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**Core Network and Interoperability Testing (INT);
VoLTE and ViLTE interconnect, interworking and
roaming test specification with QoS/QoE
(3GPP™ Release 12)**

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Core Network and Interoperability Testing (INT).

The test case list and test selection are contained in archive ts_103397v010102p0.zip which accompanies the present document.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**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).

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Introduction

Voice over LTE (VoLTE) and Video over LTE (ViLTE) are services which deliver voice and video communication over packet-based networks. VoLTE/ViLTE services can be provided by either traditional fixed or by mobile telecom operators who have implemented the LTE technology as access technology to its core IP network.

1 Scope

The present document enables interested parties to verify the VoLTE and ViLTE interworking, interconnection and roaming of networks by providing e2e scenarios based on an identification and selection of various criteria:

- Identification of the Networks
- Selection of Expression
- Determination of Access and end Device Types
- Selection of roaming scenarios

Additionally the present document provides a series of test suites for Quality of Service (QoS) and Quality of Experience (QoE) based on KPI for voice quality measurements and KPI for video quality measurements.

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 referenced document (including any amendments) applies.

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

- [1] ETSI TS 129 165: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Inter-IMS Network to Network Interface (NNI) (3GPP TS 29.165 Release 12)".
- [2] ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229 Release 12)".
- [3] IETF RFC 4566 (2006): "SDP: Session Description Protocol".
- [4] IETF RFC 3261 (2002): "SIP: Session Initiation Protocol".
- [5] IETF RFC 3264 (2002): "An Offer/Answer Model with the Session Description Protocol (SDP)".
- [6] IETF RFC 3312 (2002): "Integration of Resource Management and Session Initiation Protocol (SIP)".
- [7] ETSI TS 124 607: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Originating Identification Presentation (OIP) and Originating Identification Restriction (OIR) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.607 Release 12)".
- [8] IETF RFC 5009 (September 2007): "Private header (P-Header) extension to the Session Initiation Protocol (SIP) for authorization of Early Media".
- [9] Recommendation ITU-T V.152 (09- 2010): "Procedures for supporting Voice-Band Data over IP Networks".

- [10] Recommendation ITU-T T.38 (11-2015): "Procedures for real-time Group 3 facsimile communication over IP networks".
- [11] Recommendation ITU-T Q.1912.5: "Interworking between session initiation protocol (SIP) and bearer independent call control protocol or ISDN user part".
- [12] ETSI TS 183 036: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); ISDN/SIP interworking; Protocol specification".
- [13] IETF RFC 4733: "RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals".
- [14] IETF RFC 4028: "Session Timers in the Session Initiation Protocol (SIP)".
- [15] ETSI TS 103 222-1 (V1.3.1): "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".
- [16] ETSI TS 101 563 (V1.3.1): "Speech and multimedia Transmission Quality (STQ); IMS/PES/VoLTE exchange performance requirements".
- [17] Recommendation ITU-T Q.543 (03-1993): "Digital exchange performance design objectives".
- [18] ETSI ES 202 765-2 (V1.2.1): "Speech and multimedia Transmission Quality (STQ); QoS and network performance metrics and measurement methods; Part 2: Transmission Quality Indicator combining Voice Quality Metrics".
- [19] ETSI TS 102 250-2 (V2.6.1): "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".
- [20] Recommendation ITU-T P.863 (03-2018): "Perceptual objective listening quality assessment".
- [21] Recommendation ITU-T P.863.1 (06-2019): "Application guide for Recommendation ITU-T P.863".
- [22] Recommendation ITU-T P.501 (03-2017): "Test signals for use in telephony".
- [23] ETSI ES 202 737 (V1.4.1): "Speech and multimedia Transmission Quality (STQ); Transmission requirements for narrowband VoIP terminals (handset and headset) from a QoS perspective as perceived by the user".
- [24] ETSI ES 202 739 (V1.4.1): "Speech and multimedia Transmission Quality (STQ); Transmission requirements for wideband VoIP terminals (handset and headset) from a QoS perspective as perceived by the user".
- [25] ETSI TS 101 585 (V1.2.1): "Core Network and Interoperability Testing (INT); IMS interconnection tests at the Ic Interface; Test Suite Structure and Test Purposes (TSS&TP)".
- [26] GSMA PRD IR.67: "DNS/ENUM Guidelines for Service Providers & GRX/IPX".
- [27] ETSI ES 203 021-3 (V2.1.2): "Access and Terminals (AT); Harmonized basic attachment requirements for Terminals for connection to analogue interfaces of the Telephone Networks; Update of the technical contents of TBR 021, EN 301 437, TBR 015, TBR 017; Part 3: Basic Interworking with the Public Telephone Networks".
- [28] Recommendation ITU-T Q.4016 (01-2018): "Testing specification of call establishment procedures based on SIP/SDP and H.248 for a real-time fax over IP service2".
- [29] ETSI TS 126 114 (V13.6.0): "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Multimedia telephony; Media handling and interaction (3GPP TS 26.114 version 13.6.0 Release 13)".
- [30] ETSI TS 126 103 (V13.3.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Speech codec list for GSM and UMTS (3GPP TS 26.103 version 13.3.0 Release 13)".

