

VoLTE Roaming Testing
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1 Introduction

1.1 Scope of document

This document is the specification of the IREG end-to-end functional capability tests for VoLTE Roaming using “S8HR (S8 Home Routed)”as defined in GSMA PRD IR.88 [5], IR.65 [6] and Short Message Service (SMS) over LTE relating to the international roaming of a User Equipment (UE), belonging to a home Public Mobile Network (HPMN) (a), to and within a visited PMN (VPMN) (b).

Whilst it is expected that roaming will be a bilateral activity between two PMNs, please note that this document is written in a unidirectional context. Hence roaming is taking place by a UE (a) to VPMN (b) only. There is no reference to a UE (b) visiting PMN (a).

To complete the IREG end-to-end functional capability tests for bilateral roaming, it is necessary to perform the tests in this document twice: In the second time the real identities of PMN (a) and PMN (b) are swapped.

GSMA IREG Permanent Reference Document (PRD) IR.23 [3] defines the scope and purpose of each stage of testing. GSMA PRD IR.88 [5] defines the technical guidelines for LTE Roaming.

This document does not cover:

- Testing of High Speed Packet Access/Long Term Evolution (HSPA/LTE) data roaming
- Diameter Testing
- Exchange of PMN numbering, addressing and routing data [see Stage 3: GSMA PRDPRD IR.23 [3]
- Testing of Transferred Account Procedure (TAP), billing applications and any inter-PMN financial statement; [see IDSWG PRD TD.41 [2]. However, the production of a Toll Ticketing file, to use in the TADIG Stage 3 testing is included.
- Definition of operation and maintenance procedures such as contact points for fault reporting and notification of planned works. [see Stage 3: GSMA PRD IR 23 [3]

1.2 Objective of tests

The fundamental objective of this testing is to confirm the capability, and sample the quality of S8HR VoLTE Roaming services that mobile users will receive when roaming from their HPMN (a) to VPMN (b) in LTE. Consequently, the tests are restricted to top-level capability testing. There is no provocative or inopportune behaviour testing: this type of testing forms part of the Stage 1 testing [see GSMA PRD IR.23 [3].

Because the testing is at a top-priority, its scope includes checking the correct working of user features and any network features required by the HPMN. The scope also includes the confirmation of acceptable quality of transmission, absence of echo and call set-up delay.

The overall objective of the tests is to confirm that the functions and features, which are already known to operate correctly within each separate PMN, will also operate correctly for Inter-PMN roaming.

In addition to the handling of the tests itself the collection/comparison of charging information respective the generation of charging detailed records (CDR) is described.

The specific objectives are to prove that:

- "Registration" can be successfully completed for the UE (a) roaming to a VPMN (b).
- Incoming speech calls to the UE (a) can be handled by the HPMN (a) and the VPMN (b).

  HPMN (a) successfully routing the call.
  VPMN (b) connecting the call.
- Outgoing speech calls by the UE (a) to the VPMN (b) are handled for:

  Emergency calls
  Local calls to the VPMN (b) country
- Short Message Service is available between Home Country Service Centre and roamed mobile station.

If either the HPMN or VPMN contain Evolved Packet System (EPS) Network Entities which are supplied by more than one manufacturer, then the test cases should be repeated for each manufacturer.

The actual number of repetitions of the test cases is for bilateral agreement between the HPMN and VPMN. In order to maximize the efficiency of testing, the test cases have been specified to minimize the requirement for simultaneous joint activity by both PMN (a) and PMN (b). This concerns mainly the administration of mobile subscriber data in the HSS.

Accordingly, the program of testing forms three distinct components:

i. HPMN(a) issues pre-programmed USIMs and programmes HSS
ii. VPMN(b) performs tests
iii. VPMN(b) and HPMN(a) discuss results

An associated optional objective is to use the Toll Ticketing function of the VPMN to generate a live data file, which is used by the TADIG Stage 3 testing. After transfer to the HPMN via TADIG processes, the HPMN may use the information from the test results to validate the details of the Toll tickets, however this is not part of the GSM Association IREG roaming testing.

1.3 Definition of Terms

Term	Description
APN	Access Point Name
CDR	Charging Detailed Record
CCITT	International Telegraph and Telephone Consultative Committee
CLI	Calling Line Identity
CS	Circuit Switched
CSFB	Circuit-Switched Fallback
DNS	Domain Name System
EENL	Extended Emergency Numbers List
ENL	Emergency Numbers List
EPC	Evolved Packet Core
EPS	Evolved Packed System
GPRS	Generic Packet Radio Access
GTP	GPRS Tunnelling Protocol
HSS	Home Subscriber Server
HPMN	Home Public Mobile Network
HSPA	High Speed Packet Access
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
LEA	Law Enforcement Agency
LEMF	Law Enforcement Monitoring Facility
LI	Lawful Interception
LTE	Long Term Evolution
MME	Mobility Management Entity
MSISDN	Mobile Subscriber ISDN Number
P-CSCF	Proxy – Call Session Control Function
PDN	Packet Data Network
PGW	PDN Gateway
PIN	Personal Identification Number
PMN	Public Mobile Network
PSAP	Public-safety answering point
PSTN	Public Switched Telephone Network
PUK	PIN Unblocking Key
SIP	Session Initiation Protocol
SMS	Short Message Service
SMSC	Short Message Service Centre

S-CSCF	Serving – Call Session Control Function
SIP	Session Initiation Protocol
SMS	Short Message Service
SMSC	Short Message Service Centre
TAP	Transferred Account Procedure
UE	User Equipment
URI	Uniform Resource Identifier
USIM	Universal Subscriber Identity Module
VPMN	Visited Public Mobile Network

