



TECHNICAL SPECIFICATION

**Speech and multimedia Transmission Quality (STQ);  
Reference benchmarking,  
background traffic profiles and KPIs;  
Part 3: Reference benchmarking, background traffic profiles  
and KPIs for UMTS and VoLTE**

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Reference

DTS/STQ-219-3

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Keywords

KPI, QoS

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# Contents

Intellectual Property Rights .....	4
Foreword.....	4
Modal verbs terminology.....	4
Introduction .....	4
1 Scope .....	5
2 References .....	5
2.1 Normative references .....	5
2.2 Informative references.....	6
3 Definitions and abbreviations.....	6
3.1 Definitions .....	6
3.2 Abbreviations .....	6
4 Management Summary.....	7
4.1 Introduction .....	7
4.2 Scope of functionality .....	7
5 Technical concept.....	8
5.1 Introduction .....	8
5.2 Network side measurements in mobile networks .....	8
5.3 Call set-up delay.....	8
5.4 Telephony Setup Time .....	9
5.5 Listening speech quality .....	10
5.5.1 General aspects of Listening Speech Quality.....	10
5.5.2 General aspects of voice channel test calls .....	10
5.5.3 Connections without parallel data transfer.....	10
5.5.3.1 Connections with one voice channel.....	10
5.5.3.2 Multiple voice channel access.....	12
5.5.4 Connections with parallel data transfer.....	12
5.5.4.1 Connections with one voice channel and parallel data transfer.....	12
5.5.4.2 Parallel quality measurement of one voice channel and data transmission speed.....	13
5.5.4.3 Quality measurement of multiple voice channels and data transfer .....	13
5.5.4.4 Parallel quality measurement of multiple voice channels and data transmission speed.....	13
6 Broadband Speed Test (BST) - Measurement method of data transmission speed and transit time.....	14
6.1 Introduction .....	14
History .....	15

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## Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

The present document is part 3 of a multi-part deliverable covering then Reference benchmarking, background traffic profiles and KPIs as identified below:

- Part 1: "Reference benchmarking, background traffic profiles and KPIs for VoIP and FoIP in fixed networks";
- Part 2: "Reference benchmarking and KPIs for High speed internet";
- Part 3: "Reference benchmarking, background traffic profiles and KPIs for UMTS and VoLTE";**
- Part 4: "Reference benchmarking for IPTV, Web TV and RCS-e Video Share".

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## Modal verbs terminology

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## Introduction

The present document describes the reference benchmarking, background traffic profiles and key performance Indicators for UMTS and VoLTE.

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# 1 Scope

The offer of new NGN services requires new:

- KPIs;
- QoS measurement; and
- benchmarking methods

which are needed to ensure the quality of new services. To ensure the comparability of test results, reference benchmarking methods and background traffic load profiles are needed.

The present document:

- identifies and defines possible key performance indicators for voice and fax telephony services;
- defines benchmarking methods for the spectrum of potential applications.

The scope of the defined testing procedures is the evaluation of the network access by VoIP and FoIP for mobile - network services. The measurements are conducted between a mobile device to a measurement point which can be a mobile device or a device emulating an idealized termination point in the core network. All access technologies offered by the operator under test are considered. In this context the measurements and key performance indicators determinations are performed by analysing signals accessible on the network.

The present document is not intended to overlap with the scope of the series ETSI TS 102 250 [i.3]. Measurements described in that series are not affected by the provisions of the present document.

The present document contains possible KPIs for UMTS and VoLTE as well as framework requirements for reference benchmarking particularly with regard to background traffic profiles.

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## 2 References

### 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] Recommendation ITU-T E.800 (2008): "Definitions of terms related to quality of service".
- [2] ETSI TS 102 250-2 (V2.3.1): "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 2: Definition of Quality of Service parameters and their computation".
- [3] ETSI TS 101 563 (V1.3.1): "Speech and multimedia Transmission Quality (STQ); IMS/PES/VoLTE exchange performance requirements".
- [4] Recommendation ITU-T Q.543 (1993): "Digital exchange performance design objectives".
- [5] ETSI TS 103 222-1: "Speech and multimedia Transmission Quality (STQ); Reference benchmarking, background traffic profiles and KPIs; Part 1: Reference benchmarking, background traffic profiles and KPIs for VoIP and FoIP in fixed networks".

