LTE and EPC Roaming Testing
Version 3.0
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1 Introduction

1.1 Scope of document

This provides the specifications for the Networks Group (NG) end-to-end functional capability tests for services over Long Term Evolution (LTE) such as LTE data, Circuit Switch (CS) Fallback voice and Short Message Service (SMS) over SGs, related to a User Equipment (UE), belonging to a Home Public Land Mobile Network (HPLMN) (a), roaming within a visited PLMN (VPLMN) (b).

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

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

GSMA Permanent Reference Document (PRD) IR.23 [1] defines the scope and purpose of each stage of testing.

GSMA PRD IR.88 [5] defines the LTE roaming and LTE+2G/3G co-existence guidelines. For the 3GPP Release to be supported in each network, it is recommended to follow the guidelines in IR.88 [5].

This document does not cover:

- Voice and Short Message Service (SMS) over LTE using IMS (See IREG PRD IR.25 [2])
- Transferred Account Procedure (TAP), billing applications and any inter-PLMN financial statement; (see TADIG PRD TD.41 [6]). 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 IREG PRD IR.23 [1]).
- Proxy Mobile IP (PMIP) protocol for the S8 roaming interface. Only the GTP protocol is used for this interface.

1.2 Test objectives

The fundamental objective of this testing is to confirm the capability of LTE data/CS Fallback/SMS over SGs services that users will experience when roaming from their HPLMN(a) to a VPLMN(b). 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 IREG PRD IR.23 [1]).

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

Not all possible services should be tested.

In addition to the handling of the tests, the collection/comparison of charging information for the generation of Charging Detailed Records (CDR) is described.

The specific objectives are to prove that procedures defined in Section 2.1 of this document behave correctly.

Bilateral agreement between the HPLMN and VPLMN require these tests to be repeated in the opposite direction.

In order to maximize the efficiency of testing, the test cases have been specified so as to minimize the requirement for simultaneous joint activity by both PLMN (a) and PLMN (b). This applies mainly to the administration of mobile subscriber data in the HSS.

Accordingly, the testing program comprises three distinct stages:

a) HPLMN(a) issues pre-programmed Universal Subscriber Identity Module (USIM) and programmes Home Subscriber Server (HSS)
b) VPLMN(b) performs tests
c) VPLMN(b) and HPLMN(a) discuss results

1.3 Definition of Terms

Term	Description
APN	Access Point Name
BSS	Base Station Subsystem
CDR	Charging Detailed Record
CCITT	International Telegraph and Telephone Consultative Committee
CS	Circuit Switched
CSFB	Circuit-Switched Fallback
DNS	Domain Name System
EPC	Evolved Packet Core
EPS	Evolved Packed System
FQDN	Fully Qualified Domain Name
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GMSC	Gateway Mobile Services Switching Centre
GPRS	Generic Packet Radio Access
GTP	GPRS Tunnelling Protocol
HSS	Home Subscriber Server
HPLMN	Home PLMN
HTTP	Hypertext Transport Protocol
IMSI	International Mobile Subscriber Identifier
IP	Internet Protocol
ISP	Internet Service Provider
LTE	Long Term Evolution

MAP	Mobility Application Part
MME	Mobility Management Entity
MSC	Mobile Services Switching Centre
ODB	Operator Determined Barring
PCRF	Policy and Charging Rules Function
PDN	Packet Data Network
PDP	Packet Data Protocol
PLMN	Public Land Mobile Network
PGW	PDN Gateway
SCCP	Signalling Connection Control Part
SGSN	Serving GPRS Support Node
SGW	Serving Gateway
SMS	Short Message Service
SMSC	Short Message Service Centre
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UE	User Equipment
USIM	Universal Subscriber Identity Module
VMSC	Visited Mobile Services Switching Centre
VLR	Visitor Location Register

1.4 Document Cross-References

Ref	Document Number	Title
1	GSMA PRD IR.23	Organisation of GSM International Roaming Tests
2	GSMA PRD IR.25	VoLTE Roaming Testing
3	GSMA PRD IR.35	End-to-End Functional Capability Test Specification for Inter-PLMN GPRS Roaming
4	GSMA PRD IR.67	DNS/ENUM Guidelines for Service Providers
5	GSMA PRD IR.88	LTE and EPC Roaming Guidelines
6	GSMA PRD TD.41	Testing the Transferred Account Procedure (TAP)
7	3GPP TS 23.060	General Packet Radio Service (GPRS); Service description; Stage 2
8	3GPP TS 29.303	Domain Name System Procedures; Stage 3

2 Requirements for Testing

2.1 Overview

The test cases are divided in three (3) groups:

1. LTE-only services for UE (a) roaming to VPLMN (b) confirms a correct behaviour by testing the following procedures:

    a) LTE speed test
    b) LTE Cancel Location
    c) LTE Operator Determined Barring

2. Circuit Switch CS Fallback / SMS over SGs between UE1 (a) and UE2 (a) roaming to VPLMN (b) confirms a correct behaviour by testing the following procedures:

    a) CS Fallback – mobile originating and terminating voice calls
    b) Verify that the UE can successfully return to eUTRAN after the voice call ends
    c) SMS over SGs – mobile originated and terminated SMS

3. 2G/3G data services (i.e. web browsing) for UE (a) roaming to VPLMN (b) confirms a correct behaviour by testing the following procedures:

    a) Packet Data Protocol (PDP) Context Activation using Gp or S4/S8

For the 2G/3G data service using S4/S8, the testing of S8 interface (using GTP) is assumed to be covered in the "LTE-only" test cases (see the prerequisites in Section 2.3.3). Thus this PRD does not provide specific test cases for GTP variant for the 2G/3G data service.

Each operator has to make sure that the Access Point Name (APN) resolution algorithms are implemented correctly in their Serving GPRS Support Node (SGSN) and MME (Mobility Management Entity) according to GSMA PRD IR.88 [5] and GSMA PRD IR.67 [4].

