EURESCOM

Technical [Information | Specification]

P1103

Inter-Operator IP QoS Framework - ToIP and UMTS Case Studies

Technical Information 1 - Annex A

Criteria tables for the reviewed frameworks

Editor: Irena Grgic, Telenor Communication AS; Chris Hatch, British Telecommunications plc

Suggested readers

Experts involved in the management system development, QoS provisioning, and SLA negotiation; Researchers interested in the area of management and QoS assurance in IP-based networks

Abstract

The P1008 findings cover the negotiation process between interconnected IP network domains, as well as the reference architecture for supporting IP QoS management services. The results of P1008 build a basis for developing an Inter-operator IP QoS Provisioning Framework (IIQPF). The critical review of the existing work done by other fora (e.g. ITU-T, IETF, ETSI, 3GPP, TMF, IST projects, etc.) is needed in order to figure out the state-of art in this area, and to gain knowledge to compare these results with P1008 findings.

This document covers the description of the existing frameworks chosen as relevant for the IIQPF. The descriptions are a result of reviewing process and are presented in the form of criteria tables. This form enables harmonised way of giving a brief overview of the frameworks studied. It is an additional information (annex) to the P1103 TI1 " Review of existing IP QoS activities and extension of P1008 findings ".

Project P1103

For full publication

June 2001

EURESCOM PARTICIPANTS in Project P1103 are:

- British Telecommunications plc (BT)
- MÁTAV Hungarian Telecommunications Company Ltd. (HT)
- Telecom Italia S.p.A. (IT)
- Telenor Communication AS (NT)
- *e*ircom (TI)

Inter-Operator IP QoS Framework – ToIP and UMTS Case Studies

Review of existing IP QoS activities and extension of P1008 findings

Editors: Irena Grgic, Telenor Communication AS; Chris Hatch, British Telecommunications plc

Project leader: Niamh Quinn, eircom plc

Project supervisor: Valerie Blavette, EURESCOM GmbH

EURESCOM published project result; EDIN 0267-1103

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List of Authors

BT Chris Hatch
Dave Milham
HT Gizella Kovács
NT Mette Røhne
Terje Jensen
Thor Gunnar Eskedal
Irena Grgić
TI Denis McCarthy
Stuart Hughes
Niamh Quinn

History of the document:

Version	Date	Author	Comment
0.1	17-Jul-2001	Irena, NT	1st draft, "glued" the material cut from the main body of Technical Information (TI) 1, originally collected in the Task 2 of P1103

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1 Introduction

In order to make a systematic review of frameworks during the Step 1 of the approach for reviewing and comparison of the existing frameworks towards Inter-operator IP QoS Provision framework (IIQPF) (as explained in [P1103-ti1]), a set of criteria has to be defined. Note that the term *criterion* is used here in a meaning similar to *issue/topic*. Hence, giving the set of criteria results in a template to be used for describing the frameworks. Then, each of the frameworks can be described covering the issues given by those criteria. It is important to note that the criteria may differ from the requirements that the IIQP should fulfil. Moreover, the criteria do commonly allow for multiple "values" as explained in the next chapter.

This annex includes the criteria list template filled in for all frameworks reviewed in Chapter 4 of [P1103-ti1]. Summarising, the criteria list is basically a systematic way of reviewing a framework and concise way to summarise the information presented in a brief overview of each of the frameworks given in Chapter 4.

2 Criteria list

Before giving a set of criteria chosen for the description of the documents relevant for IIQPF, an example of associating a criterion and its value is given in the following:

Say that a criterion refers to which types of network a framework has been defined for. Some possible "values" for this criterion may be PSTN, ISDN, GSM, SDH, IP and ATM. A certain framework, only defined for an ATM-based network would then list only ATM as the "value" of that criterion. Another framework defined for PSTN/ISDN would then list this combination as the "value" of that criterion. Then, a corresponding requirement may be that the framework has to be applicable for an IP-based network.

The list of the criteria chosen for the assessing existing frameworks relevant for P1103 IIQPF is given in the following:

- **Services**: Which services have the framework been intended for? Examples of values for this criterion are ⇒ telephony, IP-based transport, SDH-based transport, generic[1] (any service), not specified, etc.
- **Service scope - horizontal/segments**: Which domain of network is considered? Typical values for this criterion are ⇒ end-to-end, access network portion, core network portion, generic (any portion).
- **Service scope – vertical/layers**: Which layer is considered? Examples of values are ⇒ user data transfer, management functions, charging/billing functions, generic (any stratum).
- **"Agreement" procedures**: What level of detail is described in the agreements and what aspects of the agreement are included? This criterion considers both the business and technical type of agreements, e.g. SLA for business and SLS/TCS for technical aspects. Also, aspects of both negotiating the agreement and the SLA type/content "template" are included. Examples may be ⇒ agreements not considered, agreements only for traffic contract parameters, verifiable conditions in the agreement (e.g. SLA assurance), SLA negotiation, etc.
- **Parameter detail**: To what level of detail are agreements parameters described (if given for the framework)? Does it cover the reference points identification for parameters? Does it cover the mapping/aggregation/correlation of the parameters? Examples of values can be ⇒ overall/generic description, description according to Y.1540/1541, description according to IETF's IPPM framework, etc.
- **Networks/technology**: Which networks/technologies has the framework been elaborated for? Examples of values are ⇒ ISDN, PSTN, GSM network, IP-based network, IP diffserv- based, IP intserv-based, PDH-based network, generic (any network), hybrid networks, DWDM networks, etc.
- **Life cycle phase**: Which phases of the service life cycle are considered in the framework (if any)? Does it describe the processes involved in a phase? As there are several ways of categorising life cycle phases, a suitable one has to be chosen. Examples of values are ⇒ service creation, service activation, service operation, and service closure, generic (any phase).
- **Abstraction level**: Which perspectives have been applied for describing the framework? One way of identifying perspectives is to use the ODP categorisation, e.g. informational, etc. Level of automation, detail of messages, information model, and so forth can also be included. Hence, this criterion goes on what level of detail is considered in the framework and how close to implementation it is. Examples of values are ⇒ informational model, specification, etc.
- **Roles/actor types**: In case business roles are identified in the framework, which roles are described? Does it describe the relationships between roles identified/addressed? Does it describe correlating the roles and actors? Does it cover single/multi-provider aspects?

