

**Telecommunications and Internet Protocol
Harmonization Over Networks (TIPHON) Release 4;
End-to-end Quality of Service in TIPHON Systems;
Part 2: Definition of Speech Quality of Service (QoS) Classes**



Reference

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON).

The present document is part 2 of a multi-part deliverable covering end-to-end Quality of Service in TIPHON systems, as identified below:

- TR 102 024-1: "General aspects of Quality of Service (QoS)";
- TS 102 024-2: "Definition of Speech Quality of Service (QoS) Classes";**
- TS 102 024-3: "Signalling and Control of end-to-end Quality of Service";
- TS 102 024-4: "Quality of Service Management";
- TS 102 024-5: "Quality of Service (QoS) measurement methodologies";
- TR 102 024-6: "Actual measurements of network and terminal characteristics and performance parameters in TIPHON networks and their influence on voice quality";
- TR 102 024-7: "Design guide for elements of a TIPHON connection from an end-to-end speech transmission performance point of view";
- Part 8: Void;
- TS 102 024-9: "Call performance Classification (Voice)";
- Part 10: To be published as part of release 5 (see note) "QoS Requirements for TIPHON Terminals";
- Part 11: To be published as part of release 5 (see note) "Domain by domain performance planning guidelines for end-to-end QoS objectives associated with TIPHON speech QoS classes";
- TS 102 024-12: "IP Telephony Service Availability".

NOTE: Quality of Service aspects of TIPHON Release 5 systems will be covered in TS 102 025 (see bibliography), and more comprehensive versions of the Release 4 documents listed above will be published as part of Release 5 as work progresses.

Introduction

The present document forms one of a series of technical specifications and technical reports produced by TIPHON Working Group 5 addressing Quality of Service (QoS) in TIPHON Systems.

1 Scope

The present document defines five classes of Quality of Service for characterizing the speech performance of TIPHON compliant IP voice telephony networks.

The classes of service apply to all the defined TIPHON Scenarios and are specified in terms of the following parameters:

- "Overall transmission quality rating";
- "Listener speech quality" (one-way non-interactive speech quality); and
- "End-to-end delay".

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] ETSI EN 300 961: "Digital cellular telecommunications system (Phase 2+) (GSM); Full rate speech; Transcoding (GSM 06.10 version 7.0.2 Release 1998)".
- [2] ETSI EN 300 726: "Digital cellular telecommunications system (Phase 2+) (GSM); Enhanced Full Rate (EFR) speech transcoding (GSM 06.60 version 7.0.2 Release 1998)".
- [3] ETSI TS 102 024-5: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; End-to-end Quality of Service in TIPHON Systems; Part 5: Quality of Service (QoS) measurement methodologies".
- [4] ITU-T Recommendation G.107: "The E-Model, a computational model for use in transmission planning".
- [5] ITU-T Recommendation G.109: "Definition of categories of speech transmission quality".
- [6] ITU-T Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".
- [7] ITU-T Recommendation G.726: "40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)".
- [8] ITU-T Recommendation P.310: "Transmission characteristics for telephone-band (300 Hz to 3 400 Hz) digital telephones".
- [9] ITU-T Recommendation G.114: "One-way transmission time".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following term and definition apply:

codec: combined speech encoder and decoder

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

EFR	Enhanced Full Rate
FR	Full Rate
GSM	Global System for Mobile communications
IP	Internet Protocol
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication standardization sector (former CCITT)
PSTN	Public Switched Telephone Network
QoS	Quality of Service

4 Definition of TIPHON Speech QoS classes

Three classes of end-to-end speech QoS are defined for TIPHON systems. The following TIPHON speech QoS classes are defined from mouth-to-ear and therefore include both the network and the TIPHON terminal characteristics:

- **WIDEBAND:** this is a type of IP telephony service will provide a user experience better than the PSTN. It is expected that these systems will be implemented using wideband codecs (codecs encoding analogue signals with bandwidth in excess of 3,1 kHz) and QoS-engineered IP networks;
- **NARROWBAND:** this is a type of IP telephony service will provide a user experience similar to PSTN. It is expected that such systems would also be implemented over QoS-engineered IP networks:
 - **NARROWBAND/HIGH:** this quality is equivalent to recent ISDN services;
 - **NARROWBAND/MEDIUM:** this quality is equivalent to recent wireless mobile telephony services in good radio conditions, for instance GSM networks using EFR codecs (see EN 300 726 [2]), or systems using ITU-T Recommendation G.726 [7] at 32 kbit/s codecs;
 - **NARROWBAND/ACCEPTABLE:** this quality is equivalent to common wireless mobile telephony services, for instance GSM networks using FR codecs (see EN 300961 [1]) or systems including a geostationary satellite.
- **BEST EFFORT:** this type of service will provide a usable communications service but will 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.

The TIPHON speech QoS classes WIDEBAND and NARROWBAND will provide performance guarantees for 95 % of all connections. The BEST EFFORT class provides no speech performance guarantees.