1.4 Document Cross-References

Ref	Document Number	Title
1	3GPP TR 21.905	Vocabulary for 3GPP Specifications
2	GSMA PRD TD.41	Testing the Transferred Account Procedure (TAP)
3	GSMA PRD IR.23	Organisation of GSM International Roaming Tests
4	GSMA PRD IR.92	IMS Profile for Voice and SMS
5	GSMA PRD IR.88	LTE and EPC Roaming Guidelines
6	GSMA PRD IR.65	IMS Roaming and Interworking Guidelines
7	GSMA PRD IR.67	DNS Guidelines for Service Providers
8	3GPP TS 23.228	IP Multimedia Subsystem (IMS); Stage 2
9	GSMA PRD TD.50	TAP Test Cases(TTC) for VoLTE Roaming Testing
10	GSMA PRD BA.27	Charging Principles
11	3GPP TS 23.167	IP Multimedia Subsystem (IMS) emergency sessions
12	GSMA PRD NG.119	Emergency communication for roamers
13	3GPP TS 23.401	GPRS enhancements for E-UTRAN access
14	GSMA PRD IR.38	LTE and EPC Roaming Testing
15	GSMA PRD IR.24	End to End Functional Capability Specification for Inter-PLMN Roaming (Stage 4 Testing)
16	3GPP TS 24.301	Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3
17	GSMA PRD TS.32	Technical Adaptation of Devices through Late Customization

2 Test Cases

The structure for testing international voice roaming and SMS interworking in LTE are recommended to be divided in four groups:

1. Basic Service (Registration and Voice Call)
2. Emergency Service

3. Short Message Service (Point to point)
4. Lawful Interception
5. Supplementary Services

Supplementary Services provided for customers in HPMN (a) are independent from the VPMN (b). However, the test communication barring in roaming scenarios is required.

The GSMA PRD IR.25 tests can have two granularities for data volume measurement, based on APN or based on QCI. If a need of observation of the data volume is identified, e.g. for the rating purpose, the APN based measurement is a default setting where all data associated with QCI 1, 5, 8 are aggregated regardless of QCI values. Optionally, the QCI based data volume measurement can be configured on the individual QCI bearers for the data volume measurement.

Note: this IR.25 test book could be used to test all services or part of them (e.g.: emergency services only).

2.1 S8HR architecture

A high level architecture diagram of S8HR VoLTE Roaming Architecture is represented in Figure 2.1. PDN-GW (P-GW) and Proxy - Call Session Control Function (P-CSCF) are located in HPMN (a).

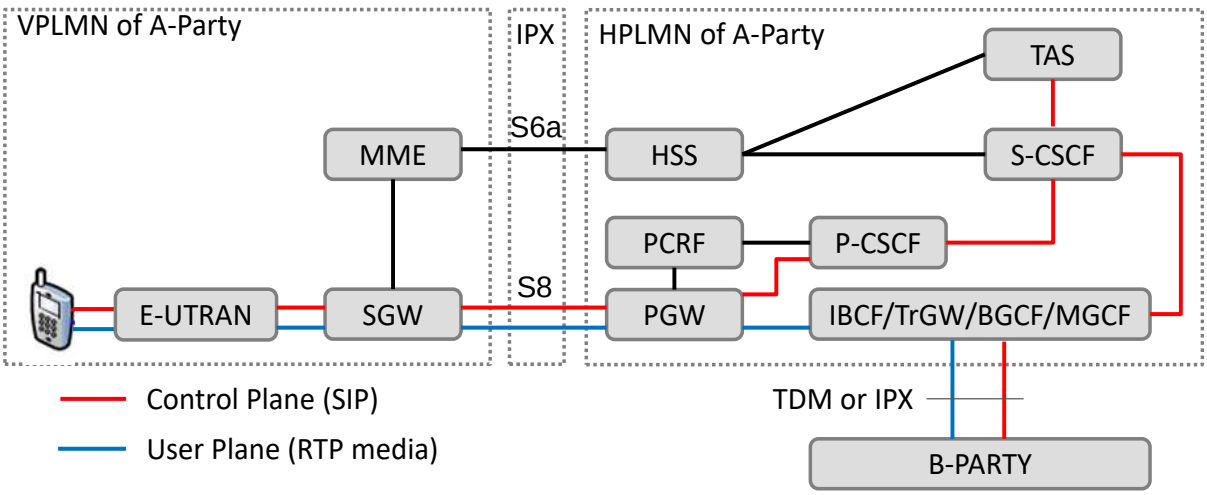


Figure 1: S8HR VoLTE Roaming Architecture

It is anticipated that it may be necessary to monitor both signalling messages and voice calls on any of the Network Entity interfaces shown in the diagrams. However, this is not a firm requirement for this test specification.

The results of the test cases shall be recorded in Annex A: Appendix IR25.xlsm.

The following roaming functions are included in the test cases defined within this PRD:

Functions	H/V	Section	Mand / Opt	Comments
VoLTE registration	H/V	2.2.1	M	Check QCI 5 bearer
VoLTE MOC / MTC	H/V	2.2.2	M	Check QCI 1 bearer + location
VoLTE call with local number	H/V	2.2.3	M	
SMSoIP MO / MT	H/V	2.3.1	O	Check location
Emergency call (UE detectable)	V	2.2.4.1	O	
Emergency call (non UE detectable)	H/V	2.2.4.2	O	Release by H IMS
Lawful Interception on original side	V	2.5.1	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
Lawful Interception on terminator side	V	2.5.2	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
Lawful Interception of forwarding call	V	2.5.3	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
Outgoing Communication Barring in roaming	H/V	2.6.1	O	Provided by H-IMS
Incoming Communication Barring in roaming	H/V	2.6.2	O	Provided by H-IMS

Table 1: List of Roaming Functions included in the Test Cases

NOTE: SMSoIP and IMS Emergency tests can be replaced with SMSoNAS and CSFB emergency respectively. The details are referred to in section 5.1.

