Interoperability Test Plan for LTE Wireless Devices

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Section 1 Introduction

1.1 Purpose

The purpose of this document is to define the CTIA Certification Program test requirements for LTE interoperability. Test requirements are applicable to both FDD and TDD supported bands and bandwidths.

1.2 Scope

This document provides cabled interoperability testing for UE and networks supporting E-UTRA as defined by 3GPP. This document includes relevant protocol related testing as well as functional testing required for interoperability requirements. This testing is intended to be performed in an infrastructure vendor test lab, and includes multimode (FDD and/or TDD).

Cabled Interoperability tests are referenced from 3GPP test specifications. All tests listed shall be included as line items in the Cabled Interoperability Test Report.

Cabled Interoperability testing is divided into two levels:

- Level 2 Cabled IOT
- Level 1 Cabled IOT

Level 2 Cabled Interoperability Testing

Level 2 Cabled IOT Testing is a comprehensive verification effort which determines the interoperability of a device prior to being released.

Level 1 Cabled Interoperability Testing

Level 1 Cabled IOT Testing is defined as a reduced set of test cases from Level 2. This level of testing is used for regression verification and / or certifying a device based on target market requirements.

1.3 References

The following documents are referenced in this test plan:

Official Document TS.11: Device Field and Lab Test Guidelines, version 21, October 23, 2017, GSM Association.

[1] TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3, 3GPP.

[2] TS 36.211: Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation, 3GPP.

[3] TS 36.213: Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures, 3GPP.

[4] TS 36.300: Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2, 3GPP.

[5] TS 36.306: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities, 3GPP

[6] TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification, 3GPP

[7] 3GPP TS 23.401: General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access

[8] 3GPP TS 36.300: Overall description; Stage 2

[9] 3GPP TS 36.101: Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception

[10] 3GPP TS 36.201: LTE physical layer; General description

[11] 3GPP TS 36.212: Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding

[12] 3GPP TS 36.413: Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)

[13] 3GPP TS 36.423: Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP)

[14] 3GPP TS 37.320: Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2

1.4 Glossary

TABLE 1.4-1 GLOSSARY

Acronym/Term	Definition
3GPP	3rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards
APN	Access Point Name
ARFCN	Absolute Radio Frequency Channel Number
BW	Bandwidth
Cell	A portion of an eNB.
CBRA	Contention-Based Random Access
CQI	Channel Quality Information

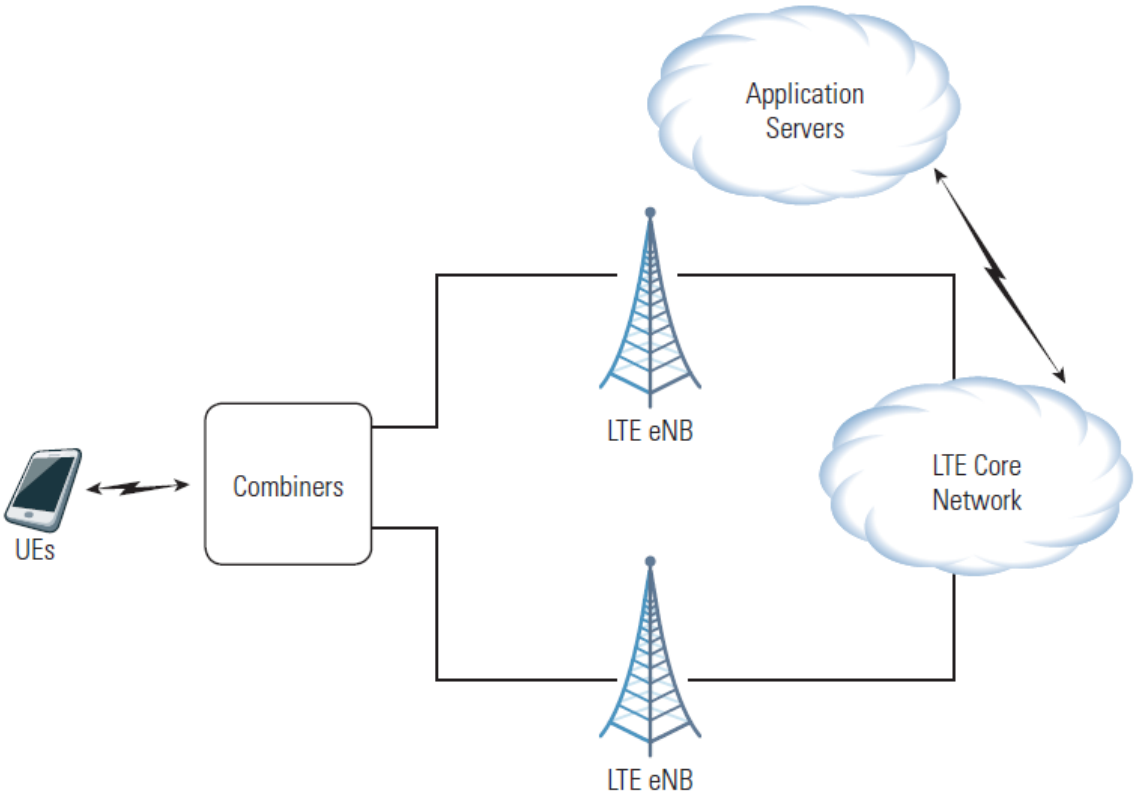
Acronym/Term	Definition
CSR	Channel Status Report
DL	Downlink
E-UTRA	Evolved Universal Terrestrial Radio Access
eNB	Evolved Node B. An eNB can consist of multiple Cells.
EMM	EPS Mobility Management
EPDCCH	Enhanced Physical Downlink Control channel
EPC	Evolved Packet Core
EPS	Evolved Packet System
FDD	Frequency Division Duplex
FTP	File Transfer Protocol
HO	Handover
HTTP	Hypertext Transfer Protocol
IMS	Internet Protocol Multimedia Subsystem
IOT	InterOperability Testing
Ipv4	Internet Protocol version 4
Ipv6	Internet Protocol version 6
LTE	Long Term Evolution
MFBI	Multiple Frequency Band Indicator
MBMS	Multimedia Broadcast and Multicast Service
MBSFN	Multicast/Broadcast over Single Frequency Network
MFBI	Multiple Frequency Band Indicator
MCS	Modulation Code Scheme
MDT	Minimization of Drive Test
MIB	Master Information Block
Mbps	Mega Bits Per Second

Acronym/Term	Definition
NAS	Non Access Stratum
OLSM	Open Loop Spatial Multiplexing
CLSM	Close Loop Spatial Multiplexing
PDN	Packet Data Network
PBCH	Physical Broadcast Channel
PDCCH	Physical Downlink Control channel
PDSCH	Physical Downlink Shared Channel
PLMN	Public Land Mobile Network
PRB	Physical Resource Blocks
PSS	Primary Synchronization Signal
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAN	Radio Access Network
RI	Rank Indication
RNTI	Radio Network Temporary Identifier
SIB	System Information Block
SSS	Secondary Synchronization Signal
SIMO	Single Input Multiple Output
TDD	Time Division Duplex
UDP	User Datagram Protocol
UE	User Equipment
UL	Uplink

1.5 Basic Lab Configuration

While no test cases are defined for Basic Attach without NAS Security Algorithms, the network should support the ability to disable NAS Security Algorithms for other troubleshooting purposes. Figure 1.5-1 below shows the basic lab configuration, which reflects the network implementation of the LTE Wireless 3GPP network deployment.

FIGURE 1.5-1 BASIC LAB CONFIGURATION



This section explicitly tests some of the procedures required for initial system acquisition and device access.

2.1 Cell Acquisition (PSS/SSS/MIB Decode)

The UE shall successfully decode the PSS, SSS and PBCH channels.

Reference:

- 3GPP2 TS 36.211, chapter 6.10 & 6.11
- 3GPP2 TS 36.213, chapter 4.1
- 3GPP2 TS 36.101
- 3GPP2 TS 36.331, chapter 5.2 & 6.2.2

Purpose:

To verify the UE can acquire radio synchronization and the physical layer identity of the cell.

Initial Configuration:

1. The UE is powered off.
2. The cell is unlocked and transmitting PSS, SSS, MIB and downlink cell specific reference signals. The UE shall not have saved a valid copy of MIB prior to execution of the test case otherwise the acquisition procedure may not be triggered.

Procedure:

1. Power on the UE.

Compliance:

The UE has acquired the cell ID correctly, stays synchronized to the cell and the MIB in correctly acquired.

2.2 SIB Decoding

The UE shall successfully decode the SIB1, SIB2, SIB3, SIB4 and SIB5 information.

Reference:

- 3GPP2 TS 36.331, chapter 5.2 & 6.2.2

Purpose:

To verify the UE can acquire all of the SIBs transmitted on the PDSCH by the eNB.

Initial Configuration:

1. The cell is unlocked and SIB1, SIB2, SIB3, SIB4 and SIB5 are being transmitted.

2. The UE shall not have saved a valid copy of SIB1, SIB2, SIB3, SIB4 or SIB5 prior to execution of the test case, otherwise the acquisition procedure may not be triggered.

Procedure:

1. Power on the UE and verify that the UE initiates the cell acquisition procedure.

Compliance:

The UE has successfully acquired the SIB1, SIB2, SIB3, SIB4 and SIB5 information.

2.3 UE RACH Procedure

The UE shall successfully perform the initial access of the network.

Reference:

- 3GPP TS 36.321, chapter 5.1 & 6.1.5

Purpose:

To verify the UE can successfully complete all steps in the CBRA RACH procedure.

Initial Configuration:

1. Verify the UE has successfully detected a cell and acquired the required System Information in order to perform random access in the cell.

2. UE has no valid Cell RNTI (C-RNTI).

Procedure:

1. Verify the UE performs random access in the cell.

Compliance:

1. The UE is connected through MAC and is known in eNB by a new unique C-RNTI.

2. The UL Synchronization status of the UE in eNB is in-sync.

2.4 Initial RRC Connection Setup and Reconfiguration

The UE shall successfully perform the “EPS Attach” and “Default EPS Bearer Context Activation” procedures.

Reference:

TS.11 (30.1.1.1); 3GPP TS 24.301

Purpose:

To verify, that the UE can successfully establish a default EPS bearer during the Network Attachment procedure.

Initial Configuration:

1. UE is powered off.

Procedure:

1. Power on the UE and verify that the UE initiates the Attach procedure by sending the "Attach Request" message if possible use a diagnostic tool to verify that this message contains the "PDN CONNECTIVITY REQUEST" to the eNodeB. The message may also contain the old GUTI.

2. The network shall respond to the UE with an "RRCConnectionReconfiguration" [ATTACH ACCEPT] message that contains the "EPS Radio Bearer Identity" and the APN for a default bearer.

3. Verify that the UE is attached and has a default EPS bearer by setting up a mobile terminated connection. If the UE is not capable to set-up a mobile terminated service, verify that the UE is attached and has a default EPS bearer by setting up a mobile originated connection without establishing a redundant Tracking Area Update procedure.

Compliance:

1. The UE successfully performs the Attach procedure.

2. The UE establishes a mobile terminated service connection or a mobile originated service connection.

Example message flow:

Step	Direction UE – NW	Message	Comments
1	→	RRCConnectionRequest	RRC
2	←	RRCConnectionSetup	RRC
3	→	RRCConnectionSetupComplete(ATTACH REQUEST(PDN CONNECTIVITY REQUEST))	RRC(EMM(ESM))
4	←	AUTHENTICATION REQUEST	EMM
5	→	AUTHENTICATION RESPONSE	EMM
6	←	SECURITY MODE COMMAND	EMM
7	→	SECURITY MODE COMPLETE	EMM
(8)	←	ESM INFORMATION REQUEST	ESM(OPTIONAL)

Step	Direction UE – NW	Message	Comments
(9)	→	ESM INFORMATION RESPONSE	ESM(OPTIONAL)
10	←	UECapabilityEnquiry	RRC
12	→	UECapabilityInformation	RRC
12	←	SecurityModeCommand	RRC
13	→	SecurityModeComplete	RRC
14	←	RRCConnectionReconfiguration(ATTACH ACCEPT(ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST))	RRC(EMM(ESM))
15	→	RRCConnectionReconfigurationComplete	RRC
16	→	ATTACH COMPLETE(ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT)	EMM(ESM)
17	←	RRCConnectionRelease	RRC

Note: Step 14 – If the UE receives an Ipv4 address set to 0.0.0.0, it may negotiate the Ipv4 address with DHCPv4 as specified in TS 29.061 [38]. If the UE receives an Ipv6 interface identifier, it may wait for the Router Advertisement from the network with the Ipv6 prefix information or it may send a Router Solicitation if necessary.

2.5 Attach Procedure with Various NAS Security Settings and Default Bearer Setup Procedure

This test verifies the UE's behavior on the attach procedure when NAS Security

Algorithms are enabled in the network.

Reference:

- 3GPP TS 24.301, clauses 5.3.1, 5.4.2, 5.4.3, 8.2.20, 8.2.21, 9.3.1, 9.9.3.23
- 3GPP TS 33.102
- 3GPP TS 23.401
- 3GPP TS 33.401
- 3GPP TS 36.323, clause 5.6
- 3GPP 36.523-1 subclause 7.3.3
- 3GPP 36.523-1 subclause 7.3.4

Purpose:

This test verifies the UE's behavior on the attach procedure when NAS Security

Algorithms are enabled in the network.

Initial Condition:

1. Provision the UE/UICC with the proper security information (e.g. the K key).
2. Provision the network and eNB for proper security with settings identified by Table 2.5-1.
3. Configure the UE/UICC so that it appears to have not been on the network before.
4. Configure the UE/UICC so that there is no valid stored security context in the UE or the UICC.
5. Power off the UE.

Procedure:

1. Power on the UE.
2. The UE initiates an attach to the network as per TS 24.301 and TS 23.401.
3. The UE attaches to the network.

Compliance:

In Step 3, verify that the UE successfully attaches to the network with NAS security enabled.

TABLE 2.5-1 NAS SECURITY SETTINGS

Case	Integrity Algorithm	Encryption Algorithm
1	EIA1 (SNOW 3G)	EEA0 (Null Ciphering)
2	EIA1 (SNOW 3G)	EEA1 (SNOW 3G)
3	128-EIA3 (ZUC)	128-EEA3 (ZUC)

2.6 AS Security

This test verifies the UE's behavior on the Attach Procedure when AS security Algorithm is enabled on the eNB under various settings.

Reference:

- 3GPP TS 24.301, clauses 5.3.1, 5.4.2, 5.4.3, 8.2.20, 8.2.21, 9.3.1, 9.9.3.23
- 3GPP TS 33.102
- 3GPP TS 23.401

- 3GPP TS 33.401
- 3GPP TS 36.323, clause 5.6
- 3GPP 36.523-1 subclause 7.3.3
- 3GPP 36.523-1 subclause 7.3.4

Purpose:

This test verifies the UE's behavior on the attach procedure when AS Security.

Algorithms are enabled in the network. The algorithms used are defined in Table 2.6-1.

Initial Condition:

1. Provision the UE/UICC with the proper security information (e.g., the K key).
2. Provision the network and eNB for proper security with settings identified by Table 2.6-1.
3. Configure the UE/UICC so that it appears to have not been on the network before.
4. Configure the UE/UICC so that there is no valid stored security context in the UE or the UICC.
5. Power off the UE.

Procedure:

1. Power on the UE.
2. The UE initiates an attach to the network as per TS 24.301 and TS 23.401.
3. The UE attaches to the network.

Compliance:

In Step 3, verify that the UE successfully attaches to the network with AS security enabled.

TABLE 2.6-1 AS SECURITY SETTINGS

Case	Integrity Algorithm	Encryption Algorithm
1	EIA1 (SNOW 3G)	EEA0 (Null Ciphering)
2	EIA1 (SNOW 3G)	EEA1 (SNOW 3G)
3	EIA1 (SNOW 3G)	EEA2 (AES)
4	EIA2 (AES)	EEA0 (Null Ciphering)
5	EIA2 (AES)	EEA1 (SNOW 3G)
6	EIA2 (AES)	EEA2 (AES)
7	128-EIA3 (ZUC)	128-EEA3 (ZUC)

2.7 UE attach to MFBI Mapped Band

Purpose:

UE can successfully attach in a cell where the same frequency could be used by more than oneb. In this case serving cell has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicate support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X).

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set

2. UE supports LTE band Y but does not support band X

3. UE and USIM has not stored any information related to the serving cell

4. UE is powered off and in automatic selection mode

5. Serving cell supports MFBI and has band X as the primary band

6. Serving cell broadcasts freqBandIndicator and multiBandInfoList in SIB1, SIB2 and SIB5. Serving cell also broadcasting additionalSpectrumEmission

7. No cells with primary Y band are available and accessible to the UE

Procedure

1. Power on the UE and attempt to attach on the serving cell

2. Verify the Serving cell's primary broadcasted band and the mapped band in Additional band

3. Verify the UE's FGI bit 31 and the UE support for band's Y and X

4. Verify that the UE is successfully attached and used band when performing UL and DL data transfer

Compliance:

1. The UE acquires serving cell in band x and successfully attaches to the serving cell which has band X is the Primary band

2. The serving cell broadcast in SIB1, SIB2 multiBandInfoList which has band Y listed

3. UE has FGI bit 31 set and has and does not have band X as a supported band

4. UE transfers UL and DL data in band X

2.8 UE in Idle Mode Reception and Response to SIB Change of an MFBI Capable Cell

Purpose:

MFBI cell SIB change triggers and MFBI capable UE in Idle mode to successfully attach or detach in a cell where the same frequency could be used by more than one Band. In this case serving cell has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicates support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X).

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set

2. UE supports LTE band Y but does not support band X

3. UE and USIM has not stored any information related to the serving cell

4. UE is powered off and in automatic selection mode

5. Serving cell supports MFBI and has band X as the primary band

6. Serving cell broadcasts freqBandIndicator and multiBandInfoList in SIB1, SIB2 and SIB5. Serving cell also broadcasting additionalSpectrumEmission

7. No cells with primary Y band are available and accessible to the UE

Procedure:

1. Power on the UE and attempt to attach on the serving cell

2. Verify that the UE is successfully attached and SIB2, SIB5's lists multiBandInfoList

3. While UE is an RRC Idle state, modify the serving cell with band X as primary to disable MFBI feature

4. Verify the UE's mobility state

5. Modify the serving cell with band X as primary to enable MFBI feature with band Y as mapped band

6. Verify the UE's mobility state

Compliance:

1. The UE acquires serving cell in band x and successfully attaches to the serving cell which has band X is the Primary band

2. The serving cell broadcast in SIB1, SIB2, SIB5 multiBandInfoList which has band Y listed

3. After sending RRC Page message with SystemInfo change, the serving cell broadcast in SIB1, SIB2 only the primary band as supported band and no additionalFreqBandList broadcasted

4. UE is not attached to the serving cell with Y band

5. The serving cell broadcast in SIB1, SIB2, SIB5 multiBandInfoList which has band Y listed

6. UE could attach to the serving cell with Y band if is the only available cell

2.9 UE in Connected Mode Reception and Response to SIB Change of an MFBI Capable Cell

Purpose:

MFBI cell SIB change triggers and MFBI capable UE in a Connected mode to successfully attach or detach in a cell where the same frequency could be used by more than one Band. In this case serving cell has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicates support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X).

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set
2. UE supports LTE band Y but does not support band X
3. UE and USIM has not stored any information related to the serving cell
4. UE is powered off and in automatic selection mode
5. Serving cell supports MFBI and has band X as the primary band
6. Serving cell broadcasts freqBandIndicator and multiBandInfoList in SIB1, SIB2 and SIB5. Serving cell also broadcasting additionalSpectrumEmission
7. No cells with primary Y band are available and accessible to the UE

Procedure

1. Power on the UE and attempt to attach on the serving cell
2. Verify that the UE is successfully attached and SIB2, SIB5's list multiBandInfoList
3. While UE is an RRC Connected state, modify the serving cell with band X as primary to disable MFBI feature
4. Verify the UE's mobility state
5. Modify the serving cell with band X as primary to enable MFBI feature with band Y as mapped band
6. Verify the UE's mobility state

Compliance:

1. The UE acquires serving cell in band x and successfully attaches to the serving cell which has band X is the Primary band
2. The serving cell broadcast in SIB1, SIB2, SIB5 multiBandInfoList which has band Y listed
3. After sending RRC Page message with SystemInfo change, the serving cell broadcast in SIB1, SIB2 only the primary band as supported band and no additionalFreqBandList broadcasted

4. UE is not attached
5. The serving cell broadcast in SIB1, SIB2, SIB5 multiBandInfoList which has band Y listed
6. UE could attach to the serving cell with Y band if is the only available cell

2.10 UE Attach in a Cell configured with 4x2 DL MIMO

To ensure that the UE can attach to a cell configured with 4x2 DL MIMO.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331

Purpose:

To ensure that the UE can attach to a cell configured with 4x2 DL MIMO.

Initial condition:

1. Configure cell with 4x2 DL MIMO

Procedure:

1. Initiate an attach to the network.

Compliance:

1. Verify that the UE is attached and has a default EPS bearer by setting up a mobile terminated connection. If the UE is not capable to set-up a mobile terminated service, verify that the UE is attached and has a default EPS bearer by setting up a mobile originated connection without establishing a redundant Tracking Area Update procedure. Verify UE measures all four antennae.

2.11 UE Attach in a Cell configured with 4x4 DL MIMO

To ensure that the UE can attach to a cell configured with 4x4 DL MIMO.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331

Purpose:

To ensure that the UE can attach to a cell configured with 4x4 DL MIMO.

Initial condition:

1. Configure cell with 4x4 MIMO.

Procedure:

1. Initiate an attach to the network.

Compliance:

1. Verify that the UE is attached and has a default EPS bearer by setting up a mobile terminated connection. If the UE is not capable to set-up a mobile terminated service, verify that the UE is attached and has a default EPS bearer by setting up a mobile originated connection without establishing a redundant Tracking Area Update procedure. Check rank indicator reported is 4 on PHY layer.

2.12 UE Attach in a Cell Configured with MBSFN

This test verifies UE attaches to a cell configured with MBSFN (Multicast/Broadcast over Single Frequency Network).

Reference:

- 3GPP TS 36.201: 4.2.1
- 3GPP TS 36.300: 5.1.5, 15.3

Purpose:

This test verifies UE attaches to a cell configured with MBSFN.

Initial Condition:

1. Configure the network to have an active eNB that supports and transmit MBSFN.
2. Configure UE with MBMS (Multimedia Broadcast and Multicast Service) application as per Operator or Market Endorsement.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. The UE attaches to the network and UE MBMS application is available.

Compliance:

1. Verify the UE attaches to the network and UE MBMS application is available.

3.1 Attach Reject, Cause #7 "EPS Services Not Allowed"

Check the UE's behavior on the reject message with cause 7 'EPS services not allowed'

Reference:

- TS.11 (30.1.1.2); 3GPP TS 24.301, clause 5.5.1.2.5

Purpose:

To verify that the UE behaves correctly on a reject message ''EPS services not allowed.'

Initial Configuration:

1. UE is powered off.

Procedure:

1. Network does not allow EPS services (e.g. this particular IMSI is not provisioned for EPS services).
2. Power on the UE and attempt Attach procedure.
3. EMM cause at the time of reception of the Attach Reject message is equal to #7 EPS services not allowed.
4. Trigger an Attach procedure (e.g., via AT command). Check whether the UE tries to perform a new registration procedure.

Compliance:

The UE attempts to perform Attach procedure.

1. After Step 2, UE shall not attempt to perform an additional Attach procedure until it is powered off or the SIM card is removed.
2. The UE shall delete any GUTI, last visited registered TAI and KSI. The UE shall consider the USIM as invalid for EPS services until switching off or the UICC containing the USIM is removed.
3. If A/Gb mode or Iu mode is supported by the UE, the UE shall in addition delete P-TMSI, P-TMSI signature, RAI and GPRS ciphering key sequence number.
4. UE shall not perform any additional Attach procedure.

3.2 Attach Reject, Cause #14 "EPS Services Not Allowed in this PLMN" - Multiple PLMN Environment

Check the UE's behavior on the reject message with cause 14 'EPS Services not allowed in this PLMN'.

