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LIAISON STATEMENT

Document Title: **Convergence of QoS approaches in 3GPP and TIPHON**

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Organisation: ETSI
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For:

Action:	X
Information:	X

1. Action/Decision Requested

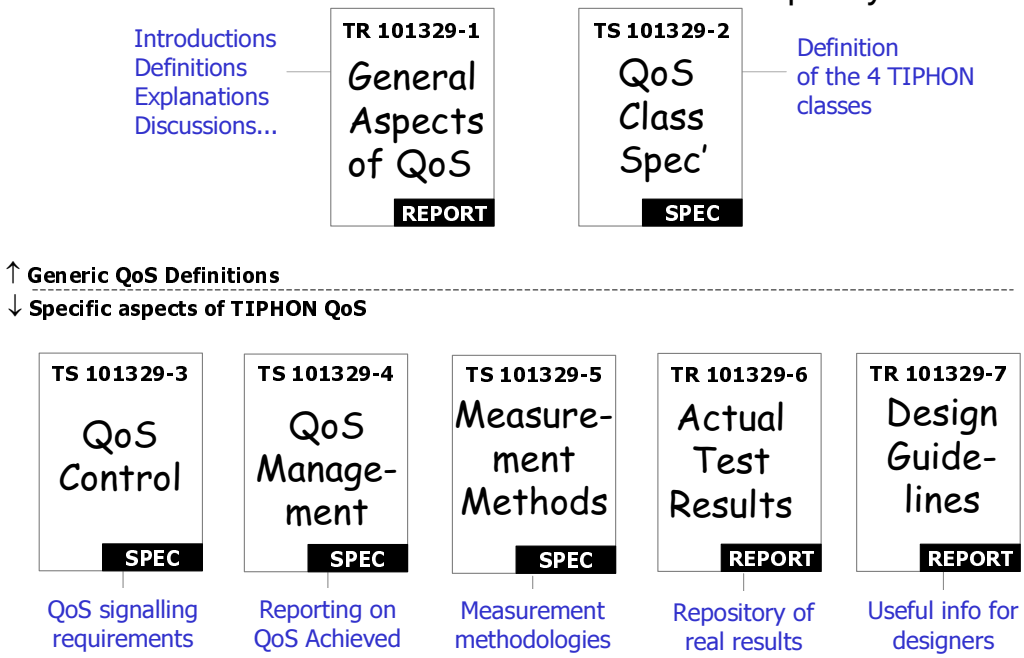
Recent work in both 3GPP and in TIPHON on Quality of Service (QoS) definitions and mechanisms are diverging although the base technologies are converging. This liaison statement offers a review of TIPHON's work in this area and some considerations of how 3GPP and TIPHON may achieve convergence.

It is asked that 3GPP consider adopting the quantitative description of class for voice services and to work with TIPHON to develop similar quantitative descriptions for other services (non-voice services). In addition 3GPP are asked to consider adopting the QoS control structures defined by TIPHON and to work together in extending this for non-voice services.

The TIPHON QoS work to date is able to refine the current single QoS class provided by 3GPP for voice.

2. References

The TIPHON QoS documents are contained within a structure shown below:



3. Overview

In TIPHON QoS is driven from the service plane, through the transport plane and into the media or network technologies. It is a core architectural element and introduces control of QoS based upon a form of contract broking. The general model is shown below (figure 1) and a broker model is also shown (figure 2).