5 TIPHON speech QoS performance metrics

Each of the classes defined in clause 4 is specified by three performance metrics:

- Overall transmission quality rating (R);
- Listener speech quality (One-way non-interactive end-to-end Speech Quality); and
- End-to-end (mean one-way) delay.

To comply with a specific speech QoS class a TIPHON system shall meet the limits of "Overall Transmission Quality Rating [R]" given in table 1. In addition the limits of "End-to-end Delay" and "Listener Speech Quality" given in tables 3 and 4 respectively shall be met in the very same class.

NOTE: The measurement of "Overall Transmission Quality Rating (R)", "Listener Speech Quality" and "End-to-end Delay" are described in TS 102 024-5 [3].

5.1 Overall transmission quality rating

Overall transmission quality rating (R) describes the full acoustic-to-acoustic (mouth to ear) quality, experienced by an average 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 [4]). For calculation purposes the use of traditional telephone handsets (ITU-T Recommendation P.310 [8]) at both sides of the connection is assumed.

Table 1: Overall transmission quality Rating (R) for TIPHON systems

	3 (WIDEBAND)	2 (NARROWBAND)			1 (BEST EFFORT)
		2H (HIGH)	2M (MEDIUM)	2A (ACCEPTABLE)	
Overall Transmission Quality Rating (R)	(see note 2)	> 80	> 70	> 50	> 50, (see 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.					
NOTE 4: The speech quality levels given in the present table shall apply for a percentage of the duration of a call. The percentage of the duration when speech quality falls below the specified levels and the distribution and duration of the intervals when this occurs is for further study.					
NOTE 5: The percentage of occasions that a requested (or contracted) speech quality level is not available for any reason is a Grade of Service issue and is a matter of policy for individual service providers.					
NOTE 6: What happens if a requested or contracted QoS level is not available is subject to the policies of individual service providers.					

The relation between overall transmission quality rating (R) and user perception of quality is defined in ITU-T Recommendation G.109 [5]. Table 2 is extracted from this recommendation.

Table 2: Categories of speech transmission quality as defined in ITU-T

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

5.2 Listener speech quality of TIPHON systems

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

Table 3: Listener speech quality of TIPHON systems

	3 (WIDEBAND)	2 (NARROWBAND)			1 (BEST EFFORT)
		2H (HIGH)	2M (MEDIUM)	2A (ACCEPTABLE)	
Relative Speech Quality (one way, non interactive speech quality)	Better than G.711 [6]	Equivalent or better than ITU-T Recommendation G.726 at 32 kbit/s [7]	Equivalent or better than GSM-FR [1]	Not defined	Not defined
Resultant Overall Transmission Quality Rating (R)	n.a.	> 86	> 73	> 50	> 50

NOTE 1: The R values above are derived from E-Model calculations assuming that perfect echo control is deployed, that there is zero delay through the system, that standard terminals are used, also that all impairments related to low bit-rate coding - including the effects of packet loss - are taken into account.

NOTE 2: "Relative speech quality" does not describe the Listener Speech Quality (the full acoustic-to-acoustic (mouth to ear) quality that will be experienced by a user). This will be dependent on the acoustic quality of the individual TIPHON terminal as well as the quality of the TIPHON network.

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

NOTE 4: The speech quality levels given in the present table shall apply for a percentage of the duration of a call. The percentage of the duration when speech quality falls below the specified levels and the distribution and duration of the intervals when this occurs is for further study.

NOTE 5: The percentage of occasions that a requested (or contracted) speech quality level is not available for any reason is a Grade of Service issue and is a matter of policy for individual service providers.

NOTE 6: What happens if a requested or contracted QoS level is not available is subject to the policies of individual service providers.

5.3 End-to-end delay

Specifications of end-to-end (mean one-way) delay for TIPHON QoS classes are based on ITU-T Recommendation G.114 [9] and are given in table 4.

Table 4: End-to-end delay for TIPHON Systems

	3 (WIDEBAND)	2 (NARROWBAND)			1 (BEST EFFORT)
		2H (HIGH)	2M (MEDIUM)	2A (ACCEPTABLE)	
End-to-end Delay	< 100 ms	< 100 ms	< 150 ms	< 400 ms	< 400 ms

NOTE 1: The delay for best effort class is a target value.

NOTE 2: The speech quality levels given in the present table shall apply for a percentage of the duration of a call. The percentage of the duration when speech quality falls below the specified levels and the distribution and duration of the intervals when this occurs is for further study.

NOTE 3: The percentage of occasions that a requested (or contracted) speech quality level is not available for any reason is a Grade of Service issue and is a matter of policy for individual service providers.

NOTE 4: What happens if a requested or contracted QoS level is not available is subject to the policies of individual service providers.

Annex A (informative): Bibliography

ETSI TS 102 025 series: TIPHON Release 5 QoS documents.

History

Document history		
V1.1.1	July 2000	Publication as TS 101 329-2 (Historical)
V2.1.1	June 2001	Publication as TS 101 329-2 (Withdrawn)
V2.1.2	July 2001	Publication as TS 101 329-2
V2.1.3	January 2002	Publication as TS 101 329-2
V4.1.1	September 2003	Publication