2.2 Test Configuration

2.2.1 GTP-based LTE Roaming Configuration

The test configuration for LTE Roaming using GPRS Tunnelling Protocol (GTP)-based S8 interface is specified below.

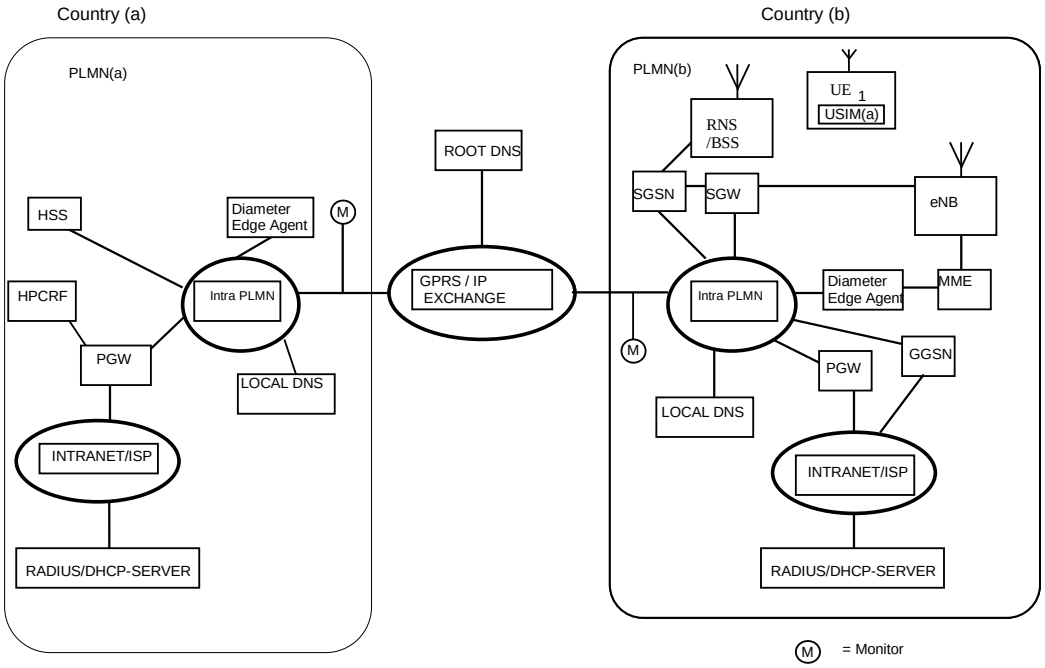

Figure 2.2.1-1: GTP based LTE Roaming Configuration

2.2.2 CS Fallback / SMS over SGs Configuration

The test configuration for CS Fallback and SMS over SGs is specified below.

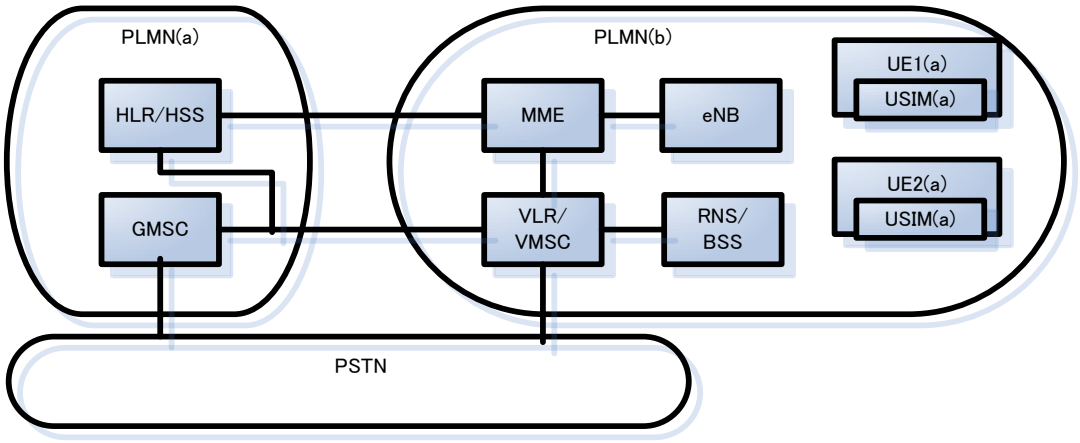

Figure 2.2.3-1: CS Fallback / SMS over SGs Configuration

2.3 Prerequisites for the Network Entities

2.3.1 Prerequisites for LTE-only Testing

Towards a first introduction of LTE Roaming, the following prerequisites are assumed:

1. UE supports necessary LTE capabilities for roaming in VPLMN (b).
2. The HSS contains LTE subscription data and routing information (PDN type, PDN address, APN, and VPLMN address allowed (only applicable when Local Breakout is

used)). These subscription data is permanent data in the HSS and has to be inserted for the tests.

The HSS is accessible from the MME via the S6a interface. For roaming UEs, the HSS is in a different PLMN than the current MME. The MME is updated with new an Evolved Packed System (EPS) subscription data along with the “Update Location Request” or the “Insert Subscriber Data” procedures.

International Mobile Subscriber Identifier (IMSI) is the primary key to the Evolved Packed System (EPS) subscription data stored in the HSS.