GSMA PRD BA.27 [10] defines the charging principles for VoLTE Roaming and SMSoIP.

VoLTE Roaming Charging Principles

Where charging by IMS APN, voice and SIP signalling will not be differentiated and both charged by data volume.
Where charging by QCI, voice is charged by differentiated QCI (QCI=1) and SIP signalling by QCI5, both can be charged by data volume. This allows differentiated charging between voice and signalling. [See section 11.6 of BA.27 [10])

SMSoIP Charging Principles

Where charging by IMS APN, SMS and SIP signalling will not be differentiated and both charged by data volume.

Where charging by QCI, SMS and SIP signalling by QCI5, both can be charged by data volume.

2.2 BASIC SERVICE TEST CASES

These test cases cover attachment, IMS registration and basic originating and terminating call.

2.2.1 IMS Registration of the UE1 (a)

2.2.1.1 Preconditions

- UE1 (a) contains Universal Subscriber Identity Module (USIM) of HPMN (a).
- HSS record contains basic and supplementary service information.
- No valid EMM contexts are established for UE1 (a).
- No valid PDN connection is established in the UE1 (a).
- One EPS bearer context subscription record exists in HSS (a) where UE1(a) has a subscription for IMS APN.

When enabling IMS voice roaming for a subscriber, the following subscription settings must be taken into account for the IMS well-known APN:

- Barring on "All Packet Oriented Services" is not active
- The P-CSCF internal database does not have the home network contact information.

The "VPMN Address Allowed" parameter in the HSS (a) must not be present or must be set to “NOTALLOWED (0)”.
An HPMN must set IMS encryption / unencryption (via IPsec) per VPMN basis for its outbound roamers, to meet the VPMN’s (local) regulatory requirements. For the LI purpose in the visiting country, the HPMN P-CSCF (a) must set null encryption for IMS signalling for the outbound roaming UEs (a) in VPMN (b) [6].

2.2.1.2 Action

Power-up UE1 (a).
Perform network attachment and initial IMS registration through a P-CSCF in HPMN (a).
Check EMM contexts in UE1 (a) and MME (b) for the IMSI/GUTI /MSISDN of UE1 (a).

Note: For the roaming scenario, EPC attachment occurs over LTE. For the non-roaming case, EPC attachment can occur over both LTE and WiFi access – see section 5.2.4.

2.2.1.3 Expected Result

PDN Connection (i.e. Default Bearer) for IMS APN is successfully established.
IMS registration is successfully completed.
Check SIP Bearer is correctly created using QCI=5.
Successful result if 200 OK arrives at the P-CSCF.

2.2.1.4 Comments

This test case confirms the operation of registration through the P-CSCF. It checks the support of the relevant Session Initiation Protocol (SIP) operations.

2.2.2 UE1 (a) Calls UE2 (a), Both Roamed in VPMN (b)

2.2.2.1 Precondition

UE1 (a) and UE2 (a) have attached successfully and established a PDN connection for IMS APN in VPMN (b).

UE1 (a) and UE2 (a) have succeeded in IMS Registration to HPMN(a).

2.2.2.2 Actions

UE1 (a) establishes call to UE2 (a).
Call answered and held for one minute.
Quality assessed

2.2.2.3 Expected Result

Successful result if the call is established in 30 seconds, and the call is stable in the unanswered and answered phases, and there is no perceptible echo to both users, and call remains in intelligible/high quality conversation phase for one minute.
Check that the Voice Media Bearer is correctly created using QCI=1 for mobile originating and terminating calls respectively.

2.2.2.4 Comments

This test case confirms Mobile Originated and Mobile Terminated call procedures for roamers.

2.2.3 UE1 (a) Calls to Local Number, UE3 (b)

2.2.3.1 Precondition

UE1 (a) is attached to VPMN (b) and has a IMS-APN PDN connectivity.
UE3 (b) is attached to VPMN (b).

2.2.3.2 Action

UE1 (a) calls UE3 (b) using non-international number format
Call answered and held for one minute
Quality assessed

2.2.3.3 Expected Result

Successful result if the call is established in 30 seconds, and the call is stable during the unanswered and answered phases, and there is no perceptible echo to both users, and call remains in intelligible/high quality conversation phase for one minute. See CCITT Rec P.84 Annex D for instructions on use of Quality Scales. This test will also confirm the correct delivery of Calling Line Identity (CLI) information (or lack thereof) or equivalent parameter in SIP message in a roaming scenario.

2.2.3.4 Comments

This test case confirms that the “Local Number Translation” procedure of IMS entities in HPMN that must support the handling of numbers in non-international format to route the call, as specified in 3GPP TS23.228 [8] and in GSMA PRD IR.65 [6].

2.3 SMS TEST CASES

2.3.1 Mobile Originated and Terminated Short Message Service (SMS-MO and SMS-MT)

2.3.1.1 Precondition

SMS- Mobile Originated / Terminated (MO/MT) Services is provisioned in HSS subscription.
UE1 (a) and UE2 (a) are registered in VPMN (b).

UE1 (a) and UE2 (a) are both SMS over IMS capable.
UE1 (a) and UE2 (a) are camping on LTE.
UE1 (a) and UE2 (a) successfully completed IMS Registration.

2.3.1.2 Actions

Switch on UE1 (a). Switch off UE2 (a).
Use UE1 (a) to transmit a 160 character Short Message to UE2 (a) via the Home Country SMS - Service Centre with Message Waiting priority selected.
Switch on UE2 (a).
Await delivery of Short Message to UE2 (a) and check contents of Short Message with those transmitted.

2.3.1.3 Expected Result

Successful result if Short Message is correctly delivered within two (2) minutes of switching UE2 (a) on.