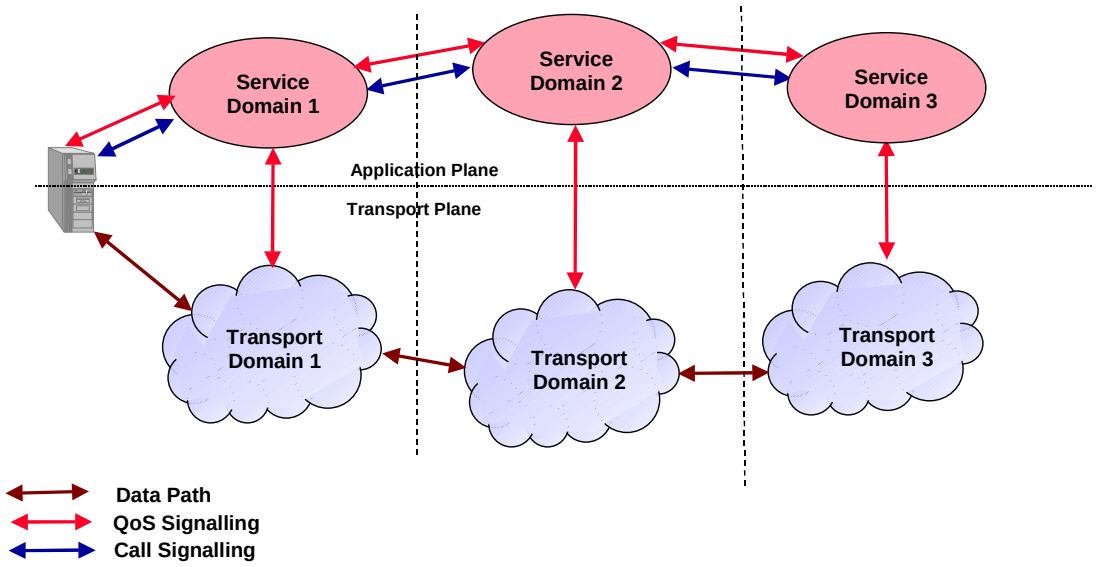


Figure 1: TIPHON QoS general model

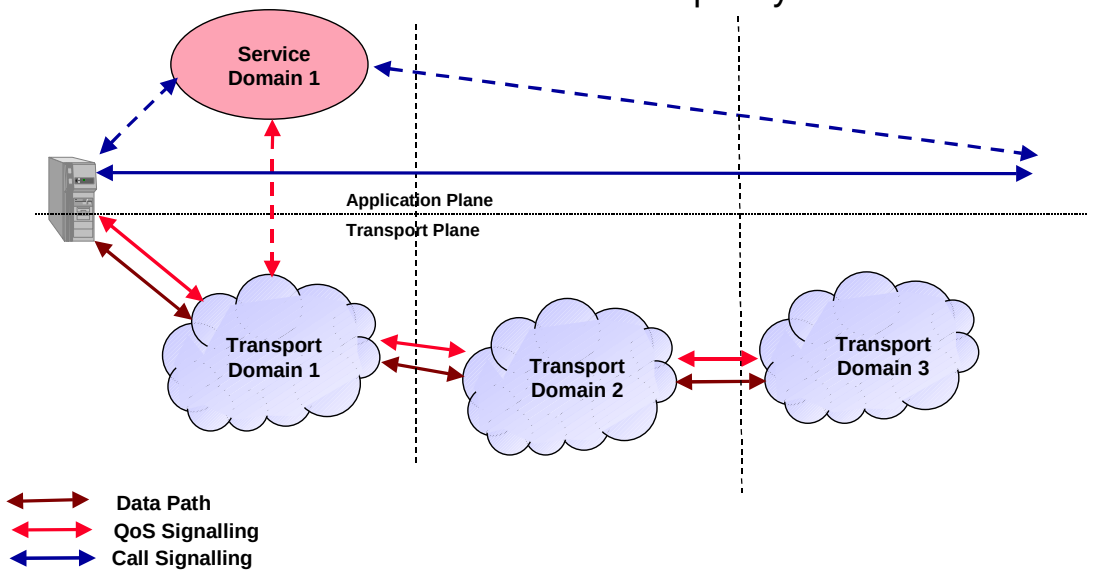


Figure 2: TIPON QoS contract broker model

The broker model allows transport domain 1 to control the QoS across many transport domains by subcontracting to those other domains. In the more general model each service domain contracts for only the local transport domain.

4. QoS class in TIPHON

TIPHON has defined in a quantitative way different classes of performance for voice traffic over IP and other network technologies. This is in contrast to the approach taken in 3GPP in which the QoS classes are not defined quantitatively with respect to voice.

The definition of end-to-end QoS class in a hybrid IP and circuit mode network shall follow that described in TS 101 329-2 which encompass both network and terminal characteristics:

- BEST: This is a type of IP telephony service that has the potential to provide a user experience better than the PSTN. It is expected that these systems will to be implemented using wideband codecs (codecs encoding analogue signals with bandwidth in excess of 3,1 kHz) and QoS-engineered IP networks and LAN environments.