Reference:

- TS.11 (30.1.1.3.1); 3GPP TS 24.301, clause 5.5.1.2.5

Purpose:

To verify that the UE behaves correctly on a reject message 'EPS Services not allowed in this PLMN'.

Initial Configuration:

1. UE is powered off and in automatic mode.
2. Two PLMNs are available:
3. PLMN1 does not allow EPS Services (e.g. no roaming agreement).
4. PLMN2 does have roaming agreement.

Procedure

1. Power on the UE and attempt Attach procedure on PLMN1.
2. EMM cause at the time of reception of Attach Reject message is equal to #14 "EPS Services not allowed in this PLMN".
3. UE selects PLMN2 through automatic PLMN selection process.

Compliance:

1. The UE attempts to perform Attach procedure.
2. The UE will not re-attempt to perform an Attach procedure in the PLMN1.
3. UE performs a new ATTACH procedure on selected PLMN – PLMN2.

3.3 Attach Reject, Cause #11 "PLMN Not Allowed"

Check the UE's behavior on the reject message with cause #11 'PLMN not allowed'.

Reference:

- TS.11 (30.1.1.5); 3GPP TS 24.301, clause 5.5.1.2.5

Purpose:

To verify that the UE behaves correctly on a reject message ''PLMN not allowed.'

Initial Configuration:

1. UE is powered off.
2. UE is configured to automatic mode.
3. PLMN1 is E-UTRA radio access technology, PLMN2 can be any RAT that is supported by the UE.
4. UE with USIM that contains EPS LOCI field with PLMN1 as last visited PLMN.
5. UE's "forbidden PLMN list" is empty.

6. Roaming is not allowed with PLMN1.

7. Roaming is allowed with PLMN2.

Procedure:

1. Power on the UE and verify that the UE sends an ATTACH REQUEST to the EPS network PLMN1.

2. The EPS network PLMN1 shall respond to the UE with an ATTACH REJECT with Reject Cause #11 'PLMN not allowed'.

3. Check that the UE performs an automatic PLMN selection to another PLMN (e.g., PLMN2) without accessing the "forbidden PLMN".

4. Perform a manual PLMN selection to PLMN1 and verify that the UE attempts to select the "forbidden PLMN".

5. Perform a manual PLMN selection to PLMN2 and verify that the UE successfully selects the PLMN.

If the UE is not capable to set-up a mobile terminated service, verify that the UE is registered by setting up a mobile originated connection.

Compliance:

1. The UE performs an Attach procedure on PLMN1.

2. The UE shall set the EPS update status to EU3 ROAMING NOT ALLOWED and shall delete any GUTI, last visited registered TAI and KSI. The UE in S1 mode stores the PLMN identity in the "forbidden PLMN" list and enters state EMM-DEREGISTERED.PLMN-SEARCH.

3. The UE performs an automatic PLMN selection without accessing the "forbidden PLMN".

4. The UE attempts to perform an ATTACH REQUEST on PLMN1, is rejected with Cause #11 and indicates an error message to the user.

5. The UE performs a successful ATTACH REQUEST on PLMN2.

3.4 Attach Reject, Cause #3 "Illegal UE"

Check the UE's behavior on the reject message with cause #3 'Illegal UE'.

Reference:

- TS.11 (30.1.1.6)

- 3GPP TS 24.301, clause 5.5.1.2.2 and clause 5.5.1.2.5

Purpose:

To verify that the UE behaves correctly on a reject message ''Illegal UE'.

Initial Configuration:

1. At least 2 PLMNs are available and accessible.

2. UE is powered off.

3. The UE cannot pass the authentication check, i.e. the RES received from the UE is different from that generated by the network.

Procedure:

1. Power on the UE and verify that the UE sends an ATTACH REQUEST to the EPS network.

2. The EPS network shall respond to the UE with an ATTACH REJECT with Reject Cause #3 'Illegal UE'.

3. Wait for 60s in order to check that the UE is not performing an ATTACH REQUEST to any network.

4. Perform a manual network selection.

5. Power Cycle the UE and verify the UE sends an ATTACH REQUEST to the EPS network.

Compliance:

1. The UE performs an Attach procedure.

2. The UE shall delete the list of equivalent PLMNs and enter state EMM-DEREGISTERED.

3. The UE does not send any ATTACH REQUEST message.

4. The UE does not send any ATTACH REQUEST message.

5. The UE performs an Attach attempt procedure with IMSI1.

3.5 Attach Reject – Cause Code #15 (No Suitable Cells in Tracking Area)

This test verifies the UE's behavior when the network rejects the attach with the Cause Code #15, "No Suitable Cells in Tracking Area."

Reference:

- 3GPP TS 24.301, clauses 5.5.1.2.2, 5.5.1.2.5 and 5.3.2

Purpose:

This test verifies the UE's behavior when the network rejects the attach with the Cause Code #15, "No Suitable Cells in Tracking Area."

Initial Condition:

1. Configure the network so that a least 2 PLMN's are available and accessible.

2. Configure the UICC so that the UE selects PLMN1 and never selects PLMN2.

3. Configure the PLMN's and the UICC so that the UE is in a tracking area that is not allowed, i.e., the HPLMN determines that the UE, by subscription, is not allowed to operate in that PLMN.

4. The UE is powered off.

Procedure:

1. Power on the UE.

2. When the UE attempts to attach to the EPS network, the EPS network shall respond to the UE with an ATTACH REJECT with Reject Cause code #15 “No Suitable Cells in Tracking Area.”

3. Wait for 60 seconds in order to check that the UE is not performing an ATTACH REQUEST to any network.

4. Perform a manual network selection to the PLMN selected in Step 1.

5. Power Cycle the UE.

6. The UE attempts to attach to the network via the PLMN selected in Step 1.

Compliance:

1. In Step 2, verify that the UE performs an Attach procedure.

2. In Step 3, verify that the UE does not send any ATTACH REQUEST messages.

3. In Step 6, verify that the UE attempts to attach to the network.

3.6 Attach Reject – Cause Code #6 (Illegal ME)

This test verifies the UE’s behavior when the network rejects the initial attach with the Cause Code #6, “Illegal ME.”

Reference:

- 3GPP TS 24.301, clause 5.5.1.2.2 and clause 5.5.1.2.5

- 3GPP TS 22.016, clause 5

Purpose:

This test verifies the UE’s behavior when the network rejects the initial attach with the Cause Code #6, “Illegal ME.”

Initial Condition:

1. Configure the network so that a least 2 PLMNs are available and accessible.

2. Configure the UICC so that the UE selects either of the PLMN’s.

3. Configure the Network Equipment Identity Register (EIR) so that the UE/ME is in the black list (black listed), or not in the white list (unknown).

4. The UE is powered off.

Procedure:

1. Power on the UE.

2. When the UE attempts to attach to the EPS network, the EPS network shall respond to the UE with an ATTACH REJECT with Reject Cause code #6 'Illegal ME'.

3. Wait for 60 seconds in order to check that the UE is not performing an ATTACH REQUEST to any network.

4. Perform a manual network selection to the PLMN selected in Step 1.

5. Power Cycle the UE.

6. The UE attempts to attach to the network via the PLMN selected in Step 1.

Compliance:

1. In Step 2, verify that the UE performs an Attach procedure.

2. In Step 3, verify that the UE does not send any ATTACH REQUEST messages.

3. In Step 6, verify that the UE attempts to attach to the network.

3.7 Attach Reject – Cause Code # 12 (Tracking Area Not Allowed)

This test verifies the UE's behavior when the network rejects the attach with the Cause Code #12, "Tracking Area Not Allowed."

Reference:

- 3GPP TS 24.301, clauses 5.5.1.2.2, 5.5.1.2.5 and 5.3.2

Purpose:

This test verifies the UE's behavior when the network rejects the attach with the Cause Code #12, "Tracking Area Not Allowed."

Initial Condition:

1. Configure the network so that a least 2 PLMN's are available and accessible.

2. Configure the UICC so that the UE selects either of the PLMN's.

3. Configure the PLMN's and the UICC so that the UE is in a tracking area that is not allowed, i.e. the HPLMN determines that the UE, by subscription, is not allowed to operate in that PLMN.

4. The UE is powered off.

Procedure:

1. Power on the UE.

2. When the UE attempts to attach to the EPS network, the EPS network shall respond to the UE with an ATTACH REJECT with Reject Cause code #12 "Tracking Area Not Allowed."

3. Wait for 60 seconds in order to check that the UE is not performing an ATTACH REQUEST to any network.

4. Perform a manual network selection to the PLMN selected in Step 1.

5. Power Cycle the UE.

6. The UE attempts to attach to the network via the PLMN selected in Step 1.

Compliance:

1. In Step 2, verify that the UE performs an Attach procedure.

2. In Step 3, verify that the UE does not send any ATTACH REQUEST messages.

3. In Step 6, verify that the UE attempts to attach to the network.

3.8 Tracking Area Update Reject, Cause Code #3 (Illegal UE)

This test case verifies that the UE behaves correctly in response to a tracking area update reject message with cause code #3 "Illegal UE."

Reference:

- 3GPP TS 24.301, clause 5.5.3.2.4 and clause 5.5.3.2.5

Purpose:

This test case verifies that the UE behaves correctly in response to a tracking area update reject message with cause code #3 "Illegal UE."

Initial Condition:

1. Configure the network to show at least 2 Tracking Areas.

2. Configure the network so that the UE can pass the authentication check for Tracking Area #1 but not for Tracking Area #2.

3. Ensure that the UE will attach to the network in Tracking Area #1.

4. UE is powered off.

Procedure:

1. Power on the UE.

2. Wait until the UE attaches to the network in Tracking Area #1.

3. Ensure that the UE is in RRC_IDLE.

4. Force the UE to reselect from Tracking Area #1 to Tracking Area #2.

5. The EPS network shall respond to the UE from Tracking Area #2 with a TRACKING AREA UPDATE REJECT with Reject Cause code #3 'Illegal UE'.

6. Wait for 60s.

7. Power off the UE.

8. Configure the network so that the UE will attach to the network in Tracking Area #1.

9. Power on the UE.

10. The UE attaches to the network Tracking Area #1.

Compliance:

1. In Step 2, verify that the UE attaches to the network in Tracking Area #1.

2. In Step 6, verify that the UE does not send any ATTACH REQUEST messages after the reject from Tracking Area #2.

3. In Step 10, verify that the UE attaches to the network in Tracking Area #1 after powering up.

3.9 Detach - With Power-off

The UE shall successfully perform a UE initiated detach procedure.

Reference:

- TS.11 (30.1.1.8.1); 3GPP TS 24.301, section 5.5.2.2

Purpose:

To verify that the UE successfully performs a UE initiated detach procedure.

Initial Configuration:

1. UE is powered off.

Procedure

1. Power off the UE.

2. If possible use a diagnostic tool to verify that the UE sends a DETACH REQUEST message with Switch off in the Detach type set to “switch off" and Type of detach in the Detach type set to “EPS detach”.

3. Perform a mobile terminated service connection (e.g. voice call or ping) from other device.

4. Verify that the mobile terminated service connection is not reachable.

Compliance:

1. The UE successfully performs the Detach procedure.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	→	*RRCConnectionRequest*	RRC
2	←	*RRCConnectionSetup*	RRC
3	→	*RRCConnectionSetupComplete*(DETACH REQUEST)	RRC(EMM)

3.10 Detach - Without Powering-off

The UE shall successfully perform a UE initiated detach procedure without powering off, e.g. when the UE is set to "flight mode" or "offline".

Reference:

- TS.11 (30.1.1.8.2)
- 3GPP TS 24.301, section 5.5.2.2.1

Purpose:

To verify that the UE successfully performs a UE initiated detach procedure without powering off, e.g., when the UE is set to "flight mode" or "offline".

Initial Condition:

2. The UE is attached and in idle state.

Procedure:

1. Set the UE to "flight mode" or "offline" so that only the RF part is switched off.
2. If possible use a diagnostic tool to verify that the UE sends a DETACH REQUEST message with Switch off in the Detach type set to "switch off" and Type of detach in the Detach type set to "EPS detach".
3. Perform a mobile terminated service connection (e.g. voice call or ping) from other device.
4. Verify that the mobile terminated service connection is not reachable.

Compliance:

1. The UE successfully performs the Detach procedure.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	→	*RRCConnectionRequest*	RRC
2	←	*RRCConnectionSetup*	RRC
3	→	*RRCConnectionSetupComplete*(DETACH REQUEST)	RRC(EMM)

3.11 Successful Normal Tracking Area Update without ISR activation

The UE shall successfully perform a Tracking Area Update procedure after reselecting a cell in a new Tracking Area.

Reference:

- TS.11 (30.2.1.1)
- 3GPP TS 24.301, section 5.5.3.2

Purpose:

To verify that the UE successfully performs a Tracking Area Update procedure, after reselecting a cell in a new Tracking Area.

Initial Configuration:

1. UE is registered and in idle state.

Procedure:

1. UE detects it has entered a new TA that is not in the list of TAIs that the UE registered with the network.
2. The UE shall send a TRACKING AREA UPDATE REQUEST message to the network. If possible use a diagnostic tool to verify that the "EPS update type" parameter is set to ''TA updating''.
3. The network shall respond with TRACKING AREA UPDATE ACCEPT message to the UE.
4. If the TRACKING AREA UPDATE ACCEPT message contained a GUTI, the UE shall return a TRACKING AREA UPDATE COMPLETE message to the MME to acknowledge the received GUTI.
5. If possible use a diagnostic tool to check the UE sets the EPS update status to EU1 UPDATED.
6. Verify that the UE is registered to the new Tracking Area correctly by setting up a mobile terminated connection after the Tracking Area Update procedure.
7. If the UE is not capable to set-up a mobile terminated service, verify that the UE is registered to the new Tracking Area by setting up a mobile originated connection without establishing a redundant Tracking Area Update procedure.

Compliance:

1. The UE performs a Tracking Area Update procedure.

2. The UE establishes a mobile terminated service connection or a mobile originated service connection.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	→	RRCConnectionRequest	RRC
2	←	RRCConnectionSetup	RRC
3	→	RRCConnectionSetupComplete(TRACKING AREA UPDATE REQUEST)	RRC(EMM)
4	←	AUTHENTICATION REQUEST	*EMM(Optional)*
5	→	AUTHENTICATION RESPONSE	*EMM(Optional)*
6	←	SECURITY MODE COMMAND	*EMM(Optional)*
7	→	SECURITY MODE COMPLETE	*EMM(Optional)*
8	←	TRACKING AREA UPDATE ACCEPT	EMM.
9	→	TRACKING AREA UPDATE COMPLETE	*EMM(Optional)*
10	←	RRCConnectionRelease	RRC

3.12 Periodic Tracking Area Update; Successful

The UE shall successfully perform a Periodic Tracking Area Update procedure after the expiry of the T3412 timer.

Reference:

- TS.11 (30.2.2.1)
- 3GPP TS 24.301, section 5.5.3.2.

Purpose:

To verify that the UE successfully performs a Periodic Tracking Area Update procedure after the expiry of the T3412 timer.

Initial Condition:

1. The UE is attached and in idle state, T3412 is reset.

Procedure:

1. Wait for the T3412 timer to expire, and if possible use a diagnostic tool to verify that the UE sends a TRACKING AREA UPDATE REQUEST message with EPS update type set to "periodic updating".

2. Verify that the UE is registered to the Tracking Area correctly by setting up a mobile terminated connection after the Tracking Area Update procedure.

3. If the UE is not capable to set-up a mobile terminated service, verify that the UE is registered to the Tracking Area by setting up a mobile originated connection without establishing a redundant Tracking Area Update procedure.

Compliance:

1. The UE performs a Periodic Tracking Area Update procedure.

2. The UE establishes a mobile terminated service connection.

3. The UE establishes a mobile originated service connection.

Example Message Flow:

Step	Direction UE - NW	Message	Comments
1	→	*RRCConnectionRequest*	RRC
2	←	*RRCConnectionSetup*	RRC
3	→	*RRCConnectionSetupComplete*(TRACKING AREA UPDATE REQUEST)	RRC(EMM)
(4)	←	*AUTHENTICATION REQUEST*	*EMM(Optional)*
(5)	→	*AUTHENTICATION RESPONSE*	*EMM(Optional)*
(6)	←	*SECURITY MODE COMMAND*	*EMM(Optional)*
(7)	→	*SECURITY MODE COMPLETE*	*EMM(Optional)*
8	←	TRACKING AREA UPDATE ACCEPT	EMM
(9)	→	*TRACKING AREA UPDATE COMPLETE*	*EMM(Optional)*
10	←	*RRCConnectionRelease*	RRC

3.13 Network Selection - Manual Mode – Network on Forbidden List

If in manual network selection mode, the UE shall list all available PLMNs. This behavior is independent from the content of the preferred PLMN list.

Reference:

- TS.11 (30.3.2.1)
- 3GPP TS 22.011, subclause 3.2.2.2

Purpose:

To ensure that the correct list of PLMNs is displayed for the purposes of manual PLMN selection.

Initial Condition:

1. UE switched on, in automatic selection mode in an area with coverage from GSM, UMTS and E-UTRAN networks.

Procedure:

1. The number of the entries in preferred PLMN list is less than or equal to 32 entries.
2. Select the manual network selection mode on the UE and ensure that the list of all available PLMNs is displayed, and that the displayed networks can be selected, even if on the forbidden list.
3. Check that the preferred PLMN list is not changed after the manual network selection.

Compliance:

The UE shall display all available PLMNs and it shall perform manual network selection on the chosen network. The preferred PLMN list is not changed after the manual network selection.

The UE shall display all available GSM/UMTS and E-UTRAN networks.

3.14 Network Selection - Manual Mode – Empty Preferred PLMN List

If in manual network selection mode, the UE shall list all available PLMNs. This behavior is independent from the content of the preferred PLMN list.

Reference:

- TS.11 (30.3.2.1)
- 3GPP TS 22.011, subclause 3.2.2.2

Purpose:

To ensure that the correct list of PLMNs is displayed for the purposes of manual PLMN selection.

Initial Condition:

1. UE switched on, in automatic selection mode in an area with coverage from GSM, UMTS and E-UTRAN networks.

Procedure:

1. The number of the entries in preferred PLMN list is empty.

2. Select the manual network selection mode on the UE and ensure that the list of all available PLMNs is displayed, and that the displayed networks can be selected, even with an empty list in the preferred PLMN list.

3. Check that the preferred PLMN list is not changed after the manual network selection.

Compliance:

1. The UE shall display all available PLMNs and it shall perform manual network selection on the chosen network. The preferred PLMN list is not changed after the manual network selection.

2. The UE shall display all available GSM/UMTS and E-UTRAN networks.

3.15 Network Selection -– Manual Mode – More than 32 Entries on Preferred PLMN List

If in manual network selection mode, the UE shall list all available PLMNs. This behavior is independent from the content of the preferred PLMN list.

Reference:

- TS.11 (30.3.2.1)

- 3GPP TS 22.011, subclause 3.2.2.2

Purpose:

To ensure that the correct list of PLMNs is displayed for the purposes of manual PLMN selection.

Initial Condition:

1. UE switched on, in automatic selection mode in an area with coverage from GSM, UMTS and E-UTRAN networks.

Procedure:

1. The number of the entries in preferred PLMN list is more than or equal to 32 entries.

2. Select the manual network selection mode on the UE and ensure that the list of all available PLMNs is displayed, and that the displayed networks can be selected, even with more than 32 entries in the preferred PLMN list.

3. Check that the preferred PLMN list is not changed after the manual network selection.

Compliance:

1. The UE shall display all available PLMNs and it shall perform manual network selection on the chosen network. The preferred PLMN list is not changed after the manual network selection.

2. The UE shall display all available GSM/UMTS and E-UTRAN networks.

3.16 Network Selection – Selection Mode Following Switch off – Manual Network Selection

The UE shall be retaining its configuration of automatic and manual network selection modes when switched off.

Reference:

- TS.11 (30.3.2.3)

- 3GPP TS 22.011, subclause 3.2.2.2

Purpose:

To ensure that the UE retains its configuration of manual selection mode when switched off.

Initial Condition:

1. UE in idle mode, with automatic network selection mode configured.

Procedure:

1. Change to manual network selection. Turn the UE off and on again. Check that the manual network selection mode is in use.

Compliance:

1. The UE has the same selection mode when switched on that it had when switched off.

3.17 Network Selection – Selection Mode Following Switch off – Automatic Network Selection

The UE shall be retaining its configuration of automatic and manual network selection modes when switched off.

Reference:

- TS.11 (30.3.2.3)

- 3GPP TS 22.011, subclause 3.2.2.2

Purpose:

To ensure that the UE retains its configuration of automatic selection mode when switched off.

Initial Condition:

1. UE in idle mode, with manual network selection mode configured.

Procedure:

1. Change to automatic network selection. Turn the UE off and on again. Check that the automatic network selection mode is in use.

Compliance:

1. The UE has the same selection mode when switched on that it had when switched off.

All Handover and Reselection tests should be done back and forth between two cells, i.e., cell-A to cell-B then back to Cell-A.

4.1 Idle Mode E-UTRA Intra-Frequency Reselection

The UE should perform a reselection without losing service.

Reference:

- TS.11 (31.1.1.1)
- 3GPP TS36.304

Purpose:

To ensure that the UE performs a reselection correctly without losing service.

Initial Condition:

1. Two cells shall be active in eNB. These cells shall belong to the same PLMN.
2. The signal of one of the cells is to be attenuated more than the other.

The UE is in state RRC_IDLE and camps on the stronger cell.

Procedure:

1. Adjust attenuation to make the other cell signal stronger . Ensure that the UE performs reselections as expected. During the reselections it is imperative the UE remains in service at all times, and that its PDN Connectivity context remains viable before and after the reselections. Where possible, this procedure should be carried out as follows:
    a. Between cells sharing a Tracking Area.
    b. Between cells utilizing the same E-UTRA ARFCN.
    c. In areas of poor signal strength.

Compliance:

1. The UE should perform reselections correctly, without losing service, and its PDN connectivity should remain viable before and after the reselections.
2. The UE should successfully establish a mobile terminated service connection after the reselections.
3. If the UE is not capable to setup a mobile terminated service, verify that the UE can setup a mobile originated connection (e.g., Service Request procedure).

4.2 Intra frequency RSRQ cell reselection

The UE should perform a reselection based on RSRQ without losing service.

Reference: 3GPP TS 36.304

Purpose:

To ensure that the UE performs a reselection based on RSRQ correctly without losing service.

Initial Condition:

1. Two cells configured to use the same EARFCN
2. The two cells have equal cell reselection priority
3. The serving cell is configured to include in SIB3 threshServingLowQ and ThreshXLowQ
4. The serving cell is configured to include in SIB3 threshold such that serving cell power (SrxLev) is always greater than neighbor's (s-IntraSearchP) or SrxLev > s-IntraSearchP
5. The serving cell is configured to include in SIB3 threshold such that serving cell quality (Squal) could be less than neighbor's (s-IntraSearchQ) or Squal < s-IntraSearchQ
6. The serving cell is Configured such that the signal strength/quality of the neighbor cell is above (Qqualmin + threshServingLowQ)
7. The Serving cell is on and the neighboring cell is off

Procedure:

1. Attach the UE to the serving cell wait for the UE to be in Idle state
2. Turn on the neighboring cell
3. Trigger RSRQ based reselection, either by manipulating threshold in SIB3 or generating noise to degrade RSRQ
4. Verify UR remains in the neighboring cell

Compliance:

1. UE attaches in the Serving cell and maintains Idle state and reads SIB1 to SIB3
2. UE evaluates Squal > s-IntraSearchQ and start searching for better or higher ranking cell
3. UE triggers RSRQ based reselection based on RSRQ

4.3 E-UTRA Handover, Default Ipv4 Bearer – Intra eNodeB Handover

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN.

Procedure:

1. Move between the different cells. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv4 bearer is required for the scenario A and only a basic test case (e.g., FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.
2. The UE should successfully resume the FTP downloads after the handovers.

4.4 E-UTRA Handover, Default Ipv4 Bearer – X2 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)

- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN.