2.3.1.4 Comments

This test case confirms correct operation of SMS - Mobile Originated / Terminated Services including "Message Waiting" and "Note UE Present" procedures.

2.4 EMERGENCY TEST CASES

These test cases cover both UE detectable, non-UE detectable emergency calls. With reference to the test methodology in section 5, the tests cover both non-roaming and roaming scenarios.

UE Detectable Emergency call

Preconditions

UE1 (a) contains USIM of HPMN (a).
A barring of all outgoing calls is activated on the UE1 (a) for testing UE detectable Emergency Calls.

Actions

Power-up UE1 (a) and perform an emergency call to:

- 112 or 911
- A national emergency number of the local country, which is either the one of emergency numbers stored on the USIM and/or UE itself, or provided by the VPMN MME to the UE

via the Emergency Number List and Extended Emergency Number List during the attach and Tracking Area Update procedures.

Expected Result

Successful result if calls are established with PSAP of the visited country or equivalent simulated PSAP.

Comments

This test checks the possibility to make an Emergency Calls both in the case of UE Detectable Emergency Calls.

The domain selection of an emergency session is referred to 3GPP TS 23.167, annex H [11].

The following Emergency Call options are possible, depending on the capabilities of UE, HPMN and VPMN (see also GSMA PRD NG.119 [12]):

CSFB Emergency Call (roaming / non-roaming)
IMS Emergency Call with Emergency Registration (non-roaming case).

IMS Emergency Call without Emergency Registration, i.e. anonymous IMS emergency call (requiring E-CSCF in VPMN) (roaming)

For the roaming case, the appropriate option needs to be specified in bilateral agreement between HPMN (a) and VPMN (b).

Non-UE Detectable Emergency call

Preconditions

As 2.4.1.1 plus,

Deactivate barring of all outgoing calls on UE1 (a) when testing non UE detectable Emergency Calls.

Actions

Power-up UE1 (a) and initiates a call to:

A national emergency number of the local country which is not detected by the UE to be a local emergency code.

Optionally perform a call to a short code of emergency service of HPMN.

Expected Result

The call attempt is recognised by the H-IMS to be a local emergency code and rejected with a response code, e.g. to utilize the SIP 380 Alternative Service informing the UE that call should be re-attempted as an emergency call. On receipt of the response code, the UE behaves as in section 2.4.1 and completes the call.

In the roaming scenario, the HPMN IMS is assumed to be aware of local emergency codes in the VPMN as part of the roaming agreement.

A short code service in the HPMN would be terminated successfully in the HPMN.

Comments

This test checks the possibility to make the Emergency Calls in the case of non UE detectable Emergency Calls. The handling of non UE detectable Emergency Calls is defined in GSMA PRD NG.119 [12] section 2.4.3.

2.5 LAWFUL INTERCEPTION TEST CASES

Disabling encryption for IMS signaling is a precondition for all LI test cases in VPMN.

2.5.1 Lawful Interception on originator side

2.5.1.1 Preconditions

UE1 (a) and UE2 (a) are attached to VPMN (b) and have IMS-APN PDN connectivity,
UE1 (a) is targeted for Lawful Interception,
To enable lawful interception within VPMN (b), the P-CSCF (a) in HPMN (a) must set null encryption for IMS signalling at the outbound UE1 (a) and UE2 (a) in VPMN (b).

2.5.1.2 Actions

UE1 (a) establishes call to UE2 (a).
Call answered and held for five minutes.

2.5.1.3 Expected Result

Call and Context Information is available in LEMF

2.5.1.4 Comments

In most cases the LEMF is situated within the LEA. In those cases, test has to be supported and result verified by LEA experts.

2.5.2 Lawful Interception on terminator side

2.5.2.1 Preconditions

UE1 (a) and UE2 (a) are attached to the VPMN (b) and have IMS-APN PDN connectivity.
UE2 (a) is targeted for Lawful Interception
To enable lawful interception within VPMN (b), the P-CSCF (a) in HPMN (a) must set null encryption for IMS signalling at the outbound UE1 (a) and UE2 (a) in VPMN (b).

2.5.2.2 Actions

UE1 (a) establishes call to UE2 (a).
Call answered and held for five minutes.

2.5.2.3 Expected Result

Call and Context Information is available in LEMF

2.5.2.4 Comments

In most cases the LEMF is situated within the LEA. In those cases, test has to be supported and result verified by LEA experts.

2.6 SUPLLEMENTARY SERVICES TEST CASES

These optional test cases cover a number of MMTEL supplementary services. See annex D.3.

3 Equipment & Networks Requirements

3.1 User Equipment Requirement

UEs are supplied based on the bilateral agreement between HPMN (a) and VPMN (b).
Two LTE compatible USIMs supplied by HPMN (a). The supply of additional USIMs may be agreed by the HPMN(a) and VPMN(b), typically for the purposes of:

Spare cards in case of failure.
Allocation from different HSSs if applicable.

- One USIMs supplied by VPMN (b).

The device service profile of the UEs supplied for testing, as well as each value deviation of the relevant IMS configuration parameters [4] from that service profile must be specified.

It is expected that manual selection will be used to select the VPMN (b) when using the USIMs supplied by the HPMN (a). To facilitate the subsequent automatic selection, it is required that bits b6 and b5 of byte 2 of the USIM Service Table (Data-field 38) be set to "1", and the chosen the VPMN that is in the PMN Selector (Data-field 30).

In order to replicate the service that general roamers will encounter, it is required that any USIM used in the tests must have one access class out of the classes 0-9 defined. No other access class (for example 10 or 11-15) must be defined.

It is recommended that on any new USIM the Location Update Status field is set to "Status not updated" before the tests start (bit b2 set to "0" and bit b1 set to "1", of byte 11 of Data-field 7E).