Examples of roles are ⇒ user, customer, network operator, service provider, generic (any role).

- **Environment/other frameworks**: Some frameworks may discuss its position related to other frameworks that have been presented. This implies that a framework may contain references to other frameworks as well as relating itself to other frameworks, e.g. being on a more abstract level, applying principles of certain frameworks, etc. Any specific concerns given for regulatory aspects should also be mentioned. Examples of values are ⇒ conformant with ITU-T E.800, adapts IETF RTFM, etc.

3 Reviewing results

The reviewing results for the frameworks described in [P1103-t1] and considered when enhancing P1008 results towards the IIQPF are presented in this chapter. The documents reviewed include:

- Current P1108 results - [P1008-d3-TI], [P1008-d3-TS], [P1008-d1], [P1008-d2]
- TMFs GB910 and GB917 - [GB910], [GB917]
- IETF TE WG - [tewg-qosr], [tewg-frmw], [tewg-diffte]
- EURESCOM P806-GI and P906-GI - [P806-site],[P806-d1], [P806-d4], [P906-site], [P906-d1], [P906-d2], [P906-TI3], [P906-d3], [P906-ti5]
- ITU-T SG13 ICA and IP framework, SG4 and SG7 work - [Y.130], [Y.1001], [Y.800], [Y.1241], [Y.1540], [Y.1541], [Y.1311], [Y.1311.1], [M.3400], [M.3208.1], [M.3208.2], [M.3208.3], [X.171], [Y.1310], [Y.1401], [M.3010], [M.1542]
- ETSI TIPHON - [ETR101300], [ETS101314], [TS101329-3], [TS101329-1] [TS101329-2] [TS101329-5] [TS101329-6] [TS101329-7]
- 3GPP - [23.107], [23.207], [23.060], [23.228]
- Internet 2 QBONE - [qbone-bb], [bb-code]
- Open Group - [og-xx]
- Others - IST projects Tequila, Aquila, Cadenus and AT&T's Policy Arena project - [teqila-sls], [aquila-sls], [cadenus], [at&t].

3.1 Current P1008 findings

Criterion	Description for P1008 results
Services:	IP-based services IP cross-connect service, simple IPVPN and simple VoIP scenarios, Managed Inter-domain IP packet forwarding with guarantees on end-to-end QoS parameters.
Service scope – horizontal/segments:	End-to-end Covers both access and core Multi IP network domains considered
Service scope – vertical/layers:	Description of underlying Transport Layer and Transmission Layer. IP Layer. Dynamic Resource Management, ICA exchange, SD advertisement, SLS order mgt, Traffic Forecast update, SLA assurance.
"Agreement" procedures:	SLA Negotiation Model, Information Model for SLA components,
Parameter detail:	Detailed parameters for SLA components. And examples of SLA/SLS instances with parameters filled in.
Networks/technology:	IP-based network, with Diffserv core network.
Life cycle phase:	The Management functions cover service operation, which includes process Service configuration, Network Management, SLA assurance/management.
Abstraction level:	Information Model of SLA, Message sequences, mapping of Information Model to XML Schema.
Roles/actor types:	Buyer and Seller, Service Customer, Service Customer Client, Service Provider, IP Network Domain Operator.
Environment/other frameworks:	State of the Art review of existing IP QoS frameworks. Based the Information Model on other IETF Internet Drafts Tequila, Aquila etc, Took into account work carried out by ebXML. TMF conformant. IntServ, DiffServ.

3.2 TMF GB910

Criterion	Description for TMF GB910 TOM framework
Services:	Generic Mostly non-specific and intended to relate to all telecom services. Special emphasis on (Applications Notes doc available) for: M.´ IP Services: Global Intranet Access Service * Mobile Services - Performance Management, Fraud and Roaming, Agreement Management
Service scope – horizontal/segments:	End-to-end Development of end-to-end process flows for Service Fulfilment, Assurance and Billing using Business Process Mapping for understanding processes from the 'outside in,' i.e., the customer's point of view
Service scope – vertical/layers:	Conformant with TMN layers All process interactions between the customer interface and the network elements, i.e., *process flow through*. Billing (customers) is a recurring theme and includes analysis of billing that has flat rate elements (e.g., one-time installation, monthly recurring charges), usage charges and possible SLA adjustments.
"Agreement" procedures:	A definition for SLA is provided. The TOM is used as the basis for establishing *Business Agreements and Information Agreements* which provide technology-independent business requirements and information models. More specific work on SLAs and their management is taken in GB917 (ref. Section 4.1.2)
Parameter detail:	No details on specific parameters are provided. Reference points are discussed at a very high level. SLA, Performance and Service Parameters are discussed at a high level.
Networks/technology:	Technology independent 'Networks' and 'Network Elements' are mentioned throughout but only in generic terms. Brief mention is made of 'underlying network and information technology infrastructure, 'SONET/SDH networks', in terms of fault handling processes.
Life cycle phase:	Generic and implicit in all the process descriptions Chapter 7 (Process Interactions) captures lifecycle inputs and outputs for each process, with detailed diagrams. Mention is made of the necessity for SLA life cycle management, but not elaborated.
Abstraction level:	High level description of process implementation The TOM claims to provide a common language and framework for supporting implementation of end-to-end operations integration and automation. Feedback from implementation experience is being sought for future issues of the TOM. TMF *Solution Sets* (developed from the TOM) provide protocol specific implementation specifications. The need for implementation of processes is described in non-specific terms throughout the TOM.
Roles/actor types:	Generic Service Provider, Network Operator, wholesale, retail roles are present in the model. No specific descriptions or definitions of the functions of each role are provided.
Environment/other frameworks:	Conformant with ITU-T TMN framework ITU-T TMN Rec. M.3400, M.3010, M.3200 are referenced. The TOM aims to provide a unique and complete set of generic process architectures for the telecoms industry, to which other frameworks should be aligned.