- [31] ETSI ES 202 667 (V1.1.5): "Speech and multimedia Transmission Quality (STQ); Audiovisual QoS for communication over IP networks".
- [32] Recommendation ITU-T P.910 (April 2008): "Subjective video quality assessment methods for multimedia applications".
- [33] Recommendation ITU-T P.911: "Subjective audiovisual quality assessment methods for multimedia applications".
- [34] IETF RFC 3761 (2004): "The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM)".
- [35] GSMA IR.65 V.28 (May 2018): "IMS Roaming and Interworking Guidelines".
- [36] ETSI TS 123 002: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Network architecture (3GPP TS 23.002 version 12.7.0 Release 12)".
- [37] ETSI TS 129 235 (V12.1.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Interworking between SIP-I based circuit-switched core network and other networks (3GPP TS 29.235 version 12.1.0 Release 12)".
- [38] ETSI TS 123 231 (V12.0.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); SIP-I based circuit-switched core network; Stage 2 (3GPP TS 23.231 version 12.0.0 Release 12)".
- [39] ETSI TS 129 231 (V12.0.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Application of SIP-I Protocols to Circuit Switched (CS) core network architecture; Stage 3 (3GPP TS 29.231 version 12.0.0 Release 12)".
- [40] ETSI TS 123 228 (V8.12.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228 version 8.12.0 Release 8)".
- [41] ETSI TS 129 162 (V12.7.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Interworking between the IM CN subsystem and IP networks (3GPP TS 29.162 version 12.7.0 Release 12)".
- [42] ETSI TS 183 043: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation; Stage 3 specification".
- [43] ETSI TS 129 163 (V12.14.0): "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Interworking between the IP Multimedia (IM) Core Network (CN) subsystem and Circuit Switched (CS) networks (3GPP TS 29.163 version 12.14.0 Release 12)".
- [44] Recommendation ITU-T Q.761: "Signalling System No. 7 - ISDN User Part functional description".
- [45] Recommendation ITU-T Q.764: "Q.764: Signalling System No. 7 - ISDN User Part signalling procedures".
- [46] ETSI TS 124 605 (V12.5.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Conference (CONF) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.605 version 12.5.0 Release 12)".

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 referenced document (including any amendments) applies.

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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 202 057-2 (V1.3.2): "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.2] ETSI TR 103 138 (V1.4.1): "Speech and multimedia Transmission Quality (STQ); Speech samples and their use for QoS testing".
- [i.3] ETSI EG 202 425 (V1.1.1): "Speech Processing, Transmission and Quality Aspects (STQ); Definition and implementation of VoIP reference point".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void

3.2 Symbols

Void

3.3 Abbreviations

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

3GPP	3 rd Generation Partnership Project
ACM	Accumulated Call Meter
ACR	Anonymous Communication Rejection
ACR-CB	Anonymous Call Rejection and Call Barring
AGCF	Access Gateway Control Function
AMR	Adaptative Multi-Rate
AMR-NB	Adaptive Multi Rate - NarrowBand
AMR-WB	Adaptive Multi Rate - Wide Band
ANM	ANswer Message
APN	Access Point Name
ATP	Access Transport Parameter
ATS	Abstract Test Suite
BCALL	Basic CALL
BICC	Bearer Independant Call Control
CB	Communication Barring
CCBS	Completion of Communications to Busy Subscriber
CCNR	Completion of Communications by No Reply
CD	Communication Deflection
CDIV	Communication DIVersion
CDP	Charging Determinating Point
CDR	Communication Data Record
CFB	Communication Forwarding Busy