3.2 Test Equipment Requirement

Clock capable of being used to allow testing personnel to record call start and chargeable start (that is, answer) time of calls to an accuracy of better than five seconds. If possible, the clock must be adjusted to be in alignment with the clock of MME in VPMN (b) which is used for the Toll Ticketing function. Stopwatch capable of measuring perceived chargeable duration of calls to an accuracy of one second. Packet counter can be prepared as appropriate application installed in UE or Network entities.

The availability of a S6a, S8, and DNS interface monitoring equipment is highly advisable. HPMN may have monitoring equipment in its IMS entities such as P-CSCF, S-CSCF and TAS. It is not mandatory but may be useful for VPMN to have packet analyser that can extract SIP signalling being exchanged over GTP tunnels. SIP traces are supposed to be located between P-CSCF and UE. GTP traces are supposed to be located between P-GW and S-GW.

If a system simulator is used as a test device for testing, it must:

- Select a correct test suite based on the HPMN and VPMN evolving type in accordance with the section 5.1,
- Simulate one of the device service profiles assigned by the HPMN and identify the deviation of the IMS configuration parameters in accordance with the section 5.2.

3.2.1 Specific Test Equipment Requirement for Emergency Call Testing

The availability of an IP and SIP protocol analyser able to show SIP messages is highly advisable.

3.3 Prerequisite of the Network Entities

3.3.1 Prerequisite of the Visited Network Entities

For the VPMN and HPMN to enable S8HR VoLTE roaming, the following conditions must be fulfilled in the EPC and E-UTRAN as specified in GSMA PRD IR.88 [5]. Conditions in IMS are not listed. The VPMN must support the following VoLTE capabilities:

SIP Bearer with QCI=5;

Voice media bearer with QCI=1;

if videocall is supported, then Video media bearer with QCI=2 in case HPMN (a) decides to use GBR bearer, or any non-GBR QCI value.

(HPMN and VPMN should agree on another QCI value for videocall if VPMN does not support QCI value of two (2).)

Indication from EUTRAN to the UE on "***ims-EmergencySupport***" in SIB1 cell broadcast

Indication from MME to the UE "IMS VoPS Supported Indicator = supported"

Indication from MME to the HSS "Homogeneous Support of IMS Voice over PS" based on the conditions specified in 3GPP TS 23.401[13]

Identifying which evolving type the VPMN belongs to.

3.3.2 Prerequisite of the Home Network Entities

For the VPMN and HPMN to enable S8HR VoLTE roaming, HPMN must support the following VoLTE capabilities:

SIP Bearer with QCI=5;

Voice media bearer with QCI=1; and

Video media bearer with QCI=2 (or non-GBR QCI).

Identifying which evolving type the HPMN belongs to

Identifying which device service profile the HPMN provisions to the UEs and identifying the deviation of the IMS configuration parameters from that profile.

As ARP settings are exclusively related to the VPMN service prioritization strategy and may change from one VPMN to another, HPMN should agree with VPMN on a right Priority Level (PL) value to set on IMS default bearer and dedicated bearer in order to ensure that its sessions will be handled with the right priority. QoS (QCI, ARP, AMBR) values should be agreed between HPMN and VPMN.

3.3.3 Additional prerequisite for Emergency Call testing

For the VPMN and HPMN to enable Emergency Calls for non UE detectable emergency numbers based on Emergency Number Lists, the VPMN must support the following capabilities:

ENL in MME

Optional EENL in MME

For the VPMN and HPMN to enable Emergency Calls for non UE detectable emergency numbers based on SIP 380 Alternative Response, the HPMN must support the following capabilities:

VPMN specific emergency number lists in P-CSCF

4 Pre-Testing Data Exchange

It is necessary for the two PMNs to have exchanged the pre-testing data defined in this Section prior to the commencement of testing.

4.1 Testing Contact Information

The following test Co-ordination contact information should be exchanged by both PMNs:

names,
telephone numbers,
fax numbers, and
email address.

4.2 USIM associated data supplied by PMN(a)

The following information as stored in the SIM and/or HSS is required individually for each of the two SIMs.

- PIN, PUK/ (SUPER PIN).
- IMSI
- MSISDN
- Basic Service Subscription Information
- Public User Identities

5 Test Methodology

VoLTE testing is based on the device-network relationship (defined in GSMA PRD IR.92 [4]). Some devices are certifying the network usage. Roaming eco-system also involves device-network (visited and home). For testing purposes, simulators can be implemented at device and network side. Figure 2 shows a VoLTE test ecosystem.

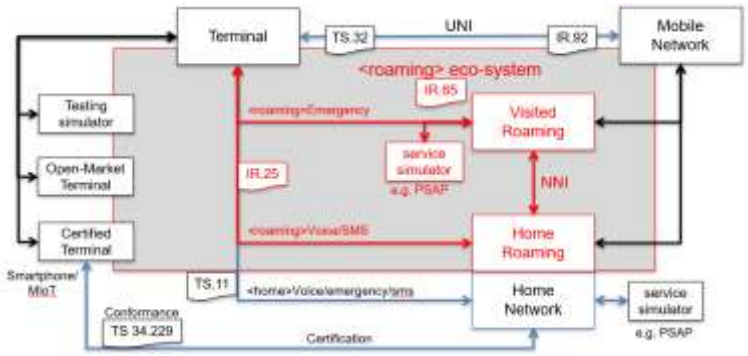


Figure 2: VoLTE Test Ecosystem

To streamline VoLTE test and to reduce device test overhead, it is recommended to break down the VoLTE roaming and non-roaming test in two stages – network test prior device test. The two testing parts complement each other and cannot replace each other.

5.1 VoLTE Network Test

Network test is initially to prove the network by using a commercially available test tool as a reference test system with suitable test suites / test cases following present IR.25. The test system is shown as testing simulator and/or service simulator in the Figure 2 above.