3.3 TMF GB917

Criterion	Description for SLA Handbook framework
Services:	Generic Examples for use of SLAs such as IP VPN, Leased Line, Frame Relay, ATM cell delivery etc. The perspective of the Handbook is that the end Customer develops telecommunication service quality requirements necessary to operate their business. These requirements are brought to the SP and the two parties begin to assemble the optimum set of SLA parameters and values for the services.
Service scope – horizontal/segments:	End-to-end Cases of SLAs between SP to Customer, SP to SP, Network Operator(NO) to NO are considered.
Service scope – vertical/layers:	Service Management Layer is focused on. Performance monitoring (network layer) is considered as well. There is a generic assumption that SLAs will be developed wherever and whenever needed for any service instance. Consequently, a SP could create an SLA with an NO, e.g., for IP transport services.
"Agreement" procedures:	SLAs considered in details All aspects relevant for any provider, including customer relationship, though in high-level detail. Topics tackled include: • Motivation and Requirements for SLA Management; • QoS and the SLA Parameter Framework; • SLA Process Life Cycle; • SLA Management Framework; • SLA Modeling and Guidelines; No detailed information model or interface specifications are provided.
Parameter detail:	Service-specific and Independent parameters for NP and QoS are listed. The *SLA Parameter Framework* described in GB917 provides a matrix for organizing parameters into six categories. Three service characteristics include 1) technology-specific, 2) service-specific and 3) technology & service-independent. The Customer has two interests: 1) impact on the single user and 2) aggregate performance for a defined period. Examples of SLA parameters for a variety of technologies and services are included. There are several examples of fairly detailed SLA mappings of QoS parameters for services such as Leased Line, ATM cell delivery, IP VPN.
Networks/technology:	Technology independent; can be tailored for e.g. ATM, IP. Mention is made of requirements for SLA parameters in respect of all well-known network technology layers including, Physical, xDSL, PDH, SDH, ATM, FR, IP. However, there is little specific elaboration in respect of use of these specific layers. Most elaboration is given in terms of services (e.g., Leased Line, ATM cell delivery, IP VPN).
Life cycle phase:	SLA Life Cycle model is elaborated. A Service runs thorough five Life Cycle stages: M.´ product/service development, (2) negotiation and sales, (3) implementation, (4) execution, (5) assessment. Each life cycle stage addresses specific operations processes in the TOM. The SLA Life Cycle provides a complete process description by delineating interactions between well-defined stages. Some cases and examples of actions following SLA violation are included as well.
Abstraction level:	High abstraction level for the SLA description Mostly high level text descriptions of SLA requirements and parameters. Interface specifications, protocols, level of detail in management messages and descriptions of how automation should be implemented are mostly unavailable. There is no disassociation of any part of the description of SLAs into technical components An annex describes how SLA implementations are due to be demonstrated by individual TMF *Catalyst* projects.

Roles/actor types:	Generic The Business Reference Model considered includes: Customer, Service Provider, Other providers and operators, suppliers, 3rd party applications vendors. Other roles identified include: network bearer service provider and network operator.
Environment/other frameworks:	Developed having ITU-T TMN and TMF references & frameworks in mind. It sets out to be the definitive SLA Handbook for providing the technical framework within which projects on Customer Service including SLA/QoS Management can function. It therefore does not specifically relate itself to external frameworks and basically aligns itself to the TOM framework only.

3.4 IETF TE WG

Criterion	Description for IETF TE WG framework
Services:	DiffServ, IntServ, RSVP and MPLS enabled IP networks
Service scope – horizontal/segments:	Covers Traffic considerations and analysis for intra-domain networks, so assumes and e2e service scope
Service scope – vertical/layers:	Covers user data transfer looks at data entering the network and routed (indirectly mentions QoS) according to its routing class.
"Agreement" procedures:	Agreement procedures for traffic contract parameters, dealing with congestion and effective bandwidth usage.
Parameter detail:	No mention of SLA/SLS agreements or parameter details, mainly deals with the technical implementation of QoS assured routing of traffic on an IP based network.
Networks/technology:	DiffServ, IntServ, RSVP and MPLS enabled IP networks
Life cycle phase:	The Management functions cover service operation, which includes Capacity Management Methods, Routing Management, QoS Resource Management and of course traffic management.
Abstraction level:	TE Process Model describes the sequence of actions to optimise the performance of an operational network. The implementers of this model could be traffic engineers or a TE automated system. This process model includes a measurement subsystem, modelling and analysis subsystem and an optimisation subsystem.
Roles/actor types:	Service Provider, IP Network Domain Operator. But no definitive definition of roles is given.
Environment/other frameworks:	This framework uses the framework set out by the ITU-T recommendations, E.801 "Framework for Service Quality Agreements", E.701 "Reference connections for Traffic Engineering" RFC-2702 "MPLS and Traffic Engineering in IP Networks"

