ETSI TR 126 944 V16.1.0 (2021-01)

Universal Mobile Telecommunications System (UMTS);
LTE;
5G;
End-to-end multimedia services performance metrics
(3GPP TR 26.944 version 16.1.0 Release 16)

Reference
RTR/TSGS-0426944vg10

Keywords
5G,LTE,UMTS

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Copyright Notification

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Legal Notice

This Technical Report (TR) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Foreword

This Technical Report has been produced by the 3GPP.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version 3.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 Indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

Introduction

The Quality of Experience (QoE), End-to-end Service Quality of Service (ESQoS) and System Quality of Service (SQoS) are important factors when introducing services to customers. When the next releases of 3G are launched to the mass market, several new mobile telecommunication multimedia services will be introduced to the general public. It is essential that a high quality if service is experienced by the user of these new 3G services in order to promote the idea of 3G as a global all-purpose communication tool for millions of people with widespread availability of terminal equipment.

The possibility of using multimedia services via 3G in a practical and reliable manner is extremely important in the near future. For these new services, it is certain that a much larger amount of traffic is generated between mobile terminals and services, i.e. traffic within 3G networks and between 3G networks and other networks will be higher than has been the case to date. This gives more importance to service quality requirements.

End-to-end multimedia service performance metrics are proposed to make it possible for operators, device provider and service providers to more conveniently evaluate their service quality as perceived by end-users. This includes:

- Definition of the performance characteristics that have most relevance to end users (the 'Quality of Experience' or QoE).
- Definition of the mapping between QoE and end-to-end service measured characteristics (the ESQoS), and mapping between ESQoS and service specific characteristics (the SQoS).

In the present document a top-down approach is used to illustrate the framework of all metrics.

The present document gives metrics of the end-to-end multimedia service performance on 3G networks that support PSS, PSC, video telephony, MBMS and IMS services, etc.

QoE parameters describe the end-to-end quality as experienced by the end users. These are difficult to measure and quantify.

SQoS parameters are metrics that are close related to the network status, and defined from the viewpoint of the service provider rather than the service user. SQoS parameters can be viewed as the inherent attributes of the networks, which are important in guaranteeing QoE requirements of the users.

ESQoS parameters describe the QoS of the end-to-end service. They are obtained directly from the QoE parameters by mapping them into parameters more relevant to operators, service providers and service providers.

In Annex A, PSS is taken as an example; several general models looking at different part of network are given. A mapping between QoE, ESQoS and SQoS is given using a mathematical approach, which defines a dimensioned relationship between user experiences and lower tiers of network performance.

1 Scope

The present document describes and defines performance metrics for popular multimedia services in 3G networks, including packed-switched streaming service (PSS), multimedia broadcast multicast service (MBMS), video telephony (VT), and IP multimedia subsystem service (IMS). The present document has a top-down approach, which starts with the Quality of Experience (QoE) parameters and metrics, and then provides End-to-end Service QoS (ESQoS) and System Quality of Service (SQoS) parameters and metrics and mapping between these different layers.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 23.107:"Technical Specification Group Services and System Aspects; Quality of Service (QoS) concept and architecture".

[2] 3GPP TS 23.207: "Technical Specification Group Services and System Aspects; End-to-end Quality of Service (QoS) concept and architecture".

[3] ETSI TS 102 250-2 V1.4.1 (2006-03): "Speech Processing, Transmission and Quality Aspects (STQ);QoS aspects for popular services in GSM and 3G networks; Part 2: Definition of Quality of Service parameters and their computation".

[4] IETF RFC 2679: "A One-way Delay Metric for IPPM".

[5] IETF RFC 3133: "Terminology for Frame Relay Benchmarking".

[6] ITU-R Recommendation BS.1387-1: "Method for objective measurements of perceived audio quality".

[7] 3GPP TS 26.234: "Technical Specification Group Services and System Aspects; Transparent end-to-end Packet-switched Streaming Service (PSS); Protocols and codecs".

[8] 3GPP TS 26.346: "Technical Specification Group Services and System Aspects; Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".

[9] ITU-T Recommendation P.10/G.100: "Vocabulary for performance and quality of service".