This scenario is designed to test inter eNB Handovers – X2 Based

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv4 bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.5 E-UTRA Handover, Default Ipv4 Bearer – S1 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423

- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

1. To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv4 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers – S1 Based (no X2 interface between eNB)

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv4 bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.6 E-UTRA Handover, Default Ipv4 Bearer – Inter-MME

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv4 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter MME Handovers

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv4 bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.7 E-UTRA Handover, Default Ipv6 Bearer – Intra eNodeB Handover

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test route.

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv6 bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.8 E-UTRA Handover, Default Ipv6 Bearer – X2 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers – X2 Based

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv6 bearer is required for the scenario A and only a basic test case (e.g., FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.9 E-UTRA Handover, Default Ipv6 Bearer – S1 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.41
- 3GPP TS 24.301

Purpose:

1. To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers – S1 Based (no X2 interface between eNB)

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv6 bearer is required for the scenario A and only a basic test case (e.g., FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.10 E-UTRA Handover, Default Ipv6 Bearer – Inter-MME

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter MME Handovers.

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario A:

Only default Ipv6 bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

4.11 E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – X2 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 and Ipv4 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers – X2 Based

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and that the FTP download is resumed correctly.

Scenario B:

Both Ipv6 and Ipv4 bearers are required for the scenario B and a dual bearer test case (e.g. FTP Download on Ipv6 bearer and FTP Upload on Ipv4 bearer).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads and uploads after the handovers.

4.12 E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – S1 Based

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 24.301

Purpose:

1. To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required Ipv6 and Ipv4 packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers – S1 Based (no X2 interface between eNB)

Procedure:

1. Move between the coverage areas of the different cells of a test route. Ensure that the UE performs reselections/handovers as expected. During the test drive it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Scenario B:

Both Ipv6 and Ipv4 bearers are required for the scenario B and a dual bearer test case (e.g. FTP Download on Ipv6 bearer and FTP Upload on Ipv4 bearer).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads and uploads after the handovers.

4.13 Intra-frequency Handover with Multiple PDNs

The UE with multiple PDNS should perform handovers as requested by the network and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300, 3GPP TS 36.331, 3GPP TS 36.423, 3GPP TS 36.413, 3GPP 23.401

Purpose:

To ensure that the UE with multiple PDNs performs handovers correctly without losing services.

Initial Condition:

1. There must be at least two eNodeBs that have the same EARFCNs and configured as neighbors

2. At least two PDNs are active and have UL/DL traffic ongoing

3. At least one dedicated bearer active that associated with one of activated above PDNs

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in

question is maintained throughout the test and data transfer is continued.

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDNs connectivity should remain viable before and after the handovers.

2. The UE should successfully resume data transfer after the handovers.

4.14 Intra-frequency Automatic Neighbor Relations Function

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS 36.300 chapter 22.3.2a
- 3GPP TS 36.331

Purpose:

To ensure that the UE performs handovers correctly without losing services and that data continues.

Initial Configuration:

1. The UE shall be in an RRC connected state.
2. The serving eNB has no entry in the Neighbor Relation List for the neighbor eNB.

Procedure:

1. Slowly increase the RF level for Cell # 2 and decrease the RF level Cell #1.
2. Wait until the UE sends a measurement report regarding eNB #2, which contains the physical Cell id (PCI) for Cell # 2.
3. The Cell#1 commands the UE to perform an additional measurement using the newly discovered PCI (in order to retrieve the EGCI of Cell #2).
4. The UE reports the detected ECGI of Cell # 2.

Example message flow:

Step	Direction UE – NW	Message	Comments
1	→	MEASUREMENT REPORT	RRC
2	←	RRC CONNECTION RECONFIGURATION	RRC
3	←	MIB BCCH/BCH/PBCH	RRC
4	→	MEASUREMENT REPORT	RRC

4.15 Intra-Frequency Event Based (Network Specified) Load Balancing

Reference:

3GPP TS36.300 section 19.2.1.19 and TS 36.331 section 5.3.8.3

Purpose:

UE can be redirected to another cell on the same frequency but in different tracking areas when requested by the network for event triggered due to network reasons, such as MME load balancing.

Initial Condition:

1. Two eNodeBs with cells configured to be on the same EARFCN but on different tracking areas
2. The network can trigger load balancing by user commands or adjusting load threshold. In this case by MME releasing the S1 connection by sending UE Context Release Command for Load Balancing with cause IE set to Load Balancing TAU Required which will triggering the UE to do tracking area for load balancing.
3. The serving cell is turned on and the target cell is off

Procedure:

1. Attach the UE to the serving cell and maintain the RRC connection by triggering UL/DL traffic
2. Turn on the target cell
3. From the network, the eNodeB triggers RRC Connection Release with release cause that indicates “loadBalancingTAURequired”, by for example issuing CLI command or adjusting tracking area load balancing thresholds in the MME to release the S1 connections of the UE towards the eNodeB.
4. Verify that UE’s RRC connection is released from the serving cell and the UE acquired the target cell and performed tracking area update procedure.

Compliance:

1. UE attaches to the serving cell and maintains UL/DL traffic
2. The target cell is on and the UE is still connected to the serving cell.
3. UE is receiving RRC Connection release with cause code that indicates “loadBalancingTAURequired” and the UE reselects the target cell
4. UE acquires the target cell and triggers tracking area update procedure

4.16 Intra-frequency inter- eNodeB Handover when UE and Both eNodeBs Support 64 QAM

Purpose:

The purpose of this test is to verify that a UL UDP data transfer with support of 64 QAM can be successfully achieved before and after a handover.

Reference:

Initial Condition:

1. eNodeB1, eNodeB2 and UE supports 64 QAM Uplink
2. Enable 64 QAM UL in eNodeBs
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB1 with channel conditions that allow the UE to achieve 64 QAM UL
2 Begin a TCP UL file transfer to test maximum throughput
3 Increase attenuation on eNodeB1 cell and decrease attenuation on eNodeB2 cell to trigger a handover from eNodeB1 to eNodeB2
4 Decrease attenuation on eNodeB2 until the UE achieves 64 QAM again

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 64 QAM UL in UECapabilityInformation message
3. On eNodeB1, verify the UE is given an UL MCS Index in the range of 21 to 28
4. During the handover, it's likely 64 QAM will not be maintained, however, once on eNodeB2 and in good channel conditions, the UL MCS Index should again return to the range of 21 to 28
5. UE throughput is greater than throughput with 16 QAM

4.17 Intra-frequency Inter eNodeB Handover when UE and Only One eNodeB Supports 64 QAM

Purpose:

The purpose of this test is to verify that a UL UDP data transfer with support of 64 QAM can be successfully achieved before and after a handover.

Reference:

Initial Condition:

1. eNodeB1, eNodeB2 and UE supports 64 QAM Uplink
2. Enable 64 QAM UL in eNodeBs
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB1 with channel conditions that allow the UE to achieve 64 QAM UL
2 Begin a long TCP UL file transfer to test maximum throughput
3 Increase attenuation on eNodeB1 cell and decrease attenuation on eNodeB2 cell to trigger a handover from eNodeB1 to eNodeB2
4 Decrease attenuation on eNodeB2 until the UE achieves 16 QAM
5 Increase attenuation on eNodeB2 cell and decrease attenuation on eNodeB1 cell to trigger a handover from eNodeB2 to eNodeB1
6 Decrease attenuation on eNodeB1 until the UE achieves 64 QAM

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 64 QAM UL in UECapabilityInformation message
3. On eNodeB1, verify the UE is given an UL MCS Index in the range of 21 to 28
4. During the handover, it's likely 64 QAM will not be maintained, however, once on eNodeB2 and in good channel conditions, the UL MCS Index should return to a range of 11 to 20 for 16 QAM
5. Once the UE returns to eNodeB1, the UL MCS Index should again be in the range of 21 to 28.
6. UE throughput on eNodeB1 is greater than throughput on eNodeB2

4.18 Intra-frequency X2 Handover in an MFBI Capable Cell

Purpose:

MFBI capable UE performs Intra-frequency X2 HO between MFBI enabled cells. In this case both serving and target cells have band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicate support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X).

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1, 3GPP TS 36.101 section 5.7.3

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set
2. UE supports LTE band Y but does not support band X
3. UE and USIM has not stored any information related to the serving cell
4. UE is powered off and in automatic selection mode
5. Both the serving and target cells support MFBI and have band X as the primary band
6. Both the serving and target cells are configured as neighbors on the primary frequency band (or X in this case)
7. Both cells are in different eNodeBs and have X2 interface between the two eNodeBs
8. Serving and target cells broadcast in freqBandIndicator and multiBandInfoList of band Y in SIB1, SIB2 and SIB5. Both cells also broadcasting additionalSpectrumEmission of band Y.
9. No cells with primary Y band are available and accessible to the UE.

Procedure:

1. Power on the UE and attempt to attach on the serving cell
2. Verify that the UE is successfully attached and SIB2, SIB5's list multiBandInfoList
3. While UE is an RRC Connected state, trigger handover from the serving cell to the target cell
4. Verify the UE's mobility state in the target cell
5. Trigger handover from the current cell back to the first serving cell

Compliance:

1. The UE acquires serving cell in band X and successfully attaches to the serving cell which has band X as the Primary band
2. UE is configured to measure event for EARFCN in an additional band (Y in this case) because UE does not support primary band (X). The EARFCN of the target cell is converted to an EARFCN in a band supported by the UE.
3. UE reports configured event for the additional frequency (EARFCN Y) to the serving cell, and the cell finds corresponding primary frequency relation for it (X) and uses the configured cell relation to trigger Handover Command which contains additional frequency band (Y band) for target cell.
4. UE successfully completes handover procedure to the target cell and maintains data transfer.
5. UE successfully completes handover procedure back to the first cell and maintains data transfer

4.19 Intra-frequency Handover from SRS Disabled Cell to an SRS Enabled Cell

Purpose:

This test verifies that UE can successfully handover from a cell with SRS disabled to a cell with SRS enabled. After successful handover to the target SRS cell, the UE will successfully configure for relation IE whether SRS config information became a setup in RRCConnectionSetup message.

Reference

TS 24.301 [[5] clauses 5.3.1.2 and 3GPP TS 36.331 [4] clauses 5.3.3.3 and 5.3.3.4.

Initial Condition:

1. Configure two available eNodeBs: eNodeB1 and eNodeB2
2. eNodeB2 is SRS enabled and eNodeB1 has SRS disabled
3. The two eNodeB's are configured as neighbor cells to one another.
4. The eNodeBs have been configured with the appropriate measurement events.

Procedure:

1. Attach the UE to eNobeB 1 which does not have SRS enabled
2. Initiate maximum UDP bidirectional traffic
3. Increase attenuation on eNodeB1 cell and decrease attenuation on eNodeB2 where the SRS parameter is set
4. UE successfully hands over to eNobeB2

Compliance:

1. The UE successfully attaches to eNodeB1
2. Verify the UE successfully hands over to eNodeB2
3. Verify the UE receives an RRCConnectionReconfiguration message with SRS IE enabling SRS when initiating the handover.
4. Verify the file transfer continues with no impact to UDP throughput

All Handover and Reselection tests should be done back and forth between two cells, i-e Cell-A to Cell-B then back to Cell-A

Reselection/Handover between FDD and TDD is part of the intra-LTE and inter-Freq reselection/handover scenarios when the cells are involved in different duplex modes (FDD or TDD). Therefore, if the UE supports dual-mode (FDD and TDD), then dual-mode scenarios shall be included in scenarios 5.3, 5.4, 5.7 and 5.8.

5.1 Idle Mode E-UTRA Inter-Frequency Intra-Band (Same BW) Reselection

The UE should perform a reselection without losing service.

Reference:

- TS.11 (31.1.1.2)
- 3GPP TS36.304

Purpose:

To ensure that the UE performs a reselection correctly without losing service.

Initial Condition:

1. There must be a sufficient number of E-UTRAN cells available on the same PLMN but on different frequencies, and the UE should be in idle mode (ECM-IDLE and EMM-REGISTERED).

Procedure:

1. Move between the different cells on a test. The test should contain the scenarios listed below. Ensure that the UE performs reselections as expected. During the reselections it is imperative the UE remains in service at all times, and that its PDN Connectivity context remains viable before and after the reselections. Where possible, this procedure should be carried out as follows:

    a. Between cells sharing a Tracking Area.

    b. Between cells utilizing different E-UTRA ARFCNs belonging to a common E-UTRA frequency band and common E-UTRA frequency bandwidth.

    c. In areas of poor signal strength.

Compliance:

1. The UE should perform reselections correctly, without losing service, and its PDN connectivity should remain viable before and after the reselections.

2. The UE should successfully establish a mobile terminated service connection after the reselections.

3. If the UE is not capable to setup a mobile terminated service, verify that the UE can setup a mobile originated connection (e.g. Service Request procedure).

5.2 Idle Mode E-UTRA Inter-Frequency Intra-Band Inter-BW Reselection

The UE should perform a reselection without losing service.

Reference:

- 3GPP TS36.304

Purpose:

To ensure that the UE performs a reselection correctly without losing service.

Initial Condition:

1. There must be a sufficient number of E-UTRAN cells available on the same PLMN but on different frequencies, and the UE should be in idle mode (ECM-IDLE and EMM-REGISTERED).

Procedure:

1. Move between the different cells on a test. The test should contain the scenarios listed below. Ensure that the UE performs reselections as expected. During the reselections it is imperative the UE remains in service at all times, and that its PDN Connectivity context remains viable before and after the reselections. Where possible, this procedure should be carried out as follows:

    a. Between cells sharing a Tracking Area.

    b. Between cells utilizing different E-UTRA ARFCNs belonging to a common E-UTRA frequency band with different E-UTRA frequency bandwidths.

    c. In areas of poor signal strength.

Compliance:

1. The UE should perform reselections correctly, without losing service, and its PDN connectivity should remain viable before and after the reselections.

2. The UE should successfully establish a mobile terminated service connection after the reselections.

3. If the UE is not capable to setup a mobile terminated service, verify that the UE can setup a mobile originated connection (e.g. Service Request procedure).

5.3 Idle Mode E-UTRA Inter-Frequency Inter-Band (Same BW) Reselection

The UE should perform a reselection without losing service.

In case of dual-mode UE, inter-band reselection may include a change of mode (TDD↔FDD).

Reference:

- 3GPP TS36.304

Purpose:

To ensure that the UE performs a reselection correctly without losing service.

Initial Condition:

1. There must be a sufficient number of E-UTRAN cells available on the same PLMN but on different frequencies, and the UE should be in idle mode (ECM-IDLE and EMM-REGISTERED).

Procedure:

1. Move between the different cells on a test. The test should contain the scenarios listed below. Ensure that the UE performs reselections as expected. During the reselections it is imperative the UE remains in service at all times, and that its PDN Connectivity context remains viable before and after the reselections. Where possible, this procedure should be carried out as follows:

    a. Between cells sharing a Tracking Area.

    b. Between cells utilizing different E-UTRA ARFCNs belonging to different E-UTRA frequency bands and common E-UTRA frequency bandwidth.

    c. In areas of poor signal strength.

Compliance:

1. The UE should perform reselections correctly, without losing service, and its PDN connectivity should remain viable before and after the reselections.

2. The UE should successfully establish a mobile terminated service connection after the reselections.

3. If the UE is not capable to setup a mobile terminated service, verify that the UE can setup a mobile originated connection (e.g. Service Request procedure).

5.4 Idle Mode E-UTRA Inter-Frequency Inter-Band Inter-BW Reselection

The UE should perform a reselection without losing service.

In case of dual-mode UE, inter-band reselection may include a change of mode (TDD↔FDD).

Reference:

- 3GPP TS36.304

Purpose:

To ensure that the UE performs a reselection correctly without losing service.

Initial Condition:

1. There must be a sufficient number of E-UTRAN cells available on the same PLMN but on different frequencies, and the UE should be in idle mode (ECM-IDLE and EMM-REGISTERED).

Procedure:

1. Move between the different cells on a test route. The test route(s) should contain the scenarios listed below. Ensure that the UE performs reselections as expected. During the reselections it is imperative the UE remains in service at all times, and that its PDN Connectivity context remains viable before and after the reselections. Where possible, this procedure should be carried out as follows:

    a. Between cells sharing a Tracking Area.

    b. Between cells utilizing different E-UTRA ARFCNs belonging to different E-UTRA frequency bands with different E-UTRA frequency bandwidths.

    c. In areas of poor signal strength.

Compliance:

1. The UE should perform reselections correctly, without losing service, and its PDN connectivity should remain viable before and after the reselections.

2. The UE should successfully establish a mobile terminated service connection after the reselections.

3. If the UE is not capable to setup a mobile terminated service, verify that the UE can setup a mobile originated connection (e.g. Service Request procedure).

5.5 Idle Mode Mobility to a Different Frequency in Same LTE Band with Different Priority

- Reference: 3GPP TS 36.331 sections 5.3.8.3, 36.304 TS 5.2.4.1

Purpose:

To ensure that the UE performs a reselection based on frequency priority information provided by the serving cell when the RRC connection was released.

Initial Condition:

1. Three neighboring cells, two on the same EARFCN and one on a different EARFCNs on the same LTE band

2. The serving cell has lower frequency priority than the other two neighboring cells

3. The cell in the different EARFCN has the highest frequency priority

4. eMBMS is not enabled

5. The Serving cell is turned on and the neighboring cells are turned off or completely attenuated

Procedure:

1. Attach the UE to the serving cell and wait for the UE to receive RRC connection Release and transition to Idle state

2. Turn on the two neighboring cells

3. Maintain the UE in Idle state and monitor the UE's mobility state and the camped on EARFCN

4. Trigger uplink data or ping from the UE to establish an RRC connection and note the serving cell and frequency

Compliance:

1. UE attaches in the Serving cell and goes to Idle state. The serving cell triggers RRC Connection Release and includes freqPriorityListEUTRA under IdleModeMobilityControlInfo. The Serving cell has lower frequency than the neighboring cells and the frequency of the other cell has the highest priority.

2. UE starts evalulating serving and neighboring cells for better or higher ranking cell or frequency

3. UE triggers reselection towards the higher ranking cell and frequency, and the UE ignores the default priority values if broadcasted in SIB3

4. The UE successfully established new connection in the newly re-selected cell which has the highest priority

5.6 Idle Mode Mobility to Different LTE Band with Different Priority

Reference:

- 3GPP TS 36.331 sections 5.3.8.3, 36.304 TS 5.2.4.1

Purpose:

To ensure that the UE performs a reselection based on frequency priority information provided by the serving cell when the RRC connection was released.

Initial Condition:

1. Three neighboring cells, two on the same EARFCN and one on a different LTE band

2. The serving cell has lower frequency priority than the other two neighboring cells

3. The cell in the different band has the highest frequency priority

4. eMBMS is not enabled

5. The Serving cell is turned on and the neighboring cells are turned off or completely attenuated

Procedure:

1. Attach the UE to the serving cell and wait for the UE to receive RRC connection Release and transition to Idle state

2. Turn on the two neighboring cells

3. Maintain the UE in Idle state and monitor the UE's mobility state and the camped on EARFCN

4. Trigger uplink data or ping from the UE to establish an RRC connection and note the serving cell and frequency

Compliance:

1. UE attaches in the Serving cell and goes to Idle state. The serving cell triggers RRC Connection Release and includes freqPriorityListEUTRA under IdleModeMobilityControlInfo. The Serving cell has lower frequency than the neighboring cells and the other band cell has the highest priority.

2. UE starts evaluating serving and neighboring cells for better or higher ranking cell or frequency

3. UE triggers reselection towards the higher ranking cell and frequency, and the UE ignores the default priority values if broadcasted in SIB3

4. The UE successfully established new connection in the newly re-selected cell which has the highest priority

5.7 Idle Mode Load Balancing

Purpose

The purpose of the IDLELB function is to improve quality of service for idle-mode users by reducing load difference among multi-carriers in the same sector.

The IDLELB carries out the following functions:

- Monitoring the load of a sector

- Distributing load through forced connection release if necessary

Reference

- **3GPP TS 36.300**

Initial Conditions

1. Enable the Idle-mode UE load balancing function, the RRC connection Release message with idleModeMobilityControlInfo is sent to the UE when call is released.
2. The idleModeMobilityControlInfo parameter specifies carrierFreq and cellReselectionPriority for freqPriorityListEUTRA
3. eNodeB can apply a different carrier priority to different UE by including IdleModeMobilityControlInfo in the RRCConnectionRelease message.

1.

Procedure

1 Attach the UE's to the eNodeB1
2 Let the UE go in the Idle Mode.
3 The eNodeB will collect the statistics data for RRC connection release for each cell.
   a. cNum → Serving Cell Index
   b. ConnRelease_NO_FAULT →The call ends successfully
   c. ConnRelease_S1AP_ CauseRadioNetwork_unspecified~ConnRelease_MAC_Others → RRC Connection Release count.

Expected Results

1 Absolute frequency priority information is broadcast in System Information Block (SIB) Type 5 message. The message includes DI-CarrierFreq and CellReselectionPriority for maximum eight (8) frequencies.
2 Most UEs would be connected to the cell with the highest priority, which results in congestion in the cell and service quality may degrade. New UEs will camp on the cell with the highest priority after reading SIB5 message. Reactivated UEs will be distributed over multiple carriers when they camp on.

5.8 Inter-frequency Intra Band RSRQ based Cell Reselection

The UE should perform a reselection based on RSRQ without losing service.

Reference:

- 3GPP TS 36.304

Purpose:

To ensure that the UE performs a reselection based on RSRQ correctly without losing service.

Initial Condition:

1 Two neighboring cells configured to be on the same band but with different EARFCN
2 the two cells have equal cell reselection priority
3 The serving cell is configured to include in SIB3 threshServingLowQ and ThreshXLowQ
4 The serving cell is configured to include in SIB3 threshold such that serving cell power (SrxLev) is always greater than neighbor's (s-IntraSearchP) or SrxLev > s-IntraSearchP
5 The serving cell is configured to include in SIB3 threshold such that serving cell quality (Squal) could be less than neighbor's (s-IntraSearchQ) or Squal < s-IntraSearchQ
6 The serving cell is Configured such that the signal strength/quality of the neighbor cell is above (Qqualmin + threshServingLowQ)
7 The serving cell has SIB5 and lists neighboring cell EARFCN
8 The Serving cell is on and the neighboring cell is off

Procedure:

1 Attach the UE to the serving cell wait for the UE to be in Idle state
2 Turn on the neighboring cell
3 Trigger RSRQ based reselection, either by manipulating threshold in SIB3 or generating noise to degrade RSRQ
4 Verify UR remains in the neighboring cell

Compliance:

1 UE attaches in the Serving cell and maintains Idle state and reads SIB1 to SIB3
2 UE evaluates Squal > s-IntraSearchQ and start searching for better or higher ranking cell
3 UE triggers RSRQ based reselection based on RSRQ

5.9 Inter band RSRQ based cell reselection

The UE should perform a reselection based on RSRQ without losing service.

Reference: 3GPP TS 36.304

Purpose:

To ensure that the UE performs a reselection based on RSRQ correctly without losing service.

Initial Condition:

1 Two neighboring cells configured to be on different bands
2 . the two cells have equal cell reselection priority
3 The serving cell is configured to include in SIB3 threshServingLowQ and ThreshXLowQ
4 . The serving cell is configured to include in SIB3 threshold such that serving cell power (SrxLev) is always greater than neighbor's (s-IntraSearchP) or SrxLev > s-IntraSearchP
5 The serving cell is configured to include in SIB3 threshold such that serving cell quality (Squal) could be less than neighbor's (s-IntraSearchQ) or Squal < s-IntraSearchQ
6 The serving cell is Configured such that the signal strength/quality of the neighbor cell is above (Qqualmin + threshServingLowQ)
7 The serving cell has SIB5 and lists neighboring cell EARFCN
8 . the Serving cell is on and the neighboring cell is off

Procedure:

1 Attach the UE to the serving cell wait for the UE to be in Idle state
2 Turn on the neighboring cell
3 Trigger RSRQ based reselection, either by manipulating threshold in SIB3 or generating noise to degrade RSRQ
4 Verify UR remains in the neighboring cell

Compliance:

1 UE attaches in the Serving cell and maintains Idle state and reads SIB1 to SIB3
2 UE evaluates Squal > s-IntraSearchQ and start searching for better or higher ranking cell
3 UE triggers RSRQ based reselection based on RSRQ

5.10 E- UTRA Handover (with measurements), Inter-Frequency Intra-Band (same BW) – Default Bearer with Data Transfer

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers with cells belonging to different E-UTRA ARFCN within common band.