For VoLTE Network Test, the reference test tool is assumed to be configured in one of the device service profiles in accordance with the IMS settings of the home IMS network. The IMS settings are described in Annex B.

5.1.1 Evolution of VoLTE networks under Test

From the service testing view, a VoLTE network (N/W) can be in one of the VoLTE service evolving stages or types. Starting from LTE (type 0), four VoLTE network types (1 - 4) are identified in the following table.

N/W Type	0	1	2	3	4
Voice	legacy	IMS	IMS	IMS	IMS
SMS	legacy	legacy	IMS	legacy	IMS
Emergency	legacy	legacy	legacy	IMS	IMS
Test suite (TS)	0	1	2	3	4

Table 2 : VoLTE network types

NOTE: It is assumed that a legacy N/W offering CSFB voice also supports CSFB emergency call.

The test suites correspond to the above N/W Types and defined as:

1. Test suite0 – CSFB Voice, SMSoNAS, CSFB Emergency
2. Test suite1 – VoLTE, SMSoNAS, CSFB Emergency
3. Test suite2 – VoLTE, SMSoIP, CSFB Emergency
4. Test suite3 – VoLTE, SMSoNAS, IMS Emergency
5. Test suite4 – VoLTE, SMSoIP, IMS Emergency

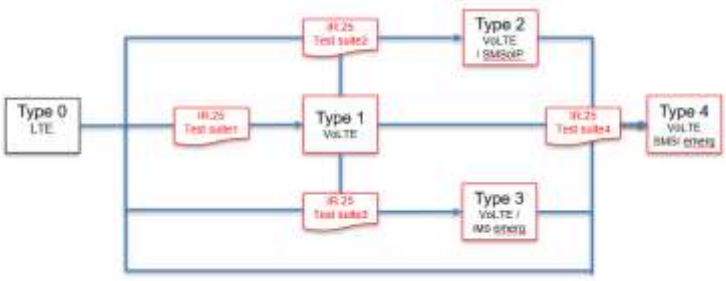


Figure 3: VoLTE evolving types & test suites applied

The test suites in figure 3 provide an evolution path of the VoLTE networks from type 0 towards one of the four types (1 – 4).

Referenced to GSMA PRD IR.38 [14], 3.2.3, an SMSoSGs test case is required by Test Suite1 & Test Suite3. Referenced to GSMA PRD IR.24 [15], 2.2.1 (i), a CSFB emergency test case is required by Test Suite1 & Test Suite2. To build Test Suite0 two CSFB Voice test cases are defined in IR.38 [14], section 3.2.1 and 3.2.2. The test suites ensure that the voice, SMS and emergency services can be tested in the different IMS network types.
The test suites ensure that the voice, SMS and emergency services can be tested:

5.1.2 VoLTE roaming test between two VoLTE evolving network types

If a VoLTE roaming is established between two types of VoLTE network, the table 2 shows which test suite (TS) abovementioned is selected for VoLTE roaming test.

VoLTE S8HR roaming A to B		**HPMN-A VoLTE N/W Type**		
		0	**1 or 3**	**2 or 4**
VPMN-B VoLTE N/W Type	0	TS0	TS0	TS0
	1 or 2	TS0	TS1	TS2
	3 or 4	TS0	TS3	TS4

Table 2: Test suite (TS) Selection

- It is assumed:SMSoIP service via S8HR is independent from VPMN-B,
- UE detectable emergency service is served by VPMN-B,

Non-UE detectable emergency service is managed by HPMN-A with 380 Alternative Service

For example, the Test suite2 (TS 2) is applied to the roaming test if a device from a Type2 HPMN (A) is outbound roaming in a Type1 VPMN (B). The S8 home-routed VoLTE and SMSoIP services as well as the CSFB Emergency service in the VPMN (B) are tested.

Another example is when a device from a Type2 HPMN (A) is outbound roaming in a Type3 VPMN (B). Either Test suite4 is applied. 3GPP TS 23.167 [11] Annex H specifies that a VoLTE capable UE supports the IMS emergency and CSFB emergency calls and can select the emergency domain accordingly in the ATTACH or RAU procedure.

5.2 Device Test

5.2.1 Device Service Profiles

Based on the IMS configuration parameters defined in GSMA PRD TS.32 [16] section 3.9, six standard device service profiles are defined to provide the device functionally interoperability test in non-roaming at home and in roaming (referred in short as device test). The profiles cover:

2 x Voice over LTE profiles,
2 x Voice & SMSoIP over LTE profiles,
2 x Voice & SMSoIP over WiFi profiles.

The defined profile details are provided in Annex B.

5.2.2 Device Test Selection (roaming)

A device must be tested in the roaming scenario taking account of all device profiles and all network type combinations. The test selection for a device in the roaming case is shown in table 4 below.

HPMN-A VoLTE network type	Device service profile	VPMN-B VoLTE network type	
		1 or 2	3 or 4
1 or 3	Voice-1 or Voice-2	TS1	TS3
2 or 4	Voice&SMS-1 or Voice&SMS-2	TS2	TS4
	VoWiFi&SMS-1 or VoWiFi&SMS -2	TS2	TS4

Table 1: Device Test selection in roaming from A to B

NOTE: All roaming tests are assumed to use LTE access only and thus absence of wireless test part contained in TS2w/TS4w in table 5.

5.2.3 Device profile differences

The differentiation between the voice profiles is characterised by the following IMS configuration parameters in GSMA PRD IR.92 [4]:

URI derivation,
Reliable 18x,
Home/Geo-Local,
Voice / Voice & Video,
Codec options.

The differentiation between Voice and Voice & SMS profiles is characterised by the IMS configuration parameter:

Enabling SMS.