- [6] ETSI TBR 003 ed.1 (11-1995): "Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access".
- [7] ETSI TBR 004 ed.1 (11-1995): "Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN primary rate access".

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EG 202 425 (V1.1.1): "Speech Processing, Transmission and Quality Aspects (STQ); Definition and implementation of VoIP reference point".
- [i.2] ETSI EG 202 057-2: "Speech and multimedia Transmission Quality (STQ); User related QoS parameter definitions and measurements; Part 2: Voice telephony, Group 3 fax, modem data services and SMS".
- [i.3] ETSI TS 102 250 (all parts): "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**benchmark:** evaluation of performance value/s of a parameter or set of parameters for the purpose of establishing value/s as the norm against which future performance achievements may be compared or assessed

NOTE: The definition is taken from Recommendation ITU-T E.800 [1].

### 3.2 Abbreviations

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

AGCF	Access Gateway Control Function
BRI	Basic Rate Interface
BST	Broadband Speed Test
CCCH	Common Control Channel
CS	Circuit Switched
CSFB	Circuit Switched Fall Back
DTMF	Dual-Tone Multi-Frequency signalling
EG	ETSI Guide
EPS	Evolved Packet System
ESM	EPS Session Management
GSM	Global System for Mobile communications
HTTP	Hypertext Transfer Protocol
IMS	Internet Multimedia Subsystem
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU-T	Telecommunication Standardization Sector of the International Telecommunications Union
KPI	Key Performance Indicator
LTE	Long Term Evolution
MMTel	Multimedia Telephony service

NGN	New Generation Network
PES	PSTN Emulation Subsystem
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
RACH	Random Access Channel
RRC	Radio Resource Control
SIP	Session Initiation Protocol
TV	Television
UMTS	Universal Mobile Telecommunications System
VGW	Voice GateWay
VoIP	Voice over IP
VoLTE	Voice over LTE

## 4 Management Summary

### 4.1 Introduction

The spectrum of potential applications of a benchmarking platform requires measurements including but not limited to the following: analogue (a/b), ISDN, VoIP (including SIP trunking), high-speed internet, UMTS and VoLTE.

The performance data which are collected will be relevant for a real-world environment encompassing a mix of technologies. This approach ensures that service quality is evaluated from a customers' point of view, since all system components involved in an end-to-end connection are incorporated into the test.

### 4.2 Scope of functionality

A benchmarking platform can be distributed across a larger region or an entire country. In this case several server systems should be also part of the setup, including: a business intelligence platform; a data warehouse, a management system and a system for evaluating of media (e.g. video, audio and voice) quality.

The measurement systems at the **user premises** are connected electrically to VoLTE and UMTS.

**The test system** (QoS control and data server) is connected through UMTS, LTE or ISDN connections (via IMS PES with AGCF (or PSTN or ISDN Access) or IMS PES with VGW) or MMTel (IMS) fixed access lines for voice quality measurements.