Procedure:

1. Move between the coverage areas of different cells on a test route. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

5.11 E-UTRA Handover (with Measurements), Inter-Frequency Intra-Band Inter-BW – Default Bearer with Data Transfer

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers with cells belonging to different E-UTRA ARFCN within a common E-UTRA band but with different E-UTRA bandwidths.

Procedure:

1. Move between the coverage areas of different cells on a test route. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

5.12 E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band (Same BW) – Default Bearer with Data Transfer

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

In case of dual-mode UE, inter-band reselection may include a change of mode (TDD↔FDD)

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers with cells belonging to different E-UTRA ARFCN and different E-UTRA band.

Procedure:

1. Move between the coverage areas of different cells on a test route. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

5.13 E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band Inter-BW – Default Bearer with Data Transfer

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

In case of dual-mode UE, inter-band reselection may include a change of mode (TDD↔FDD).

Reference:

- TS.11 (31.2.1.1)
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services.

Initial Condition:

1. There must be a sufficient number of E-UTRA cells available on the same PLMN. Required packet bearers to be tested should be active, and available in all parts of the test.

This scenario is designed to test inter eNB Handovers with cells belonging to different E-UTRA ARFCN with different E-UTRA bands and different E-UTRA bandwidths.

Procedure:

1. Move between the coverage areas of different cells on a test route. Ensure that the UE performs reselections/handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g. FTP Download).Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers.

2. The UE should successfully resume the FTP downloads after the handovers.

5.14 Intra-LTE inter-eNB inter-frequency handover with Multiple PDNs

The UE with multiple PDNS should perform handovers as requested by the network and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300, 3GPP TS 36.331, 3GPP TS 36.423, 3GPP TS 36.413, 3GPP 23.401

Purpose:

To ensure that the UE with multiple PDNs performs handovers correctly without losing services.

Initial Condition:

1. There must be at least two eNodeBs that have different EARFCNs and configured as neighbors

2. At least two PDNs are active and have UL/DL traffic ongoing

3. At least one dedicated bearer active that associated with one of activated above PDNs

Procedure:

1. Move between the different cells of a test. Ensure that the UE performs handovers as expected. During the test it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test and data transfer is continued.

Compliance:

1. The UE should perform handovers correctly, without losing service, and its PDNs connectivity should remain viable before and after the handovers.

2. The UE should successfully resume data transfer after the handovers.

5.15 Inter-frequency Intra-LTE Automatic Neighbor Relations Function

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS 36.300 chapter 22.3.2a
- 3GPP TS 36.331

Purpose:

To ensure that the UE performs handovers correctly without losing services and that data continues.

Initial Configuration:

1. The UE shall be in an RRC connected state.
2. The serving eNB has no entry in the Neighbor Relation List for the neighbor eNB.

Procedure:

1. Slowly increase the RF level for Cell # 2 and decrease the RF level Cell #1.
2. Wait until the UE sends a measurement report regarding eNB #2, which contains the physical Cell id (PCI) for Cell # 2.
3. The Cell#1 commands the UE to perform an additional measurement using the newly discovered PCI (in order to retrieve the EGCI of Cell #2).
4. The UE reports the detected ECGI of Cell # 2.

Example message flow:

Step	Direction UE - NW	Message	Comments
2	→	MEASUREMENT REPORT	RRC
3-A	←	RRC CONNECTION RECONFIGURATION (with Report ECGI)	RRC
3--B	←	Cell2: MIB BCCH/BCH/PBCH/SIB1 (Cell 2 ECGI)	RRC
4	→	MEASUREMENT REPORT to Cell 1 (including Cell 2ECGI)	RRC

Compliance:

1. For InterFrequency ANR, the eNB will issue additional RRC Reconfiguration in order to configure the UE with longer DRX inactive periods.

2. UE reports ECGI of the neighboring cell to the serving eNB. The UE should support ECGI reporting of the Neighbor Cell at RSRQ > -5 dBm.

3. A new entry in the Neighbor Relation List was created in the serving eNB that specifies the neighbor eNB.

4. The UE is able to successfully complete X2 or S1 handover to the new neighbor cell.

5. Measure and report the time between which the UE receives the RRC Connection Reconfiguration and the time the UE sends the Measurement Report with the ECGI. The time is expected to be within 400 ms.

5.16 RRC Connection Release with Redirect to a Different Frequency at the Same LTE Band

Purpose:

UE can be redirected to another cell on a different frequency in the same LTE band when a configured threshold and event criteria are met

Reference:

3GPP TS36.300 and TS 36.331 sections 5.5.2 and 5.5.4

Initial Condition:

1. Two cells configured to be on different EARFCNs and on the same band

2. The two cells have equal cell or frequency priority

3. Both cells are set to configure the UE in RRC Connection Reconfiguration with proper event and measurement threshold, example of using RSRP and Events such as A2, A5

4. Both cells are set to configure the UE in RRC with Release with Redirection when receiving the proper threshold by the UE's measurement report

5. The Serving cell is turned on and the target cell is off

Procedure:

1. Attach the UE to the serving cell and trigger UL/DL traffic

2. Turn on the target cell

3. Trigger RRC Release with Redirection, by for example attenuating the serving cell. As an example, the RSRP value for the serving cell may need to be lower than RSRP configured to for event A2

4. Verify that UE remains in the target cell and data transfer continued

5. Repeat steps 3 and 4 to perform handover back to the first serving cell

Compliance:

1. UE attaches in the Serving cell and maintains UL/DL traffic

2. UE is configured with Event and measurement threshold to trigger Release with Redirection

3. UE send measurement reports that meets Redirection threshold and eNodeB triggers an RRC message to Release and Redirect the UE to the target EARFCN

4. UE acquires and mains the target cell without losing RRC connection and data transfer continues in the target cell

5. UE is handed back and data transfer continued

5.17 RRC Connection Release with redirect to a Different LTE Band

Purpose:

UE can be redirected to another cell on a different frequency in a different LTE band when a configured threshold and event criteria are met

Reference:

3GPP TS36.300 and TS 36.331 sections 5.5.2 and 5.5.4

Initial Condition:

1. Two cells configured to be on different EARFCNs and on different bands

2. The two cells have equal cell or frequency priority

3. Both cells are set to configure the UE in RRC Connection Reconfiguration with proper event and measurement threshold, example of using RSRP and Events such as A2, A5

4. Both cells are set to configure the UE in RRC with Release with Redirection when receiving the proper threshold by the UE's measurement report

5. the Serving cell is turned on and the target cell is off

Procedure:

1. Attach the UE to the serving cell and trigger UL/DL traffic
2. Turn on the target cell
3. Trigger RRC Release with Redirection, by for example attenuating the serving cell. As an example, the RSRP value for the serving cell may need to be lower than RSRP configured to for event A2
4. Verify that UE remains in the target cell and data transfer continued
5. Repeat steps 3 and 4 to perform handover back to the first serving cell

Compliance:

1. UE attaches in the Serving cell and maintains UL/DL traffic
2. UE is configured with Event and measurement threshold to trigger Release with Redirection
3. UE send measurement reports that meets Redirection threshold and eNodeB triggers an RRC message to Release and Redirect the UE to the target EARFCN
4. UE acquires and mains the target cell without losing RRC connection and data transfer continues in the target cell
5. UE is handed back and data transfer continued

5.18 RSRQ triggered inter-frequency handover

Purpose:

The UE should perform inter-frequency handover based on RSRQ without losing service.

Reference:

3GPP TS36.300, 3GPP TS 36.331, 3GPP TS 36.423, 3GPP TS 36.413, 3GPP 23.401

Initial Condition:

1. Two neighboring cells configured to be on different EARFCNs and on the same band
2. the two cells have equal cell or frequency priority

3. Both cells are set to configure the UE in RRC Connection Reconfiguration with Event and measurement threshold using RSRQ, example of Events A2, A5 or A3

4. Both cells are set to configure the UE in RRC Connection Reconfiguration with neighbor's EARFCN for measurement

5. the Serving cell is turned on and the neighboring cell is off

Procedure:

1. Attach the UE to the serving cell and trigger UL/DL traffic

2. Turn on the neighboring cell and check the Events and measurement configured and sent to the UE by the serving cell and check for RSRQ threshold

3. Trigger RSRQ based handover, either by manipulating thresholds in cells to favor neighboring cell or generating noise to degrade RSRQ of serving cell. The RSRP value for the target cell may need to be to be also higher than RSRP of serving cell.

4. Verify that UE remains in the neighboring cell and data transfer continued without interruption

5. Repeat steps 3 and 4 to perform handover back to the first serving cell

Compliance:

1. UE attaches in the Serving cell and maintains UL/DL traffic

2. UE is configured with Event and RSRQ measurement

3. UE triggers RSRQ measurement report and eNodeB reconfigures UE for handover

4. UE handed over successfully and data transfer continues in the target cell

5. UE handed back based on RSRQ measurement report and data transfer continued

5.19 RSRQ triggered inter-band inter-frequency handover

Purpose:

The UE should perform inter-frequency handover based on RSRQ without losing service.

Reference:

3GPP TS36.300, 3GPP TS 36.331, 3GPP TS 36.423, 3GPP TS 36.413, 3GPP 23.401

Initial Condition:

1. Two neighboring cells configured to be on different EARFCN and on the different bands
2. the two cells have equal cell or frequency and band priorities
3. Both cells are set to configure the UE in RRC Connection Reconfiguration with Event and measurement threshold using RSRQ, example of Events A2, A5 or A3
4. Both cells are set to configure the UE in RRC Connection Reconfiguration with neighbor's EARFCN for measurement
5. the Serving cell is turned on and the neighboring cell is off

Procedure:

1. Attach the UE to the serving cell and trigger UL/DL traffic
2. Turn on the neighboring cell and check the Events and measurement configured and sent to the UE by the serving cell and check for RSRQ threshold
3. Trigger RSRQ based handover, either by manipulating threshold in cells to favor neighboring cell or generating noise to degrade RSRQ of serving cell. The RSRP value for the target cell may need to be to be also higher than RSRP of serving cell.
4. Verify that UE remains in the neighboring cell and data transfer continued without interruption
5. Repeat steps 3 and 4 to perform handover back to the first serving cell

Compliance:

1. UE attaches in the Serving cell and maintains UL/DL traffic
2. UE is configured with Event and RSRQ measurement

3. UE triggers RSRQ measurement report and eNodeB reconfigures UE for handover

4. UE handed over successfully and data transfer continues in the target cell

5. UE handed back based on RSRQ measurement report and data transfer continued

5.20 Inter-frequency S1 HO in a MFBI Capable Cell

Purpose:

MFBI capable UE performs Inter-frequency S1 HO from an a MFBI enabled cell. In this case the serving and target cells has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicate support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X). The target cell has band Z as a native (Primary) band and band Y is a mapped band.

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1, 3GPP TS 36.101 section 5.7.3

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set

2. UE supports LTE band Y but does not support band X nor band Z

3. UE and USIM has not stored any information related to the serving cell

4. UE is powered off and in automatic selection mode

5. The serving and target cells support MFBI and have band X and Z respectively as the primary bands

6. Both the serving and target cells are configured as neighbors on the primary frequency band (or X and Z respectively in this case)

7. Both cells are in different eNodeBs and has X2 interface between the two cells disabled or not available

8. Serving and target cells broadcast in freqBandIndicator and multiBandInfoList of band Y in SIB1, SIB2 and SIB5. Both cells also broadcasting additionalSpectrumEmission of band Y.

9. No cells with primary Y band are available and accessible to the UE.

Procedure

1. Power on the UE and attempt to attach on the serving cell

2. Verify that the UE is successfully attached and SIB2, SIB5's list multiBandInfoList

3. While UE is an RRC Connected state, trigger handover from the serving cell to the target cell

4. Verify the UE's mobility state in the target cell

5. Trigger handover from the current cell back to the first cell

Compliance:

1. The UE acquires serving cell in band X and successfully attaches to the serving cell which has band X is the Primary band

2. UE is configured to measure event for EARFCN in an additional band (Y in this case) because UE does not support primary band (X). The EARFCN of the target cell is converted to an EARFCN in a band supported by the UE.

3. UE reports configured event for the additional frequency (earfcn Y) to the Serving cell, and the cell finds corresponding primary frequency relation for it and uses the configured cell relation to trigger Handover Command which contains additional frequency band (Y band) for target cell which has Z as primary band.

4. UE successfully completes handover procedure to the target cell and maintains data transfer.

5. UE successfully completes handover procedure back to the first cell and maintains data transfer

5.21 Inter-frequency X2 Handover in a MFBI Capable Cell

Purpose:

MFBI capable UE performs Inter-frequency X2 Handover from an a MFBI enabled cell. In this case the serving and target cells has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicate support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X). The target cell has band Z as a native (Primary) band and band Y is a mapped band.

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1, 3GPP TS 36.101 section 5.7.3

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set
2. UE supports LTE band Y but does not support band X nor band Z
3. UE and USIM has not stored any information related to the serving cell
4. UE is powered off and in automatic selection mode
5. The serving and target cells support MFBI and have band X and Z respectively as the primary bands
6. Both the serving and target cells are configured as neighbors on the primary frequency band (or X and Z respectively in this case)
7. Both cells are in different eNodeBs and has X2 interface between the two cells configured and enabled
8. Serving and target cells broadcast in freqBandIndicator and multiBandInfoList of band Y in SIB1, SIB2 and SIB5. Both cells also broadcasting additionalSpectrumEmission of band Y.
9. No cells with primary Y band are available and accessible to the UE.

Procedure

1. Power on the UE and attempt to attach on the serving cell
2. Verify that the UE is successfully attached and SIB2, SIB5's list multiBandInfoList
3. While UE is an RRC Connected state, trigger handover from the serving cell to the target cell
4. Verify the UE's mobility state in the target cell

5. Trigger handover from the current cell back to the first cell

Compliance:

1. The UE acquires serving cell in band X and successfully attaches to the serving cell which has band X is the Primary band

2. UE is configured to measure event for EARFCN in an additional band (Y in this case) because UE does not support primary band (X). The EARFCN of the target cell is converted to an EARFCN in a band supported by the UE.

3. UE reports configured event for the additional frequency (earfcn Y) to the Serving cell, and the cell finds corresponding primary frequency relation for it and uses the configured cell relation to trigger Handover Command which contains additional frequency band (Y band) for target cell which has Z as primary band.

4. UE successfully completes handover procedure to the target cell and maintains data transfer.

5. UE successfully completes handover procedure back to the first cell and maintains data transfer

5.22 MFBI Cell Trigger's RRC Connection Release with Redirection

Reference:

3GPP TS 36.331 sections 5.2, 6.2.2 and 6.3.1, 3GPP TS 36.101 section 5.7.3

Purpose:

MFBI capable UE is redirected by serving cell, by the RRC layer, from an a MFBI enabled cell. In this case, the serving and target cells has band X as a native (Primary) band and band Y is a mapped band, meanwhile the UE capabilities indicate support for the mapped band (Y) in SupportedBandListEUTRA but has no support for the Primary band (X). The target cell has band Z (or Y if no Z band available) as a native (Primary) band and band Y is a mapped band.

Initial Configuration:

1. UE supports MBFI and FGI bit 31 is set
2. UE supports LTE band Y but does not support band X nor band Z
3. UE and USIM has not stored any information related to the serving cell
4. UE is powered off and in automatic selection mode
5. The serving and target cells support MFBI and have band X and/or Z respectively as the primary bands
6. Both the serving and target cells are configured as neighbors on the primary frequency band (or X and Z respectively in this case)
7. Serving and target cells broadcast in freqBandIndicator and multiBandInfoList of band Y in SIB1, SIB2 and SIB5. Both cells also broadcasting additionalSpectrumEmission of band Y.
8. No cells with primary Y band are available and accessible to the UE.

Procedure

1. Power on the UE and attempt to attach on the serving cell
2. Verify that the UE is successfully attached and SIB2, SIB5's list multiBandInfoList
3. While UE is an RRC Connected state, trigger RRC Connection Release with redirection from the serving cell to the target cell where the target cell has the mapped Y frequency
4. Verify the UE's mobility state in the target cell

5. Trigger handover from the current cell back to the first cell

Compliance:

1. The UE acquires serving cell in band X and successfully attaches to the serving cell which has band X is the Primary band

2. UE is configured to measure event for EARFCN in an additional band (Y in this case) because UE does not support primary band (X). The EARFCN of the target cell is converted to an EARFCN in a band supported by the UE.

3. UE reports configured event for the additional frequency (earfcn Y) to the Serving cell, and the cell finds corresponding primary frequency relation for it and uses the configured cell relation to trigger RRC Connection Release with Redirection to the target cell which contains additional frequency band (Y band) for the target cell which has X or Z as primary band.

4. UE successfully completes RRC Release with Redirection procedure to the target cell and continues data transfer.

5. UE successfully completes RRC Release with Redirection procedure back to the first cell and maintains data transfer

5.23 Inter eNodeB E-UTRAN Handover from 4x2 DL MIMO Cell to a 2x2 DL MIMO Cell

The UE shall perform handovers from eNB with 4x2 DL MIMO cell to 2x2 DL MIMO Cell.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 23.401

Purpose:

The UE shall perform handovers from eNB with 4x2 DL MIMO cell to 2x2 DL MIMO Cell.

Initial condition:

1. UE must support 4x2 MIMO.
2. Configure 2 Inter-frequency neighbor cells on two eNodeBs available on the same PLMN.

3. Use a two cell configuration setup with frequency f1 (Cell A) and f2 (Cell B) with same bandwidth.
4. Cell A configured as 4x2 MIMO cell.
5. Cell B configured as a 2x2 MIMO cell.
6. Configure both eNodeBs for handovers.

Procedure:

1. Verify that the UE camps on cell A.
2. Start data transfer (e.g. FTP download) on default bearer.
3. Increase attenuation of active cell and decrease attenuation of the neighbor cell till UE performs X2 handover to neighbor cell.
4. Cell A > Cell B > Cell A

Compliance:

1. The UE shall perform handovers correctly, without losing service, and its PDN connectivity shall remain viable before and after the handovers.
2. The UE shall successfully resume the data transfer after the handovers.
3. Verify correct Transmission Mode is in use after handovers.

5.24 Inter eNodeB E-UTRAN Handover from 4x4 DL MIMO Cell to a 2x2 DL MIMO Cell

The UE shall perform handovers from eNB with 4x4 DL MIMO cell to 2x2 DL MIMO Cell.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 23.401

Purpose:

The UE shall perform handovers from eNB with 4x4 DL MIMO cell to 2x2 DL MIMO Cell.

Initial condition:

1. UE must support 4x4 MIMO.
2. Configure 2 Inter-frequency neighbor cells on two eNodeBs available on the same PLMN.
3. Use a two cell configuration setup with frequency f1 (Cell A) and f2 (Cell B) with same bandwidth.
4. Cell A configured as 4x4 MIMO cell.
5. Cell B configured as a 2x2 MIMO cell.
6. Configure both eNodeBs for handovers.

Procedure:

1. Verify that the UE camps on cell A.
2. Start data transfer (e.g. FTP download) on default bearer.
3. Increase attenuation of active cell and decrease attenuation of the neighbor cell till UE performs S1 handovers to neighbor cell.
4. Cell A > Cell B > Cell A

Compliance:

1. The UE shall perform handovers correctly, without losing service, and its PDN connectivity shall remain viable before and after the handovers.
2. The UE shall successfully resume the data transfer after the handovers.
3. Verify correct Transmission Mode is in use after handovers.

5.25 Inter-Frequency Event Based (Network Specified) Load Balancing

Reference:

3GPP TS36.300 section 19.2.1.19 and TS 36.331 section 5.3.8.3

Purpose:

UE can be redirected to another cell on different frequencies and in different tracking areas when requested by the network for event triggered due to network reasons, such as MME load balancing.

Initial Condition:

1. Two eNodeBs with cells configured to be on the different EARFCNs and different tracking areas.
2. The network can trigger load balancing by user commands or adjusting load threshold. In this case by MME releasing the S1 connection by sending UE Context Release Command for Load Balancing with cause IE set to Load Balancing TAU Required which will triggering the UE to do tracking area for load balancing.
3. The serving cell is turned on and the target cell is off

Procedure:

1. Attach the UE to the serving cell and maintain the RRC connection by triggering UL/DL traffic
2. Turn on the target cell
3. From the network, the eNodeB triggers RRC Connection Release with release cause that indicates "loadBalancingTAURequired", by for example issuing CLI command or adjusting tracking area load balancing thresholds in the MME to release the S1 connections of the UE towards the eNodeB.
4. Verify that UE's RRC connection is released from the serving cell and the UE acquired the target cell and performed tracking area update procedure.

Compliance:

1. UE attaches to the serving cell and maintains UL/DL traffic

2. The target cell is on and the UE is still connected to the serving cell.
3. UE is receiving RRC Connection release with cause code that indicates “loadBalancingTAURequired” and the UE reselects the target cell
4. UE acquires the target cell and triggers tracking area update procedure

5.26 Inter-Frequency Handover from non MBSFN cell to a cell Configured with MBSFN

This test verifies Inter-Frequency Handover from non MBSFN cell to a cell configured with MBSFN.

Reference:

- 3GPP TS 36.201: 4.2.1
- 3GPP TS 36.300: 5.1.5, 15.3

Purpose:

This test verifies Inter-Frequency Handover from non MBSFN cell to a cell configured with MBSFN.

Initial Condition:

1. Configure the network to have two active eNBs having different frequencies, with one eNB that does not support MBSFN and one eNB that does support MBSFN.
2. Adjust attenuation so that non MBSFN eNB signal is stronger than MBSFN eNB signal.
3. Configure UE with MBMS application as per Operator or Market Endorsement.
4. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. The UE attaches to non MBSFN eNB and UE MBMS application is available.
4. Increase attenuation of non MBSFN eNB and decrease attenuation of MBSFN eNB until UE performs handover to MBSFN eNB.
5. The UE stays on MBSFN eNB without losing MBMS application.

Compliance:

1. Verify the UE attaches to the network and UE MBMS application is available when connected to eNB that does not support MBFSN.
2. Verify the UE performs a reselection correctly without losing MBMS application when connected to eNB that does support MBFSN.

6.1 System Lost – LTE System Lost in RRC_IDLE

Verify the UE's behavior when an RRC_IDLE UE loses a Cell and subsequently finds another Cell.

Reference:

- 3GPP TS 24.301, clause 5.5.1
- 3GPP TS 36.331

Purpose:

Verify the UE's behavior when an RRC_IDLE UE loses a Cell and subsequently finds another Cell.

Initial Condition:

1. Configure the network to have at least two active Cells.
2. Designate one Cell as Cell #1 and the other as Cell #2.
3. Configure the network to ensure that the UE will find Cell #1 first.
4. UE is powered off.

Procedure:

1. Power on the UE.
2. After the UE attaches to Cell #1, wait until the UE changes state to RRC_IDLE.
3. Force the UE to lose Cell #1.
4. The UE finds Cell #2 and initiates an attach to Cell #2.

Compliance:

1. In Step 1, verify that the UE attaches to Cell #1.
2. In Step 3, verify that the UE loses its connection to Cell #1.
3. In Step 4, verify that the UE attaches to Cell #2.

6.2 System Lost – LTE System Lost in RRC_ACTIVE

Verify the UE's behavior when an RRC_ACTIVE UE loses connection to an Cell and subsequently finds another Cell in the same tracking area.

Reference:

- 3GPP TS 24.301
- 3GPP TS 24.301, clause 5.5.1, 5.6.1
- 3GPP TS 36.331

Purpose:

Verify the UE's behavior when an RRC_ACTIVE UE loses connection to an Cell and subsequently finds another Cell in the same tracking area.