The relevant parameters for the IREG testing in the HSS must be configured according to the following table:

Field	Description
IMSI	IMSI is the main reference key.
MSISDN	The basic Mobile Subscriber ISDN Number (MSISDN) of the UE (Presence of MSISDN is optional).
MME Capabilities	Indicates the capabilities of the MME with respect to the core functionality e.g. regional access restrictions.
ODB parameters	Indicates the status of the operator determined barring
Access Restriction	Indicates the access restriction subscription information.
EPS Subscribed Charging Characteristics	The charging characteristics for the MS, e.g. normal, prepaid, flat-rate, and/or hot billing subscription.
Trace Reference	Identifies a record or a collection of records for a particular trace.
Trace Type	Indicates the type of trace, e.g. HSS trace, and/or MME/ Serving GW / PDN GW trace.
OMC Identity	Identifies the OMC that shall receive the trace record(s).
Subscribed-UE-AMBR	The Maximum Aggregated uplink and downlink MBRs to be shared across all Non-GBR bearers according to the subscription of the user.
APN-OI-Replacement	Indicates the domain name to replace the APN OI when constructing the PDN GW FQDN upon which to perform DNS queries. This replacement applies for all the APNs in the subscriber's profile.
RFSP Index	An index to specific RRM configuration in the E-UTRAN
URRP-MME	UE Reachability Request Parameter indicating that UE activity notification from MME has been requested by the HSS.
Each subscription profile contains one or more PDN subscription contexts:	
Context Identifier	Index of the PDN subscription context.
PDN Address	Indicates subscribed IP address(es).
PDN Type	Indicates the subscribed PDN Type (IPv4, IPv6, IPv4v6).
Access Point Name (APN)	A label according to DNS naming conventions

	describing the access point to the packet data network (or a wildcard).
EPS subscribed QoS profile	The bearer level QoS parameter values for that APN's default bearer (QCI and ARP).
Subscribed-APN-AMBR	The maximum aggregated uplink and downlink MBRs to be shared across all Non-GBR bearers, established for this APN.
EPS PDN Subscribed Charging Characteristics	The charging characteristics of this PDN Subscribed context for the MS, e.g. normal, prepaid, flat-rate, and/or hot billing subscription. The charging characteristics are associated with this APN.
VPLMN Address Allowed	Specifies whether for this APN the UE is allowed to use the PDN GW in the domain of the HPLMN only, or additionally the PDN GW in the domain of the VPLMN.
PDN GW identity	The identity of the PDN GW used for this APN. The PDN GW identity may be either a Fully Qualified Domain Name (FQDN) or an IP address. The PDN GW identity refers to a specific PDN GW.
PDN GW Allocation type	Indicates whether the PDN GW is statically allocated or dynamically selected by other nodes. A statically allocated PDN GW is not changed during PDN GW selection.
List of APN - PDN GW ID relations (for PDN subscription context with wildcard APN):	
APN - P GW relation #n	The APN and the identity of the dynamically allocated PDN GW of a PDN connection that is authorized by the PDN subscription context with the wildcard APN. The PDN GW identity may be either a Fully Qualified Domain Name (FQDN) or an IP address. The PDN GW identity refers to a specific PDN GW.

Table 1: HSS Configuration for LTE-only roaming

3. S8 interface is implemented in HPLMN(a) and VPLMN(b) and both HPLMN(a) and VPLMN(b) are using the same protocol (e.g. GTP)
4. MME has access to Domain Name System (DNS) functionality.
5. VPMLN MME local policies are configured for the Quality of Service.
6. Configuration of the test environment for transparent or non-transparent access to Intranet/ Internet Service Provider (ISP) (The key point for the access of an Intranet or an ISP infrastructure is the APN-Network-Identifier). This is sent by the UE during Initial Attach or is set by default by the HSS. The APN-Network Identifier defines to which external network the PDN Gateway (PGW) is connected to. This means, in detail, the interface of the PGW to an external network. This external interface at the PGW is connected to the infrastructure providing Intranet functionality (e.g. local Hypertext Transport Protocol-Server or HTTP-Server) or similar to a Serverfarm providing ISP functionality (HTTP-Server, Proxy-Server or File Transfer Protocol-Server (FTP-Server) with connection to the external Internet). This mechanism provides the physical path to the Intranet/ISP-functionality. However each operator

needs to guarantee that the APN-resolution algorithms are implemented correctly in his MME accordingly.
7. Dynamic Internet Protocol (IP) Address allocation for access to Intranet/ISP.

2.3.2 Prerequisites for CS Fallback / SMS over SGs Testing

For CS Fallback / SMS over SGs testing, the following prerequisites are assumed:

1. IREG tests for legacy 2G/3G CS domain services have already been performed between HPLMN (a) and VPLMN (b) according to PRD IR.23 [1].
2. IREG tests for LTE-only services have already been performed between HPLMN (a) and VPLMN (b) as specified in this document.
3. UE supports necessary CS Fallback and SMS over SGs capabilities for roaming in VPLMN (b).
4. SGs interface is implemented between MME and Mobile Switching Centre/ Visitor Location Register (MSC/VLR) in VPLMN (b).
5. Prerequisites for LTE-only testing have been met according to Section 2.2.4.1.

2.3.3 Prerequisites for LTE+2G/3G Co-existence Testing

For LTE+2G/3G Co-existence testing, the following prerequisites are assumed:

1. IREG tests for legacy 2G/3G PS domain services have already been performed between HPLMN (a) and VPLMN (b) according to PRD IR.23 [1].
2. IREG tests for LTE-only services have already been performed between HPLMN (a) and VPLMN (b) as specified in this document.
3. LTE and GPRS UE supporting the network operation modes in VPLMN (b).
4. HSS contains EPS subscription data for LTE roaming. Prerequisites are same as described in Section 2.2.4.1.

The HSS contains GPRS and EPS subscription data and routing information (e.g. PDP/PDN type (S)) for 2G/3G roaming.

This subscription data is permanent data in the HSS and must be inserted for the tests. The HSS is accessible from the SGSN via the Gr interface. For roaming UEs, the HSS is in a different PLMN than the current SGSN. The SGSN is updated with new GPRS and EPS subscription data with the “Insert Subscriber Data” procedure.

IMSI is the primary key to the GPRS subscription data stored in the HSS.