The differentiation between LTE and WiFi Profiles, as well as between the WiFi profiles is characterised by the following IMS configuration parameters:

PS Voice Preference,
HO settings (WLAN to LTE).

5.2.4 Parameters impacting roaming

Independent from the device profiles, the setting following IMS configuration parameters has impact on roaming test:

Policy on local numbers,
Media type restriction policy when roaming,
PS Voice Preference Indicator when roaming,
XCAP PS Data Off Exempt,
MMTEL Voice PS Data Off Exempt,
Device Management PS Data Off Exempt,
SMS over IP PS Data Off Exempt,
USSI_PS Data Off Exempt,
PRE AND POST CALL DATA OFF,
MMTEL Video PS Data Off Exempt,
Allow Handover of IMS PDN connection from WLAN to LTE,
RCS VoLTE Single Registration

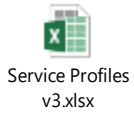
Annex A Appendix IR25.xlsm

This annex contains IR.25 testbook. The test cases / test suites have been designed to apply to VoLTE non-roaming and roaming test.


IR25v5_0.xlsm

Annex B Device Service Profiles

The six device service profiles are defined in the attached sheets.



Device test suites

The device test deploys the same test suites defined in section 5.1.1. The behaviours of the networks in the test suites are simulated in a test lab, while the device is under test.

Test Suite Selection (non-roaming)

A device must be tested against all device service profiles and across all network types. The device EPS attach behaviours are referred to Annex C1. The test selection for a device in the non-roaming case is shown in table 4 below.

		Home VoLTE network type			
		1	2	3	4
Device service profiles	Voice-1 or Voice-2	TS1	-	TS3	-
	Voice&SMS-1 or Voice&SMS-2	-	TS2	-	TS4
	VoWiFi&SMS-1 or VoWiFi&SMS - 2	-	TS2w		´TS4w

Device Test selection (non-roaming)

NOTE 1: The profiles Voice-1 and Voice-2 are not applicable to Network Types 2 & 4. The remaining profiles are not applicable to Network Types 1 & 3.

NOTE 2: The profile TS2w/TS4w refers to TS2/TS4 with the difference that the UE attaches to the EPC via S2b using untrusted WLAN IP access.

Annex C LTE-EPS network settings and EPS attach procedure

This section describes the UE and N/W test requirements for the attach procedure as determined by the device service profiles (see section 5.2.1) and N/W types (see section 5.1.1).

All test requirements in this section are based on an assumption that the UE is authorised to access the EPS N/W.

Device Test Requirements

A UE with a Type0 HPMN does not use IMS and does not have a device service profile (i.e. IMS Enabled=No). Such a UE requests a combined EPS /IMSI attach including Voice Domain Preference & UE's Usage Setting indicating "Voice Centric" and "CS Voice Only".

A UE with device service profiles Voice-1 or Voice-2 must request a combined EPS attach (combined TA/LA updating) with Additional Update Type set to "SMS only".

A UE with device service profile Voice&SMS-1, Voice&SMS-2, VoWiFi&SMS-1 and VoWiFi&SMS-2 must request an EPS attach (TA updating).

For all device service profiles, the UE must include the Voice Domain Preference & UE's Usage Setting indicating "Voice Centric" and "PS Voice Preferred, CS Voice Secondary".

All UEs must support IMS emergency call and CSFB emergency call and correctly prioritise and select the PS or CS domain to initial emergency session based on the UE attach status to PS and CS domains and the network support for IMS emergency and IMS voice over PS (Ref. to TS 23.167 [11], Annex H.5).

Network Test Requirements for N/W type 0 - 4

Network setting in non-roaming

Table 6 shows the N/W settings and EPS attach result based on the Network Type (see section 4.1.1) in the non-roaming scenario.

	EPS attach result	Additional information of attach accept	EPS N/W feature support / IMSVoIP	EPS N/W feature support / EMC BS	EUTRA SIB1 cell broadcast **/** *ims-EmergencySupport*
	Combined EPS/IMSI attach	Absent	No	No	Absent
	Combined EPS/IMSI attach	SMS only + a non-broadcast LAI	Yes		
	EPS only	CS Fallback not preferred/ Absent (Note)			
	Combined EPS/IMSI attach	SMS only + a non-broadcast LAI		Yes	Present
	EPS only	Cause #18 (CS domain not available)/ Absent (Note)			
Note: Additional attach type is set to CS Fallback not preferred or EMM cause is set to Cause #18 if the UE requests a combined EPS/IMSI attach, otherwise the IE is absent.					

LTE/EPS network setting and Attach result (non-roaming)

Network setting in roaming

Table 7 is used to determine the LTE/EPS N/W settings of VPMN in the EPS attach or TAU procedures for inbound VoLTE roaming. In the table, the setting of the three columns of a VPMN for 'EPS attach result', 'Additional information of attach accept' and 'EPS N/W feature support IMSVoIP' are determined by the HPMN Type of the inbound VoLTE roamers and determined by the S8HR VoLTE Roaming agreement (specifically SMS interworking and Voice interworking parameters). The setting of the two columns, 'EPS N/W feature support EMC BS' and 'EUTRA SIB1 cell broadcast ***ims-EmergencySupport'***, are determined by the VPMN N/W Type.

VPMN-B	**HPMN-A**	**VPMN-B LTE/EPS network setting**				
Type	**Type**	**EPS attach result**	**Additional information of attach accept**	**EPS N/W feature support / IMSVoIP**	**EPS N/W feature support / EMC BS**	**EUTRA SIB1 cell broadcast / *ims-EmergencySupport***
0	0, 1, 2, 3 or 4	Combined EPS/IMSI attach	Absent	No	No	Absent
1 or 2	0	Combined EPS/IMSI attach	Absent	No	No	Absent
	1 or 3	Combined EPS/IMSI attach	SMS only + a non-broadcast LAI	Yes		
	2 or 4	EPS only	CS Fallback not preferred/ Absent (Note)			
3 or 4	0	Combined EPS/IMSI attach	Absent	No	Yes	Present
	1 or 3	Combined EPS/IMSI attach	SMS only + a non-broadcast LAI	Yes		
	2	EPS only	CS Fallback not preferred/ Absent (Note)			
	4	EPS only	Cause #18 (CS domain not available) /Absent (Note)			

Note : Additional attach type is set to CS Fallback not preferred or EMM cause is set to Cause #18 if the UE requests a combined EPS/IMSI attach, otherwise the IE is absent.