3 Abbreviations

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

AS	Application Server
BGCF	Breakout Gateway Control Function
BM-SC	Broadcast-Multicast - Service Centre
CBC	Cell Broadcast Centre
CSCF	Call Session Control Function
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
ESQoS	End-to-end Service QoS
GGSN	Gateway GPRS Support Node

HSS	Home Subscriber Server
I-CSCF	Interrogating-CSCF
IMS	IP Multimedia Subsystem
IP-CAN	IP-Connectivity Access Network
LAV	Least Acceptable Value
MBMS	Multimedia Broadcast/Multicast Service
MGCF	Media Gateway Control Function
MGW	Media GateWay
P-CSCF	Proxy-CSCF
PSC	Packet-Switched Conversational service
PSS	Packed-Switched Streaming service
QoE	Quality of Experience
QoS	Quality of Service
SQoS	System Quality of Service
UE	User Equipment
VLR	Visitor Location Register
VT	Video Telephony

4 General description and approach

4.1 Definitions

Quality of Experience (QoE)

The overall acceptability of an application or service, as perceived subjectively by the end-user (see notes 1 and 2).

NOTE 1: Quality of Experience includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc).

NOTE 2: Overall acceptability may be influenced by user expectations and context.

For the purpose of the present document, QoE is limited to those parameters that are reasonably expected to be under the control of the Service Provider, i.e. it excludes aspects of specific terminal equipment implementation. In the document, the exact E2E measurement point will be defined for each service.

QoE indicates performance metrics as expressed from the end service user's point of view. They can be required or reported by the common users, and may be stated irrespective of their measurability.

SA4 has defined Quality of Experience (QoE) metrics and their transport for PSS and MBMS in [7] and [8], respectively. The PSS and MBMS QoE metrics features are optional for both PSS and MBMS streaming server and clients, and shall not disturb the PSS and MBMS service. A PSS or MBMS client supporting the feature shall perform the quality measurements in accordance to the measurement definitions, aggregate them into client QoE metrics and report the metrics to the PSS or MBMS server using described procedures in [7] and [8] for PSS and MBMS, respectively. The way the QoE metrics are processed and made available is out of the scope of the present document.

In general, a Service Provider will set service requirements in line with the end-user's expected QoE, which needs to be translated into parameters or metrics that the service provider can control or measure. Thus, it is necessary to map QoE metrics to measurable End-to-end Service QoS and System QoS parameters, which provide the means for the service providers to guarantee the service quality.

End-to-end Service QoS (ESQoS)

ESQoS is generally used to specify the performance of services from the perspective of operators and service providers. As the number of new services proliferates and becomes more complex, it is important for an operator to measure a network's ESQoS accurately and continuously improve it to achieve customer loyalty and maintain competitive edge.

ESQoS is measurable. It can be quantified exactly by several digital parameters, unlike QoE.

System Quality of Service (SQoS)

The concept of SQoS is a subset of conventional QoS, which is defined in ITU-T Recommendation E.800 as the collective effect of service performances which together determines the satisfaction of a user of a service. It is characterized by the combined aspects of performance factors applicable to all services, such as:

- service support performance;
- service operability performance;
- service accessibility performance;
- service retainability performance;
- service integrity performance;
- service security performance;

Compared with ESQoS, SQoS denotes the point-to-point QoS, which is specifically related to the units and links of network systems, rather than the whole service or a network. SQoS can be viewed as the QoS consideration from the viewpoint of network operators.

4.2 QoE parameters

From the user perspective, the QoE cannot be defined only from technical measurements. It should be defined by user investigation using the following methods:

1. Users provide an opinion of QoE only with their feeling and experience. The QoE metric is subjective.
2. With some classic indicators of QoE, users can make a decision to choose some of them as the necessary indicators of QoE.

Service performance is characterized by the following:

Because QoE parameters and metrics directly relate to the definition of the service itself, it is possible to map the components of the service onto measurable ESQoS and SQoS parameters or metrics, as these relate directly to the performance of the components of the service.

This concept can be illustrated by considering the example of a video service, where QoE includes items such as:

- service setup delay;
- re-buffering duration;
- end to end delay;
- corruption duration;
- mean time between corruption;
- content quality(e.g. digital TV-like quality, analog TV-like quality, DSL-like video conference quality ISDN-like video conference quality, etc.);
- audio/video synchronization (or 'lip sync');
- service availability.

Common user requirements for different services are therefore collected and classified as our QoE, disregarding the measurability.