3.5 EURESCOM P806

Criterion	Description for P806-GI EqoS framework
Services:	Generic Applicability "tested" on the VoIP and IP services in general
Service scope – horizontal/segments:	Generic Focuses on a pair of user-provider along the provision chain end-to-end
Service scope – vertical/layers:	Generic Can be applied to any layer, but does not specify any particular functionality at the level
"Agreement" procedures:	Agreements considered Interconnection agreement structure presented - focus on the QoS part (5 elements: interface description, traffic pattern, QoS parameters/values, measurements, reaction pattern) Organisation of parameters, their values, measurements, and reactions are described. "Checked" for VoIP provision scenario adapted from ETSI TIPHON Scenario 1.
Parameter detail:	Overall description Organising according the generalised I.350

	Identifies reference points by referring to I.380 Mapping is considered, but in very general terms, refers to E.800 for telephony services
Networks/technology:	Generic - technology independent
Life cycle phase:	Generic, but no specific phase addressed, elaborates some on the operational phase, Processes are not described in details, but rather referred to TMF BPRM
Abstraction level:	High-level abstraction in order to reach generality Applicability of EqoS in details presented for a VoIP service provision scenario in [P806-d4]
Roles/actor types:	Generic, with focus on two main roles - user and provider Relationships considered between these roles, focus on the interconnection agreements Mapping between roles and actors studied and exemplified (one role taken by multiple actors and many roles taken by a single actor (multiple actors) Introduces "one-stop" responsibility concept (a primary provider is the main responsible towards the service delivery to the user, and should regulate his relationships within the chain further on hiding it from his user) Note that the *user* role include various types of service users, e.g. residential human end-user, machine, application, SME, large enterprises as customers; types of providers considered were service provider, network operator, content provider Roles defined for VoIP service provision scenario (example): user, ITSP, ICP, IPNP, SCNP, and their relationships Multi-provider environment considered
Environment/other frameworks:	Considers/conformant with ITU-T E.800, ITU-T I.350, ETR 003, ISO/OSI layered model, TINA-C, NMF BRM, ITU-T X.641 (in the sense that is considered on a "higher" level abstraction), ITU-T GII In accordance with the EU's ONP

3.6 EURESCOM P906

Criterion	Description for QUASIMODO model
Services:	IP-based services Both intserv and diffserv have been considered and implemented
Service scope – horizontal/segments	End-to-end, but only single-provider environment was considered Note that the focus has been put in the core portion that is to be controlled by a provider; access portion has not been discussed, but it was considered to be characterised
Service scope – vertical/layers:	User/application/service/network (not below IP level)
"Agreement" procedures:	Agreements are considered Service Offer Specification (SOS) described; contains: ° Network Performance Level (NPL; a set of QoS parameters defined per application category in a certain quality class) that includes delay, jitter, loss; ° traffic profile - throughput, directions ° guarantees for assuring NPL, ° price/charging scheme. Note that the model is application aware in the sense that the demands on the quality from applications are captured in NPL for each of application categories with attached quality. Measurements and monitoring of conditions stated in SOS are described Sketch of flow chart for reaching an agreement included
Parameter detail:	Applications are grouped in so called Application Categories (AC). ACs are characterised by three parameters: delay, jitter, loss. The parameters chosen are measurable, as it is described in details in the

	QUASImodel implementations. In addition, a selection of parameters can be used for QoS charging as done in QUASI-model charging work. Reference points (for QoS charging, and monitoring/measurements) are identified, tests have been run Mapping of parameters is considered from the application level to network level. AC which is provided by a service from one of the Quality Categories (QC) builds a (QC, AC) pair that has attached an NPL. The problem with current implementations is that the mapping is unidirectional/non-reversible because of the technical solutions implemented.
Networks/technology:	IP-based, including both intserv and diffserv
Life cycle phase:	Service operational phase, partially negotiation SOS may be considered for design, implementation phases No processes are described directly, but some guidelines are given through the implementations (QUASI-intserv, QUASI-diffserv) and tests descriptions
Abstraction level:	Theoretical model was developed and implemented for two scenarios (QUASI-intserv, QUASI-diffserv), and the details are available. Mainly focuses on the IP-level Information model of SOS, though not formalised
Roles/actor types:	User, service provider, network operator Relationships are considered for the case of selling SOS to the user
Environment/other frameworks:	IETF IPPM, IETF RTFM

3.7 ITU-T SG 13 – ICA framework

Criterion	Description for the ITU-T ICA framework (Y.130 series)
Services:	Information Communication Infrastructure services offered by the middleware: access control offered for applications/customers through contact agent, session mgmt by info exchange agent, transport select from the baseware/physical transport layer with QoS through the transport agent. Multiservices support addressed.
Service scope – horizontal/segments	End-to-end, user to user service support Support of services from the infrastructure considers horizontal segments including the access and transport.
Service scope – vertical/layers:	The GII model defined middleware above the baseware, with interfaces and services offered for the applications layer Charging-billing, security and authentication services offered.
"Agreement" procedures:	Generic SLA considered, but with no details The negotiation, session control (even dynamic) is supported by the concept/model through the agent concept and brokerage Separation between networks and services, access and information/data exchange and profile selection supported, agent concept for this
Parameter detail:	Model, only high level parameter description given (yet) by the basic document (Y.130) Reference points are identified, relationships outlined.
Networks/technology:	Any network technologies are allowed - the concept is to hide it from the users by middleware. The ICA itself focuses on middleware. Regarding the end-to-end concerns, IP-based networks are considered.
Life cycle phase:	The following SLC phases are considered: M.´ Design of network solutions and infrastructure, B) Implementing support, middleware capabilities, services and control of delivery, C) when operational, to support only high level process descriptions, with some or no details are presented - other documents in Y.130-series (e.g. the FILC framework for location identification etc.) contain technical details
Abstraction level:	Distributed object/agent interaction model, high level of abstraction, with some examples showing its applicability