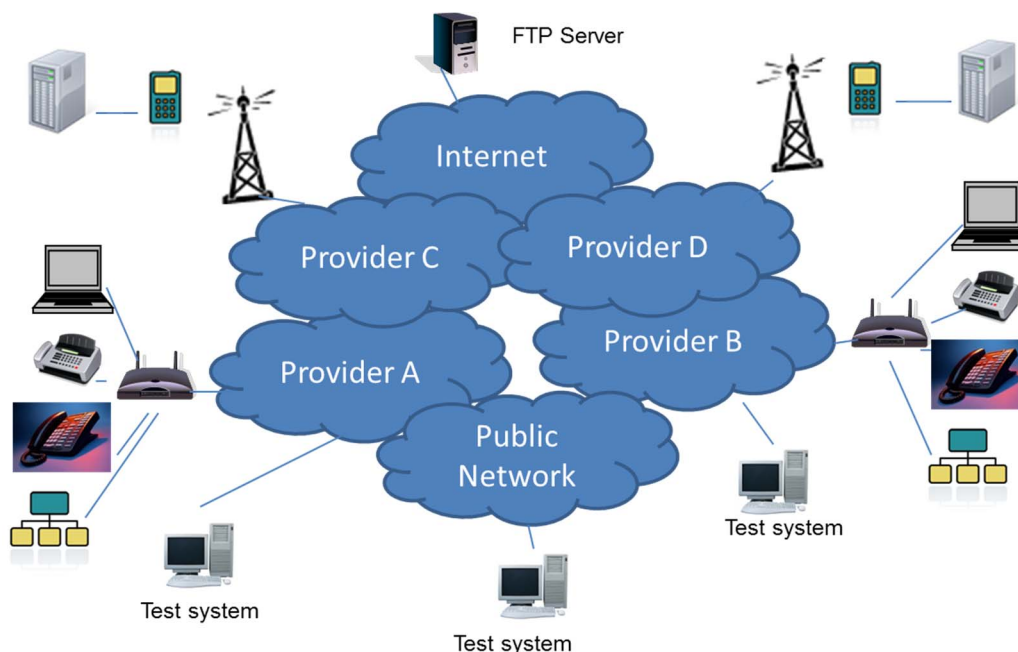


Figure 1: Setup of the benchmarking platform

## 5 Technical concept

### 5.1 Introduction

The conduction of voice quality measurements is following the guidelines given in ETSI EG 202 057-2 [i.2], Recommendation ITU-T Q.543 [4], ETSI TS 101 563 [3] and ETSI TS 102 250-2 [2].

### 5.2 Network side measurements in mobile networks

The conduction of voice quality measurements is following the descriptions that can be found in ETSI EG 202 057-2 [i.2], Recommendation ITU-T Q.543 [4], ETSI TS 101 563 [3] and ETSI TS 102 250-2 [2], clauses 6.6.3.1 and 6.6.3.2.

The access points of the test equipment which are used for inserting or retrieving the signals needed for determining the speech quality parameters shall conform to the reference characteristics as laid down in the following relevant standards:

- ETSI EG 202 425 [i.1] for VoIP access;
- ETSI TBR 003 [6] for analogue access and ISDN BRI access;
- ETSI TBR 004 [7] for ISDN PRI access.

The following KPI values are recorded as part of the voice quality measurements.

**Table 1: Overview of Quality characteristics for voice quality measurements**

Overview of quality benchmarking for voice quality measurements	
1.	call set-up delay [4] and session initiation call set-up delay [3], see clause 5.2
2.	call set-up time (Post Dialling Delay) [5], see clause 5.3
3.	Premature release probability (Call Failure Rate), see clause 5.4 in [5]
4.	Telephony Cut-off Call Ratio [%] (Call drop rate), see clause 5.5 in [5]
5.	Media establishment delay, see clause 5.6 in [5]
6.	Level of active speech signal, see clause 5.7 in [5]
7.	Noise level, see clause 5.8 in [5]
8.	Signal to Noise ratio, see clause 5.9 in [5]
9.	Speech signal attenuation, see clause 5.10 in [5]
10.	Talker echo delay, see clause 5.11 in [5]
11.	Double talk, see clause 5.12 in [5]
12.	Interrupted voice transmission, see clause 5.13 in [5]
13.	Listening speech quality, see clause 5.4
14.	Listening speech quality stability, see clause 5.15 in [5]
15.	End-to-end audio delay, see clause 5.16 in [5]
16.	End-to-end audio delay variation, see clause 5.17 in [5]
17.	Frequency response, see clause 5.18 in [5]
18.	Fax transmission T.30 (Fax, bit rate $\leq$ 14,4 kbit/s and Fax, bit rate $\geq$ 14,4 kbit/s), see clause 5.19 in [5]
19.	Early media, see clause 5.20 in [5]
20.	Jitter Buffer and IP periodization response time, see clause 5.21 in [5]

### 5.3 Call set-up delay

The testing methodology is described in ETSI TS 101 563 [3], the trigger points for mobile devices are described in clause 6.6.2 of [2].

Call set-up delay is defined as the interval from the instant when the signalling information required for outgoing circuit selection is received from the incoming signalling system until the instant when the corresponding signalling information is passed to the outgoing signalling system.



For ISDN Implementations the Call set-up delay starts when the SETUP message has been received from the user signalling system. For UMTS implementation the Call set-up delay starts with the first "RRC CONNECTION REQUEST" with Establishment Cause "Originating Conversational Call" message carried on the CCCH logical channel and mapped to the RACH transport channel is sent.

For VoLTE Call set-up delay is defined as the time in seconds from the sending of the LTE-RRCConnectionRequest (if no signalling connection is established) or the ESM Activate dedicated EPS Bearer context request (if occurring before the SIP:INVITE) until the instant when the corresponding INVITE signalling information is passed on the terminating U-u interface to the called user.