Users have different requirements for different services. So the QoE for service analysis varies with the types of services, methods of delivery and points of monitoring.

Figure 1 shows the model.

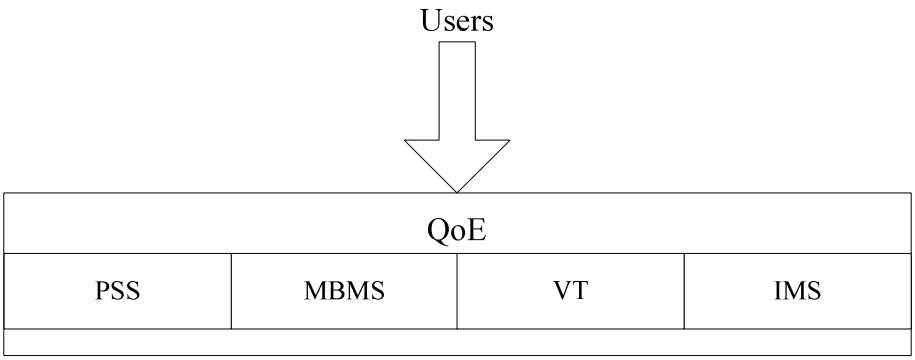

Figure 1: QoE

4.3 ESQoS parameters

As discussed, the user's definition of QoE does not consider measurability and so ESQoS parameters need to be introduced. These express QoS from the viewpoint of operators and service providers. ESQoS parameters are from end-to-end perspective, i.e. across the full set of components which together provide a service, and, most importantly can be measured and quantified.

ESQoS parameters depend on the type of service, and so there will be a set corresponding to each service.

Figure 2 shows the model including both the QoE and ESQoS aspects.

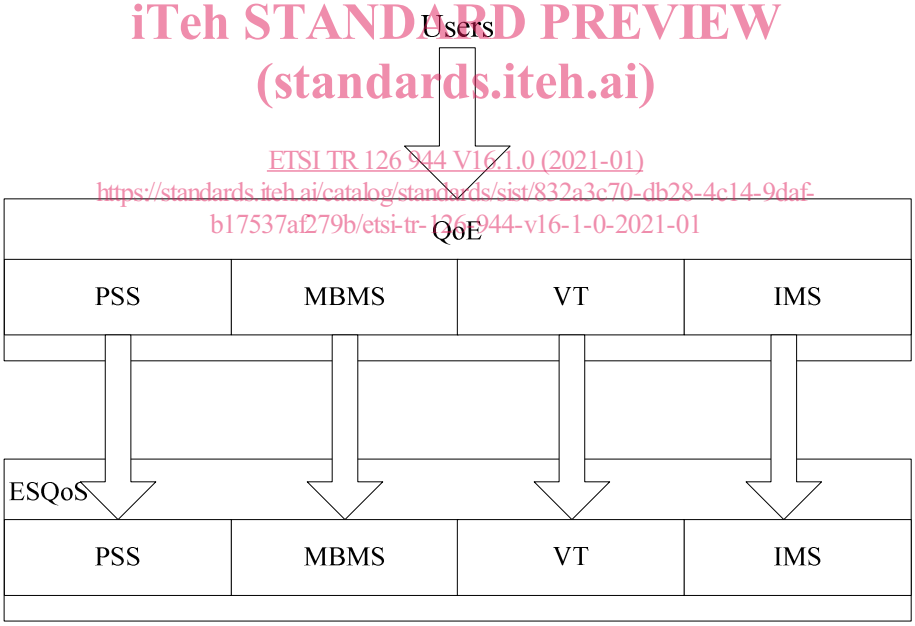

Figure 2: QoE and ESQoS parameters

4.4 SQoS parameters

The quality of a service perceived by the user perceives is influenced by the network as well as by the terminal equipment. As the intelligence and complexity of an application used in 3G increases, application performance becomes an important factor in determining the quality perceived by the user. Within the present document, the influence of the terminal equipment and application have not been included.

Services are applications running on the common network components. SQoS parameters are specific metrics that provide measurements which reflect network component status, and are defined from the viewpoint of the service provider rather than the service user.

SQoS parameters can be classified to five classes as shown in figure 3.

NOTE: The network entities in the core network (CN) can be considered as servers.