Roles/actor types:	User, customer, provider, brokerage included. Agent model is describing how middleware service offering is used/delivered. Support services for peers or for client type users require different relationships/interface specifications Multi-provisioning, multi-provider issues are not focused on, but are not excluded either. Relationships between roles are considered and expressed as interactions.
Environment/other frameworks:	Based on the ITU-T's GII concept [Y.110], [Y.120]. Related to ODP and TINA - differences are explained and outlined

3.8 ITU-T SG 13 - IP framework

Criterion	Description of the ITU-T SG 13 IP framework
Services:	Generic GII applications and user-to-user services, to be provided over the global infrastructure with IP-based networks, domains included. Special focus on IP transport capabilities, IP network services (cross-connect service, IP VPN), VoIP and multimedia communications support
Service scope – horizontal/segments	End-to-end Multiservice, multi-provisioning over all IP, hybrid and IP in the access, various combinations in the core. Models for the access segments, for the transport chains, end-to-end HRP for IP are also given
Service scope – vertical/layers:	Service hierarchy and underlying services concept included. Information appliances are using services middleware and baseware in the general model. User-to-user or client/server applications are on the top, in the IP based service plane, IP transfer capabilities defined above the IP service plane (Y.1241) are below. Other underlying service capabilities (like ATM transfer capabilities above the ATM layer, FR service capabilities above the FR layer, etc.) are allowed, as "IP over XXX". Separate layer services, offered also by the individual IP domains may be considered, the end-system model is also layered Protocol reference model for IP based networks allows plane management and layer management - the concept for management by layers included
"Agreement" procedures:	High level procedure for SLAs, SLA development and implementation in networks tackled in Y.1241. Concept for services offering is defined as attribute-based transport capabilities with list of SLA components: service level objectives, service monitoring components, financial compensation components. Business to business, provider-user, SP-NP covered, interfaces for interactions, including interconnection and sub-contracting Detailed list of SLA attributes for creating the SLAs [Y.1241] Negotiation between roles is given in the GII model. IP framework allows selecting CoS or QoS. Support for a dynamic profile selection and re-negotiation.
Parameter detail:	Traffic types, communication attributes for transfer capability description are listed List of attributes, parameters for SLAs and operation control, for monitoring is presented by the generic framework Event and state monitoring based QoS control, monitoring and performance evaluation measurements (and MRP-s) are proposed. Parameters, reference points/interfaces are defined for different technology domains, for implementation solutions, for the interconnection (Y.140, Y.1401, Y.1311 etc.) and tailored mapping guidelines are given by the engineering framework Recs., like Y.1310 for IP over ATM, or Y.1311 for IP-VPNs, I.351 for multimedia communications support, etc. IP packet transfer performance and availability parameters are defined [Y.1540]. Service classes and categories to support IP-based services are drafted along with some guidelines on mappings [Y.1541]
Networks/technology:	Hybrid (i.e. interconnected connection-oriented telecommunications networks and IP based networks) networks, IP overlay, all IP access and transport segments, IP

	over XXX covered or planned to be covered. IP intserv, diffserv and MPLS solutions are also considered.
Life cycle phase:	Generic Service Creation with Service (offer) requirements definition, implementation of SLA-s In [X.641], [X.642] QoS management support for the operational life cycle phase is given. Processes considered for SLA Negotiation, SLA implementation, resource allocation, user control during service operation phase
Abstraction level:	High-level in the generic IP networking and implementation model, more detailed in the interconnect framework by examples. Detailed for the IP transfer capability and monitoring based IP performance management. Engineering details given for implementation and technology solutions Models to support end-to-end QoS and performance allocation, along the chains, between responsibility domains [Y.800], [Y.1541] Below the generic framework, a tailored engineering framework for implementation scenarios, with traffic type/attribute selection proposed, control/measurement, management issues covered Generic TE, QoS management guidelines, and tailored parameters, recommended methods are under development. QoS control and management, traffic control and certain resource control and performance monitoring based techniques are discussed by the engineering framework Recommendations (Y.iptc, Y.17oam, Y.17ps, Y.1310, E.351
Roles/actor types:	User, Customer, application (value added, IP based), SP, network (and control, management) service provider, NO, access, transport and interconnect service providers Note that these roles depend on the scenarios focused on within different documents(i.e. generic, performance and/or engineering framework). As the IP and interconnect framework is based on the generic GII concept, business and technical, role models and functional entities, domain operators etc. are all included.
Environment/other frameworks:	Multi-service, multi-provisioning, value chains, OSI and ODP architecture models, interconnection and interworking with any other communication infrastructure implementations/solutions, multimedia communication support from other ITU-T, ISO-IEC JTC1 frameworks. Relationship explained for IETF intserv, diffserv. QoS and performance parameters, attributes are developed in accordance with E.800 and I.350 (in Y.800, Y.1540 series), and enhanced with guidelines for traffic engineering, for “IP convergence” and interoperability platforms for various networking technology (MPLS, ATM, FR Forum-s, etc.) TMN and OSI, ODP management compliance and compatible with TINA concepts

