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QUESTIONS: 6/13

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TITLE: Response to liaison statement on Generic QoS Service Requirements

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LIAISON STATEMENT / COMMUNICATION / INFORMATION

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General

Study Group 13 welcomes the opportunity to collaborate on generic QoS issues that require broad consideration beyond the development of BICC. User-to-user QoS control with multiple network technologies requires considerable co-ordination. The attached document is work-in-progress, and gives our current view of the QoS signalling information exchange between users and networks, and between networks. In particular, the work on parameter commitments is still under discussion. Work on this topic is in progress, and other alternatives will be considered. There is also a companion reply to an earlier SG 11 liaison on QoS signalling in BICC CS3.

In the sections that follow, we provide specific answers to many of the questions contained in Annex A of the file sat004r2.zip in the SG 11 IFA, as directed in your request.

Service requirements for existing Networks

Is there a requirement to introduce QoS service levels for the existing PSTN/ISDN/GSM services?

<u>None foreseen at this time.</u>

QoS capabilities for BICC CS3 networks, and interworking with existing networks

How/where is the service level determined; is it determined by the A-party service, the B-party service, the charged party service, or some other criteria?

The party requesting service may request the QoS Class.

Once the required service level has been chosen, what is the service impact if the required QoS level cannot be delivered? For example, will the call be rejected, or will it be allowed to continue with an indication that the required service level has not been delivered.

The Network signals that it cannot meet the request, and at the same time offers an alternative QoS Class that can be met. The ultimate acceptance of any offer lies with the user.

Is the QoS service selection dependent on interworking to other networks? That is, in cases where there is interworking to an existing network, could the interworking point determine the QoS service?

An interworking point determines the needed mapping between the QoS Classes of the two networks.

When interworking to an existing network where end-to-end QoS cannot be controlled and may not be known, what is the service impact? Shall the call be accepted or rejected if the end-to-end QoS service cannot be determined, or is there an indication of unknown QoS service level due to interworking?

The Network signals that it cannot meet the request, and at the same time offers an Unspecified QoS Class.

Service across multiple Operator Domains

Consider a connection crossing several operator networks as shown in the example network of the figure.

Are the QoS characteristic details common across a set of operators, or is it dependent on individual operator agreements?

QoS Classes are standardized.

If QoS service levels are standardised, it would eliminate problems associated with multiple different service agreements. However, it requires agreement on a set of QoS services that can be offered. Such an agreement would need to identify the QoS requirements on the end-to-end connection.

See Y.1541, I.356, and X.146 for end-to-end IP, ATM, and Frame Relay Networks. The problem of end-to-end QoS for network interconnection needs work, but the IP QoS classes show promise for this role.

An agreement on end-to-end QoS service levels specifies the QoS characteristics required for each defined service level across the end-to-end connection. Where the connection crosses multiple networks as shown in the figure above, how is the available QoS budget distributed to the different operators?

Dynamically, with help from the QoS Signaling protocol, or using fixed allocation rules where they have been specified.

If it is done at the service level, then the QoS service definition must allocate the budget for different types of network elements/domains. Such allocation must consider different network cases to ensure that important call cases (eg international and mobile network calls) are not negatively affected.

This is why dynamic allocation has a role.

What are the QoS service levels to be supported, and what their detailed characteristics?

The Y.1541 IP QoS classes show promise for this. They address the transport performance needs of a wide range of user applications and application quality categories. When interworking between sets of classes is needed, the Y.1541 set might be the classes referred to.

How is cost accounting between operators affected by the agreements and mechanisms to support end-to-end QoS?

Study Group 3 addresses accounting topics.

QUESTIONS: 6/13 (IP Performance and Availability)

SOURCE: Question 6 Experts Group

TITLE: Discussion of Information Exchange for User-To-User Qos Control and Signalling Protocols

DRAFT DOCUMENT -- 29 JAN 2002

1 Introduction

This document recognises that an automated system for obtaining User to User QoS on IP Networks, and combinations of various network technologies, will require standard signalling protocols for communicating the requirements among the major entities. For the purposes of this document, we define these entities as:

1. Users and their end Terminal Equipment (TE).
2. Network Service Providers/Operators and their equipment, especially equipment implementing the inter-working function between networks, and between users and networks.

These entities must be able to make requests for service quality with the following main attributes:

?? The user Application type and quality from among several quality categories, when such categories are available. The type of application may be completely specified from the chosen quality category (e.g., Speech - High).

?? The network QoS Class (e.g., Y.1541/Table 1).

?? The network Capacity required, at both the application and network (e.g., Y.iptc) levels.