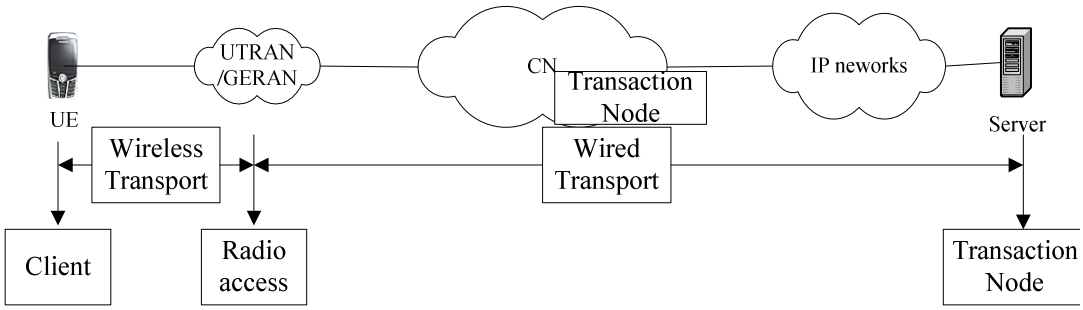

Figure 3: Five classes' scopes

Each class also has three layers which reflect the protocol layers in the network.

- The first s the Application layer.
- The second is the Transport layer.
- The third consists of Network, Data link and Physical layers.

Figure 4 presents the overall model.

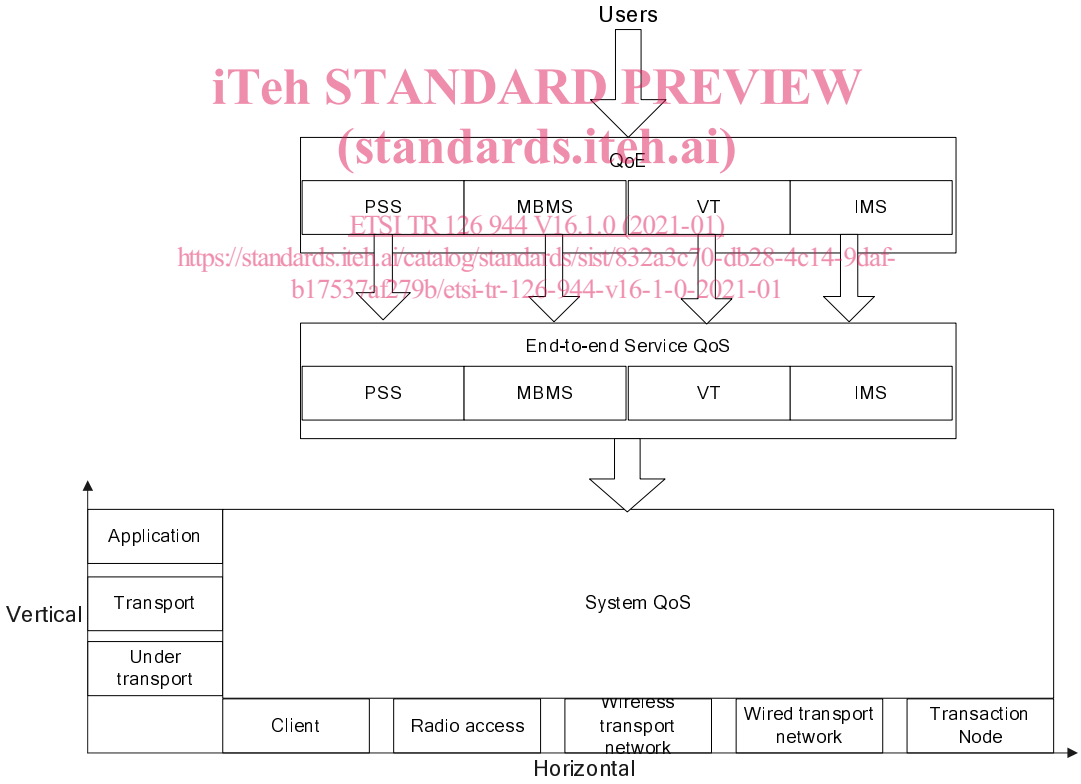

Figure 4: QoE, ESQoS and SQoS parameters

5 QoE parameters

5.1 General

The parameters and values in the following sections are necessary for the support of 3G services.