VPMN-B LTE/EPS network setting for inbound roamer from HPMN-A

The networks of Type 1 – 4 must accept a combined EPS/IMSI attach for the inbound roamers from N/W Type 0.

Irrespective of non-roaming/roaming and N/W Type, the N/W must accept an EPS attach request from the UE.

Irrespective of non-roaming/roaming and N/W Type, on receipt of a combined EPS/IMS attach request from a VoLTE capable UE:

- if the UE sets Additional update type to SMS Only in the combined attach request the N/W must accept combined EPS/IMS attach with Additional attach type set to SMS Only and allocate a non-broadcast LAI as described in 3GPP TS 24.301 [16], section 5.5.1.3.4.2,
- determined by the VPMN N/W Type and/or the VoLTE Roaming agreement, the N/W must accept the attach via one of the following options:

combined EPS/IMS attach with Additional attach type set to SMS Only and allocate a non-broadcast LAI, or
EPS Only attach with Additional attach type set to CS Fallback not preferred (as described in 3GPP TS 24.301 [16], section 5.5.1.3.4.2), or
EPS Only attach with EMM cause set to Cause #18 - CS domain not available as described in 3GPP TS 24.301 [16], section 5.5.3.3.4.3.

In both the combined and EPS attach procedures the N/W must inform the UE about the support of specific features, such as IMS voice over PS session and emergency bearer services.

The EUTRA SIB1 cell broacast ***ims-EmergencySupport*** indicates whether the cell supports IMS emergency bearer services via EPC for UEs in limited service mode. If this indicator is absent, IMS emergency call via EPC is not supported by the network in the cell for UEs in limited service mode.

Annex D Non-Roaming Network Test (home test)

The test methodology, as described in section 5, requires the testing of the non-roaming scenario prior to the roaming scenario.

The non-roaming test consists of the network test and device test. The latter is described in Annex B.

The network test in non-roaming deploys the same test suites as the roaming test specified in 5.1.1. Depending upon the home VoLTE network type, the test suite selection is referred to table 2 in 5.1.1.

MMTel Supplementary Services features and requirements in IR.92 [4], section 2.3 need to be covered in the test.

Non-roaming test cases

Functions	H/V	Section	Mand / Opt	Comments
VoLTE registration	H	2.2.1	M	Check QCI 5 bearer
VoLTE MOC / MTC	H	2.2.2	M	Check QCI 1 bearer + location
VoLTE call with local number	H	2.2.3	M	
SMSoIP MO / MT	H	2.3.1	O	Check location
Emergency call (UE detectable)	H	2.4.1	O	
Emergency call (non UE detectable)	H	2.4.2	O	Release by H IMS
Lawful Interception on original side	H	2.5.1	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
Lawful Interception on terminator side	H	2.5.2	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
Lawful Interception of forwarding call	H	D.2	O	Null encryption for SIP signalling in roaming (to be specified in bilateral agreement)
SS1	H	D.3.1	O	Provided by H-IMS
SS2	H	D.3.2	O	Provided by H-IMS

List of non-roaming test cases

Lawful Interception of forwarded call

Preconditions

1. UE1 (a), UE2 (a) and UE3 (a) are attached to VPMN (b) and have IMS-APN PDN connectivity.
2. UE2 (a) has call forwarding active to UE3 (a)
3. UE2 (a) is targeted for Lawful Interception
4. To enable lawful interception within VPMN (b), the P-CSCF (a) in HPMN (a) must set null encryption for IMS signalling at the outbound UE1 (a), UE2 (a) and UE3 (a) in VPMN (b).

Actions

1. UE1 (a) establishes call to UE2 (a).
2. Call answered and held for five minutes.

Expected Result

1. Call and Context Information is available in LEMF

D.1.1 Comments

In most cases the LEMF is situated within the LEA. In those cases, test has to be supported and result verified by LEA experts.

D.2 SUPPLEMENTARY SERVICES TEST CASES

These optional test cases cover a number of MMTEL supplementary services.

EditorsEditor's Note :- This is a place holder for a further CR to add details.

Annex E Document Management

Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	19 Feb 2013	New PRD (IREG CR1001).Approved at PSMC#118	IREG #64 PSMC	Alfonso Della Fera, Telecom Italia
2.0	3 May 2016	CR 1002 added with S8HR description	NG #3	Veronique Verhé, SIGOS GmbH
2.1	15 May 2018	IR.25 CR1003 IREG to TADIG validation with one to one mapping of test cases	NG#7	Veronique Verhé, SIGOS GmbH
2.2	11 Oct 2019	IR.25 CR1004 Clean-up embedded Excel Sheets	NG#10	Veronique Verhé, SIGOS GmbH

3.0	6 April 2020	IR.25 CR1005 Clean-up embedded Excel sheets and convergence S8HR-LBO	NG	Veronique Verhé, SIGOS GmbH
4.0	15 Oct 2020	IR.25 CR1006 IR.25 CR LBO Removal	NG#12	Veronique Verhé, SIGOS GmbH
5.0	12 May 2021	IR.25 CR1007 Clarification of EPS attach result of different VoLTE network type etc	NG#13	Veronique Verhé, SIGOS GmbH

Other Information

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