- HIGH: This is a type of IP telephony service that has the potential to provide a user experience similar to PSTN (or recent wireless mobile telephony services in good radio conditions, for instance GSM networks using EFR codecs, or systems using G.726 codecs). It is expected that such systems would be implemented over QoS–engineered IP networks where bandwidth usage is optimized.

- MEDIUM: This is a type of IP telephony service that has the potential to provide a user experience similar to common wireless mobile telephony services, for instance GSM networks using FR codecs [z]. It is expected that such systems would be implemented over QoS-engineered IP networks, where network losses or end to end delay are not tightly controlled.

- BEST EFFORT: This type of service will provide a usable communications service but may not provide guarantees of performance. There may be periods of significantly impaired speech quality, and large end-to-end delays which are likely to impact the overall conversational interactivity. It is expected such communications will operate over non QoS-engineered IP networks such as the public Internet.

NOTE: Connections that include a geostationary satellite will incur long propagation delay and consequently will fall into the BEST EFFORT QoS class. It is well recognized that such a satellite section may nevertheless be assumed to be well engineered. QoS characteristics, other than end-to-end delay, may be experienced by the user as corresponding to higher classes as defined in this Document.

For the purposes of voice quality, each of the above classes is defined by three performance metrics:

- Overall Transmission Quality Rating (R);
- Listener Speech Quality (One-way non-interactive end-to-end Speech Quality);
- End-to-end (mean one-way) Delay.

For a system to be considered as achieving a specified QoS class, it shall meet all the three specified performance metrics for that particular class, for 95% of all connections.

4.1 Overall Transmission Quality Rating

Overall transmission quality rating (R) describes the full acoustic-to-acoustic (mouth to ear) quality, experienced by a user, for a typical situation using a "standard" telephony handset.

The overall transmission quality rating is calculated using the E-Model (ITU-T Recommendation G.107). For calculation purposes the use of traditional telephone handsets (ITU-T Recommendation P.310) at both sides of the connection is assumed.

Table 1: **Overall Transmission Quality Rating (R)**

	4 (BEST)	3 (HIGH)	2 (MEDIUM)	1 (BEST EFFORT)
Overall Transmission Quality Rating (R)	See note 2	> 85	> 70	> 50, note 3
NOTE 1: The R-value incorporates all degradations, including the effects of packet loss. NOTE 2: The R-value characterization of systems employing wideband codecs is under study. NOTE 3: The rating for the best effort class is a target value and can be treated as a guaranteed service if the target value is achieved.				

Figure 3 shows the mapping between the "QoS Classes" specified in this document and the "Categories of Speech Transmission Quality" as defined in ITU-T Recommendation G.109.

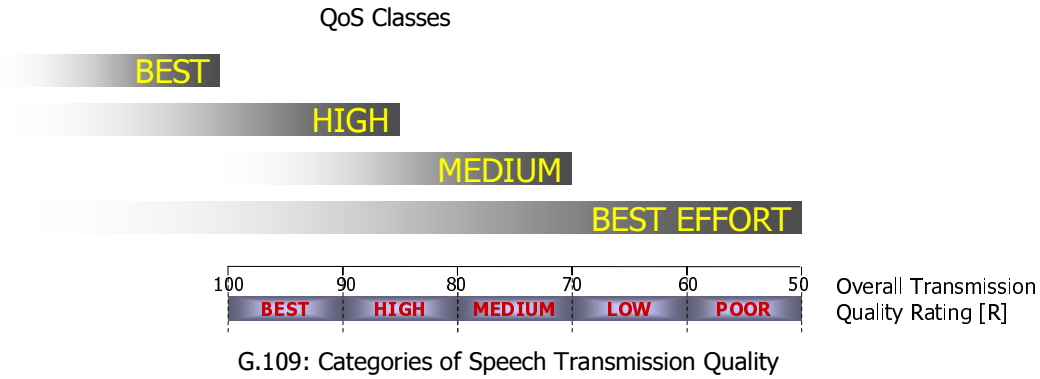


Figure 3: Mapping of QoS Classes to ITU-T Categories

The relation between overall transmission quality rating (R) and user perception of quality is defined in ITU-T Recommendation G.109. Table 2 is extracted from this Recommendation.