If Gn/Gp interface is used for 2G/3G roaming, the subscription information stored in HSS/HLR for 2G/3G roaming is defined in "Prerequisites for GPRS only roaming" table as specified in PRD IR.35 [3].

If S4/S8 interfaces are used for 2G/3G roaming, the relevant parameters “GPRS Subscription Data” for the IREG testing in HSS must be configured according to the following table:

HSS GPRS Subscription Data:	
Field	**Description**
IMSI	IMSI is the main reference key.
MSISDN	The basic MSISDN of the MS
Subscribed Charging Characteristics	The charging characteristics for the MS e.g. normal, prepaid, flat-rate, and /or hot billing subscription
Trace Reference	Identifies a record or a collection of records for a particular trace.
Trace Type	Indicates the type of trace, e.g. Mobile Services Switching Centre (MSC/BSS) trace, HLR trace, and/or SGSN/GGSN/BSS trace.
OMC Identity	Identifies the OMC that shall receive the trace record(s)
SMS Parameters	SMS-related parameters, e.g. operator-determined barring
GPRS-CSI	Optional GPRS CAMEL Subscription information, see TS23.016
MG-CSI	Optional Mobility Management for GPRS CAMEL subscription information, see TS23.016
APN-OI Replacement	Indicates the domain name to replace the APN-OI when constructing the Gateway GPRS Support Node (GGSN) FQDN upon which to perform a DNS resolution. This replacement applies for all the APNs in the subscribers' profile.
ODB for PS parameters	Indicates the status of the operator determined barring for packet oriented services.
Access Restriction	Indicates the access restriction subscription information (Note: the access restriction applies to both packet and circuit oriented services).
RFSP Index	An index to specific RRM configuration in the UTRAN/GERAN
Each IMSI contains zero or more of the following PDP context subscription records:	
PDP Context Identifier	Index of the PDP context
PDP Type	PDP type, e.g., PPP or IP (IPv4, IPv6, IPv4v6)
PDP Address	PDP address, e.g., and IP address. This field shall be empty if dynamic addressing is allowed.
Access Point Name	A label according to DNS naming conventions describing the access point to the external packet data network. In case of “Wild Card APN” this field shall be filled with
QoS Profile Subscribed	The quality of service profile subscribed. QoS Profile Subscribed is the default level if a particular QoS profile is not requested.
VPLMN Address Allowed	Specifies whether the MS is allowed to use the APN in the domain of the HPLMN only, and additionally the APN in the domain of the VPLMN.
PDP Context Charging Characteristics	The charging characteristics of this PDP Bearer Context e.g. normal, prepaid, flat-rate and/or hot billing
EPS subscribed QoS profile	The EPS bearer level QoS parameter values for that APN's default bearer (QCI and ARP)
APN-AMBR	The maximum aggregated uplink and downlink MBR values to be shared across all Non-GBR EPS bearers, which are established for

	this APN.

Table 2: Additional HSS Configuration for 2G/3G Roaming using S4/S8 interface

1. Towards GPRS no supplementary services are invoked.
2. The Gp-Interface or S8-Interface is implemented between HPLMN (a) and VPLMN (b).
3. SGSN in VPLMN (b) has access to DNS functionality.
4. Configuration of the test environment for transparent or non-transparent access to Intranet/ISP (The key point for the access of an Intranet or an ISP infrastructure is the APN-Network-Identifier). This is sent by the handset during PDP-context activation or is set by default by the SGSN. The APN-Network Identifier defines to which external network the PGW is connected to. This means, in detail, the interface of the PGW to an external network. This external interface at the PGW (a) is connected to the infrastructure providing Intranet functionality (e.g. local HTTP-Server) or similar to a Serverfarm providing ISP functionality (HTTP-Server, Proxy-Server or FTP-Server with connection to the external Internet). This mechanism will provide the physical path to the Intranet/ISP-functionality. However each operator has to make sure that the APN-resolution algorithms are implemented correctly in his SGSN according to 3GPP TS 23.060 [7] and Annex A of 3GPP TS 23.060 [7].
5. Dynamic IP Address allocation for access to Intranet/ISP.

2.3.4 Prerequisites for 5G NSA Testing

For 5G NSA testing, the following prerequisites are assumed:

1. VPLMN is supporting EN-DC (Evolved-Universal Terrestrial Radio Access-New Radio Dual Connectivity):

MME is sending the Feature Bit 27 in the Features of Feature-List-ID 2 of the Feature List AVP as request in ULA or answer in IDA messages

2. HPLMN is supporting EN-DC (Evolved-Universal Terrestrial Radio Access-New Radio Dual Connectivity:

HSS is sending the Feature Bit 27 in the Features of Feature-List-ID 2 of the Feature List AVP as answer in ULR or request in IDS messages

3. MS1(a) is not restricted to NR access and is LTE Attached in VPLMN and with a default bearer

2.4 User Equipment

The UE described in this section is necessary for undertaking the test cases described in this document. This applies to all groups specified in Section 2.1 of this document:

1. Two UEs supplied by VPLMN (b).
2. Two LTE compatible USIMs supplied by HPLMN (a).

The supply of additional USIMs may be agreed by the HPLMN (a) and VPLMN (b), typically for the purposes of:

a) Spare cards in case of failure
b) Allocation from different HSSs

3. It shall be possible to specify what types of UEs are supplied for testing between operator agreement (HPLMN (a) and VPLMN (b)).

2.5 Test Equipment

2.5.1 Test equipment for LTE-only Testing

The availability of a SGi, S6a, S8 and DNS interface IP testing and monitoring equipment is highly advisable.

It is also recommended to have sample files and applications for data transfer testing.

2.5.2 Test equipment for CS Fallback / SMS over SGs Testing

The availability of an International Telegraph and Telephone Consultative Committee (CCITT) # 7 tester able to decode Signalling Connection Control Part (SCCP), Transaction Capabilities Application Part (TCAP) and Mobile Application Part (MAP) is highly advisable, but not strictly necessary for these tests. However it is essential for any analysis of test case failures.

