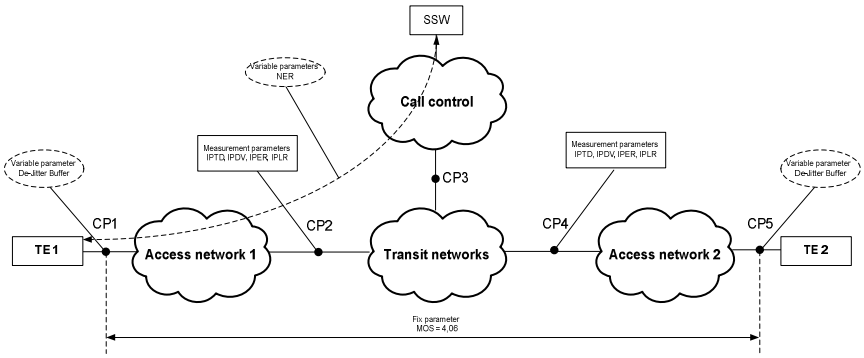
SA%=100-SUA%,

where *SUA* – **Service Unavailability**:

$$SUA\% = \frac{\sum_{k=1}^{K}\sum_{n=1}^{N} t_d(n) \times SDF_k}{T}$$

- T – time period for QoS measurement (min);
- td(n) – stable time period "n" (the service does not available) or service provided with less quality,
- N – the mount of stable time period (min);
- *SDFk* – **Service Degradation Factor**, which characterized SA with less quality
- *k* – the mount of factors determined SA (for instance NER, Latency, MOS) SDF_k is the value which characterized grade of dependent factors on SA and to determine with network operator agreement

The instance of NP measurement for calculating SA



Compensation instance

Class of quality for service	$SA_{VPN\ L2}$	$SA_{VPN\ L3}$
Platinum	> 99,95%	> 99,95%
Gold	> 99,6%	> 99,6%
Silver	> 97%	> 97%
-	-	-

	SA VPN L2	SA VPN L3	Compensation (% of month payment)
Platinum	99,86% - 99,95%	99,86% - 99,95%	1%
	99,79% - 99,86%	99,79% - 99,86%	2%
	99,72% - 99,79%	99,72% - 99,79%	5%
	99,6% - 99,72%	99,6% - 99,72%	10%
	<90%	<90%	100%
Gold	99,44% - 99,6%	99,44% - 99,6%	1%
	99,37% - 99,44%	99,37% - 99,44%	2%
	99,3% - 99,37%	99,3% - 99,37%	5%
	99,16% - 99,3%	99,16% - 99,3%	10%
	<80%	<80%	100%
Silver	90% - 98%	90% - 98%	5%
	80% - 90%	75% - 90%	10%
	<50%	<50%	100%
-	-	-	-

The typical methods of NP monitoring

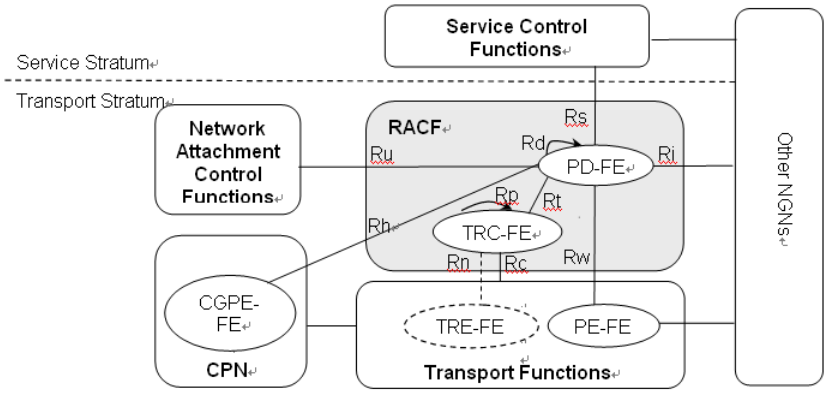
- ✓ **Channel performance analyze under overload by requirement type of services with determined QoS (Mode 1)**
- ✓ **The QoS parameters determination on existing channel under overload (Mode 2)**