Firstly, for mobile communication systems, service performance depends on network availability factors expressed in terms of time availability (% of the time) and radio coverage availability (% of the radio coverage).

Service-specific QoE parameters may include, for the telephony service as an example, speech quality, level of background noise, level of echo, delay, etc. This section provides a parameter list for a Audio/Video service, each parameter would be calibrated on the following basis:

- 95 % probability;
- mean;
- target value;
- Least Acceptable Value (LAV).

This forms the basis of candidate material for standardization, and must be aligned with the work of the ITU-T.

5.2 Service non-access

The service cannot be accessed by the UE when requested by the user. The service non-access may be caused by the network unavailability or shutdown of service server, etc.

5.3 Service failure

The service can be accessed, but something occurs once the service is in use resulting in failure of service for the user. The service failure may be caused by overload of server, handoff of user or network congestion, etc.

5.4 Service setting-up time

The service setting-up time is the period from the time of service request to the time of service playing. The service setting-up time may vary from microsecond to seconds, and depends on the service requested by the user.

5.5 Re-buffering

Re-buffering denotes the time and the frequency of re-buffering during the usage of service. The main reason of re-buffering is the data network transmission rate cannot keep up with the real-time play requirements of the user's terminal.

5.6 Image corruption

Image corruption refers to the degree of corruption quality of a single image.

5.7 Edge noise

Edge Noise denotes the form of edge busyness that is characterized by spatially varying distortion that occurs in close proximity to the edges of objects in a video display.

5.8 Blurriness

Blurriness denotes the image/video quality as being indistinct.

5.9 Colour reproduction accuracy

Colour reproduction denotes the quality of accuracy in colour reproduction procedure.

5.10 Blockiness

Blockiness refers to the degree of image distortions that occurs in DCT-block edge compression due to compression error or packet loss.

5.11 Incontinuous image with block

Incontinuous image with block denotes the degree of data block consistency among continuous frames.

5.12 Freeze image

Freeze image refers to the degree of frozen image when video is playing, which is caused by inadequate received data or low frame transmission rate.

5.13 Audio quality

Audio quality describes the quality of audio as perceived by the user and mainly is decided by the codec algorithm, network transmission delay and capacity of terminal.

5.14 Audio/Video synchronization error

Audio/video synchronization error describes the time difference of the audio and video signal at the user side. Audio/video synchronization error is mainly caused by the network transmission delay and buffering delay.

6 ESQoS parameters

6.1 General

The ESQoS parameters can be obtained directly from the QoE. The process is shown in figure 5.

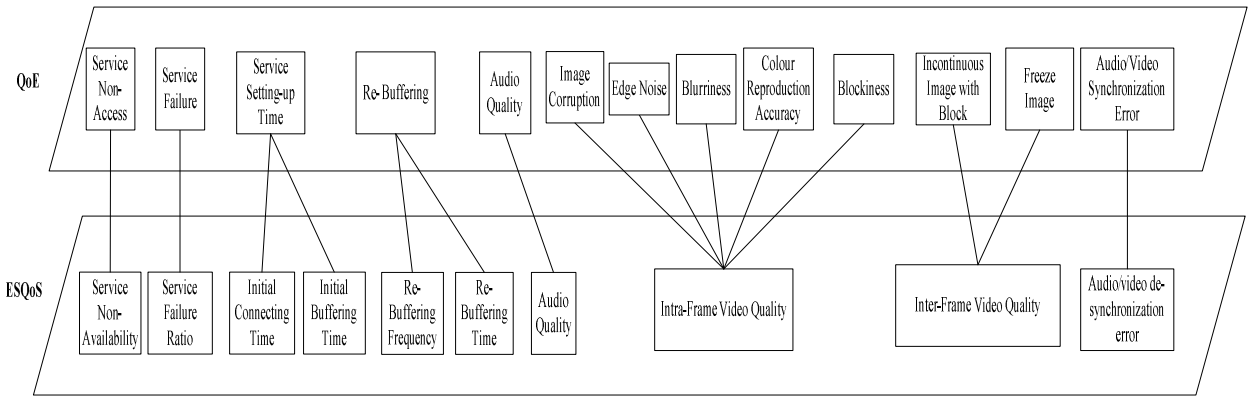

Figure 5: The ESQoS parameters from QoE