3.9 ITU-T SG 4

Criterion	Description of ITU-T SG4/SG7 management framework
Services:	Any telecommunications network based services and applications are to be supported by network management, and functionality description of all the management services presented in M.3400. X.171 gives an architectural framework for the Customer Network Management services by the carrier and gives recommendations for the *Alarm notification* service, as a part of the provision of total management services at the NNM interface X. 905 is the QoS management framework model for the ODP
Service scope – horizontal/segments	TMN services, network-to-network included, end-to-end for control and management support along connectivity and information transport chains, covering interconnected access, and transport segments with multiple operators/network domains
Service scope – vertical/layers:	Service hierarchy and underlying services concept included Management services identified for layers in the general functional model are to

	be considered for/by layers. However, orthogonal to the hierarchic service layers, the TMN model identified planes (user plane, control plane, management plane) are also considered.
"Agreement" procedures:	As TMN management function is a co-operative interaction, rules, content, format, etc. for the management services-related information exchange are to be based on agreements. Reaction patterns of QoS-part of an agreement covered. When selecting sets of functions, and relevant functions for the management services provisioning, the GDMF template of Rec. M.3020 is to be used. In [M.3400], requirements on the alarm summary function set of the alarm surveillance group of Fault management are presented as detailed example. [M.1542] gives details for the performance of the Network maintenance service; also gives a guide for creating and implementing usage of the related performance agreement. Agreement procedure is considered in [X.171], in general, for Network-network management services for data networks.
Parameter detail:	[M.3400] contains detailed description of the management requirements, with input and output information flows for management function sets, using a GDMF template. TMN function sets are described in [M.3400] to be of potential use or re-use, implying thus their reusability for the IP-based environment. Although developed for TMN services in OSI data networks, [M.3208] series is dealing with management services for dedicated and re-configurable circuits network; an information model for connection management of pre-provisioned link connections is given. Ideas for mappings and aggregation of parameters may be devised from the [X.171]
Networks/technology:	[M.3400] is generic, implying its applicability of specifying the management service function sets for management of any networks, technology, implementations. [M. 3208] is tackling pre-provisioned, re-configurable link services, e.g. IP based
Life cycle phase:	Generic, focused on (mainly of management) Service Creation, interface and Service (offer) requirements definition, for implementation of managed SLAs and to realise operational TMN. Processes are described to some details in M.3208-series, and X.171.
Abstraction level:	Very generic in M3400 and in X.905 Some details described in the other SG4 and SG7 Recommendations. M.3400 gives inputs for tailoring the detailed description of management functions and function sets. M3208.2 and 3 gives implementation details for link management X.171 gives guidelines related to the network-network management interface
Roles/actor types:	Dealt with from the perspective of management services: user and provider of management services, and peer-to-peer network operator roles are directly involved. The network operators may be users of third party presented management services also.
Environment/other frameworks:	M.3400 envelops TMN model basic documents Also, X.641 and X.642 concepts and methodology are reflected.

3.10 ETSI TIPHON

Criterion	Description for ETSI TIPHON

Services:	TIPHON is focusing on the IP Telephony service. Functional architecture, interconnect scenarios are considered for end-to-end services (TE_{ip}-to-SCN, SCN-to-TE_{ip}, SCN-to-SCN via IP, IP-to-IP via SCN) . Guidelines and requirements are presented e.g., for architectural design, end-to-end virtual or physical call control/session control, based on analysis of requirements identified for relevant aspects of interoperability, interworking, methods/requirements for end-to-end QoS control, QoS signalling, generic management issues (in Release3). SCN = Switched Circuit Network (e.g. PSTN, ISDN, GSM) TE_{ip} = terminal equipment for IP telephony, e.g. H.323 terminal, PC etc.
Service scope – horizontal/segments	End-to-end, considers all segments for the various interconnect scenarios. In details, the call-model based service delivery chain and the gateway architecture model is used, therefore access and transport segments of any combinations from SCNs and IP-based network portions are covered.
Service scope – vertical/layers:	Four layers are considered (end-to-end application, service control, media control, and the transport layers). Release3 is working on requirements as for management, and charging/accounting, too. VASP to NP interfaces, and interactions between entities in the different layers are covered. For the call-based end-to-end service delivery, the management and "open settlement" support issues are still under development (in Release3)
"Agreement" procedures:	User-SP agreements based on end-to-end service delivery and QoS scenarios, and SP-NP, or peer-to-peer negotiations, are supported by templates and protocol usage. The focus is on the QoS agreements and design, configuration control and management based on end-to-end requirements. The TIPHON framework is also open towards negotiation-based QoS profile selection, agreed traffic profile based control and management functions. Implementation of interfaces for negotiations is covered, in the business model, accounting and control/management works, too.
Parameter detail:	End-to-end QoS parameters, requirements are described in details (including the descriptions for the CPE, TE domain entities). Reference points for any interactions and measurements, within the four layers and end-to-end segmented model, are presented. QoS signalling and traffic descriptors are proposed to support interworking and standard based interactions at the inter-operator interfaces. Architectural and functional design guidelines are presented based on the QoS parameter allocation scenarios discussed in detailed. But the gateway architecture model requires/gives no special details for network performance parameters within/inside the transport layer. Therefore, parameters for the peer-to-peer IP NP interface, or for the IP packet transfer quality evaluation are not discussed: instead, ITU-T documents are referred to, when measurements, or mappings between domains are needed. Analysis, guidelines for mappings, as well as data interchange templates, based on specified parameters, are produced for end-to-end services with call/session control.
Networks/technology:	The TIPHON framework considers interconnection and interworking of different technology domains, SCN and IP.