For VoIP Call set-up delay is defined as the interval from the instant when the INVITE signalling information is received from the calling user on the originating Gm interface until the instant when the corresponding INVITE signalling information is passed on the terminating Gm interface to the called user.

Table 2 gives an overview about the Call set-up delay configurations options.

**Table 2: Call setup delay configurations**

	From	To
<b>Call set up delay</b>	VoLTE	MMTel (IMS) fixed access
	MMTel (IMS) fixed access	VoLTE
	VoLTE	VoLTE
	UMTS	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	UMTS
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	LTE with CS fallback
	UMTS	IMS PES with VGW
	IMS PES with VGW	UMTS
	IMS PES with VGW	LTE with CS fallback
	UMTS	UMTS
	UMTS	LTE with CS fallback

## 5.4 Telephony Setup Time

The trigger points for mobile devices are described in clause 6.6.2 of [2].

NOTE: Some mobile networks are sending an early ALERTING before the user has been reached with paging. These networks cannot be tested with this test method.

To determine the call set-up time in a VoLTE implementation, the time in seconds from the sending of the LTE-RRCConnectionRequest (if no signalling connection is established) or the ESM Activate dedicated EPS Bearer context request (if occurring before the SIP:INVITE) or the INVITE message through the "A" side until the receipt of the 200 OK signal is measured on the "A" side or the time in seconds from the sending of the INVITE signal through the "A" side until the receipt of the 180 Ringing signal is measured on the "A" side.

Table 3 gives an overview about the call set-up time configurations options.

**Table 3: Call set-up time configurations**

Call set up time	From	To
	VoLTE	MMTel (IMS) fixed access
	MMTel (IMS) fixed access	VoLTE
	VoLTE	VoLTE
	UMTS	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	UMTS
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	LTE with CS fallback
	UMTS	IMS PES with VGW
	IMS PES with VGW	UMTS
	IMS PES with VGW	LTE with CS fallback
UMTS	UMTS	
UMTS	LTE with CS fallback	

## 5.5 Listening speech quality

### 5.5.1 General aspects of Listening Speech Quality

The general aspects of Listening Speech Quality are described in clause 5.14.1 of [5].

### 5.5.2 General aspects of voice channel test calls

The general aspects of voice channel test calls are described in clause 5.14.2 of [5].

### 5.5.3 Connections without parallel data transfer

#### 5.5.3.1 Connections with one voice channel

For the **single voice channel Test**, a test call consisting of the three following parts should be used:

- Channel Convergence Quality test;
- Listening Speech Quality test;
- DTMF test.

Table 4 gives an overview of the connection options without parallel data transfer.

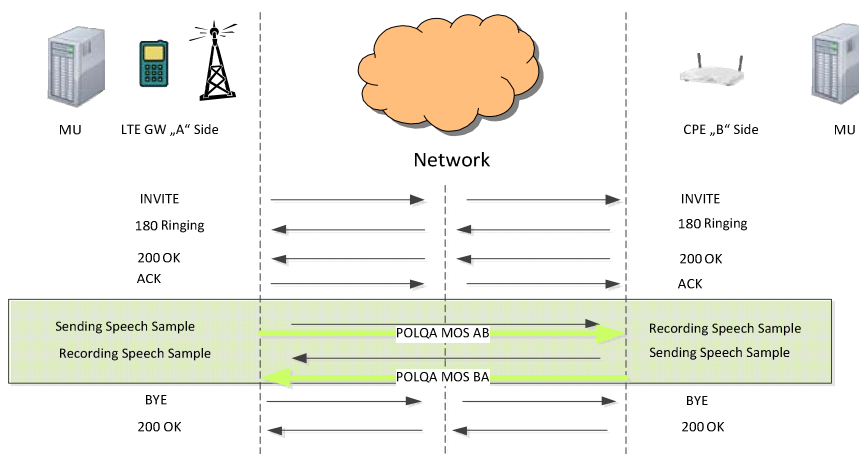
**Table 4: Configurations options for connections without parallel data transfer**

Connections without parallel data transfer	Voice from	Voice to
	VoLTE	MMTel (IMS) fixed access
	VoLTE	VoLTE
	LTE Mobile network with CSFB	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)
	UMTS	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)
	LTE Mobile network with CSFB	IMS PES with VGW
	UMTS	IMS PES with VGW
	UMTS	UMTS