Initial Condition:

1. Configure the network to have at least two active Cell.
2. Designate one Cell as Cell #1 and the other as Cell #2.
3. Configure the network to ensure that the UE will find Cell #1 first.
4. UE supports browsing or is connected to a PC that supports HTTP browsing.
5. UE is powered off.

Procedure:

1. Power on the UE.
2. After the UE attaches to Cell #1, initiate a browser session with an available web page.
3. Cause the UE to lose Cell #1 (complete RLF failure).
4. The UE finds Cell #2.
5. Direct the browser to a different available web page.

Compliance:

1. In Step 2, verify that the UE attaches to Cell #1 and that the UE connects to the internet.
2. In Step 3, verify that the UE loses its connection to Cell #1.
3. In Step 4, verify that the UE attaches to Cell #2 and a new context is established.
4. In Step 5, verify that the browser session still works.

6.3 UE Radio Link Failure Triggers RRC Connection Re-establishment

Purpose

The purpose of this test is to verify that the UE can be successfully re-established after brief UE loss of the LTE system and radio link failure (RLF).

Reference

3GPP TS 36.523-1[4], clause 8.2.2.3.1, TS 36.331

Initial Conditions

1. eNodeB is configured to support RLF and Re-Establishment procedures
2. Timers T310 and T311 in the eNodeB are set to a minimum of 2 seconds and 5 seconds respectively.
3. The eNodeB supports the RRC connection re-establishment procedure

Procedure

1 Attach the UE to the eNodeB
2 Rapidly attenuate the eNodeB signal until signal to the eNodeB is completely non-accessible by the UE for the 3 seconds.
3 After 3 seconds, rapidly increase signal of the eNodeB until the RSRP > -100 dBm.
4 Allow UE to perform system selection and attach to the eNodeB.
5 UE completes RRC connection Re-establishment according to 3GPP TS 36.523-1 [4], clause 8.2.4.7

Expected Results

1 After signal loss, the UE acquires the eNodeB and sends an RRCConnectionReestablishmentRequest message to the cell initiating the reestablishment procedure
2 Upon RRC connection re-establishment procedure initiation, verify that:
   a. The RRC message exchange is successful and that the re-establishment cause is set the value "OtherFailure"
   b. SRB1 has been reconfigured and data traffic is resumed after reestablishment completed

6.4 UE Triggers RRC Connection Re-establishment to Another Cell in Same eNodeB

Purpose

The purpose of this test is to verify that the UE can be successfully re-established on a different cell of the same eNodeB after a permanent loss of the LTE system and radio link failure (RLF).

Reference

3GPP TS 36.523-1[4], clause 8.2.2.3.1, TS 36.331

Initial Conditions

1. Prepare two cells from the same eNodeB that are configured to support RLF and Re-Establishment procedures
2. The eNodeB cell1 is configured for handover to cell2, a neighboring cell of the same eNodeB
3. Timers T310 and T311 in the eNodeB are set to a minimum of 2 seconds and 5 seconds respectively.
4. The eNodeB supports the RRC connection re-establishment procedure

Procedure

1 Attach the UE to the cell1
2 Rapidly attenuate cell1 signal completely non-accessible by the UE for the 3 seconds.
3 Immediately and rapidly increase the signal of cell2 until the RSRP > -100 dBm.
4 Allow UE to perform system selection and send an RRCConnectionReestablishmentRequest on cell2.
5 UE completes RRC connection Re-establishment according to 3GPP TS 36.523-1 [4], clause 8.2.4.7

Expected Results

1 After signal loss, the UE acquires the signal from cell2 and sends an RRCConnectionReestablishmentRequest message to the cell initiating the reestablishment procedure
2 Upon RRC connection re-establishment procedure initiation, verify that:
    a. The RRC message exchange is successful and that the re-establishment cause is set the value “OtherFailure”
    b. SRB1 has been reconfigured and data traffic is resumed after reestablishment completed

6.5 UE Triggers RRC Connection Re-establishment to Another Cell in a Different eNodeB

Purpose

The purpose of this test is to verify that the UE can be successfully re-established on a different eNodeB after a permanent loss of the LTE system and radio link failure (RLF).

Reference

3GPP TS 36.523-1[4], clause 8.2.2.3.1, TS 36.331

Initial Conditions

1. Prepare two eNodeBs that are configured to support RLF and Re-Establishment procedures
2. eNodeB1 and eNodeB2 are configured for handover
3. Timers T310 and T311 in the eNodeB are set to a minimum of 2 seconds and 5 seconds respectively.
4. The eNodeB supports the RRC connection re-establishment procedure

Procedure

1 Attach the UE to the eNodeB1
2 Rapidly attenuate eNodeB1s signal completely non-accessible by the UE for the 3 seconds.
3 Immediately and rapidly increase the signal of eNodeB2 until the RSRP > -100 dBm.
4 Allow UE to perform system selection send an RRCConnectionReestablishmentRequest.
5 UE completes RRC connection Re-establishment according to 3GPP TS 36.523-1 [4], clause 8.2.4.7

Expected Results

1 After signal loss, the UE acquires the signal from eNodeB2 and sends an RRCConnectionReestablishmentRequest message to the cell initiating the reestablishment procedure
2 Upon RRC connection re-establishment procedure initiation, verify that:
   a. The RRC message exchange is successful and that the re-establishment cause is set the value “OtherFailure”
   b. SRB1 has been reconfigured and data traffic is resumed after reestablishment completed

6.6 Transition – Idle to Active Transition – Service Request

The UE shall successfully perform a UE initiated service request procedure.

Reference:

- 3GPP TS 24.301, clause 5.6.1

Purpose:

The UE shall successfully perform a UE initiated service request procedure.

Initial Condition:

1. UE is attached and in RRC_IDLE.

Procedure:

1. Trigger any data service in the UE to send Uplink data in order to trigger service request procedure.

Compliance:

1. In Step 1, verify UE successfully performs the UE initiated service request procedure and enters RRC_CONNECTED state.

6.7 Transition – Idle to Active Transition – Paging

This test verifies that the UE can successfully perform a UE initiated service request procedure after being paged.

Reference:

- 3GPP TS 24.301, clause 5.6.1

Purpose:

This test verifies that the UE can successfully perform a UE initiated service request procedure after being paged.

Initial Condition:

1. UE is attached and in RRC_IDLE.

Procedure:

1. Trigger any data service in the network to trigger a paging procedure

Compliance:

1. In Step 1, verify UE successfully responds to the paging message and enters RRC_CONNECTED state.

7.1 Ipv4 – Without Mobility – SIMO Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2
- 3GPP TS24.301 clause 5
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Initial Condition:

1. The Antenna configuration is SIMO.
2. The Uplink Modulation is determined by the Lab.
3. The UE is RRC_Idel.
4. The UE is connected to a network server with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMP Ping from the UE to the Internet server with a payload of 32 bytes using Ipv4.
2. Measure the round trip time which includes the time to change state from RRC Idle to Connected state.
3. Repeat Steps 1 and 2 an additional 99 times, while the UE in an RRC_Connected state.
4. Calculate the average value of the round trip time for all 100 measurements.

Compliance:

1. In Step 4, verify that the average total round trip delay is less than 50 ms.

7.2 Ipv4 – Without Mobility – Transmit diversity (MIMO) Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2
- 3GPP TS24.301 clause 5

- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Initial Condition:

1. The Antenna configuration is Transmit Diversity.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_Idle.
4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMP Ping to a network server.
2. Record the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of the round trip time for the 100 measurements.

Compliance:

1. In Step 4, verify that the average round trip time is less than 50 msec.

7.3 Ipv4 – Without Mobility – Open Loop Multiplexing – Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2,
- 3GPP TS24.301 clause 5,
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Initial Condition:

1. The antenna configuration is Open Loop Spatial Multiplexing.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_CONNECTED.

4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMP Ping to a network server.
2. Measure the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of RTT for the 100 measurements.

Compliance:

1. In Step 4, verify that the average total user plane round trip delay is less than 50 ms.

7.4 Ipv4 – Without Mobility – Close Loop Multiplexing – Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2,
- 3GPP TS24.301 clause 5,
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv4.

Initial Condition:

1. The antenna configuration is Close Loop Spatial Multiplexing.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_CONNECTED.
4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMP Ping to a network server.
2. Measure the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of RTT for the 100 measurements.

Compliance:

1. In Step 4, verify that the average total user plane round trip delay is less than 50 ms.

7.5 Ipv6 – Without Mobility – SIMO Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2,
- 3GPP TS24.301 clause 5,
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Initial Condition:

1. The Antenna configuration is SIMO.
2. The Uplink Modulation is determined by the Lab.
3. The UE is RRC_CONNECTED.
4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMP Ping to a network server.
2. Measure the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of the round trip time for all 100 measurements.

Compliance:

1. In Step 4, verify that the average total round trip delay is less than 50 ms.

7.6 Ipv6 – Without Mobility – Transmit Diversity (MIMO) Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2,
- 3GPP TS24.301 clause 5,

- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Initial Condition:

1. The Antenna configuration is Transmit Diversity.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_CONNECTED.
4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMPv6 Ping to a network server using Ipv6.
2. Record the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of the round trip time for the 100 measurements.

Compliance:

1. In Step 4, verify that the average round trip time is less than 50 msec.

7.7 Ipv6 – Without Mobility – Open Loop Multiplexing – Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2
- 3GPP TS24.301 clause 5
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Initial Condition:

1. The antenna configuration is Open Loop Spatial Multiplexing.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_CONNECTED.

4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMPv6 Ping to a network server using Ipv6.
2. Measure the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of RTT for the 100 measurements.

Compliance:

1. In Step 4, verify that the average total user plane round trip delay is less than 50 ms.

7.8 Ipv6 – Without Mobility – Close Loop Multiplexing – Delay of Ping

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Reference:

- 3GPP TS36.300 clause 7 and Annex A.2
- 3GPP TS24.301 clause 5
- 3GPP TS36.331 clause 5

Purpose:

This test verifies UE meets requirements for user plane round trip delay over Ipv6.

Initial Condition:

1. The antenna configuration is Closed Loop Spatial Multiplexing.
2. The downlink modulation level is determined by the Lab.
3. The UE is RRC_CONNECTED.
4. The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and Ipv4v6 dual stack addressing.

Procedure:

1. Initiate a one ICMPv6 Ping to a network server using Ipv6.
2. Measure the round trip time.
3. Repeat Steps 1 and 2 an additional 99 times.
4. Calculate the average value of RTT for the 100 measurements.

Compliance:

1. In Step 4, verify that the average total user plane round trip delay is less than 50 ms.

7.9 PDN Connectivity Request –ESM Information transfer flag=TRUE

In case if UE wants to include the APN name in PDN Connectivity request and/or usage of default APN requires Authentication – UE shall include ESM Information transfer flag and set it to TRUE

Reference:

- TS.11 (32.1.1)
- 3GPP TS 24.301, clause 6.5.1.2

Purpose:

To verify that UE is correctly setting ESM Information transfer flag and additional information like APN name and Authentication information is exchanged using ESM INFORMATION procedure

Initial Condition:

1. UE is powered off.
2. APN name is explicitly configured on UE side.
3. Usage of APN requires Authentication.
4. The necessary Authentication Username/password is configured on UE side.

Procedure:

1. Power on the UE and verify that the UE sends ESM Information Transfer flag and set it to TRUE in "PDN CONNECTIVITY REQUEST."
2. The network shall respond to the UE with a ESM INFORMATION REQUEST message.
3. After UE replies with ESM INFORMATION RESPONSE containing APN IE and PCO (Protocol Configuration Options), the network shall respond to the UE with an "RRCConnectionReconfiguration" message that contains the "EPS Radio Bearer Identity" and the APN for a default bearer.

Compliance:

1. After Step 3: Verify that PDN Connectivity is functional to the network where this APN gives access to (e.g. loading a designated HTML page, which is only accessible via this network).

Example message flow:

Step	Direction UE - NW	Message	Comments
1	→	RRCConnectionRequest	RRC
2	←	RRCConnectionSetup	RRC
3	→	RRCConnectionSetupComplete(ATTACH REQUEST(PDN CONNECTIVITY REQUEST))	RRC(EMM(ESM)) **ESM Information transfer flag is included and set to TRUE**
4	←	AUTHENTICATION REQUEST	EMM(OPTIONAL)
5	→	AUTHENTICATION RESPONSE	EMM(OPTIONAL)
6	←	SECURITY MODE COMMAND	EMM(OPTIONAL)
7	→	SECURITY MODE COMPLETE	EMM(OPTIONAL)
8	←	ESM INFORMATION REQUEST	ESM(OPTIONAL)
9	→	ESM INFORMATION RESPONSE	*ESM(OPTIONAL)*
10	←	UECapabilityEnquiry	RRC
12	→	UECapabilityInformation	RRC
12	←	SecurityModeCommand	RRC
13	→	SecurityModeComplete	RRC
14	←	RRCConnectionReconfiguration(ATTACH ACCEPT(ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST)),	RRC(EMM(ESM))
15	→	RRCConnectionReconfigurationComplete	RRC
16	→	ULInformationTransfer(ATTACH COMPLETE (ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT))	RRC (EMM(ESM))
17	→	FIRST UPLINK DATA	
18	←	FIRST DOWNLINK DATA	

7.10 PDN Connectivity Reject, ESM Cause #27 Missing or Unknown APN

Verify that the UE inform the user of reject of PDN connectivity establishment

Reference:

- TS.11 (32.1.2)
- 3GPP TS 24.301, section 6.5.1.4

Purpose:

To ensure that the UE is not able to achieve PDN connectivity with an unknown APN.

Initial Condition:

1. UE is in EMM-REGISTERED state.

Procedure:

1. Initiate a secondary PDN connectivity request, for example by means of an embedded web browser or DUN connection and specify explicitly an APN name different than default one.
2. MME reject PDN CONNECTIVITY REQUEST with cause #27 "Missing or unknown APN"

Compliance:

1. At Step 2 – Verify that the user is informed for unsuccessful PDN Connectivity request

Example message flow:

Step	Direction UE – NW	Message	Comments
1	→	RRCConnectionRequest	*RRC(Optional)*
2	←	RRCConnectionSetup	*RRC(Optional)*
3	→	RRCConnectionSetupComplete(SERVICE REQUEST)	*RRC(EMM)(Optional)*
4	←	IDENTITY REQUEST	*EMM(Optional)*
5	→	IDENTITY RESPONSE	*EMM(Optional)*
6	←	AUTHENTICATION REQUEST	*EMM(Optional)*
7	→	AUTHENTICATION RESPONSE	*EMM(Optional)*
8	←	SECURITY MODE COMMAND	*EMM(Optional)*

Step	Direction UE – NW	Message	Comments
9	→	SECURITY MODE COMPLETE	*EMM(Optional)*
10	←	SecurityModeCommand	*RRC(Optional)*
11	→	SecurityModeComplete	*RRC(Optional)*
12	←	RRCConnectionReconfiguration	*RRC(Optional)*
13	→	RRCConnectionReconfigurationComplete	*RRC(Optional)*
14	→	PDN CONNECTIVITY REQUEST	ESM
15	→	PDN CONNECTIVITY REJECT, ESM CAUSE 27	ESM

Note: RRC procedures are optional in case if UE is in RRC_CONNECTED state.

7.11 PDN Disconnect Procedure – UE Initiated

This test verifies that the UE can successfully disconnect from one PDN (not the last).

Reference:

- 3GPP TS 24.301, clauses 6.5.2

Purpose:

To ensure the UE initiated PDN disconnect procedure works.

Initial Condition:

UE is attached to at least two PDNs and is in RRC IDLE state.

Procedure:

1. UE initiates a PDN disconnect to one PDN only.

Compliance:

1. Verify that the PDN disconnect procedure is successful.

7.12 Detach Procedure – Network Initiated

This test verifies that the UE can successfully detach from the network upon receipt of a Detach Request from the network.

Reference:

- 3GPP TS 24.301, clauses 5.5.2, 6.4.4 and 6.5.4

- 3GPP TS 23.401, clauses 5.4.4 and 5.3.8

Purpose:

This test verifies that the UE can successfully detach from the network upon receipt of a Detach Request from the network.

Initial Condition:

1. UE is attached to the network.

Procedure:

1. Network initiates a Detach Request.

2. UE responds with the Detach Acknowledge.

Compliance:

1. In Step 2, verify that the UE is detached from the network.

7.13 Multiple PDN Connections – Second PDN Connectivity Request (UE Initiated)

Verify that the UE can successfully activate a second PDN Connection

Reference:

- TS.11 (32.1.3)

- 3GPP TS 24.301, section 6.5.1

- 3GPP TS 23.401, section 5.10

Purpose:

To ensure the UE is able to have multiple PDN connections correctly established.

Initial Condition:

1. UE is in EMM-REGISTERED state.

2. UE subscription has multiple APNs.

Procedure:

1. Initiate a second PDN connectivity request, for example by means of an embedded web browser or DUN connection and specify explicitly an APN name different than default one.

Compliance:

1. Verify transfer of user data using second PDN (for example).
   - In case of embedded web browser, try to open a known web page
   - In case of DUN Connection, ping a known reachable IP address

Example message flow:

Step	Direction UE – NW	Message	Comments
1	→	RRCConnectionRequest	*RRC(Optional)*
2	←	RRCConnectionSetup	*RRC(Optional)*
3	→	RRCConnectionSetupComplete(SERVICE REQUEST)	*RRC(EMM)(Optional)*
4	←	IDENTITY REQUEST	*EMM(Optional)*
5	→	IDENTITY RESPONSE	*EMM(Optional)*
6	←	AUTHENTICATION REQUEST	*EMM(Optional)*
7	→	AUTHENTICATION RESPONSE	*EMM(Optional)*
8	←	SECURITY MODE COMMAND	*EMM(Optional)*
9	→	SECURITY MODE COMPLETE	*EMM(Optional)*
10	←	SecurityModeCommand	*RRC(Optional)*
11	→	SecurityModeComplete	*RRC(Optional)*
12	←	RRCConnectionReconfiguration	*RRC(Optional)*
13	→	RRCConnectionReconfigurationComplete	*RRC(Optional)*
14	→	PDN CONNECTIVITY REQUEST	ESM
15	←	RRCConnectionReconfiguration [ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST]	RRC(EMM, ESM)
16	→	RRCConnectionReconfigurationComplete	RRC(EMM, ESM)
17	→	ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	ESM

7.14 Multiple PDN Connections – Second PDN Connectivity Disconnect

Verify that the UE can successfully deactivate second PDN Connection.

Reference:

- TS.11 (32.1.4)
- 3GPP TS 24.301, section 6.5.2
- 3GPP TS 23.401, section 5.10

Purpose:

To ensure that the UE is able to deactivate a second PDN Connection correctly while maintaining the former PDN Connection active.

Initial Condition:

1. UE is in EMM-REGISTERED state.
2. UE has already two active PDN Connections by means of, respectively, an externally initiated packet data session and an embedded browser session.

Procedure:

1. Verify that an externally initiated packet data session is already established.
2. Verify that an embedded browser session is already established.
3. Manage to deactivate one of the primary PDP contexts (e.g. Terminate DUN session).
4. Verify that DUN session is not active.
5. Verify that the other PDP connection is still active (e.g. try to open a known web page).

Compliance:

1. The UE shall be able to deactivate one of the PDN connections while maintaining the other PDN Connection active.

Example message flow:

Step	Direction UE – NW	Message	Comments
1	➔	[PDN DISCONNECT REQUEST	
2	➔	RRC CONNECTION RECONFIGURATION [DEACTIVATE EPS BEARER CONTEXT REQUEST]	
3	➔	RRC CONNECTION RECONFIGURATION COMPLETE	
4	➔	DEACTIVATE EPS BEARER CONTEXT ACCEPT	

7.15 Detach Procedure – UE Initiated

This test verifies that the UE can successfully initiate a detach from the network.

Reference:

- 3GPP TS 24.301, clauses 5.5.2, 6.4.4 and 6.5.4
- 3GPP TS 23.401, clauses 5.4.4 and 5.3.8

Purpose:

This test verifies that the UE can successfully initiate a detach from the network.

Initial Condition:

1. UE is attached to the network.

Procedure:

1. The UE initiates a Detach Request.
2. The Network responds with the Detach Acknowledge.

Compliance:

1. In Step 2, verify that the UE is detached from the network.

7.16 HTTP Browsing

Measure the time the UE takes to correctly download and render a Web page containing pictures, text and CSS formatting.

This test is possible if embedded browsing application of UE supports HTML format. Alternatively the download can be performed from an external device (e.g. a laptop) tethered to the UE.

Reference:

- TS.11 (32.2.2)
- 3GPP TS 36.331

Purpose:

To measure the UE performance in case of repeated downloads of small size files, such as Ipv4 and Ipv6 addressable HTML pages.

Two test procedures are defined, one to give an indication of the download speed and one to give an indication of the download speed and the time taken to perform state transitions.

To help measure the download size and speed, tools such as in https://gtmetrix.com, Android's adb shell "busybox wget" command, or Chrome's development menu for network could help.

Initial Condition:

1. The UE is attached to the network and has an always-on IP connectivity after establishing a default EPS bearer during Network Attachment.
2. Set up the browser to ensure that the page is downloaded from the network each time and not just loaded from the browser cache

Procedure:

1. Manage on the UE (or on the external device) to download the same reference web page (preferably facebook.com or an operator endorsed reference web page)
    a. Repeat rapidly for 10 times in a row.
    b. For the second part, repeat 3 times in a row leaving a sufficient pause between each download to revert to idle mode.
2. Verify than the download of the page is correct each time (number of elements).
3. Measure the time to download the reference web page and calculate the average download time per page, for steps 1.a and 1.b as separate averages.
4. Repeat with an Ipv4 or Ipv6 addressable reference web page (whichever was not previously used).

Compliance:

The UE shall be able to download the reference Web pages. Record the duration of the web page download. Also record the URL of the reference page used for the test.

For passing criteria please refer to and use the Minimum throughput criteria as defined by the operator.

For all the test cases in this section record the average and the maximum value over the one minute period.

TABLE 8.1-1 TRANSMISSION MODES SPECIFICATION

Transmission modes	Transmission Schema for Test	Configuration
1	Single transmit antenna	Single antenna port
2	Transmit diversity	2 or 4 antennas
3	Open loop spatial multiplexing with cyclic delay diversity (CDD)	2 or 4 antennas
4	Closed loop spatial multiplexing	2 or 4 antennas
5	Multi-user MIMO	2 or 4 antennas
6	Closed loop spatial multiplexing using a single transmission layer	2 or 4 antennas
7	Beamforming	Single antenna port
8	Dual-layer beamforming	Dual-layer transmission, two antenna ports

8.1 DL UDP Data Transfer in SIMO with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL UDP throughput in SIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to force UE to SIMO.

2. After UE is powered up, SIMO PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL SIMO configuration for the given network configuration shall be recorded.

8.2 DL UDP Data Transfer in Tx Diversity with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL UDP throughput in Tx Diversity mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to support Transmit Diversity schema.

2. After UE is powered up, Tx Diversity PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL Tx Diversity configuration for the given network configuration shall be recorded.

8.3 DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL UDP throughput in open loop MIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up configured to support OLSM.

2. After UE is powered up, open loop MIMO PDSCH Tx Mode (TM=3) is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL open loop MIMO configuration for the given network configuration shall be recorded.

8.4 DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL UDP throughput in close loop MIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to support CLSM.

2. After UE is powered up, close loop MIMO PDSCH Tx Mode (TM=4) is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

The UE peak Ipv4 throughput over the DL close loop MIMO configuration for the given network configuration shall be recorded.

8.5 DL FTP Data Transfer in SIMO with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL FTP throughput in SIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up configured to support SIMO.

2. After UE is powered up, SIMO PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL SIMO configuration for the given network configuration shall be recorded.

8.6 DL FTP Data Transfer in Tx Diversity with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL FTP throughput in Tx Diversity mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to support TXD.

2. After UE is powered up, Tx Diversity PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL Tx Diversity configuration for the given network configuration shall be recorded.

8.7 DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL FTP throughput in open loop MIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to support OLSM.

2. After UE is powered up, open loop MIMO PDSCH Tx Mode (TM=3) is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL open loop MIMO configuration for the given network configuration shall be recorded.