RACF

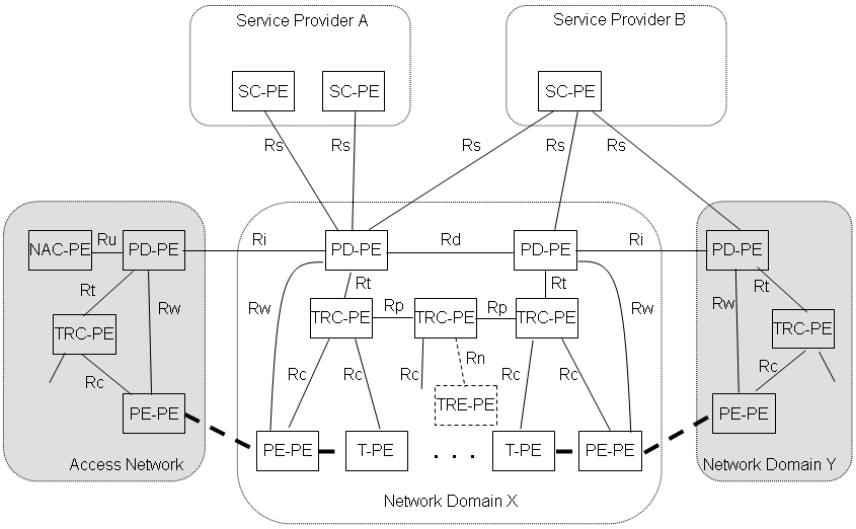
RACF (Resource and Admission Control Functions) can provide guaranteed QoS for services in NGN

- Application-driven (network-independent) real-time control
- Management of transport resources within networks (access or core) and at network boundaries
- Policy-based authorization and allocation of resources supporting
- Dynamic control of NAPTs, firewalls and NAT traversal

RACF architecture



RACF example of technical realization



ITU-T standardization RACF

Interface	Supporting Entities	Protocol Base (Note)	Rec. No.	Status
Rs	SC-PE, PD-PE	Diameter	Q.3301.1	Published
Rp	Between TRC-PE	RCIP	Q.3302.1	Published
Rw	PD-PE, PE-PE	Introduction	Q.3303.0	Published
		COPS-PR	Q.3303.1	Published
		H.248	Q.3303.2	Published
		Diameter	Q.3303.3	Published
Rc	TRC-PE, T-PE	COPS-PR	Q.3304.1	Published
		SNMP	Q.3304.2	Published
Rt	PD-PE, TRC-PE	Diameter	Q.3305.1	Published
Rd	PD-PE to PD-PE (intra-domain)	Diameter	Q.3306.1	Published
Ri	PD-PE to PD-PE (inter-domain)	Diameter	Q.3307.1	Published
Q.QCP	QoS Coordination Protocol	RSVP	Q.3309	Published
Rn	TRC-PE, TRE-PE	Interface is for further study	--	--

The ZNIIS experience on QoS and NP testing

- ✓ International projects for services and limit values of NP testing (ETSI STF 392, STF 394)
- ✓ The CIS model network benchmarking under joint ITU-D-ZNIIS project on creation International Telecommunication Testing Center (ITTC)
- ✓ Combined solution for creation NP and QoS monitoring system IXIA-ZNIIS

The approach of realization system on monitoring and supporting quality of service and QoS parameters on operators network

1. The quality of service parameters determination
2. The set of network performance parameters determination
3. Correlation of network performance and QoS parameters for different services
4. The limit values of network performance parameters determination for supporting require QoS and QoE parameters
5. The network performance parameters monitoring on the existing network and comparing with determined limit values
6. The requirements creation of traffic control for different services for integration it to RACF/RACS based on determined values of NP
7. SLA control

Conclusions

- ✓ Model network is the best solution for realization and approbation different testing cases. It could be used for all type of test (conformance, interoperability, services, QoS and NP)
- ✓ Services in NGN should be tested for conformance to solve interoperability issues
- ✓ To control QoS level it should be tested and rated
- ✓ The approach for determination of limit value of NP and QoS for QoE for different service on the existing operators networks will help support requirement parameters for live conditions
- ✓ RACF systems should be tested for protocol conformance and could be as global system for not only monitoring – for supporting QoE, QoS and NP.

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