?? In the future, the Reliability with which the service is to be sustained, and other elements of QoS.

The topology of Network Connectivity desired (e.g., point to point), and addresses, address translations, etc. are covered by non-QoS-related protocol features.

The purpose of this document is to provide detail on procedures for QoS signalling, from the viewpoint of those who have specified IP Network QoS Classes, to convey how these classes should be used in support of a wide range of user applications. Note that the recent work to standardise IP QoS Classes and capacity requirements is useful now, through the implementation of static agreements between network service providers and their users.

2 User - Network QoS Signalling

The user community should be able to make requests with all attributes listed in section 1. Terminal Equipment (TE) should compose the detailed request on the user's behalf, possibly based on configurations set by the user or equipment installer. Many TE have the flexibility to match the user's request for application quality with network QoS classes by selecting parameters such as packet size.

Users/TE should be able to omit some attributes when appropriate, such as the application quality category. For example, Speech quality categories have been defined in ITU-T Rec. G.109, but there is no comparable standard range of quality categories for Web browsing, financial transactions, or many other applications of networks (each is associated with a limited quality range in new ITU-T Rec. G.1010). We note that ITU-T Rec. P.911 tabulates quality categories for Multimedia Communication (a.k.a video/audio/data conferencing) and Television applications. Sophisticated users or enterprises may simply wish to make requests for capacity, network QoS, and reliability.

The user/TE must be prepared to make its QoS request in terms the network understands, starting with the signalling protocol and parameters for Network QoS. The Network QoS Classes and Network Capacity specifications in the signalling protocol must contain values that are verifiable by users (the classes in Y.1541 meet that requirement). TE may conduct measurements to ensure that the committed performance and capacity levels are achieved by the network(s).

When the user/TE request is for a voiceband channel (to support speech or voice band modems), the QoS request (or other associated message) should contain the preferred voiceband codec and packet size. Other optional parameters may be included such as use of silence supression, need for network echo cancellation, and alternate codecs/packet sizes. We note here that many of the capacity attributes will be determined by this codec choice, and that the network operation benefits form knowledge of the codec, when the need for voice transcoding can be identified (and possibly avoided). However, much of the negotiation of application parameters takes place beyond the network's purview.

Network Service providers should be able to communicate the following messages and attributes (in the case of user-network interaction):

1. The simple acknowledgement and acceptance of user/TE requests.
2. The performance level is expected. The ability to commit to a performance level that is better than an aspect of the QoS Class response, if the network operator desires. This commitment may be made for a single performance parameter, or for a combination of parameters.
3. The ability to reject a request, and at the same time offer a modified service level which can be met. The response may modify the request, and may include commitments to an alternate QoS Class, a lower capacity, and other commitments such as those in item 2.

The final decision to accept or reject an offered service is left to the user/TE. The processing of each request and determination of acceptance require considerable work on behalf of the network provider/operator. However, these are simple tasks from the signalling point of view, and the rejections with alternatives are more interesting.

An example of item 2 (parameter commitments) is a case where the network provider confirms the requested Class and offers better objectives for Delay and Delay Variation than Class 0 specifies. The network's intent to commit to the parameter objectives is specified in the Status field. If there is no commitment, the values specified are simply estimates of performance, and the only commitment is to the QoS Class.

Table 1 Example of acceptance with specified parameter commitments

Field Name	Value	Mandatory Field?
QoS Class Requested	Class 0	Yes
QoS Class Response	Accept	Yes
Mean Transfer Delay (IPTD)	80 ms	No
99.9% - min Delay Var. (IPDV)	20 ms	No
Loss (IPLR)		No
Errored Packets (IPER)		No
Status of Specified Parameters	Commit	No

An example of item 3 (rejections and alternate commitments) is a case where the network provider rejects the requested Class and offers another Class with a specified parameter commitment for Delay.

Table 2 Example of rejection with alternative offer and commitment

Field Name	Value	Mandatory Field?
QoS Class Requested	Class 0	Yes
QoS Class Reponse	Reject	Yes
QoS Class Offered	Class 1	No
Mean Transfer Delay (IPTD)	180 ms	No
99.9% - min Delay Var. (IPDV)		No
Loss (IPLR)		No
Errored Packets (IPER)		No
Status of Specified Parameters	Commit	No

3 Network - Network QoS Signalling

The section treats the case where multiple networks co-operate to realise the end-to-end connectivity desired. Beyond the applications considerations mentioned above, network providers/operators primarily deal with Network QoS Classes, Network Capacity, and Reliability. Network-network signalling is the principle way for networks to determine multi-network compliance with QoS classes, since fixed performance allocations are not currently possible on IP Networks.