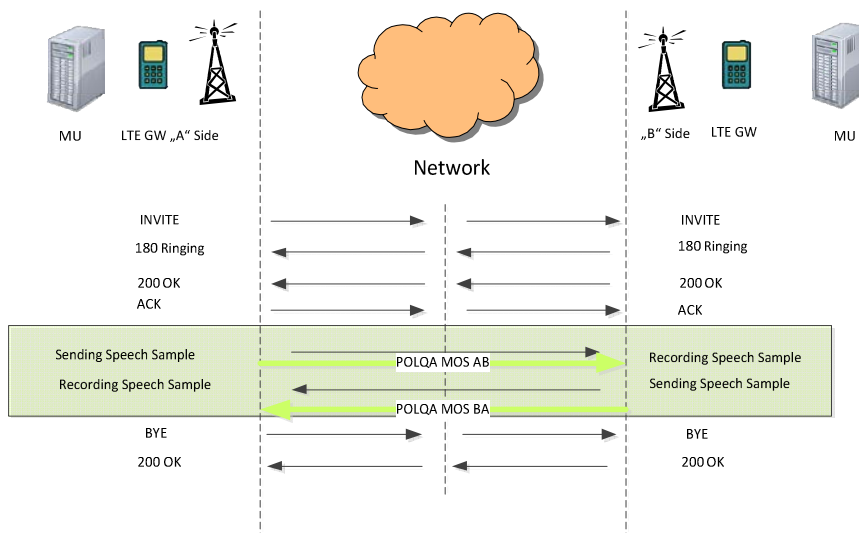
If the duration of the interruption of the voice transmission time is  $> 1$  s and the call connection maintained the call is considered as interrupted (see clause 6.13 of [5]).

Figures 2 and 3 depicts the scenarios VoLTE to VoLTE and VoLTE to MMTel, whereas figures 4 and 5 depict the scenarios UMTS to UMTS and UMTS to ISDN for the measurement of voice quality.

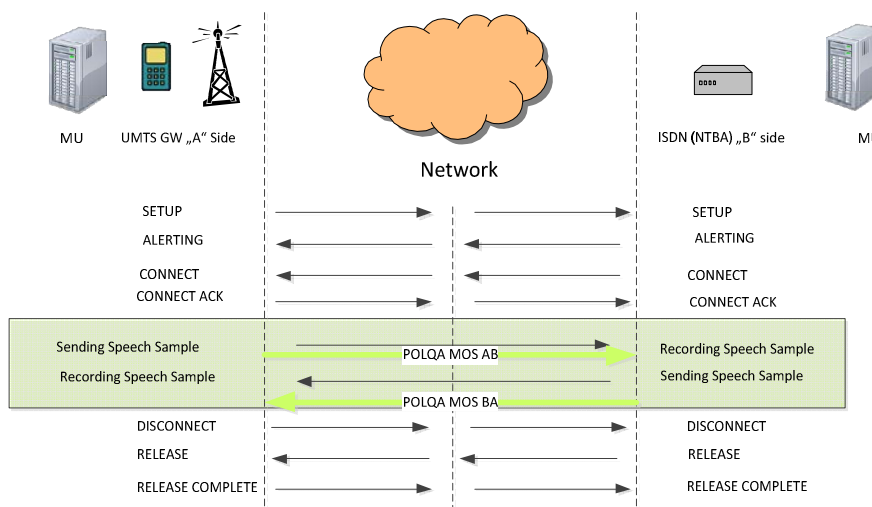
Figure 13 in clause 5.14.3.1 of [5] depicts the detailed description of the single **voice channel test**.



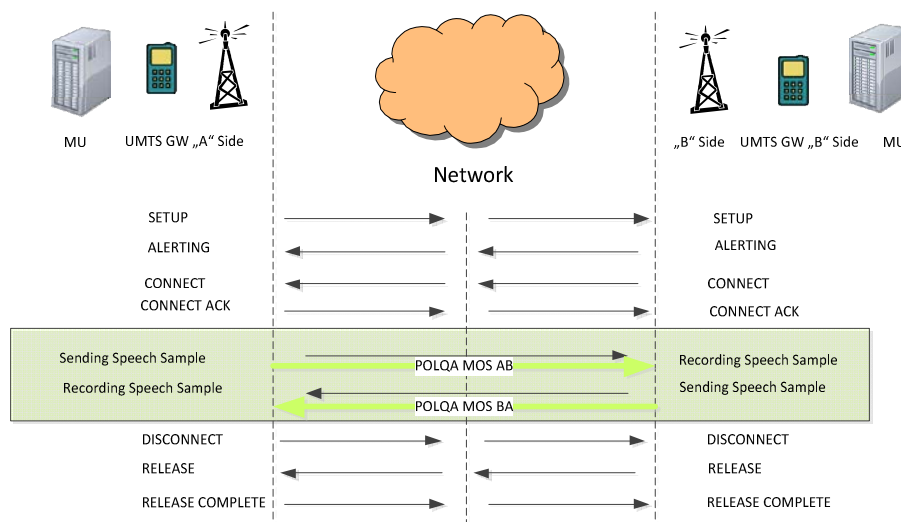
**Figure 2: VoLTE voice quality measurement for a Mobile - Fixed network connection**