8.8 DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer

Purpose:

To measure the UE peak DL FTP throughput in close loop MIMO mode with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and configured to support CLSM.

2. After UE is powered up, close loop MIMO PDSCH Tx Mode (TM=4) is assigned to UE by eNB and UE obtains valid Ipv4 address over default bearer.

3. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv4 throughput over the DL close loop MIMO configuration for the given network configuration shall be recorded.

8.9 UL UDP Data Transfer with Default Ipv4 Bearer

Purpose:

To measure the UE peak UL UDP throughput with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and after UE is powered up, UE obtains valid Ipv4 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UL UDP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UL UDP for the given network configuration.

Compliance:

1. The UE peak Ipv4 UL throughput for the given network configuration shall be recorded.

8.10 UL FTP Data Transfer with Default Ipv4 Bearer

Purpose:

To measure the UE peak UL FTP throughput with Ipv4 bearer.

Initial Condition:

1. LTE cell is up and after UE is powered up, UE obtains valid Ipv4 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UL FTP transfer over the data bearer on which the Ipv4 address was assigned.

2. Record the maximum throughput possible in UL FTP for the given network configuration.

Compliance:

The UE peak Ipv4 UL throughput for the given network configuration shall be recorded.

8.11 DL UDP Data Transfer in SIMO with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL UDP throughput in SIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configure to support SIMO.

2. After UE is powered up, SIMO PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

The UE peak Ipv6 throughput over the DL SIMO configuration for the given network configuration shall be recorded.

8.12 DL UDP Data Transfer in Tx Diversity with Default Ipv6 Bearer

Purpose:

To measure the UE peakDL UDP throughput in Tx Diversity mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support TXD.

2. After UE is powered up, Tx Diversity PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv6 address was assigned.

Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL Tx Diversity configuration for the given network configuration shall be recorded.

8.13 DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL UDP throughput in open loop MIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support OLSM.

2. After UE is powered up, open loop MIMO PDSCH Tx Mode (TM=3) is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL open loop MIMO configuration for the given network configuration shall be recorded.

8.14 DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL UDP throughput in close loop MIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support CLSM.

2. After UE is powered up, close loop MIMO PDSCH Tx Mode (TM=4) is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UDP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in UDP DL for the given network configuration.

Compliance:

The UE peak Ipv6 throughput over the DL close loop MIMO configuration for the given network configuration shall be recorded.

8.15 DL FTP Data Transfer in SIMO with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL FTP throughput in SIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configure to support SIMO.

2. After UE is powered up, SIMO PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL SIMO configuration for the given network configuration shall be recorded.

8.16 DL FTP Data Transfer in Tx Diversity with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL FTP throughput in Tx Diversity mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support TXD.

2. After UE is powered up, Tx Diversity PDSCH Tx Mode is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL Tx Diversity configuration for the given network configuration shall be recorded.

8.17 DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL FTP throughput in open loop MIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support OLSM.

2. AFTER UE is powered up, open loop MIMO PDSCH Tx Mode (TM=3) is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL open loop MIMO configuration for the given network configuration shall be recorded.

8.18 DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer

Purpose:

To measure the UE peak DL FTP throughput in close loop MIMO mode with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and configured to support CLSM.

2. AFTER UE is powered up, close loop MIMO PDSCH Tx Mode (TM=4) is assigned to UE by eNB and UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an FTP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in FTP DL for the given network configuration.

Compliance:

1. The UE peak Ipv6 throughput over the DL close loop MIMO configuration for the given network configuration shall be recorded.

8.19 UL UDP Data Transfer with Default Ipv6 Bearer

Purpose:

To measure the UE peak UL UDP throughput with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and after UE is powered up, UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UL UDP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in UL UDP for the given network configuration.

Compliance:

1. The UE peak Ipv6 UL throughput for the given network configuration shall be recorded.

8.20 UL FTP Data Transfer with Default Ipv6 Bearer

Purpose:

To measure the UE peak UL FTP throughput with Ipv6 bearer.

Initial Condition:

1. LTE cell is up and after UE is powered up, UE obtains valid Ipv6 address over default bearer. This default bearer should be used for the data throughput testing.

Procedure:

1. Perform an UL FTP transfer over the data bearer on which the Ipv6 address was assigned.

2. Record the maximum throughput possible in UL FTP for the given network configuration.

Compliance:

1. The UE peak Ipv6 UL throughput for the given network configuration shall be recorded.

8.21 DL UDP Transfer when both UE and eNodeB Support DL 256QAM

Purpose:

To measure the UE peak DL UDP throughput when both the UE and eNodeB support 256 DL QAM modulation.

Reference

Initial Condition:

1. eNodeB and UE supports 256 QAM downlink
2. Enable 256 QAM DL in eNodeB
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB which supports 256 QAM.
2 Begin a UDP DL file transfer to test maximum throughput
3 Record the maximum throughput achieved.

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 256 QAM DL in UECapabilityInformation message
3. Verify the UE is given a DL MCS Index in the range of 21 to 27
4. UE throughput is greater than throughput with 64 QAM

8.22 UL UDP Transfer when both UE and eNodeB support UL 64QAM

Purpose:

The purpose of this test is to verify that a UL UDP data transfer with support of 64 QAM can be successfully performed and the throughput is proportional to the bandwidth, antenna configuration and modulation.

Reference:
TS 36.213, 36.331

Initial Condition:

1. eNodeB and UE supports 64 QAM
2. Enable 64 QAM UL in eNodeB
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB which supports 64 QAM.
2 Begin a UDP UL file transfer to test maximum throughput
3 Record the maximum throughput achieved.

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 64 QAM UL in UECapabilityInformation message
3. Verify the UE is given an UL MCS Index in the range of 21 to 28
4. UE throughput is greater than throughput with 16 QAM

8.23 DL/UL UDP Transfer with DL256QAM/UL64QAM

To measure Peak simultaneous UL/DL UDP using DL256QAM and UL64QAM.

Reference:

- GSMA TS.11 (31.2.1.1)
- 3GPP TS36.213
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 23.401
- 3GPP TS 36.306

Purpose:

To measure peak simultaneous UL/DL UDP throughput using DL256QAM and UL64QAM.

Initial condition:

1. Configure eNB to support DL256 QAM and UL 64 QAM.
2. Ensure that the device is under good RF conditions in terms of RSRP and SINR

Procedure:

1. Perform a simultaneous UL and DL UDP data transfer on default bearer IPv4.
2. Record the maximum UL/DL UDP data transfer possible for the given network configuration.

Compliance:

1. The peak UL and DL UDP data transfer rate possible for the given network configuration shall be recorded.

8.24 DL TCP Transfer when both UE and eNodeB Support DL 256QAM

Purpose:

To measure the UE peak DL UDP throughput when both the UE and eNodeB support 256 DL QAM modulation.

Reference

Initial Condition:

1. eNodeB and UE supports 256 QAM downlink
2. Enable 256 QAM DL in eNodeB
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB which supports 256 QAM.
2 Begin a TCP DL file transfer to test maximum throughput
3 Record the maximum throughput achieved.

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 256 QAM DL in UECapabilityInformation message
3. Verify the UE is given a DL MCS Index in the range of 21 to 27
4. UE throughput is greater than throughput with 64 QAM (tested in test....?)

8.25 UL TCP Transfer when both UE and eNodeB support UL 64QAM

Purpose:

The purpose of this test is to verify that a UL UDP data transfer with support of 64 QAM can be successfully performed and the throughput is proportional to the bandwidth, antenna configuration and modulation.

Reference:
TS 36.213, 36.331

Initial Condition:

1. eNodeB and UE supports 64 QAM Uplink
2. Enable 64 QAM UL in eNodeB
3. Target cell status is enabled and the RSRP > -80 dBm
4. UE and DM is ready for testing

Procedure:

1 Attach UE to eNodeB which supports 64 QAM.
2 Begin a TCP UL file transfer to test maximum throughput
3 Record the maximum throughput achieved.

Compliance:

1. UE Successfully attaches to eNodeB
2. UE indicates support of 64 QAM UL in UECapabilityInformation message
3. Verify the UE is given an UL MCS Index in the range of 21 to 28
4. UE throughput is greater than throughput with 16 QAM

8.26 Link adaptation with different radio conditions when support DL 256QAM

The UE shall perform MCS changes during varying radio conditions using DL 256 QAM without losing service.

Reference:

- GSMA TS.11 (31.2.1.1)
- 3GPP TS36.213
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 23.401
- 3GPP TS 36.306

Purpose:

To ensure the UE can perform MCS changes during varying radio conditions using DL 256 QAM without losing service.

Initial condition:

1. Configure eNB with DL 256 QAM and Link adaptation enabled.

Procedure:

1. Start data transfer (e.g. FTP download) on default bearer.
2. Increase/decrease attenuation of active cell sufficient to cause the UE to vary MCS indexes up and down.

Compliance:

1. Verify that UE can successfully vary MCS indexes as RF conditions degrade without losing connection.
2. Verify that UE begins using 256 QAM in good conditions and resumes 256 QAM when UE returns to good RF conditions.

8.27 Link Adaptation under Different Radio Condition when using UL 64QAM

Purpose:

To check the link adaptation and measure the UE average UL UDP throughput under different radio conditions when both the UE and eNB support UL 64QAM modulation.

Reference

Initial Condition:

5. Both eNB and UE support and configured for UL 64QAM modulation
6. RF tools to trigger changes on rf radio conditions to simulate UE is in near, middle and border conditions
7. ENodeb is configured for link adaption
8. Network transport, UDP server, EPC and UE subscription are configured to support 64QAM UL with configured bandwidth.

Procedure:

4 Attach UE to eNB under test and check UE's UL capabilities for UL 64 QAM support, and the eNodeb SIB2 for UL 64QAM support
5 Check and record the cell under test configured UL bandwidth
6 Set up the RF conditions to for the UE to experience near cell RF conditions, so the cell will have high SINR and RSRP
7 Start or restart UL UDP traffic with maximum possible throughput
8 After 60 seconds, record the mode or average of UL MCS, also record the average throughput achieved at the server side
9 Set up the RF conditions so the UE can experience mid cell RF conditions
10 Repeat steps 4 and 5
11 Set up the RF conditions so the UE can experience border cell RF conditions
12 Repeat steps 4 to 6

Compliance:

1. UE successfully attaches to eNB and indicates support of UL 64 QAM
2. Recorded configured bandwidth which will be proportional with UL through measured
3. Verify the RF conditions represents near cell and good rf conditions
4. UL UDP traffic started successfully and could be checked at the serve side
5. UL MCS and average throughput are within range for near-cell conditions, when RF conditions are good it is expected to observe 64QAM with MCS range from 21 to 28.
6. Verify the RF conditions represents mid cell and good rf conditions
7. UL MCS and average throughput are within range for mid-cell conditions
8. Verify the RF conditions represents border cell and good rf conditions
9. UL MCS and average throughput are within range for border-cell conditions

8.28 Inter eNodeB E-UTRAN Handover DL 256QAM

To ensure that the UE shall perform handovers while using DL 256 QAM as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- GSMA TS.11 (31.2.1.1)
- 3GPP TS36.213
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP TS 23.401
- 3GPP TS 36.306

Purpose:

To ensure that the UE shall perform handovers while using DL 256 QAM as requested by the network, and behave as expected from the user perspective without losing services.

Initial condition:

1. Configure 2 Intra frequency cells on the different eNB available on the same PLMN
2. Configure the 2 cells as neighbors
3. Enable DL 256 QAM on both eNBs.
4. Use a two cell configuration setup with frequency f1 (Cell A) and (Cell B) with same bandwidth.
5. Configure the PDN Type set on the UE to be IPv4
6. Configure both eNBs for X2 handovers.

Procedure:

1. Verify that the UE camps on cell A.
2. Start data transfer (e.g. FTP download) on default bearer.
3. Increase attenuation of active cell and decrease attenuation of the neighbor cell till UE performs X2 handover to neighbor cell.

4. Cell A > Cell B > Cell A

Compliance:

1. The UE shall perform handovers correctly, without losing service, and its PDN connectivity shall remain viable before and after the handovers.

2. The UE shall successfully resume the data transfer after the handovers.

8.29 Inter eNodeB E-UTRAN Handover with DL256QAM/UL64QAM

The UE shall perform handovers as requested by the network, and behave as expected from the user perspective without losing services while using DL256QAM and UL64QAM.

Reference:

- GSMA TS.11 (31.2.1.1)
- 3GPP TS36.213
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401
- 3GPP TS 36.306

Purpose:

The UE shall perform handovers as requested by the network, and behave as expected from the user perspective without losing services while using DL256QAM and UL64QAM.

Initial condition:

1. Configure eNBs to use DL 256 QAM and UL 64 QAM.
2. Configure 2 Inter-frequency neighbor cells on two eNBs available on the same PLMN.
3. Use a two cell configuration setup with frequency f1 (Cell A) and f2 (Cell B) with same bandwidth.

4. Configure the PDN Type set on the UE to IPv6
5. Configure both eNBs for X2 handovers.

Procedure:

1. Attach UE to Cell A.
2. Start data transfer (e.g. FTP download) on default bearer IPv6.
3. Increase attenuation of active cell and decrease attenuation of the neighbor cell till UE performs X2 handover to neighbor cell.
4. Cell A > Cell B > Cell A

Compliance:

1. Verify that the UE performs handovers correctly, without losing service, and its PDN connectivity shall remain viable before and after handovers.
2. Verify that the data transfer continues on the target cell and that throughput is as expected for UL/DL per respective modulation.

8.30 Inter eNodeB E-UTRAN Handover when UE and only one eNodeB Support DL 256QAM

The UE shall perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- GSMA TS.11 (31.2.1.1)
- 3GPP TS36.213
- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401
- 3GPP TS 36.306

Purpose:

The UE shall perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Initial condition:

1. Configure 2 Intra frequency Neighbor cells.
2. Use a two-cell configuration setup with frequency f1 (Cell A) and (Cell B)
3. Configure the PDN Type set on the UE to IPv4
4. Configure Cell A to support DL 256 QAM
5. Configure Cell B to support DL 64 QAM
6. Configure both eNodeBs for S1 handovers.

Procedure:

1. Verify that the UE camps on cell A.
2. Start data transfer (e.g. FTP download) on default bearer.
3. Increase attenuation of active cell and decrease attenuation of the neighbor cell till UE performs S1 handover to neighbor cell.
4. Cell A > Cell B > Cell A

Compliance:

1. The UE shall perform handovers correctly, without losing service, and its PDN connectivity shall remain viable before and after the handovers.

2. The UE shall successfully resume the data transfer after the handovers at the expected rate for modulation.

8.31 DL UDP Transfer in Cell Configured with 4x2 DL MIMO

The UE shall perform UDP DL while using 4x2 MIMO.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331

Purpose:

The UE shall perform UDP DL while using 4x2 MIMO.

Initial condition:

1. UE must support 4x2 MIMO.
2. Cell shall be configured using 4x2 MIMO.

Procedure:

1. Perform UDP DL data transfer on default bearer IPv6 in good RF conditions.
2. Perform UDP DL data transfer on default bearer IPv6 at cell edge.

Compliance:

1. The UE peak maximum DL throughput for IPv6 bearer for the given network configuration for both good RF conditions and cell edge shall be recorded.

8.32 DL UDP Transfer in Cell Configured with 4x4 DL MIMO

The UE shall perform UDP DL while using 4x4 MIMO.

Reference:

- 3GPP TS36.211
- 3GPP TS36.300
- 3GPP TS 36.331

Purpose:

The UE shall perform UDP DL while using 4x4 MIMO.

Initial condition:

1. UE must support 4x4 MIMO.
2. Cell shall be configured using 4x4 MIMO.

Procedure:

1. Perform UDP DL data transfer on default bearer IPv6 in good RF conditions.
2. Perform UDP DL data transfer on default bearer IPv6 at cell edge.

Compliance:

1. The UE peak maximum DL throughput for IPv6 bearer for the given network configuration for both good RF conditions and cell edge shall be recorded.

8.33 DL/UL UDP Transfer in a Cell configured with 4x4 DL MIMO

This test verifies UE can perform bidirectional UDP transfer while using 4x4 MIMO.

Note: Only default IPv6 bearer is required for this test case.

Reference:

- 3GPP TS 36.211
- 3GPP TS 36.300
- 3GPP TS 36.331

Purpose:

This test verifies UE can perform bidirectional UDP transfer while using 4x4 MIMO.

Note: Only default IPv6 bearer is required for this test case.

Initial Condition:

1. Configure the network to have an active eNB that supports 4x4 MIMO.
2. Configure UE to support 4x4 MIMO.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. The UE attaches to the network.
4. Perform bidirectional UDP data transfer on default bearer IPv6 in good RF conditions.
5. Perform UDP DL data transfer on default bearer IPv6 at cell edge.

Compliance:

1. Verify the UE attaches to the network with 4x4 MIMO in use.

2. The UE peak maximum UL and DL throughput for IPv6 bearer for the given network configuration for both good RF conditions and cell edge shall be recorded.

8.34 UL UDP data at the maximum UL throughput when UE Configured for SRS

Purpose:

To verify the UE sends maximum UL throughput while sending SRS

Reference:

3GPP 36.331, 36.211 clause 5.5.3, 36.213

Initial Condition:

1. All the EPS network Elements and the O&M run normally.
2. Target cell status is enabled.
3. UE and DM is ready for testing.

Procedure:

1. Enable SRS on the eNodeB.
2. Attach UE and generates UL UDP traffic for maximum throughput.
3. Disable SRS on the eNodeB
4. Attach UE and generate UL UDP traffic for maximum throughput

Compliance:

1. At step 2, confirm through SRS relation IE whether SRS config information setup in RRCConnectionSetup message. The eNodeb will send RRC Connection Set up message that contains SRS configuration, example:

   soundingRS-UL-ConfigDedicated setup :
   srs-Bandwidth bw3,
   srs-HoppingBandwidth hbw0,
   freqDomainPosition 0,
   duration TRUE,
   srs-ConfigIndex 12,
   transmissionComb 0,
   cyclicShift cs0

2. Verify the UL UDP throughput is the expected throughput per lab configuration whether SRS is enabled or disabled.

Section 9 Dedicated Bearer

9.1 Network Initiated Dedicated Ipv4 Bearer Establishment and Data Connectivity

The purpose of this test is to verify default and dedicated bearer establishment and data connectivity.

Reference:

- 3GPP2 TS 24.301

Purpose:

To ensure the UE can successfully establish a dedicated bearer in addition to the default bearer.

Initial Configuration:

1. UE establishes a default EPS bearer to an Ipv4 PDN.

Procedure:

1. Trigger network establishment of a dedicated Ipv4 bearer.
2. Initiate a UDP traffic on each default and dedicated bearer and on the UL and DL directions.

Compliance:

1. UE establishes and maintains data connectivity with both the default and dedicated bearers.

9.2 Network Initiated Dedicated Ipv6 Bearer Establishment and Data Connectivity

The purpose of this test is to verify default and dedicated bearer establishment and data connectivity.

Reference:

- 3GPP2 TS 24.301

Purpose:

To ensure the UE can successfully establish a dedicated bearer in addition to the default bearer.

Initial Configuration:

1. UE establishes a default EPS bearer to an Ipv6 PDN.

Procedure:

1. Trigger network establishment of a dedicated Ipv6 bearer.
2. Initiate a UDP traffic on each default and dedicated bearer and on the UL and DL directions.

Compliance:

1. UE establishes and maintains data connectivity with both the default and dedicated bearers.

10.1 Long and Short DRX

The purpose of this test is to verify that when the UE is configured with DRX, the UE shall correctly apply the DRX configuration as specified by the eNB in the Radio Resource Configuration.

Reference:

- 3GPP2 TS 36.523-1 sub-clause 7.1.6.1
- 3GPP reference 36.331 rev. 8.8.0, Annex B1

Purpose:

To ensure the UE shall correctly apply the requested DRX configuration as specified by the eNB.

Initial Configuration:

1. Ensure that the UE is set to support Long + Short DRX for the default bearer.

2. Set the Long+Short DRX configuration on the eNB

3. Sample of RRC timers for long+shortDRX: onDurationTimer=psf10, drx-InactivityTimer=psf10, longDRX-CycleStartOffset=sf1280, shortDRX=sf640, drxShortCycleTimer=1 or per Operator Market Endorsement.

4. UE is in RRC_CONNECTED State.

Procedure:

1. Start a DL ping, from Network to UE, at an interval of 1 second and record the Round Trip Time (RTT) for at least 60 seconds.

2. Verify that the RTT is observed to be longer and variable than the RTT values recorded in a reference test when the DRX is not turned ON.

3. Stop Ping and trigger the setup of a different bearer that has different set of DRX values, Dedicated bearer with QCI for example or a different default bearer

4. Start a DL ping, from Network to UE, at an interval of 1 second and record the Round Trip Time (RTT) for at least 60 seconds.

5. Verify that the RTT is observed to be longer and variable than the RTT values recorded in a reference test when the DRX is not turned ON.

Compliance:

1. Ping starts correctly.

2. UE supports DRX functionality and Pint RTT is in accordance with configured DRX settings.

3. Ping stops and new bearer type is established successfully

4. . Ping starts correctly

5. UE supports DRX functionality and Pint RTT is in accordance with configured DRX settings

10.2 Activation and Deactivation of TTI bundling

Reference:

- **3GPP TS 36.213 section 5.4.2.1 and 36.331 sections 5.4, 5.5**

Purpose:

This test checks that a UE can turn on TTI Bundling feature when requested by the network.

Initial Condition:

1. cell supports TTI bundling feature and has configured the proper thresholds to trigger bundling such as SNIR or RSPR thresholds

2. UE is supporting and capable of activating TTI bundling

Procedure:

1. Attach to the cell that support and configured for TTI bundling.

2. Trigger UL/DL traffic. The type of traffic profile or QCI to trigger bundling depends on eNodeB implementation.

3. Triggering TTI bundling, if SINR or RSRP is used for triggering then allow the UE to fall below certain RSRP or SNIR threshold for the eNB to enable TTI bundling

4. Continue the UL/DL traffic and allow the UE to rise above the SNIR threshold for the eNB to disable the UE use of TTI Bundling

5. Allow the RSPR or SINR threshold to go above the TTI bundling to allow for eNodeB to disable bundling

Compliance:

1. Verify UE's support for TTI bundling in featureGroupIndicators, bit 3, in the IE UE-EUTRA-Capability

2. Verify that UL traffic is ongoing which the eNodeB will use to monitor for triggering TTI bundling

3. When reaching the configured threshold, verify that the eNB sends an RRC Reconfiguration message to enable TTI bundling and the UE acknowledges with a RRC Reconfiguration complete message

4. verify that the UL traffic is continuing without interruption while using TTI bundling

5. When reaching the configured threshold to disable TTI bundling, verify that the eNB sends an RRC Reconfiguration message to disable TTI bundling and the UE acknowledges with a RRC Reconfiguration complete message

10.3 UE Switch to TTI Bundling followed by Inter-Frequency Handover

- **Reference: 3GPP TS 36.213 section 5.4.2.1 and 36.331 sections 5.4, 5.5**

Purpose:

This test checks that a UE can turn on TTI bundling and bundling is could also be enabled after performing inter-frequency handover

Initial Condition:

1. Two neighboring celconfigured to be on the same band but with different EARFCN

2. The two cells support TTI bundling feature and have configured the proper thresholds to trigger bundling such as SNIR or RSPR thresholds

3. UE is supporting and capable of activating TTI bundling

Procedure:

1. Attach to the serving and keep the target cell off

2. Trigger UL/DL traffic. The type of traffic profile or QCI to trigger bundling depends on eNodeB implementation.

3. Triggering TTI bundling, if SINR or RSRP is used for triggering then allow the UE to fall below certain RSRP or SNIR threshold for the eNB to enable TTI bundling

4. Turn on the target cell and attenuate the serving or target cells to trigger handover

5. In the target cell, if bundling has not been already enabled, allow the RSPR or SINR threshold to go below the TTI bundling to allow for eNodeB to enable TTI bundling

Compliance:

1. Verify UE's support for TTI bundling in featureGroupIndicators, bit 3, in the IE UE-EUTRA-Capability

2. Verify that UL traffic is ongoing which the eNodeB will use to monitor for triggering TTI bundling

3. When reaching the configured threshold, verify that the eNB sends an RRC Reconfiguration message to enable TTI bundling and the UE acknowledges with a RRC Reconfiguration complete message

4. While UL traffic is continuing, the UE is successfully performed handover to the target cell

5. When reaching the configured threshold to enable TTI bundling, verify that the eNB sends an RRC Reconfiguration message to enable TTI bundling and the UE acknowledges with an RRC Reconfiguration complete message

10.4 UE Switch to Frequency Hopping Mode

This test verifies that a UE can operate in PUSCH Frequency Hopping.