Life cycle phase:	Based on the ETSI defined, generic service life cycle model, and QoS management concepts of ITU-T and ETSI models. Complete life-cycle management is intended to be supported by TIPHON framework, developed for enabling end-to-end speech conversation and multimedia call based telecommunications services, with supplementary, control and management service components, in a multi-provider environment. For the service delivery related operations, TIPHON describes concepts, guidelines, procedures and tools/techniques for control and QoS management, supporting service interworking over different network segments and responsibility domains.
Abstraction level:	Varies from high-level abstraction model to particular details on implementation. Generic concepts for QoS support and interoperability support etc. are presented, as well as there are case studies, with various functional architecture and technology implementations (like H.323, SIP signalling) discussed. Control and interoperability requirements are detailed by certain documents as far as there are ETSI TIPHON developed control/support protocol specifications (such as the OSP), and implementation guidelines (for SIP etc.). Detailed QoS measurement specifications (for the coded speech transfer/end-to-end call quality), and QoS classes with end-to-end parameter objectives are specified. Not only the interoperability and interworking specific requirements are presented, but also guidelines on implementing and use of various controls, traffic descriptors, QoS classes CDR templates, are developed.
Roles/actor types:	Multiple roles in the functional model and concept are considered, and several actors in the TINA compatible business model are involved/allowed. End-User (and customer, for the VPN scenarios), access providers and transport network operators, value added service provider (VASP), end-to-end application or communication service providers, and some service or resource broker entities are considered in the TIPHON business model. The functional entity roles in TIPHON cover, e.g., the owners/operators of interconnect and control gateways (for media control, signalling control), the back-office service provisioning roles (entities responsible for access control, resource usage authentication, providers of usage metering based charging /billing /accounting), and network management. Multi-provisioning, multi-service delivery and business environment is considered and such implementation cases are discussed as well.

Environment/other frameworks:	Complaint with ITU-T's GII and TINA business model. Regarding QoS issues, complaint with the ITU-T E.800 and the ETSI service life-cycle concepts/ models. As for the management, ITU-T M-series defined TMN framework and related MIBs are referred to. However, as no details for the IP network access and IP transport carrier domain are presented, TIPHON is open towards IETF QoS and policy framework results, too. Release3 is conformant with the TMF service provisioning process model, management framework interfaces/concepts. The basic QoS approach, and - focusing on telephony like services, also the parameters, end-to-end measurement types etc. are based on the ITU-T E-series and P-series documents, as QoS engineering framework "source documents". QoS and network/system performance mappings, parameters and rules to allocate requirements for end-to-end VoIP call completion scenarios, are also ITU-T based. For the IPNP (transport carrier) domain, diffserv and intserv, or SIP based QoS signalling etc. results may be also used.

3.11 I2 – QBONE

Criterion	Description for Qbone framework
Services:	IP-based, IP cross-connect service, IP VPN and VoIP
Service scope – horizontal/segments:	End-to-End multi IP network domain, chain of Bandwidth Brokers, cascade model
Service scope – vertical/layers:	Network Layer, Bandwidth Broker, Resource Allocation Requests
"Agreement" procedures:	Resource Allocation Request messages
Parameter details:	Simple Inter-domain Bandwidth Broker Signalling
Networks/technology:	IP diffserv-based
Life cycle phase:	Service Creation, Service Negotiation, Service Activation, Service operation
Abstraction level:	Message Sequences: Resource Allocation Requests, Simple Inter-domain Bandwidth Broker Signalling
Roles/actor types:	Customer, network service provider
Environment/other frameworks:	New concept

3.12 3GPP QoS framework

Criterion	**Description for 3GPP QoS framework**
Services:	Circuit switched services as telephony, multimedia, SMS, etc. Packet switched services as VoIP, multimedia, file transfer, e-mail, interactive web based applications.
Service scope – horizontal/segments:	Radio segment , Radio access network (RAN), UMTS core network, backbone network (i.e. external to UMTS), UMTS internal, as well as end-to-end scenarios
Service scope – vertical/layers:	User data transfer, control and management functions, charging/billing functions, interconnect to external networks
"Agreement" procedures:	Technical specifications of traffic contract enforcement. Policy framework strongly related to IETF policy framework (RFC

	2753)
Parameter details:	Mapping of parameters are considered but out of scope of standardisation. Translation function specified, but not exact mappings. Per flow policy (pr PDP context)
Networks/technology:	Cellular Radio network, both Packet based and circuit switched radio transport (DCH, CCH), ISDN core network, IP based infrastructure, AAL2/(AAL5)/ATM transport. IP DiffServ specified or ATM QoS
Life cycle phase:	All phases from network attachment, authorisation, authentication, connection setup, operation, tear down, Idle mode, active mode, standby mode, routing updates, location procedures, negotiation of resources and QoS parameters
Abstraction level:	Very detailed, and close to implementation (due to it being a standardisation effort). Framework covers all levels and planes (i.e. user, control). Message sequence charts are specified, as well as all messages and Information Elements (Ies)
Roles/actor types:	User, Customer, network (operator), service provider. Home network, visited network (due to mobility)
Environment/other frameworks:	IETF policy framework and service architectures (diffserv, RSVP, etc.) To a certain degree also ITU-T specifications of ATM and ATM QoS framework and signalling/control/management. Legacy GSM/GPRS

3.13 Open Group framework

Criterion	Description for Open Group framework
Services:	Not specified.
Service scope – horizontal/segments:	End-to-end, from the Client Network across a WAN to a Service Network.
Service scope – vertical/layers:	They mention management data transfer and user data transfer in the framework.
"Agreement" procedures:	They use the term SLA to indicate an agreement between QoS zones (domains). It includes Application Profiling, QoS specifications, Fault Mgt specifications and Configuration specifications
Parameter details:	No detail on this level
Networks/technology:	Seems to be an IP based network, with Policy Decision Point and Traffic Conditioner, but doesn't explicitly state IP or otherwise.
Life cycle phase:	No life cycle phase as such.
Abstraction level:	Too early in the Open Group QoS Task Force to have such detail
Roles/actor types:	Has two solutions/architectures one is Single Authority E2E, similar to P1008 Hub, and Federated E2E, similar to P1008 Cascade. Within each they contain the following: User, Client Network Resource Manager, WAN Resource Manager, service Network Manager, End-to-End Resource Manager.
Environment/other frameworks:	At present they are also reviewing other standards and QoS related work, with a view to inputting/aiding the development of E2E QoS.