Clock capable of being used to allow testing personnel to record call start and chargeable start (answer) time of calls to an accuracy of better than five seconds is required. If possible, the clock shall be adjusted to be in alignment with the internal MSC clock which is used for the Toll Ticketing function.

Stopwatch capable of measuring perceived chargeable duration of calls to an accuracy of one second.

2.5.3 Test equipment for LTE+2G/3G Co-existence Testing

The availability of a CCITT # 7 tester able to decode SCCP, TCAP, and MAP (for Gr interface) is highly advisable, but not strictly necessary for these tests. However it is essential for any analysis of test case failures.

The availability of a SGi, Gn, Gp, S6a, S6d, S8, S4 and DNS interface IP testing and monitoring equipment is highly advisable.

It is also recommended to have sample files and applications for data transfer testing.

3 Test Cases

3.1 LTE-only Testing

3.1.1 LTE Speed test

Preconditions

1. UE1 contains USIM of HPLMN(a).
2. Neither MSC/VLR nor MME record exists for MS.
3. HLR/HSS record contains basic service information.
4. HPLMN to supply a HTTP/FTP page and file (20MB as per LTE GRQ) to download

Action

1. Power-up UE1 (a) and perform Combined Attach procedure on VPLMN (b)'s LTE network.
2. Check MME and MSC/VLR record for the IMSI/MSISDN of UE1.
3. Start the HTTP/FTP transfer
4. Check HTTP/ FTP mean data rate

Information Flow

Note: The information flow for Combined Attach is not provided in this version of the document.

Expected Result

1. Successful result if the following results are both achieved:

- MSC/VLR and MME record is identical to the pre-testing information supplied by PLMN (a).
- the HTTP/FTP mean data rate is in line with the following values:

	Threshold	
QoS parameter (KPI)	Geo-distance < 4000 km	Geo-distance ≥ 4000 km
FTP download mean data rate (Mbit/s)	≥ 13.5	≥ 6
HTTP mean data rate (Mbit/s)	≥ 11	≥ 5

Table 3: HTT/FTP Data rate values

Comments

This test case confirms the operation of Update Location and Insert Subscriber Data procedure using SGs interfaces. It checks the support of the relevant SGs-AP, MAP and Diameter (S6a) operations, TCAP processes and SCCP addressing for both E.214 and E.164 Global Titles, between the HLR/HSS (a) and Visited Mobile Services Switching Centre (VMSC) (b). It also checks the LTE speed.

The mean date rate is dependent on the local testing conditions. If the local testing environment is different than the production one, then the VPLMN should inform the HPLMN about the customer experience in the latter case.

3.1.2 LTE Cancel Location

Preconditions

1. MME (b) in VPLMN (b) contains EPS subscription information of UE1 (a).
2. PDN connectivity for UE1 (a) is activated.

Action

HPLMN (a) personnel deletes UE1 (a) EPS-subscription from HSS (a) either using HSS`s Man-Machine Interface or via Administrative Data Centre (ADC) input to HSS (a).

Information Flow

The information flow for LTE Cancel Location procedure is described as follows:

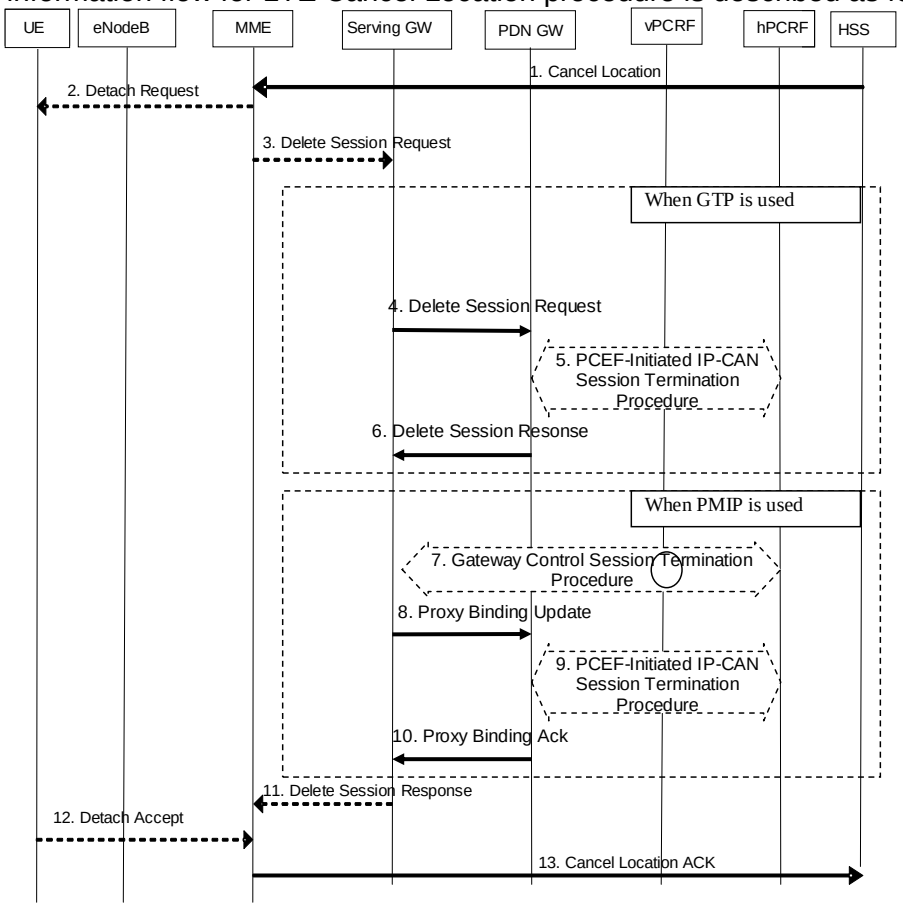

Figure 3: LTE Cancel Location Procedure

Expected Result

Successful result if records in MME (b), Serving Gateway (SGW) (b), PGW (a) and hPCRF (a) for UE1 (a) have been erased and PDN connectivity for UE1 (a) has been deactivated.