CFNL	Communication Forwarding Not Logged in
CFNR	Communication Forwarding No Reply
CFU	Communication Forwarding Unconditional
CONF	CONference
CPG	Call Progress Message
CS	Circuit-Switched
CSCF	Call Session Control Function
CSFB	Circuit Switched Fall Back
CUG	Closed User Group
CW	Communication Waiting
DRX	Discontinuous Reception
DTMF	Dual Tone Multi Frequency
ECM	EPS Connection Management
ECT	Explicit Communication Transfer
ENUM	Telephone Number Mapping
FFS	For Further Study
GBR	Gross Bit Rate
GRX/IPX	GPRS Roaming eXchange/IP eXchange
GW	GateWay
HEVC	High Efficiency Video Coding
HLC	High Layer Compatibility
HOLD	communication HOLD
HPLMN	Home Public Land Mobile Network
HPMN	Home Public Mobile Network
IAM	Initial Address Message
IBCF	Interconnect Border Control Function
II-NNI	Inter-IMS Network to Network Interface
IPTV	Internal Protocol TeleVision
ISDN	Integrated Services Digital Network
ISIM	Inter-System Interface Mobility Management
IUT	Implementation Under Test
IVR	Interactive Voice Response
JPEG	Joint Photographic Expert Group
LBO	Local Break Out
LI	Lawful Interception
LLC	Low Layer Compatibility
LPC	Linear Predictive Coding
MBR	Maximum BitRate
MCID	Malicious Communication Identification
MGCF	Media Gateway Control Function
MPV	Management Protocol Version
MTBF	Mean Time Between Failure
MWI	Message Waiting Indication
NDUB	Network Determined User Busy
NNI	Network to Network Interface
OIP	Originating Identification Presentation
OIR	Originating Identification presentation Restriction
OMR	Optimal Media Routeing
OVL	OVER-Load point
PASP	Public Answering Safety Point
PBX	Private Branch eXchange
PCMA	Pulse-Code-Modulation- A law
PCMU	Pulse Code Modulation μ -law
PCRF	Policy and Charging Rule Function
PDD	Post Dial Delay
PDN	Public Data Network
PGW	Packet GateWay
PICS	Protocol Implementation Conformance Statement
PRACK	Provisional Response Acknowledgement
PS	Packet Switched
PSTN	Public Switched Telephone Network
QCELP	Qualcomm Code-Excited Linear Prediction

QCI	QoS Class Identifier
QCIF	Quarter Common Intermediate Format
QoS	Quality of Service
R-NNI	Roaming Network to Network Interface
RTCP	Real Time Control Protocol
SDU	Service Data Unit
SIP	Session Initiation Protocol
SIP-I	Session Initiation Protocol - ISUP (SIP with encapsulated ISUP)
SRVCC	Single Radio Voice Call Continuity
SWB	Super Wide Band
TBR	Technical Basis for Regulation
TIP	Terminating Identification Presentation
TIR	Terminating Identification Restriction
TMF	Management Task Force
TP	Test Purpose
TRFO	Transcoder free operation
TSS	Test Suite Structure
UAC	User Agent Client
UDUB	User Determined User Busy
UUS	The User-to-User Signalling supplementary service
VGW	Voice GateWay
VoPS	IMS Voice over PS session
VPLMN	Visited Public Land Mobile Network
VPMN	Visited Public Mobile Network
XCAP	eXtended Camel Application Part

4 General principles of interconnection of VoLTE-based networks

4.0 Overview

Voice over LTE (VoLTE) and Video over LTE (ViLTE) services deliver voice and video communication over packet-based networks which include LTE technology on the access layer. It means that VoLTE/ViLTE services can be provided by either traditional fixed or mobile telecom operators who have implemented LTE technology as access technology to its core IP network.

VoLTE/ViLTE services are so-called "managed" voice and video services which are based on standardized SIP/IMS signalling and provided by telecom operators, while Over The Top (OTT) applications are services in the Internet provided by independent third party, without standardized signalling protocols, traffic prioritization and guaranteed quality of services.

The IMS platform is used as a service control layer which is used for managing VoLTE/ViLTE sessions. The reference architecture of the IP Multimedia Core Network Subsystem described in ETSI TS 123 002 [36] is shown in figure 4.0-1.