3.14 IST Tequila

Criterion	Description for Tequila framework
Services:	IP QoS cross-connection VPN, VoIP, VLL, Bandwidth pipe, real-time
Service scope –	End-to-end, cascade model

horizontal/segments:	
Service scope – vertical/layers:	Network – Traffic engineering tools, signalling protocol Service - SLS
"Agreement" procedures:	SLS described in details - both structure and potential content for example services SLS negotiation described as well
Parameter details:	SLS Parameter Model
Networks/technology:	IP-based networks, with particular focus on diffserv
Life cycle phase:	Subscription to a service, Invocation of the service
Abstraction level:	Functional architecture given, SLS Model as well
Roles/actor types:	User, customer, provider
Environment/other frameworks:	The work formalised in the form of IETF drafts. Leads the interests group for establishing a charter in IETF, so called SLSU charter.

3.15 IST Aquila

Criterion	Description for Aquila framework
Services:	IP-based services, in particular those realised in the DiffServ enabled IP networks.
Service scope – horizontal/segments:	Access network portion Admission control and resource control agents that the user contacts via an end user application tool.
Service scope – vertical/layers:	Proposes a new layer; RCL: Resource Control Layer, which exists above the DiffServ layer to provide dynamic access to QoS services.
"Agreement" procedures:	Suggests to standardise SLS types for different applications. Basic template for SLS is the one provided by Tequila. An End User application Toolkit (EAT) makes a reservation request to an Admission Control Agent (ACA), where an ACA controls an edge router or border router.
Parameter details:	Parameters are as used in Tequila. There is a generic example of a reservation request scenario.
Networks/technology:	Any IP-based network.
Life cycle phase:	Service creation, service operation.
Abstraction level:	An overall description on the implementation of the RCL within a DiffServ network is given.
Roles/actor types:	The roles described are ACA's and EAT's which are controlled by a Resource Control Agent (RCA), where several ISP's are connected by border routers and access networks connected by edge routers, which are controlled by the ACA's. The EAT exists at the end user point. There is no definition of these roles given.
Environment/other frameworks:	Accepts the Tequila approach for the SLS structure, with minor changes. Co-operates with Tequila, AT&T Policy Arena and Cadenus projects, for the standardisation of SLS (and predefined SLS) in IETF - to-day no charter has been established though a lot of interest has been shown by various actors in IETF.

3.16 IST Cadenus project

Criterion	Description for Cadenus project
Services:	IP Transport with QoS and value-added services e.g. IP Telephony, VPN
Service scope – horizontal/segments:	The focus is on end-user to network (retail SLA), but they also look at end-to-end, provider to provider. With the concept of Access network, Backbone network and Next network.
Service scope – vertical/layers:	Creation and management of Services. Service configuration and Resource Management. No charging or billing.
"Agreement" procedures:	The use of SLA between the user (customer) and service provider (retailer) & between SP and SP is outlined.

Parameter detail:	No detail on the parameter values.
Networks/technology:	Premium IP networks and SLA networks
Life cycle phase:	The SLA Management Life Cycle is as follows: • Product/Service Development defines Service & SLA templates • Negotiation and Sales uses the Service & SLA template • Implementation generates policies and configurations for the network • Operation and Assessment
Abstraction level:	No detail on the messages, or information model. But they do make a set of requirements on the model: • A core model to be extended for each new service. • A conceptual model with mapping rules to a development model e.g. XML. These mapping rules create the link from Service to it's implementation The goal is to automate SLA mgmt through contract negotiation, service provisioning/activation and monitoring.
Roles/actor types:	Customer, Retailer, Service Provider, Network Provider. There are relationships defined between the different roles, with both Retail and Wholesale SLAs identified.
Environment/other frameworks:	Considered TMF SLA Mgmt Handbook, DMTF CIM/DEN, Tequila SLS and IETF.

3.17 AT&T Policy arena

Criterion	Description for AT&T framework
Services:	IP based networks; Layer 3 only – mapping to layer 2 is NOT considered.
Service scope – horizontal/segments:	Access network
Service scope – vertical/layers:	Describes the automation of the SLS, i.e. concerned with automation relating to the interaction of the customer and provider domains, NOT with the network configuration and monitoring within a domain.
"Agreement" procedures:	Agreements considered are only between the customer and the provider. Agreements are made regarding the required QoS on the customers part.
Parameter detail:	Description of the units and sub-units contained in each SLS structure. Also, some sample topologies are described.
Networks/technology:	Any IP-based network.
Life cycle phase:	Service creation i.e. customer declares its' requirements and the provider decides whether or not they can be fulfilled.
Abstraction level:	Detailed information model; a QoS unit (a complex description block used to describe the traffic streams that are the subject of the SLA) is broken down into three components, each of which is described in detail.
Roles/actor types:	Customer and provider: "…are roles played by negotiating entities in the process and are not to be confused with "end users" or "carriers". For instance, two carriers negotiating arrangements may each play the role of the others customer."
Environment/other frameworks:	Specifies that the SLS should NOT standardise services, only vendors and customers should. No other frameworks are referred to.

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[1] Note that a value called "generic" implies that the framework reviewed can be applied on a "general" basis/for all cases)