Table 2: Categories of Speech Transmission Quality as defined in ITU-T

Overall Transmission Quality Rating	90 ≤ R < 100	80 ≤ R < 90	70 ≤ R < 80	60 ≤ R < 70	50 ≤ R < 60
User's satisfaction	Very satisfied	Satisfied	Some users dissatisfied	Many users dissatisfied	Nearly all users dissatisfied

4.2 Listener Speech Quality

Specifications of listener speech quality for QoS classes are given in Table 3.

Table 3: Listener Speech Quality of TIPHON Systems

	4 (BEST)	3 (HIGH)	2 (MEDIUM)	1 (BEST EFFORT)
Listener Speech Quality (one way, non interactive speech quality)	Better than G.711	Equivalent or better than G.726 at 32 kbit/s	Equivalent or better than GSM-FR	Not defined
NOTE 1: The descriptions in this table include the effects of packet loss. NOTE 2: Listener speech quality may not describe the full acoustic-to-acoustic (mouth to ear) quality that will be experienced by a user, which is dependent on the acoustic quality of the terminal as well as the quality of the network.				

NOTE: The use of codec examples in Table 3 indicates a minimum expected end-to-end speech quality, not a recommended codec for implementation. The performance levels include any degradation caused by network or terminal, such as packet loss.

4.3 End-to-end Delay

Specifications of end-to-end (mean one-way) delay for QoS classes are given in Table 4.

Table 4: End-to-end Delay

	4 (BEST)	3 (HIGH)	2 (MEDIUM)	1 (BEST EFFORT)
End-to-end Delay	< 100 ms	< 100 ms	< 150 ms	< 400 ms
NOTE: The delay for best effort class is a target value.				

5. QoS budget control

In order to enable TIPHON's model of QoS it is essential to consider how the QoS budget within any one class is distributed (brokered). Figure 4 outlines the problem area.

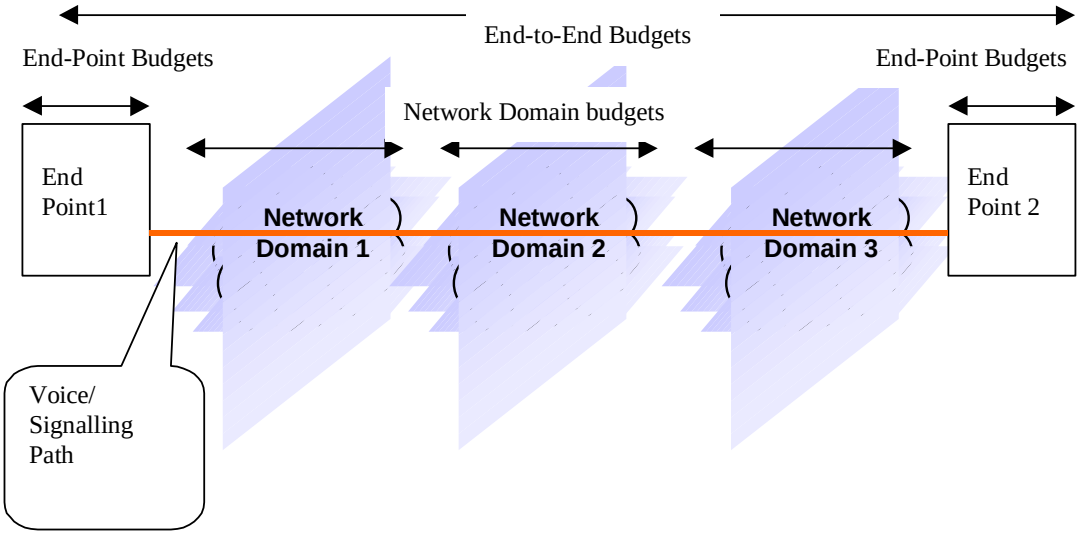


Figure 4: QoS budget allocation

The actual control of budget is achieved using a set of information flows between elements as shown in figure 5:

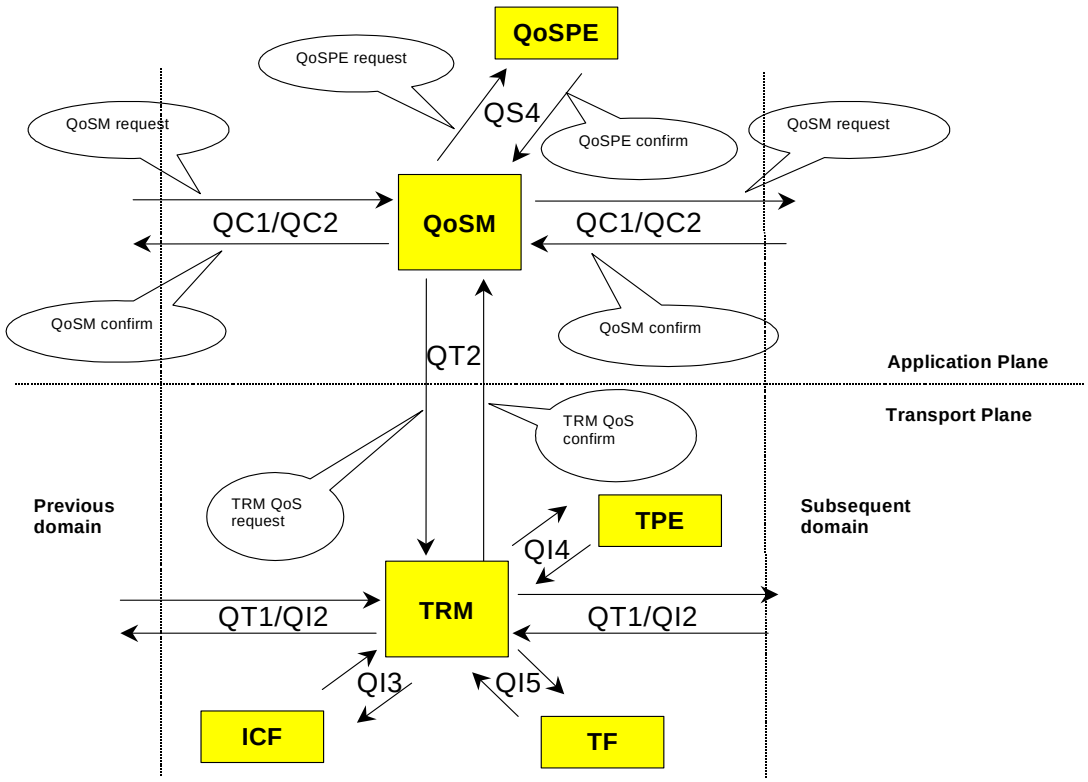


Figure 5: QoS Control information flows

6. QoS Bearer Descriptor

To allow control a number of parameters have to be set and/or established during the negotiation (brokering) phase. These are outlined in figure 6.

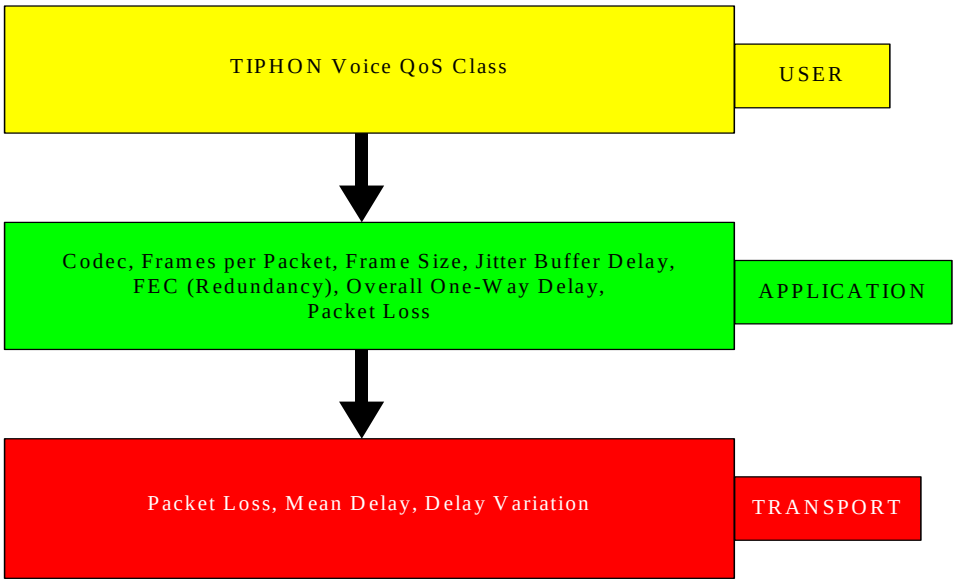


Figure 6: Parameters in control of QoS

The Transport QoS Parameters (Maximum End to end delay, Maximum End-to-end delay variation Maximum Packet loss) completely specify the QoS requirements of the transport flow carrying the bearer.