Comments

This test case confirms that the “Cancel Location” procedure between HSS (a) and MME (b) and the subsequent “Detach initiated by the network" procedure has behaved correctly.

3.1.3 LTE Operator Determined Barring

Preconditions

UE1 (a) is attached to VPLMN (b) and has a PDN connectivity.

Action

1. HPLMN (a) personnel activates Operator Determined Barring (ODB) for PDN connectivity for UE1 (a) from HSS (a) either using HSS`s Man-Machine Interface or via Administrative Data Centre (ADC) input to HSS (a).
2. Check MME (b) for records of UE1(a).
3. Try to make a LTE-attach from UE1 (a) and send attach request from UE1 (a).

Information Flow

The information flow for LTE ODB procedure is described as follows:

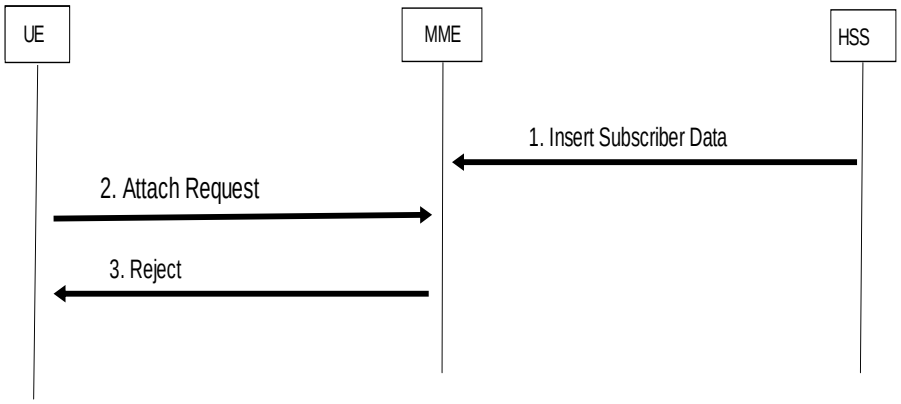

Figure 4: LTE Operator Determined Barring Procedure

Expected Result

Successful result if MME (b) record for UE1 (a) containing ODB information, attach request is rejected and no PDN connectivity establishment is successful.

Comments

This test case confirms that the “Operator Determined Barring” procedure between HSS (a) and MME (b) behaves correctly.

3.2 CS Fallback / SMS over SGs Testing

3.2.1 CS Fallback Mobile Originating Voice Calls

Preconditions

1. UE1 (a) is CS Fallback capable.
2. UE1 (a) is camping on LTE.
3. UE2 (a) has attached successfully in VPLMN (b).

Action

1. UE1 (a) establishes call to UE2 (a).
2. Call is answered.

Information Flow

Note: The information flow for CS Fallback Mobile Originating Voice Calls is not provided in this version of the document.

Expected Result

Test is successful if the following results are both achieved

- Call is established.
- The UE successfully returns to eUTRAN in 9 to 11 seconds after the voice call is ended.

Comments

This test case confirms the Mobile Originated call procedures using CS Fallback for roamers. It checks the support of originating call setup procedures using SGs interface. It also checks that the UE can successfully return to eUTRAN after the voice call ends.

3.2.2 CS Fallback Mobile Terminating Voice Calls

Preconditions

1. UE1 (a) is CS Fallback capable.
2. UE1 (a) is camping on LTE.
3. UE2 (a) has attached successfully in VPLMN (b).

Action

1. UE2 (a) establishes call to UE1 (a).
2. Call answered.

Information Flow

Note: The information flow for CS Fallback Mobile Terminating Voice Calls is not provided in this version of the document.

Expected Result

1. Successful result if call is established.
2. Successful result if the UE successfully returns to eUTRAN after the voice call ends

Comments

This test case confirms Mobile Terminated call procedures using CS Fallback for roamers. It checks the support of terminating call setup procedures using SGs interface. It also checks that the UE can successfully return to eUTRAN after the voice call ends.

3.2.3 SMS over SGs (Mobile Originated and Mobile Terminated)

Preconditions

1. SMS-MO/MT is provisioned in HLR subscription. UE1 (a) and UE2 (a) are registered in VPLMN (b).
2. UE1 (a) and UE2 (a) are both SMS over SGs capable.
3. UE1 (a) and UE2 (a) are camping on LTE.

Action

1. Switch on UE1 (a) and UE2 (a).
2. Use UE1 (a) to transmit a 160 character Short Message to UE2 (a) via Short Message Service Centre (SMSC) in HPLMN (a).
3. Await delivery of Short Message to UE2 (a) on LTE.
4. Check contents of Short Message with those transmitted.

Information Flow

Note: The information flow for SMS over SGs is not provided in this version of the document.

Expected Result

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

Comments

This test case confirms correct operation of SMS over SGs - Mobile Originated / Terminated for roamers.

3.3 LTE+2G/3G Co-existence Testing

3.3.1 Data Access from 2G/3G using PGW in HPLMN (a) over Gp Interface

Preconditions

1. UE1 (a) is GPRS-Attached in VPLMN (b) and camping on 2G/3G (e.g. UE in STANDBY or READY state for 2.5G). The UE1 (a)'s LTE capability may be disabled manually to fulfil this precondition.
2. No valid PDP contexts/EPS Bearers are established in the UE1 (a).
3. PDP context/EPS Bearers subscription record(s) exists in HSS (a) where PDP type(S) = PDP type(R).
4. One PDP/PDN context subscription record exists in HSS (a) where APN(S) = APN(R).
5. VPLMN not allowed for selected PDP/EPS Bearer context subscription records.
6. Access Point Name (APN) resolution algorithms are implemented correctly in SGSN and PGW according to GSMA PRD IR.88 [5] and GSMA PRD IR.67 [4].