Reference:

- 3GPP TS 36.211: 5.3.4
- 3GPP TS 36.212: 5.3.3.1.1
- 3GPP TS 36.213: 8.4

Purpose:

This test verifies that a UE can operate in PUSCH Frequency Hopping.

Initial Condition:

1. Configure the network to have an active eNB that supports PUSCH Frequency Hopping.
2. Configure UE to support PUSCH Frequency Hopping.

Procedure:

1. Connect UE to network.
2. Verify the UE attaches to the network.
3. Verify the network specifies PUSCH details of hopping pattern via SIB2 and DCI 0.
4. Verify the UE performs PUSCH frequency hopping by verifying the single bit Frequency Hopping (FH) field in a corresponding PDCCH/EPDCCH with DCI format 0 is set to 1 and the uplink resource block assignment is type 0.

Compliance:

1. Verify the UE operates in PUSCH Frequency Hopping.

10.5 Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 DL MIMO

This test verifies UE can send Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 MIMO.

Note: Only default IPv6 bearer is required for this test case.

Reference:

- 3GPP TS 36.211
- 3GPP TS 36.300
- TS36.101: 9.5
- 3GPP TS 36.212: 5.2.2.6
- 3GPP TS 36.213: 7
- 3GPP TS 36.331: 6.3.2

Purpose:

This test verifies UE can send Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 MIMO.

Initial Condition:

1. Configure the network to have an active eNB that supports 4x2 MIMO.
2. Configure UE to support 4x2 MIMO.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. The UE attaches to the network.
4. Perform UDP DL data transfer on default bearer IPv6 in good RF conditions.
5. Verify network sends DL_CCCH RRCConnectionSetup message with CQI-ReportConfig having

   CQI-ReportModeAperiodic and CQI-ReportPeriodic Setup / ri-ConfigIndex configured.

6. Verify UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 2.
7. Attenuate DL signal to one UE antenna (Rx1) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 1.
8. Increase DL signal to one UE antenna (Rx1) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 2.

Compliance:

1. Verify the UE attaches to the network with 4x2 MIMO in use.

2. Verify UE can send different Rank Index values in PUSCH CSF or PUCCH CSF message for 4x2 MIMO.

10.6 Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 DL MIMO

This test verifies UE can send Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 MIMO.

Note: Only default IPv6 bearer is required for this test case.

Reference:

- 3GPP TS 36.211
- 3GPP TS 36.300
- TS36.101: 9.5
- 3GPP TS 36.212: 5.2.2.6
- 3GPP TS 36.213: 7
- 3GPP TS 36.331: 6.3.2

Purpose:

This test verifies UE can send Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 MIMO.

Initial Condition:

1. Configure the network to have an active eNB that supports 4x4 MIMO.
2. Configure UE to support 4x4 MIMO.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. The UE attaches to the network.
4. Perform UDP DL data transfer on default bearer IPv6 in good RF conditions.
5. Verify network sends DL_CCCH RRCConnectionSetup message with CQI-ReportConfig having

   CQI-ReportModeAperiodic and CQI-ReportPeriodic Setup / ri-ConfigIndex configured.

6. Verify UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 4.

7. Attenuate DL signal to one UE antenna (Rx1) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 3.
8. Attenuate DL signal to one UE antenna (Rx2) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 2.
9. Attenuate DL signal to one UE antenna (Rx3) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 1.
10. Increase DL signal to one UE antenna (Rx1) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 2.
11. Increase DL signal to one UE antenna (Rx2) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 3.
12. Increase DL signal to one UE antenna (Rx3) until UE sends PUSCH CSF or PUCCH CSF message with Rank Index = 4.

Compliance:

13. Verify the UE attaches to the network with 4x4 MIMO in use.
14. Verify UE can send different Rank Index values in PUSCH CSF or PUCCH CSF message for 4x4 MIMO.

Section 11 TDD Specific Test Cases

11.1 Simultaneous UL and DL Data throughput with Default IPV4 Bearer

Purpose:

To measure the UE peak simultaneous UL and DL UDP throughput in close loop MIMO mode with Ipv4 bearer using applicable TDD Frame Configuration and Special Subframe Configuration(s) per market endorsement of target operator.

This test case must be executed for all TDD Frame Configuration and Special Subframe Configuration combinations listed in the market endorsement of target operator.

Reference:

- 3GPP TS 36.331

Initial Condition:

1. UE is successfully attached to eNB and assigned closed loop MIMO PDSCH Tx Mode (TM=4).
2. UE obtains valid Ipv4 address over default bearer.
3. The default bearer should be used for the data throughput testing.
4. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator.

Procedure:

1. Perform a UDP UL transfer over the data bearer on which the Ipv4 address was assigned.
    a. Record the maximum throughput achieved in UDP UL for Frame Configuration and Special Subframe Configuration.
2. Perform a UDP DL transfer over the data bearer on which the Ipv4 address was assigned.
    a. Record the maximum throughput achieved in UDP DL for Frame Configuration and Special Subframe Configuration.

Compliance:

1. The UE must achieve minimum threshold for Ipv4 throughput as per market endorsement of target operator.

11.2 Simultaneous UL and DL Data throughput with Default IPV6 Bearer

Purpose:

To measure the UE peak simultaneous UL and DL UDP throughput in close loop MIMO mode with IPV6 bearer using applicable TDD Frame Configuration and Special Subframe Configuration(s) per market endorsement of target operator.

This test case must be executed for all TDD Frame Configuration and Special Subframe Configuration combinations listed in the market endorsement of target operator.

Reference:

- 3GPP TS 36.331

Initial Condition:

1. UE is successfully attached to eNB and assigned closed loop MIMO PDSCH Tx Mode (TM=4).
2. UE obtains valid Ipv6 address over default bearer.
3. The default bearer should be used for the data throughput testing.
4. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator.

Procedure:

1. Perform a UDP UL transfer over the data bearer on which the Ipv6 address was assigned.
    a. Record the maximum throughput achieved in UDP UL for Frame Configuration and Special Subframe Configuration.
2. Perform a UDP DL transfer over the data bearer on which the Ipv6 address was assigned.
    a. Record the maximum throughput achieved in UDP DL for Frame Configuration and Special Subframe Configuration.

Compliance:

1. The UE must achieve minimum threshold for Ipv6 throughput as per market endorsement of target operator.

11.3 E-UTRA Handover, Default IPV4 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv4 Bearer is Used)

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs Intra Frequency handovers correctly without losing services and successfully changes frame configuration from (1:3) to (2:3) using Ipv4 Bearers.

Initial Condition:

- There must be a sufficient number of E-UTRA cells available on the same PLMN and same frequency. Required Ipv4 packet bearers to be tested should be active, and available in all parts of the test route.
- There must be one cell configured with Frame Config #1 and Special Subframe Config #3
- The must be another cell configured with Config#2 and Special Subframe Config #3
- This scenario is designed to test inter eNB Handovers – X2 Based

Procedure:

Move between the coverage areas of different cells on a test route. The test route(s) should contain the scenarios listed in the table above. Ensure that the UE performs reselections/handovers as expected. During the test drive it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Repeat the Handover Scenario from Serving Cell -> Target Cell -> Serving Cell.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g. FTP Download).

Compliance:

The UE should successfully change TDD Frame configuration as Inter-eNB handovers are performed correctly without loss of data.

The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers. The UE should successfully resume the FTP downloads after the handovers.

11.4 E-UTRA Handover, Default IPV6 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv6 Bearer is Used)

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs handovers correctly without losing services and successfully changes frame configuration from (1:3) to (2:3) using Ipv6 Bearers.

Initial Condition:

There must be a sufficient number of E-UTRA cells available on the same PLMN and same frequency. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test route.

There must be one cell configured with Frame Config #1 and Special Subframe Config #3.

The must be another cell configured with Config#2 and Special Subframe Config #3.

This scenario is designed to test inter eNB Handovers – X2 Based.

Procedure:

Move between the coverage areas of different cells on a test route. The test route(s) should contain the scenarios listed in the table above. Ensure that the UE performs reselections/handovers as expected. During the test drive it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Repeat the Handover Scenario from Serving Cell -> Target Cell -> Serving Cell.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g., FTP).

Compliance:

The UE should successfully change TDD Frame configuration as Inter-eNB handovers are performed correctly without loss of data.

The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers. The UE should successfully resume the FTP downloads after the handovers.

11.5 E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based Between Frame Config (1:4) and Frame Config (2:4) (Ipv4 Bearer is Used)

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs Inter-Frequency handovers correctly without losing services and successfully changes frame configuration from (1:4) to (2:4) using Ipv4 Bearers.

Initial Condition:

There must be a sufficient number of E-UTRA cells available on the same PLMN and different frequencies. Required Ipv4 packet bearers to be tested should be active, and available in all parts of the test route.

There must be one cell configured with Frame Config #1 and Special Subframe Config #4.

The must be another cell configured with Config#2 and Special Subframe Config #4.

This scenario is designed to test inter eNB Handovers – S1 Based (There is no S2 link between the two eNBs).

Procedure:

Move between the coverage areas of different cells on a test route. The test route(s) should contain the scenarios listed in the table above. Ensure that the UE performs reselections/handovers as expected. During the test drive it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Repeat the Handover Scenario from Serving Cell -> Target Cell -> Serving Cell.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g., FTP).

Compliance:

The UE should successfully change TDD Frame configuration as Inter-eNB handovers are performed correctly without loss of data.

The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers. The UE should successfully resume the FTP downloads after the handovers.

11.6 E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based between Frame Config (1:9) and Frame Config (2:9) (Ipv6 Bearer is Used)

The UE should perform handovers as requested by the network, and behave as expected from the user perspective without losing services.

Reference:

- 3GPP TS36.300
- 3GPP TS 36.331
- 3GPP TS 36.423
- 3GPP TS 36.413
- 3GPP 23.401

Purpose:

To ensure that the UE performs Inter-Frequency handovers correctly without losing services and successfully changes frame configuration from (1:9) to (2:9) using Ipv6 Bearers.

Initial Condition:

There must be a sufficient number of E-UTRA cells available on the same PLMN and different frequencies. Required Ipv6 packet bearers to be tested should be active, and available in all parts of the test route.

There must be one cell configured with Frame Config #1 and Special Subframe Config #9.

The must be another cell configured with Config#2 and Special Subframe Config #9.

This scenario is designed to test inter eNB Handovers – S1 Based (There is no S2 link between the two eNBs).

Procedure:

Move between the coverage areas of different cells on a test route. The test route(s) should contain the scenarios listed in the table above. Ensure that the UE performs reselections/handovers as expected. During the test drive it is imperative the UE remains in service at all times, that the packet bearer in question is maintained throughout the test route and that the FTP download is resumed correctly.

Repeat the Handover Scenario from Serving Cell -> Target Cell -> Serving Cell.

Scenario A:

Only default bearer is required for the scenario A and only a basic test case (e.g., FTP).

Compliance:

The UE should successfully change TDD Frame configuration as Inter-eNB handovers are performed correctly without loss of data.

The UE should perform handovers correctly, without losing service, and its PDN connectivity should remain viable before and after the handovers. The UE should successfully resume the FTP downloads after the handovers.

12.1 HPUE Uses Power Class 2 when attached in PCell that is configured for Power Class 2

Purpose:

HPUE supporting power class 2 can successfully attach to a cell that is configured for power class 2 and also for carrier aggregation. During the attach procedure, the HPUE will be configured for power class 2 and also carrier aggregation.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.304
- 3GPP TS 36.331

Initial Condition:

1. EnodeB uses an LTE band that supports and configured for power classes 2
2. Enodeb is configured for 2DL CA and 3DL CA intra-band inter-frequency carrier aggregation where the LTE band supports power class 2
3. The primary and secondary carriers must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7.
4. One cell available to be configured as SCC for 2CC DL CA.

Procedure:

1. Trigger attach from the UE and check the broadcasted SIB1 from the serving to cell and p-max value
2. Check the UE capability to ensure support for intra-band inter-frequency
3. Ensure UE is configured for carrier aggregation with available carrier
4. Initiate full buffer DL UDP traffic to trigger activation of DL carrier aggregation.
5. Stop the DL traffic and configure the eNodeb or unlock the additional carrier to support 3CC DL CA configuration
6. Trigger attach from the UE and check the broadcasted SIB1 from the serving to cell and p-max value
7. Ensure UE is configured by the eNodeb for 3CC DL carrier aggregation with available carriers
8. Initiate full buffer DL UDP traffic to trigger activation of DL carrier aggregation

Compliance:

1. UE successfully attaches and the p-max is set for 26 db for class 2

2. HP UE is successfully configured and activated for 2CC and then 3CC while it is in power class 2

12.2 HP UE Transmit power per Broadcasted P-Max value in SIB1

Purpose:

HPUE can is transmitting at correct power level and according to the P-max value transmitted in SIB1 of the serving cell.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.331

Initial Condition:

1. EnodeB uses an LTE band that supports both power classes 2 and 3
2. Enodeb is configured for Power Class 2 for the initial configuration
3. HPUE is successfully attached to the serving cell supporting the required power class for the test
4. RF conditions at the serving cell is similar to a cell edge for HPUE where UE measures RSRP close to -129 dBm
5. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7.

Procedure:

1. Perform an UL transfer over the data bearer for about one minute
2. Record the average UL transmitted power during UL transmission
3. Change the serving cell to switch broadcasting from Power Class 2 to Power Class 3
4. Change the RF conditions in the serving so to have RSRP close to -115 dBm
5. Perform an UL transfer over the data bearer for about one minute
6. Record the average UL transmitted power during UL transmission

Compliance:

1. When cell was set to power class 2, the HPUE transmitted an average power of more than 23 dBm and up to 26 dBm
2. When cell was set to power class 3, the HPUE transmitted an average power less or close to 23 dBm

12.3 HPUE Cell Reselection from TDD to FDD using SIB5 to determine the Power Class of target neighbor cell

Purpose:

UE camped on TDD band using power class 2 and reselects to FDD band. Verify that the neighbor cell config in SIB5 determines the Power class of neighbor cell during cell reselection by adjusting the P-max/Qrxlevmin.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.133
- 3GPP TS 36.304
- 3GPP TS 36.331

Initial Condition:

1. TDD Serving cell is configured for Power Class 2
2. FDD neighboring cell is configured for Power Class 3 (default LTE power class)
3. TDD cell has the FDD cell configured as idle mode inter-frequency neighbor cell. Similarly, the FDD has the TDD cell configured as a reselection neighbor.
4. The FDD cell is completely attenuated
5. HPUE is successfully attached to the serving cell supporting the required power class for the test and can read SIB5 that lists the FDD cell as a neighbor cell
6. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7
7. If provided, the absolute priorities of different E-UTRAN frequencies Both serving and target neighbor cells have equal priority

Procedure:

1. Ensure that the UE is camped and in RRC Idle state in the TDD power class cell
2. Check and record SIB5 listed frequency carrier in SIB5 for the FDD neighbor cell info that includes q-RxLevMin and if available, p-Max of the target cell.
3. Change the RF conditions in the serving and neighboring cells so to trigger the UE to meet the inter-frequency reselection criteria
4. Check the newly selected FDD cell from the UE side for SIB1 and SIB5
5. Check and record SIB5 listed frequency carrier in SIB5 for the TDD neighbor cell info that includes q-RxLevMin and if available, p-Max of the target cell.
6. While the UE is in RRC Idle State Trigger reselection from the FDD to the TDD cell

Compliance:

1. When the UE was in the TDD cell it used SIB1, SIB3 and SIB5 info and thresholds to triggered reselection to the FDD when the RF threshold were met

2. When the UE was in the FDD cell it used SIB1, SIB3 and SIB5 info and thresholds to triggered reselection to the TDD when the RF threshold were met

12.4 HPUE Power Head Room Reported Based on Cell Power Class During Handover

Purpose:

This test to verify that If the UE on TDD band using Power Class 2 cell and handovers to FDD band using Power Class 3, that the Power Head Room (PHR) report based on Power Class 2 or Power Class 3 after performing handover.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.133
- 3GPP TS 36.331

Initial Condition:

1. TDD Serving cell is configured for Power Class 2
2. FDD neighboring cell is configured for Power Class 3 (default LTE power class)
3. TDD cell has the FDD cell configured as Connected Mode inter-frequency neighboring cell. Similarly, the FDD cell has the TDD cell configured as a handover neighbor.
4. The FDD Cell is completely attenuated.
5. HPUE is successfully attached to the TDD serving cell
6. The TDD serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7.
7. If provided, the absolute priorities of different E-UTRAN frequencies of both serving and target neighbor cells have equal priority
8. p0-NominalPUSCH values are the same at the serving and target cells
9. q-RxLevMin values are the same at both the serving and target cells
10. PHR report can be monitored from the device or the eNodeb

Procedure:

1. Start UDP UL traffic in the TDD serving cell
2. Maintain the RF threshold to be at -80 dBm and record the PHR reported from the device to the TDD cell
3. Change the RF conditions in the serving and neighboring cells to trigger inter-frequency handover to the FDD cell
4. After the UE has successfully handed over to the FDD cell maintain the UE at RSRP level of -80 dBm and UL traffic and record the average PHR reported from the device to the FDD cell
5. Trigger handover back from the FDD cell to the TDD cell and maintain the UE at -80 dBm and at the same traffic rate
6. Record the average PHR reported from the device to the TDD cell

Compliance:

1. When the UE was in the TDD cell it used p0-NominalPUSCH and the Power Class 2 to calculate the PHR
2. When the UE was in the FDD cell it used p0-NominalPUSCH and the Power Class 2 to calculate the PHR
3. Average PHR reported while the UE was in the TDD Power Class 2 cell is higher than the average PHR when the UE was in the FDD cell

12.5 HPUE UL Throughput Gain Comparison between Power Class 2 and Class 3 at Cell Edge

Purpose:

To measure the HP UE UL UDP throughput in TDD cell when the UE and the Cell are configured for Power Class 2 then at the same RF conditions.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.331

Initial Condition:

1. EnodeB uses an LTE band that supports both power classes 2 and 3
2. Enodeb is configured for Power Class 2 for the initial configuration
3. HPUE is successfully attached to the serving cell supporting the required power class for the test
4. RF conditions at the serving cell is similar to a cell edge where UE measures RSRP close to -115 dBm
5. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7.

Procedure:

1. Perform a FTP UL transfer over the data bearer for about one minute
2. Record the average throughput achieved in UL direction
3. Change the serving Cell to switch broadcasting from Power Class 2 to Power Class 3
4. Perform a FTP UL transfer over the data bearer for about one minute
5. Record the average throughput achieved in UDP UL

Compliance:

1. FTP UDP transfer when the HPUE was using Class 2 is higher than when using Class 3

12.6 HPUE Attach at Cell Edge Comparison between Power Class 2 then Class 3

Purpose:

HPUE using power class 2 can successfully attach at the cell edge where RSRP level is lower comparing when UE is using power Class 3, due to HPUE ability to transmit UL higher power and thus deeper coverage.

Reference:

- 3GPP TS 36.101
- 3GPP TS 36.331

Initial Condition:

1. Uses an LTE band that supports both power classes 2 and 3
2. Enodeb is configured for Power Class 2 for the initial configuration
3. RF conditions at the serving cell is similar to an HPUE cell edge where UE measures RSRP close to -129 dBm
4. The serving cell must be configured with Frame Configuration and Special Subframe Configuration per market endorsement of target operator, otherwise use 20 MHZ bandwidth and FC/SSC of 1/7.
5. No other cell is available to the UE under test except for the configured cell above.

Procedure:

1. Trigger attach from the UE and check the measured RSRP of the serving cell to be around -129 dBm
2. Trigger Ping from the UE side
3. Observe the UL UE transmit power
4. Change the serving Cell to switch broadcasting from Power 2 to Power Class 3
5. Restart the UE to trigger attach when the serving cell is still around -129 dBm
6. Observe UE attempt to attach in the previously serving cell

Compliance:

1. UE successfully attaches when it is using Power Class 2
2. UE UL Transmit power is close to 26 dBm
3. UE fails to attach when the serving cell is switched to broadcast Power Class 3

Section 13 Minimization of Drive Test

13.1 UE Configured to Report A2 Event based MDT – Logged MDT (UE Idle State)

This test verifies that a UE can be provisioned and report A2 Event based MDT (Minimization of Drive Test) – Logged MDT (UE Idle State).

Reference:

- 3GPP TS 37.320

Purpose:

This test verifies that a UE can be provisioned and report A2 Event based MDT (Minimization of Drive Test) – Logged MDT (UE Idle State).

Initial Condition:

1. Configure the network to have an active eNB that supports Logged MDT.
2. Configure UE to support Logged MDT.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. Verify the UE attaches to the network.
4. Verify the UE is configured for Logged MDT measurements by verifying the Logged MDT measurements availability indicator in ueCapabilityInformation message (loggedMeasurementsIdle). This indicates that the UE supports logging of downlink pilot strength measurements.
5. Verify the network initiates the MDT procedure to UE by sending LoggedMeasurementConfiguration message, which is used to transfer configuration parameters for Logged MDT.
6. Note: For configuration of the triggering of logging events, only periodic measurement trigger is supported, for which the logging interval is configurable. The parameter specifies the periodicity for storing MDT measurement results
7. Verify the UE is configured to perform Logged MDT downlink pilot strength measurements by verifying the Logged MDT measurements availability indicator in RRCConnectionSetupComplete message during connection establishment.
8. Adjust attenuation so that eNB signal is lower than A2 event setting.
9. Verify UE MDT logs before and after A2 event.

Compliance:

1. Verify the UE supports Logged MDT.
2. Verify the UE MDT logs before and after an A2 event.

13.2 UE Configured to Report Location based MDT – Logged MDT (UE Idle State)

This test verifies that a UE can be provisioned and report Location based MDT – Logged MDT (UE Idle State).

Reference:

- 3GPP TS 37.320

Purpose:

This test verifies that a UE can be provisioned and report Location based MDT – Logged MDT (UE Idle State).

Initial Condition:

1. Configure the network to have an active eNB that supports Logged MDT and location based reporting.
2. Configure UE to support Logged MDT and stand-alone GNSS positioning.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. Verify the UE attaches to the network.
4. Verify the UE is configured for Logged MDT measurements by verifying the Logged MDT measurements availability indicator in ueCapabilityInformation message (loggedMeasurementsIdle). This indicates that the UE supports logging of downlink pilot strength measurements.
5. Verify the UE is configured for Location Based MDT information by verifying the stand-alone GNSS positioning availability indicator in ueCapabilityInformation message (standaloneGNSS-Location).
6. Verify the network initiates the MDT procedure to UE by sending LoggedMeasurementConfiguration message, which is used to transfer configuration parameters for Logged MDT.
7. Note: For configuration of the triggering of logging events, only periodic measurement trigger is supported, for which the logging interval is configurable. The parameter specifies the periodicity for storing MDT measurement results
8. Verify the UE is configured to perform Logged MDT downlink pilot strength measurements by verifying the Logged MDT measurements availability indicator in RRCConnectionSetupComplete message during connection establishment.
9. Verify UE MDT logs contain location information.

Compliance:

1. Verify the UE supports Logged MDT and stand-alone GNSS positioning.
2. Verify the UE MDT logs contain location information.

13.3 UE Configured to Report of MDT after Handover – Logged MDT (UE Idle State)

This test verifies that a UE can be provisioned and report Logged MDT (UE Idle State) after a handover.

Reference:

- 3GPP TS 37.320

Purpose:

This test verifies that a UE can be provisioned and report Logged MDT (UE Idle State) after a handover.

Initial Condition:

1. Configure the network to have two active eNBs (Cell A and Cell B) that support Logged MDT.
2. Configure UE to support Logged MDT.
3. UE is powered off.