**Figure 3: VoLTE voice quality measurement for a Mobile - Mobile connection**



**Figure 4: UMTS voice quality measurement for Mobile - Fixed network connection**



**Figure 5: UMTS voice quality measurement for Mobile - Mobile network connection**

### 5.5.3.2 Multiple voice channel access

In the case that the LTE Access is used for SIP trunking or multiple voice channel transmission, the testing procedure described in clause 5.14.3.2 of [5] applies.

## 5.5.4 Connections with parallel data transfer

### 5.5.4.1 Connections with one voice channel and parallel data transfer

In the case when the access link is used for voice and data application the voice quality measurement sequence with parallel upload/download shall be used. Table 5 gives an overview about the connections options with parallel data transfer. The testing procedure for connections with one voice channel and parallel data transfer are described in clause 5.14.4.1 of [5].

**Table 5: Connection options with parallel data transfer**

	From		To	
	Voice	Data	Voice	Data
<b>Connections with parallel data transfer</b>	VoLTE	User data server or user data application	VoLTE	User data server or user data application
	VoLTE	User data server or user data application	MMTel (IMS) fixed access	Webserver
	VoLTE	User data server or user data application	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	Webserver
	VoLTE	User data server or user data application	IMS PES with VGW	Webserver
	UMTS	User data server or user data application	UMTS	User data server or user data application
	UMTS	User data server or user data application	MMTel (IMS) fixed access	Webserver
	UMTS	User data server or user data application	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	Webserver
	UMTS	User data server or user data application	IMS PES with VGW	Webserver
	MMTel (IMS) fixed access	User data server or user data application	VoLTE	User data server or user data application
	MMTel (IMS) fixed access	User data server or user data application	LTE Mobile network with CSFB	User data server or user data application
	MMTel (IMS) fixed access	User data server or user data application	UMTS	User data server or user data application
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	User data server or user data application	VoLTE	User data server or user data application
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	User data server or user data application	LTE Mobile network with CSFB	User data server or user data application
	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	User data server or user data application	UMTS	User data server or user data application
	IMS PES with VGW	User data server or user data application	VoLTE	User data server or user data application
	IMS PES with VGW	User data server or user data application	LTE Mobile network with CSFB	User data server or user data application
	IMS PES with VGW	User data server or user data application	UMTS	User data server or user data application
	LTE Mobile network with CSFB	User data server or user data application	IMS PES with AGCF with AGCF (or PSTN or ISDN Access)	Webserver

#### 5.5.4.2 Parallel quality measurement of one voice channel and data transmission speed

In the case that the LTE Access is used for SIP trunking or multiple voice channel transmission, the testing procedure for Parallel quality measurement of one voice channel and data transmission speed is described in clause 5.15.4.2 of [5].

#### 5.5.4.3 Quality measurement of multiple voice channels and data transfer

In the case that the LTE Access is used for SIP trunking or multiple voice channel transmission, the testing procedure for Quality measurement of multiple voice channels and data transfer is described in clause 5.15.4.3 of [5].

#### 5.5.4.4 Parallel quality measurement of multiple voice channels and data transmission speed

In the case that the LTE Access is used for SIP trunking or multiple voice channel transmission, the testing procedure for Quality measurement of multiple voice channels and data transmission speed is described in clause 5.15.4.4 of [5].

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## 6 Broadband Speed Test (BST) - Measurement method of data transmission speed and transit time

### 6.1 Introduction

The measurement method of data transmission speed and transit time (Broadband Speed Test (BST) is described in clause 6 of [5].

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## History

<b>Document history</b>		
V1.1.1	December 2015	Publication