Action

1. UE1 (a) performs "Activate PDP Context Request". PDP type (R) is sent by UE1 (a).
2. A PDP Address is not sent by UE1 (a) and is not present in a PDP context subscription record. (Dynamic address allocation).
3. APN (R) (Network-ID, no Operator-ID) is sent by UE1 (a).
4. Pre-defined file is requested/transferred from External Network (Network-ID) to UE1 (a) by accessing HTTP-server over WEB-browsing.
5. UE1 (a) performs "Deactivate PDP Context Request".

Information Flow

The information flow for the procedures to support data access from 2G/3G using PGW in HPLMN (a) over Gp interface is described as follows:

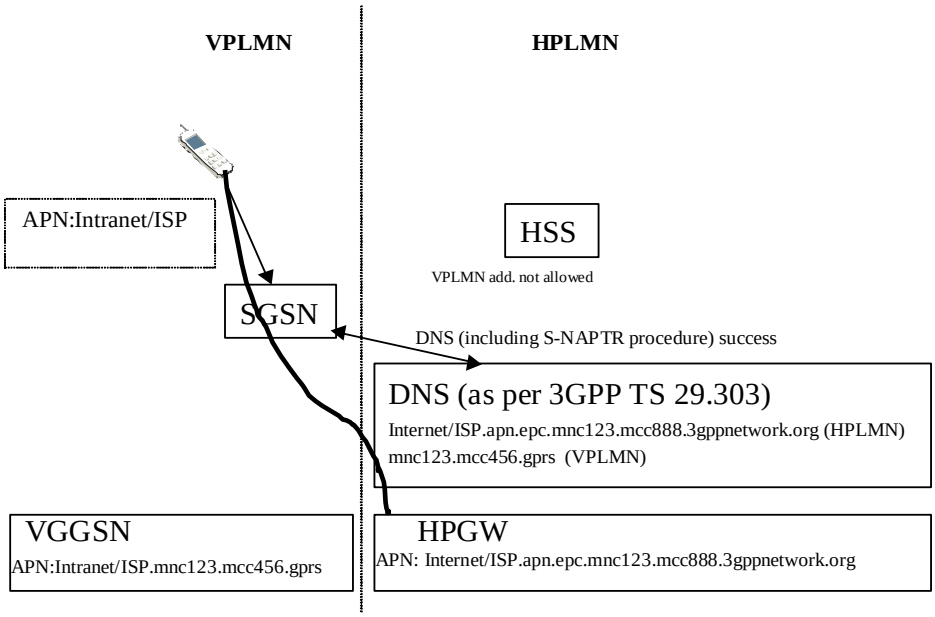

Figure 5: Data access from 2G/3G using PGW in HPLMN (a) over Gp interface

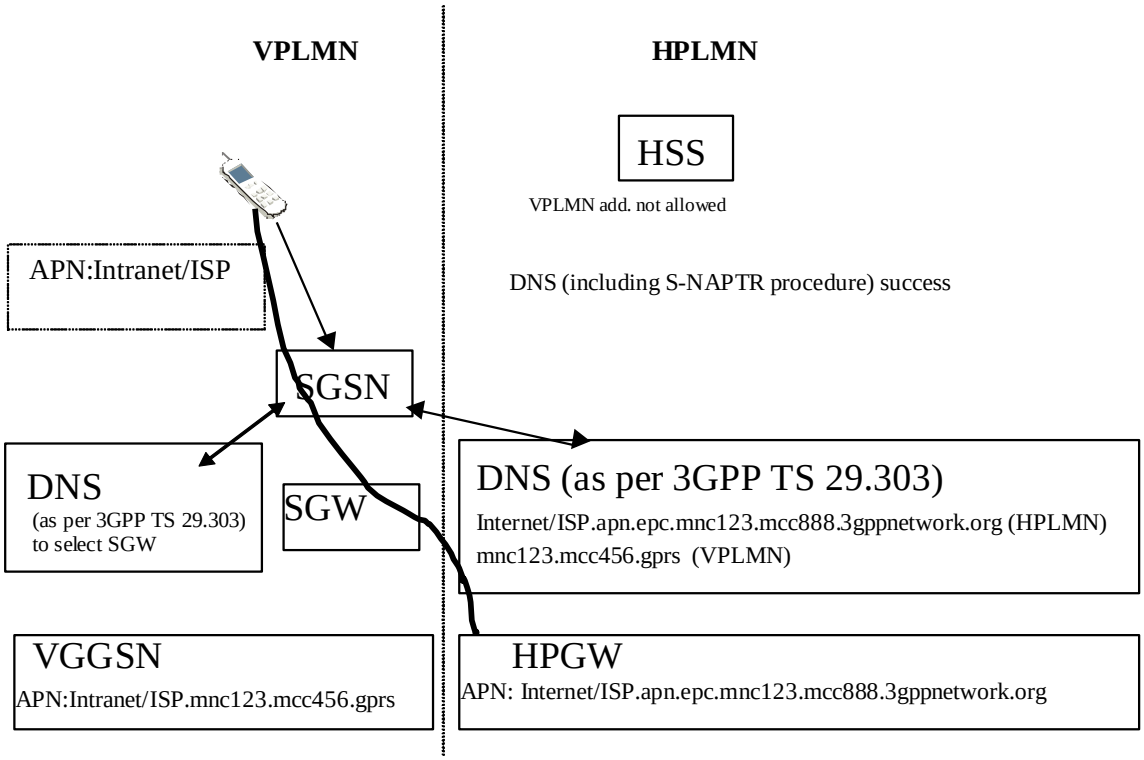

Figure 6: Data access from 2G/3G using PGW in HPLMN (a) over S8 interface

Expected Result

1. SGSN (b) receives APN (R) sent by UE1 (a).

2. SGSN (b) selects PDP context subscription record (APN(S), APN(S) = (APN(R)) and sets selection mode parameter to “subscribed”.
3. SGSN interrogates DNS-Functionality using procedures defined in 3GPP TS29.303 [8] with selected APN with appended HPLMN APN-Operator-ID.
4. Selected APN is translated to a PGW-Address in the HPLMN (a).
5. SGSN (b) returns an “Activate PDP Context Accept” message to the UE1 (a) including PDP type and PDP address.
6. Valid PDP contexts are established in the UE1 (a).
7. Connection to Network specified by APN (Network-ID) is established.
8. Pre-defined file is successfully transferred at an agreed quality (data rate) with no errors after using HTTP-Service.
9. EPS Bearer Context is deactivated, UE1 (a) performs "Deactivate PDP Context Request".

Comments

This test case confirms PDP context activation/deactivation towards a home PGW (a) over Gp interface with:

1. APN (R) is not empty, (Network-ID, no Operator-ID).
2. Setting of APN (Operator-ID) by subscription for HPLMN (a) = (APN(S)).
3. Setting up IP-tunnel connections (GTP, IP, User Datagram Protocol / Transmission Control Protocol (UDP/TCP).
4. Root address lookup and dynamic address allocation.

If the PDP context activation procedure fails or if the SGSN returns an “Activate PDP Context Reject” (Cause, PDP Configuration Options) message, then the user may attempt another activation to the same APN up to a maximum number of attempts.

3.4 4G+5G NSA Testing

Preconditions

1. UE1 (a) is camping on LTE.

Action

1. Perform a speed test and record the results
2. MS1(a) moves under 5G coverage
3. Perform another speed test and record the new results

Expected Result

1. Additional bearer with 5G NR as Secondary RAT is activated
2. Speedtest rates are clearly higher than those measured from test 3.1.1
3. Captured trace in S1 shows gNodeB usage and validates NR usage

Comments

This test case confirms the usage of NR as Secondary RAT with a 5G capable handset.

4 Pre-Testing Data Exchange

4.1 General

It is necessary for the two PLMNs to have exchanged the pre-testing data defined in the following sections prior to the commencement of testing.

4.2 Testing Contact Information

The following test co-ordination contact information should be exchanged by both PLMNs:

1. Names
2. Telephone numbers