Network - Network signalling should support the determination of the QoS Class offered to the user/TE, by communicating both the Network QoS Class requested, and the extent to which each specified parameter is already consumed. This implies that each network knows the performance from the entrance node to the (most likely) exit node(s) for the network that has the best opportunity to complete the end-end path. Policies may also determine the next network chosen. The best-next network receives the network-network signalling request.

Networks must also determine if the desired capacity and reliability are available to support the specified Network QoS Class, again from entrance to exit node(s). The attributes of the network's request are:

- The user Application type and quality category, when such categories are available and meaningful.
- The network QoS Class (e.g., Y.1541/Table 1), along with the consumption of individual objectives that are specified by the class.
- The network Capacity required, at both the application and network (e.g., Y.iptc) levels.
- The interconnecting point(s), where user/TE traffic will leave the requesting network and enter the next network.
- In the future, the Reliability with which the service is to be sustained, and other elements of QoS.

The new aspect of signalling is communication of the consumption of the network (source NI to destination NI) objectives. The fields used in signalling may take several forms:

Table 3 Example of accumulating and signalling current performance

	Requested	Currently Achieved
QoS Class	Class 0	Class 0
Mean Transfer Delay (IPTD)	100 ms	20 ms
99.9% - min Delay Var. (IPDV)	50 ms	10 ms
Loss (IPLR)	10^{-3}	$<10^{-3}$
Errored Packets (IPER)	10^{-4}	$<10^{-4}$
Status of Network Commitments		Commit

Note that the requested parameter values are fully specified by the QoS Class, but are included in this table for simple comparison. Only the achieved values and the requested/achieved Class number require signalling fields.

The network receiving this message determines its performance from entrance node to the destination, or to the most likely exit node to the best-next network. The network would add its contribution to the Currently Achieved fields (according to a specified set of summation rules for each parameter), and send these fields on to the next network or back toward the requesting user. In case the requested QoS Class is not achieved, the response can contain the committed performance in excess of the offered Class, using the Currently Achieved values.

A variation on this allows each network to enter and communicate its contribution to the achieved performance level, as shown below:

Table 4 Example of accumulating and signalling current performance

	Requested	Network 1	Network 2	Currently Achieved
QoS Class	Class 0	Class 0	Class 0	Class 0
Mean Transfer Delay (IPTD)	100 ms	20 ms	10 ms	30 ms
99.9% - min Delay Var. (IPDV)	50 ms	10 ms	10 ms	15 ms
Loss (IPLR)	10^{-3}	$<10^{-3}$	$<10^{-3}$	$<10^{-3}$
Errored Packets (IPER)	10^{-4}	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Status of Network Commitments		Commit	Commit	Commit

A complete tabulation of the accumulated performance would allow corrective network actions if the Requested Class were not achieved.

Summation rules are simple for transfer delay. Average values for each network sum to the currently achieved value. More study is needed to determine the summation rules for delay variation and other parameters.

Again, network providers should be able to respond with the following messages and attributes (in the case of network-network interaction):

1. The simple acknowledgement and acceptance of requests.
2. The ability to commit to a performance level that exceeds an aspect of the request/response, if the network operator desires.
3. The network that reaches the destination has ability to suggest a response to a request, and at the same time report a modified service level that can be met. The end-network report may suggest to modify the request, and may include commitments to an alternate QoS Class, a lower capacity, and other commitments such as those in item 2.

It is possible that a chain of network-network QoS requests will encounter a network that does not support the QoS signalling protocol, or QoS Classes in general. If this network is an essential section of the end-to-end path, then several results are possible. One is to reject the request, but at the same time offer an Unspecified Class (e.g., Class 5 of Y.1541), possibly with some additional commitments.

When making entrance to exit performance commitments, only one of the interconnecting links will be included for all networks, except the (first/last - this is TBD).

4 Multiprotocol Network QoS Signalling

The section treats the case where multiple networks co-operate to realise the end-to-end connectivity desired, but the underlying network technologies differ.

In principle, the entrance-to-exit node performance and capacity information may be available regardless of the underlying network technology, whether it be IP, ATM, Frame Relay, etc. All that is required is support of the signalling protocol, and more specific performance information than usual. QoS Classes may best be mapped among these networking technologies as follows:

Table 5 Mapping between QoS Classes

IP QoS Class	ATM QoS Class	FR QoS Class
0	1	3
1	1	2
2		
3		
4		
5	4	0

The table entries for Y.1541 "data" classes (2, 3, and 4) will be completed following more study.

5 Suggested Mapping between Application types and QoS Classes

Table 2/Y.1541 provides an initial mapping.