The format in which these parameters are specified may vary depending on individual circumstances. Different levels of instantaneous control are possible and the way in which the parameters are specified will determine this. In general, there are three possibilities:

1. Specification of whether QoS is to be controlled on the bearer. Best Effort speech communication implies that QoS levels are not specified.

2. Specification that any or all of the three parameters are to be controlled but that the values for the parameters are specified elsewhere. e.g. by service level agreements.

3. Specification of the absolute values for the three parameters.

These three possibilities are provided by the general format of the Transport QoS Parameter Group which is listed below.

Sub-Field 1: Control QoS

ControlQoS	**(boolean)**

Sub-Field 4: Maximum End-to-end delay

FixedDelay	**(boolean)**
MaxDelay	**(numeric)**

Sub-Field 5: Maximum End-to-end delay variation

Fixed MaxDelayVariation	**(boolean)**
MaxDelayVariation	**(numeric)**

Sub-Field 6: Maximum Packet Loss

FixedPacketLoss (boolean)

MaxPacketLoss (numeric)

The definition of each of the above parameters is as follows:

ControlQoS:

This parameter specifies whether QoS is to be specified or controlled over the bearer. If this parameter is not set then the rest of the fields in the Parameter Group would be null fields. TIPHON Class 4 could result in a null being set for this parameter. Best Efforts results would then be a consequence.

FixedDelay:

This parameter would be set for interactive voice communications. There is at present little difference between the maximum permitted end-to-end delay parameters for the three guaranteed TIPHON classes. When this parameter is set, unless specified otherwise in a service level agreement, the default value of 100ms will apply in all cases. When this parameter is set the **MaxDelay** parameter will be null. For streaming applications (which are at present outside the scope of TIPHON) this parameter would be a null as would the **Max Delay** parameter.

FixedMaxDelayVariation:

When this parameter is set a maximum delay variation as specified in a service level agreement shall apply. When this parameter is set the **MaxDelayVariation** parameter will be null. For data or streaming applications (which are at present outside the scope of TIPHON) this parameter would be a null as would the **MaxDelayVariation** parameter.

FixedPacketLoss:

When this parameter is set a maximum packet loss as specified in a service level agreement shall apply. When this parameter is set the **MaxPacketLoss** parameter will be null. For some media flows, such as data (which are at present outside the scope of TIPHON), packet loss is not a critical factor, as error control mechanisms, such as those found in TCP, may be applied. In this situation it may not be necessary to specify maximum packet loss. This is achieved by setting this parameter also the **MaxPacketLoss** parameter to a null.

The numeric fields contain values of delay and delay variation specified in ms, bit rates in bits/s, and packet loss in lost packets/sec.

7. Control of QoS in TIPHON

As has already been broadly described the QoS control mechanisms in TIPHON are layered and distributed using a form of contract broking. The further detail of how this management is performed is shown in figure 7 which illustrates the functional elements and how they fit to the planar architecture.