3. Fax numbers
4. Email address

4.3 PLMN/IP-addressing, numbering and routing data

4.3.1 LTE-only testing

For LTE-only testing is performed, the following information should be exchanged between both PLMNs:

1. MME IP addresses used
2. SGW IP addresses used
3. PGW IP addresses used
4. Diameter Edge Agent IP addresses and FQDNs used
5. HSS IP addresses used
6. PDN subscription context
7. APNs
8. DNS IP-Addresses
9. HTTP/FTP page and 20MB file name

4.3.2 CS Fallback / SMS over SGs testing

If CS Fallback / SMS over SGs testing is performed, the confirmation of the PLMN addressing numbering and routing data as referenced in PRD IR.23 [1] is regarded as advisable. Such information includes:

1. E212-E214 translation
2. MSC/VLR and HLR E.164 addresses
3. MSRN number ranges
4. International Signalling Point Codes (if applicable)
5. SMS Service Centre E.164 address

4.3.3 LTE+2G/3G Co-existence testing

If LTE+2G/3G Co-existence testing is performed, the following information should be exchanged between both PLMNs:

1. E212-E214 translation
2. E164 Number range
3. International Gateway Signalling Point Codes
4. SMS Service Centre E164 address
5. SGSN-/PGW-IP addresses used
6. SGSN Global Title Address used
7. PDP Context / EPS Bearer profiles
8. APNs
9. DNS IP-Addresses

4.4 USIM associated data supplied by PLMN (a)

The following information as stored in the USIM and/or HSS is required individually for each of the USIMs.

1. PIN, PUK/(SUPER PIN).
2. IMSI
3. MSISDN
4. Basic Service Subscription Information
5. Subscriber data concerning PDN connectivity
6. Access point names

In order to perform the tests, following USIM-card profile is required:

1. APN Name: “This should contain one HPLMNs APN” or “ * ” (wild card)
2. VPLMN allowed = no

4.5 Inter-PLMN Connection Parameters

In order to establish Inter-PLMN connectivity it is necessary to exchange information such as:

1. Link transport, capacity and routing parameter
2. Link carrier and topology
3. Gp/S8 interface information
4. Security related information if necessary towards interconnection
5. LTE+2G/3G Co-existence scenarios being supported (see IR.88 [5] for the details)

4.6 IP-Server Information

The following information is required to provide IP-connectivity testing:

1. IP address of HPLMN (a) server (HTTP-, DNS-, PROXY-server), accessed via PGW (a)

5 Test Cases Excel Sheet

IR.38 V3.xlsm

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
0.1-0.3		Initial drafts for discussion	Networks Group PSMC	Itsuma Tanaka, NTT DOCOMO
0.4	24 August 2013	Version for approval	Networks Group PSMC	Itsuma Tanaka, NTT DOCOMO
1.0	03 April 2014	CR for approval	Networks Group	Itsuma Tanaka NTT DOCOMO
2.0	07 November 2016	CR1001 PMIP removal CR1002 Simplification Testing and adding Speed Test	Networks Group/PSMC	Jignesh Patel Verizon
3.0	27 October 2020	CR1003 5G NSA Test Case	NG	Jignesh Patel Verizon

Other Information

Type	Description
Document Owner	NG PACKET
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It is our intention to provide a quality product for your use. If you find any errors or omissions, please contact us with your comments. You may notify us at prd@gsma.com

Your comments or suggestions & questions are always welcome.