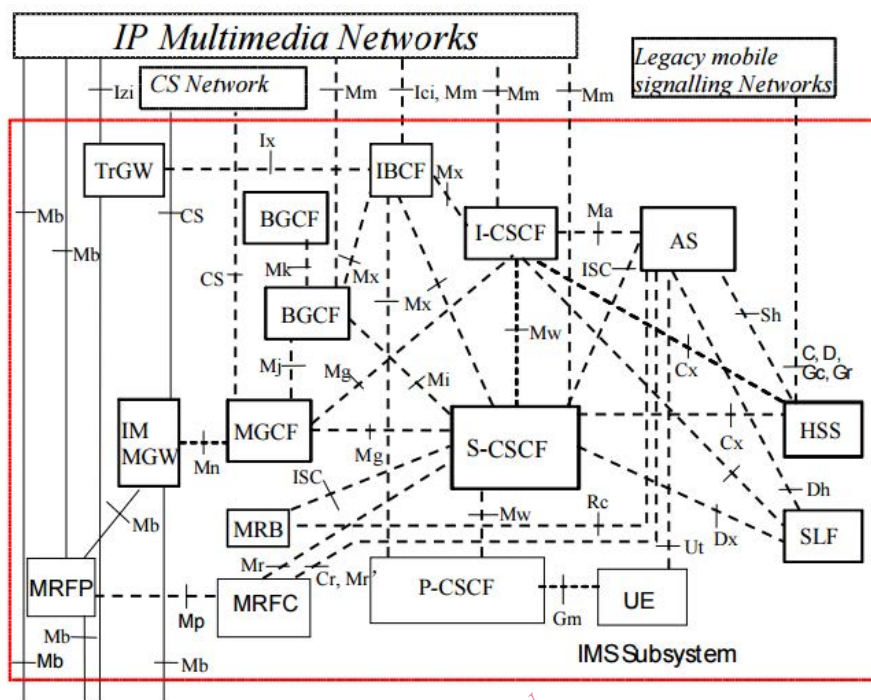


Figure 4.0-1: Reference Architecture of the IP Multimedia Core Network Subsystem

VoLTE/ViLTE interconnection implies interconnection of IMS platforms for providing VoLTE/ViLTE and legacy e2e sessions.

Some of the types of interconnection between IMS-based telecom operators:

- Interconnection for delivering sessions amongst users of different operators (hereafter Interworking scenarios);
- Interconnection for providing roaming of users of the Home networks in Visited networks (hereafter Roaming scenarios).

There are also options for interconnection between the VoLTE/ViLTE and IMS-based networks with existing legacy networks (e.g. PSTN, PLMN).

The ENUM/DNS translation mechanism as specified in IETF RFC 3761 [34] can be used by all IMS nodes that require E.164 address to SIP URI resolution and subsequently, the GSMA published PRD IR.67 [26] "DNS and ENUM Guidelines for Service Providers and GRX/IPX Providers".

4.1 E2E scenarios in terms of interworking, interconnection and roaming

The tests shall be executed according to the tests case selection expression and the type of end devices which are contained in the excel test list attached to the present document. The excel list is a normative part of this ETSI standard. The interconnection and roaming scenarios should be selected depending on the network infrastructure and company strategy.

The reference configuration depicted in figure 4.1-1 shall be used to perform an interconnection test between two network operators. Depicted is the reference point to observe the message flow at the 'Ic' interface between the two networks.

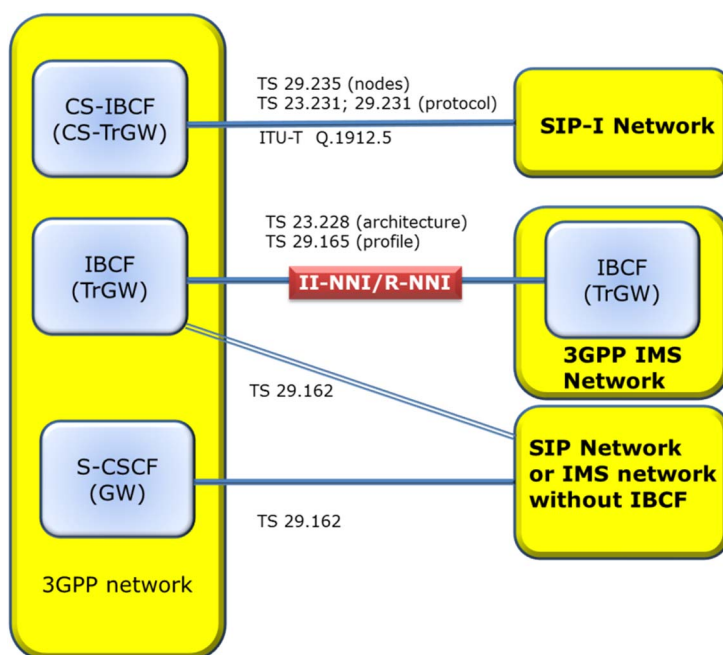


Figure 4.1-1: Reference configuration for the interconnection test

4.2 Interconnection and roaming scenarios test selection description (Excel file)

4.2.0 General

The interconnection and roaming test scenarios selection procedure is divided in five steps.

4.2.1 First step- "Identification of the Networks"

During the first step the table "Identification of the Networks" should be completed.

Table 4.2.1-1: Identification of the Networks, with examples

	Network A	Network B
Network under Test identification	Telekom Austria	Deutsche Telekom
Responsibility		
Name:	Martin Brand	Gerhard Ott
Telephone number:		
Facsimile number:		
Additional information:		
Product Supplier	Nokia	Huawei
Date of the statement:		
Dates of Testing (from .. to ..)		

4.2.2 Second step - Selection Expression

During the second step the Selection Expression form sheet should be completed. The Selection Expression depicted in table 4.2.2-1 was developed to select the scope of the compatibility test between network operator A and network operator B. By doing that, test purposes are selected automatically. The table shall be filled out (yes/no). This table can be used as a PICS form as used in a conformance test.