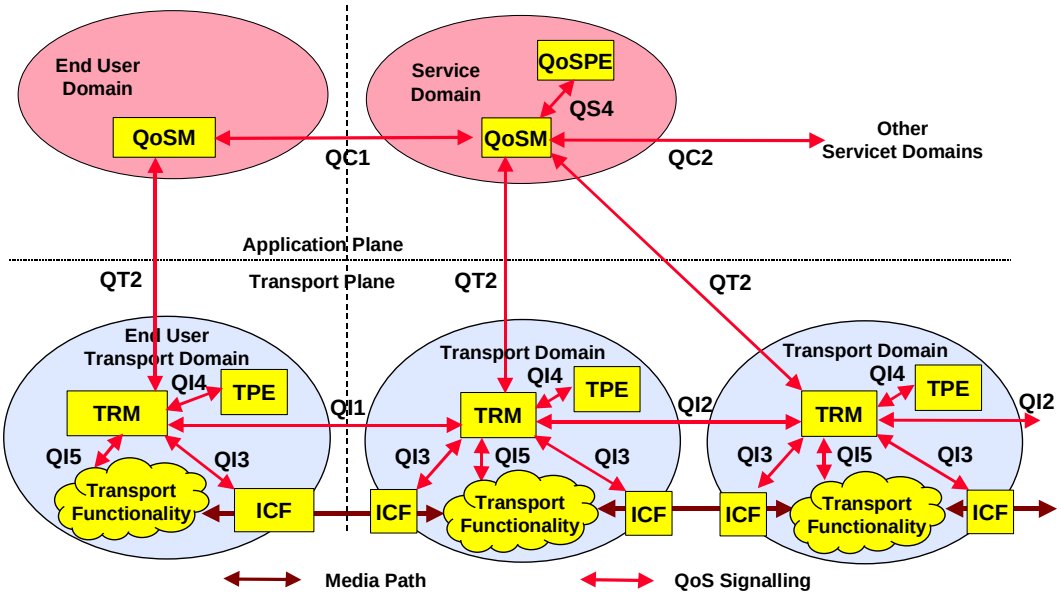


Figure 7: Functional elements in TIPHON QoS

The elements shown in the picture have the following definitions:

QoS Policy Entity (QoSPE): An entity that manages policies and provides authorisation of permitted and default QoS levels. It receives requests from and issues responses to QoSMs to establish the authorised end to end QoS levels.

QoS Service Manager (QoSM): An entity that mediates requests for end to end QoS in accordance with policy determined by the QoSPE. It communicates with User Equipment, other QoSMs and with RPMs to determine, establish and control the offered QoS.

Transport Resource Manager (TRM): An entity that applies a set of policies and procedures to a set of transport resources to ensure that those resources are allocated to enable QoS guarantees across the domain of control of the RM.

Transport Policy Entity (TPE): An entity that manages policies and provides authorisation of permitted and default QoS levels. It receives requests from, and issues responses to TRMs to establish the authorised end-to-end QoS levels.**Interconnect Function (ICF):** An entity that polices authorised media flows within a Transport Domains to ensure they are consistent with the QoS policy specified by the Transport Resource Manager.

7.1 Application with SIP

Figure 8 shows how the same form of architecture fits to the SIP domain.

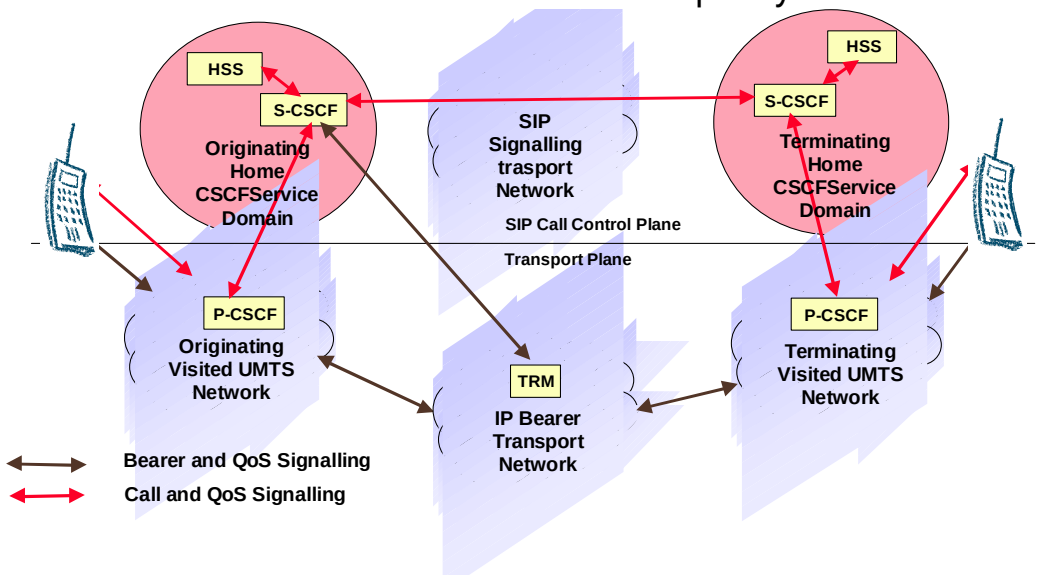


Figure 8: Functional elements of TIPHON QoS applied to SIP

8. Conclusion

The work done in TIPHON to date complements that of 3GPP for both the all-IP transport case (R2000) and for the mixed transport case. It is recommended that the work of 3GPP and of TIPHON should be combined to generate a general model for QoS in future networks for future services.