Procedure:

1. Connect UE to network where Cell A has stronger signal than Cell B
2. Power on the UE.
3. Verify the UE attaches to Cell A.
4. Verify the UE is configured for Logged MDT measurements by verifying the Logged MDT measurements availability indicator in ueCapabilityInformation message (loggedMeasurementsIdle). This indicates that the UE supports logging of downlink pilot strength measurements.
5. Verify the network initiates the MDT procedure to UE by sending LoggedMeasurementConfiguration message, which is used to transfer configuration parameters for Logged MDT.
6. Note: For configuration of the triggering of logging events, only periodic measurement trigger is supported, for which the logging interval is configurable. The parameter specifies the periodicity for storing MDT measurement results
7. Verify the UE is configured to perform Logged MDT downlink pilot strength measurements by verifying the Logged MDT measurements availability indicator in RRCConnectionSetupComplete message during connection establishment.
8. Increase attenuation of active cell A and decrease attenuation of the neighbor cell B till UE does handover to neighbor cell B.
9. Verify UE MDT logs before and after handover.

Compliance:

1. Verify the UE supports Logged MDT.
2. Verify the UE MDT logs before and after handover.

13.4 UE Configured to Report of MDT after RRC Connection Re-Establishment

This test verifies that a UE can be provisioned and report Logged MDT (UE Idle State) after RRC Connection Re-Establishment.

Reference:

- 3GPP TS 37.320

Purpose:

This test verifies that a UE can be provisioned and report Logged MDT (UE Idle State) after RRC Connection Re-Establishment.

Initial Condition:

1. Configure the network to have an active eNB that supports Logged MDT.
2. Configure UE to support Logged MDT.
3. UE is powered off.

Procedure:

1. Connect UE to network.
2. Power on the UE.
3. Verify the UE attaches to the network.
4. Verify the UE is configured for Logged MDT measurements by verifying the Logged MDT measurements availability indicator in ueCapabilityInformation message (loggedMeasurementsIdle). This indicates that the UE supports logging of downlink pilot strength measurements.
5. Verify the network initiates the MDT procedure to UE by sending LoggedMeasurementConfiguration message, which is used to transfer configuration parameters for Logged MDT.
6. Note: For configuration of the triggering of logging events, only periodic measurement trigger is supported, for which the logging interval is configurable. The parameter specifies the periodicity for storing MDT measurement results
7. Verify the UE is configured to perform Logged MDT downlink pilot strength measurements by verifying the Logged MDT measurements availability indicator in RRCConnectionSetupComplete message during connection establishment.
8. Adjust attenuation so that eNB signal is lost.
9. Adjust attenuation so that eNB signal is strong.
10. Verify UE sends RRCConnectionReestablishmentComplete message.
11. Verify UE goes to Idle State.
12. Verify UE MDT logs before eNB signal loss and after eNB signal reconnection.

Compliance:

1. Verify the UE supports Logged MDT.
2. Verify UE MDT logs before eNB signal loss and after eNB signal reconnection.

Section 14 Commercial Mobile Alert Service

14.1 CMAS Message Reception with SIB12 Reading in Idle Mode. of Messages of Different Priority presidential, Extreme, and Severe and Child Abduction

Purpose:

CMAS (Commercial Mobile Alert Service) is a public warning system to notify of military threats, kidnapping or disasters. CMAS warning notifications are composed of multiple short messages. This test ensures the UE is capable of receiving and displaying messages of varying priority.

Reference

Initial Condition:

1. Enable SIB12 and periodicity in eNodeB
2. Prepare CMAS messages each with the priority of Presidential, Extreme, Severe and Child Abduction to be sent to the UE

Procedure:

1. Attach the UE to the eNodeB
2. Send a Presidential priority CMAS message alert to the UE
3. Send an Extreme priority CMAS message alert to the UE
4. Send a Severe priority CMAS message alert to the UE
5. Send a Child Abduction CMAS message alert to the UE

Compliance:

1. Verify SIB12 is enabled in SIB1
2. In all cases verify:
    a. The UE is paged with cmas-Indication-r9 true
    b. SIB12 is broadcast to the UE with the CMAS message
    c. The UE displays the expected alert message to the user

14.2 CMAS Message Reception in RRC Connected Mode

Purpose:

CMAS (Commercial Mobile Alert Service) is a public warning system to notify of military threats, kidnapping or disasters. CMAS warning notifications are composed of multiple short messages. This test ensures the UE is capable of receiving a CMAS message while in RRC Connected Mode.

Reference

Initial Condition:

1. Enable SIB12 and periodicity in eNodeB
2. Prepare a CMAS message with the priority of your choosing

Procedure:

1. Attach the UE to the eNodeB
2. Begin a file transfer in order to keep the UE in RRC Connected mode
3. Send a CMAS message alert to the UE

Compliance:

1. Verify SIB12 is enabled in SIB1
2. Verify the UE is paged with cmas-Indication-r9 true
3. Verify SIB12 is broadcast to the UE with the CMAS message
4. The UE displays the expected alert message to the user
5. The file transfer continues

14.3 CMAS Notifications Replacement of Current Notification with New Notifications

Purpose:

CMAS (Commercial Mobile Alert Service) is a public warning system to notify of military threats, kidnapping or disasters. CMAS warning notifications are composed of multiple short messages. This test ensures the UE is capable of receiving a CMAS message while in RRC Connected Mode.

This test ensures that if a CMAS notification is received by a UE and a updated notification is sent to the user, the existing notification will be displayed to the user in place of the original.

Reference

Initial Condition:

1. Enable SIB12 and periodicity in eNodeB
2. Prepare a CMAS message with the priority of your choosing

Procedure:

1. Attach the UE to the eNodeB
2. Begin a file transfer in order to keep the UE in RRC Connected mode
3. Send a CMAS message alert to the UE
4. Send a different CMAS message alert to the UE

Compliance:

1. Verify SIB12 is enabled in SIB1
2. Verify the UE is paged with cmas-Indication-r9 true
3. Verify SIB12 is broadcast to the UE with the CMAS message
4. The UE displays the expected alert message to the user
5. The UE displays the second alert message to the user

15.1 Level 2 Test Cases

TABLE 15.1-1 LEVEL 2 TEST CASES (FOR VERSION 2.1 TEST PLAN ONLY, VERSION 3.0 TBD)

Test ID	Test Title	Primary Band	Secondary Band	Tertiary Band
2	**Basic LTE Attach**			
2.1	Cell Acquisition (PSS/SSS/MIB Decode)	X	X	X
2.2	SIB Decoding	X	X	X
2.3	UE RACH Procedure	X	X	X
2.4	Initial RRC Connection Setup and Reconfiguration	X	X	X
2.5.1	Attach procedure (with S security) and default bearer setup procedure - Test 1	X	X	X
2.5.2	Attach procedure (with S security) and default bearer setup procedure - Test 2	X	X	X
2.6.1	AS Security - Test 1	X	X	X
2.6.2	AS Security - Test 2	X		
2.6.3	AS Security - Test 3	X		
2.6.4	AS Security - Test 4	X		
2.6.5	AS Security - Test 5	X		
2.6.6	AS Security - Test 6	X		
2.7	UE attach to MFBI Mapped Band	X	X	X
2.8	UE in Idle Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.9	UE in Connected Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.10	UE Attach in a Cell configured with 4x2 DL MIMO	X		X
2.11	UE Attach in a Cell configured with 4x4 DL MIMO	X		X
2.12	UE Attach in a Cell Configured with MBSFN	X	X	X

3	Network Access Test Cases			
3.1	Attach Reject, Cause #7 "EPS Services Not Allowed"	X		
3.2	Attach Reject, Cause #14 "EPS Services Not Allowed in this PLMN" - Multiple PLMN Environment	X		
3.3	Attach Reject, Cause #11 "PLMN Not Allowed"	X		
3.4	Attach Reject, Cause #3 "Illegal UE"	X		
3.5	Attach Reject – Cause Code #15 (No Suitable Cells in Tracking Area)	X		
3.6	Attach Reject – Cause Code #6 (Illegal ME)	X		
3.7	Attach Reject – Cause Code # 12 (Tracking Area Not Allowed)	X		
3.8	Tracking Area Update Reject, Cause Code #3 (Illegal UE)	X		
3.9	Detach - With Power-off	X	X	X
3.10	Detach - Without Powering-off	X	X	X
3.11	Successful Normal Tracking Area Update without ISR activation	X	X	X
3.12	Periodic Tracking Area Update; Successful	X		
3.13	Network Selection - Manual Mode – Network on Forbidden List	X		
3.14	Network Selection - Manual Mode – Empty Preferred PLMN List	X		
3.15	Network Selection -– Manual Mode – More than 32 Entries on Preferred PLMN List	X		
3.16	Network Selection – Selection Mode Following Switch off – Manual Network Selection	X		
3.17	Network Selection – Selection Mode Following Switch off – Automatic Network Selection	X		

4	Intra-LTE Mobility (Intra-Freq)			
4.1	Idle Mode E-UTRA Intra-Frequency Reselection	X	X	X
4.2	Intra frequency RSRQ cell reselection	X	X	X
4.3	E-UTRA Handover, Default Ipv4 Bearer – Intra eNodeB Handover	X	X	X
4.4	E-UTRA Handover, Default Ipv4 Bearer – X2 Based	X		
4.5	E-UTRA Handover, Default Ipv4 Bearer – S1 Based	X	X	X
4.6	E-UTRA Handover, Default Ipv4 Bearer – Inter-MME	X		
4.7	E-UTRA Handover, Default Ipv6 Bearer – Intra eNodeB Handover	X	X	X
4.8	E-UTRA Handover, Default Ipv6 Bearer – X2 Based	X		
4.9	E-UTRA Handover, Default Ipv6 Bearer – S1 Based	X		
4.10	E-UTRA Handover, Default Ipv6 Bearer – Inter-MME	X		
4.11	E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – X2 Based	X		
4.12	E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – S1 Based	X		
4.13	Intra-frequency Handover with Multiple PDNs	X	X	X
4.14	Intra-frequency Automatic Neighbor Relations Function	X	X	X
4.15	Intra-Frequency Event Based (Network Specified) Load Balancing	X	X	X
4.16	Intra-frequency inter- eNodeB Handover when UE and Both eNodeBs Support 64 QAM	X	X	X
4.17	Intra-frequency Inter eNodeB Handover when UE and Only One eNodeB Supports 64 QAM	X	X	X
4.18	Intra-frequency X2 Handover in an MFBI Capable Cell	X	X	X
4.19	Intra-frequency Handover from SRS Disabled Cell to an SRS Enabled Cell	X	X	X

5	Intra-LTE Mobility (Inter-Freq)			
5.1	Idle Mode E-UTRA Inter-Frequency Intra-Band (Same BW) Reselection	X		
5.2	Idle Mode E-UTRA Inter-Frequency Intra-Band Inter-BW Reselection	X		
5.3	Idle Mode E-UTRA Inter-Frequency Inter-Band (Same BW) Reselection	X	X	X
5.4	Idle Mode E-UTRA Inter-Frequency Inter-Band Inter-BW Reselection	X	X	X
5.5	Idle Mode Mobility to a Different Frequency in Same LTE Band with Different Priority	X		X
5.6	Idle Mode Mobility to Different LTE Band with Different Priority	X		X
5.7	Idle Mode Load Balancing	X		X
5.8	Inter-frequency Intra Band RSRQ based Cell Reselection	X	X	X
5.9	Inter band RSRQ based cell reselection	X	X	X
5.10	E- UTRA Handover (with measurements), Inter-Frequency Intra-Band (same BW) – Default Bearer with Data Transfer	X		
5.11	E-UTRA Handover (with Measurements), Inter-Frequency Intra-Band Inter-BW – Default Bearer with Data Transfer	X		
5.12	E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band (Same BW) – Default Bearer with Data Transfer	X	X	X
5.13	E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band Inter-BW – Default Bearer with Data Transfer	X	X	X
5.14	Intra-LTE inter-eNB inter-frequency handover with Multiple PDNs	X		X
5.15	Inter-frequency Intra-LTE Automatic Neighbor Relations Function	X	X	X
5.16	RRC Connection Release with Redirect to a Different Frequency at the Same LTE Band	X		X
5.17	RRC Connection Release with redirect to a Different LTE Band	X		X
5.18	RSRQ triggered inter-frequency handover	X		X
5.19	RSRQ triggered inter-band inter-frequency handover	X		X
5.20	Inter-frequency S1 HO in a MFBI Capable Cell	X	X	X
5.21	Inter-frequency X2 Handover in a MFBI Capable Cell	X		
5.22	MFBI Cell Trigger's RRC Connection Release with Redirection	X		X
5.23	Inter eNodeB E-UTRAN Handover from 4x2 DL MIMO Cell to a 2x2 DL MIMO Cell	X		
5.24	Inter eNodeB E-UTRAN Handover from 4x4 DL MIMO Cell to a 2x2 DL MIMO Cell	X		X
5.25	Inter-Frequency Event Based (Network Specified) Load Balancing	X		X
5.26	Inter-Frequency Handover from non MBSFN cell to a cell Configured with MBSFN	X	X	X

6	**System Loss and State Transition**			
6.1	System Lost – LTE System Lost in RRC_IDLE	X	X	X
6.2	System Lost – LTE System Lost in RRC_ACTIVE	X	X	X
6.3	UE Radio Link Failure Triggers RRC Connection Re-establishment	X		X
6.4	UE Triggers RRC Connection Re-establishment to Another Cell in Same eNodeB	X		X
6.5	UE Triggers RRC Connection Re-establishment to Another Cell in a Different eNodeB	X		X
6.6	Transition – Idle to Active Transition – Service Request	X	X	X
6.7	Transition – Idle to Active Transition – Paging	X	X	X
7	**PS Data**			
7.1	Ipv4 – Without Mobility – SIMO Delay of Ping	X	X	X
7.2	Ipv4 – Without Mobility – Transmit diversity (MIMO) Delay of Ping	X	X	X
7.3	Ipv4 – Without Mobility – Open Loop Multiplexing – Delay of Ping	X	X	X
7.4	Ipv4 – Without Mobility – Close Loop Multiplexing – Delay of Ping	X		
7.5	Ipv6 – Without Mobility – SIMO Delay of Ping	X		
7.6	Ipv6 – Without Mobility – Transmit Diversity (MIMO) Delay of Ping	X		
7.7	Ipv6 – Without Mobility – Open Loop Multiplexing – Delay of Ping	X	X	X
7.8	Ipv6 – Without Mobility – Close Loop Multiplexing – Delay of Ping	X		
7.9	PDN Connectivity Request –ESM Information transfer flag=TRUE	X		
7.10	PDN Connectivity Reject, ESM Cause #27 Missing or Unknown APN	X		
7.11	PDN Disconnect Procedure – UE Initiated	X		
7.12	Detach Procedure – Network Initiated	X		
7.13	Multiple PDN Connections – Second PDN Connectivity Request (UE Initiated)	X	X	X
7.14	Multiple PDN Connections – Second PDN Connectivity Disconnect	X		
7.15	Detach Procedure – UE Initiated	X		
7.16	HTTP Browsing	X		

8	Peak Throughput Validation with Different PDSCH Transmission Mode			
8.1	DL UDP Data Transfer in SIMO with Default Ipv4 Bearer	X	X	X
8.2	DL UDP Data Transfer in Tx Diversity with Default Ipv4 Bearer	X	X	X
8.3	DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer	X		
8.4	DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer	X		
8.5	DL FTP Data Transfer in SIMO with Default Ipv4 Bearer	X		
8.6	DL FTP Data Transfer in Tx Diversity with Default Ipv4 Bearer	X		
8.7	DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer	X	X	X
8.8	DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer	X		
8.9	UL UDP Data Transfer with Default Ipv4 Bearer	X	X	X
8.10	UL FTP Data Transfer with Default Ipv4 Bearer	X	X	X
8.11	DL UDP Data Transfer in SIMO with Default Ipv6 Bearer	X		
8.12	DL UDP Data Transfer in Tx Diversity with Default Ipv6 Bearer	X		
8.13	DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer	X	X	X
8.14	DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer	X		
8.15	DL FTP Data Transfer in SIMO with Default Ipv6 Bearer	X		
8.16	DL FTP Data Transfer in Tx Diversity with Default Ipv6 Bearer	X	X	X
8.17	DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer	X	X	X
8.18	DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer	X		
8.19	UL UDP Data Transfer with Default Ipv6 Bearer	X		
8.20	UL FTP Data Transfer with Default Ipv6 Bearer	X		
8.21	DL UDP Transfer when both UE and eNodeB Support DL 256QAM	X		
8.22	UL UDP Transfer when both UE and eNodeB support UL 64QAM	X		
8.23	DL/UL UDP Transfer with DL256QAM/UL64QAM	X	X	X
8.24	DL TCP Transfer when both UE and eNodeB Support DL 256QAM	X		X
8.25	UL TCP Transfer when both UE and eNodeB support UL 64QAM	X		X
8.26	Link adaptation with different radio conditions when support DL 256QAM	X		X
8.27	Link Adaptation under Different Radio Condition when using UL 64QAM	X		X
8.28	Inter eNodeB E-UTRAN Handover DL 256QAM	X		X
8.29	Inter eNodeB E-UTRAN Handover with DL256QAM/UL64QAM	X		X
8.30	Inter eNodeB E-UTRAN Handover when UE and only one eNodeB Support DL 256QAM	X		X

8.31	DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		
8.32	DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		X
8.33	DL/UL UDP Transfer in a Cell configured with 4x4 DL MIMO	X		X
8.34	UL UDP data at the maximum UL throughput when UE Configured for SRS	X	X	X
9	**Dedicated Bearer**			
9.1	Network Initiated Dedicated Ipv4 Bearer Establishment and Data Connectivity	X	X	X
9.2	Network Initiated Dedicated Ipv6 Bearer Establishment and Data Connectivity	X	X	X
10	**DRX**			
10.1	Long and Short DRX	X	X	X
10.2	Activation and Deactivation of TTI bundling	X		X
10.3	UE Switch to TTI Bundling followed by Inter-Frequency Handover	X		X
10.4	UE Switch to Frequency Hopping Mode	X		X
10.5	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		
10.6	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		X
11	**TDD Specific Test Cases**			
11.1	Simultaneous UL and DL Data throughput with Default IPV4 Bearer	X		
11.2	Simultaneous UL and DL Data throughput with Default IPV6 Bearer	X		
11.3	E-UTRA Handover, Default IPV4 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv4 Bearer is Used)	X		
11.4	E-UTRA Handover, Default IPV6 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv6 Bearer is Used)	X		
11.5	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based Between Frame Config (1:4) and Frame Config (2:4) (Ipv4 Bearer is Used)	X		
11.6	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based between Frame Config (1:9) and Frame Config (2:9) (Ipv6 Bearer is Used)	X		
12	**High Power UE**			
12.1	HPUE Uses Power Class 2 when attached in PCell that is configured for Power Class 2			X
12.2	HP UE Transmit power per Broadcasted P-Max value in SIB1			X
12.3	HPUE Cell Reselection from TDD to FDD using SIB5 to determine the Power Class of target neighbor cell			X
12.4	HPUE Power Head Room Reported Based on Cell Power Class During Handover			X
12.5	HPUE UL Throughput Gain Comparison between Power Class 2 and Class 3 at Cell Edge			X
12.6	HPUE Attach at Cell Edge Comparison between Power Class 2 then Class 3			X

13	**Minimization of Drive Test**			
13.1	UE Configured to Report A2 Event based MDT – Logged MDT (UE Idle State)	X		X
13.2	UE Configured to Report Location based MDT – Logged MDT (UE Idle State)	X		X
13.3	UE Configured to Report of MDT after Handover – Logged MDT (UE Idle State)	X		X
13.4	UE Configured to Report of MDT after RRC Connection Re-Establishment	X		X
14	**Commercial Mobile Alert Service**			
14.1	CMAS Message Reception with SIB12 Reading in Idle Mode. of Messages of Different Priority presidential, Extreme, and Severe and Child Abduction	X	X	X
14.2	CMAS Message Reception in RRC Connected Mode	X	X	X
14.3	CMAS Notifications Replacement of Current Notification with New Notifications	X	X	X

16.1 Level 1 Test Cases

TABLE 16.1-1 LEVEL 1 TEST CASES (FOR VERSION 2.1 TEST PLAN ONLY, VERSION 3.0 TBD)

Test ID	Test Title	Primary Band	Secondary Band	Tertiary Band
2	**Basic LTE Attach**			
2.1	Cell Acquisition (PSS/SSS/MIB Decode)	X		
2.2	SIB Decoding	X		
2.3	UE RACH Procedure	X		
2.4	Initial RRC Connection Setup and Reconfiguration	X		
2.5.1	Attach procedure (with S security) and default bearer setup procedure - Test 1	X	X	X
2.5.2	Attach procedure (with S security) and default bearer setup procedure - Test 2			
2.6.1	AS Security - Test 1	X	X	X
2.6.2	AS Security - Test 2			
2.6.3	AS Security - Test 3			
2.6.4	AS Security - Test 4			
2.6.5	AS Security - Test 5			
2.6.6	AS Security - Test 6			
2.7	UE attach to MFBI Mapped Band	X	X	X
2.8	UE in Idle Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.9	UE in Connected Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.10	UE Attach in a Cell configured with 4x2 DL MIMO	X		
2.11	UE Attach in a Cell configured with 4x4 DL MIMO	X		X
2.12	UE Attach in a Cell Configured with MBSFN	X	X	X

3	Network Access Test Cases			
3.1	Attach Reject, Cause #7 "EPS Services Not Allowed"	X		
3.2	Attach Reject, Cause #14 "EPS Services Not Allowed in this PLMN" - Multiple PLMN Environment			
3.3	Attach Reject, Cause #11 "PLMN Not Allowed"	X		
3.4	Attach Reject, Cause #3 "Illegal UE"			
3.5	Attach Reject – Cause Code #15 (No Suitable Cells in Tracking Area)	X		
3.6	Attach Reject – Cause Code #6 (Illegal ME)			
3.7	Attach Reject – Cause Code # 12 (Tracking Area Not Allowed)			
3.8	Tracking Area Update Reject, Cause Code #3 (Illegal UE)			
3.9	Detach - With Power-off	X	X	X
3.10	Detach - Without Powering-off	X	X	X
3.11	Successful Normal Tracking Area Update without ISR activation	X	X	X
3.12	Periodic Tracking Area Update; Successful	X		
3.13	Network Selection - Manual Mode – Network on Forbidden List	X		
3.14	Network Selection - Manual Mode – Empty Preferred PLMN List			
3.15	Network Selection -– Manual Mode – More than 32 Entries on Preferred PLMN List			
3.16	Network Selection – Selection Mode Following Switch off – Manual Network Selection	X		
3.17	Network Selection – Selection Mode Following Switch off – Automatic Network Selection	X		

4	Intra-LTE Mobility (Intra-Freq)			
4.1	Idle Mode E-UTRA Intra-Frequency Reselection	X	X	X
4.2	Intra frequency RSRQ cell reselection	X	X	X
4.3	E-UTRA Handover, Default Ipv4 Bearer – Intra eNodeB Handover	X	X	X
4.4	E-UTRA Handover, Default Ipv4 Bearer – X2 Based	X		
4.5	E-UTRA Handover, Default Ipv4 Bearer – S1 Based	X	X	X
4.6	E-UTRA Handover, Default Ipv4 Bearer – Inter-MME			
4.7	E-UTRA Handover, Default Ipv6 Bearer – Intra eNodeB Handover	X	X	X
4.8	E-UTRA Handover, Default Ipv6 Bearer – X2 Based	X		
4.9	E-UTRA Handover, Default Ipv6 Bearer – S1 Based	X		
4.10	E-UTRA Handover, Default Ipv6 Bearer – Inter-MME			
4.11	E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – X2 Based	X		
4.12	E-UTRA Handover, Dual Ipv6/Ipv4 Bearer – S1 Based	X		
4.13	Intra-frequency Handover with Multiple PDNs	X		
4.14	Intra-frequency Automatic Neighbor Relations Function	X	X	X
4.15	Intra-Frequency Event Based (Network Specified) Load Balancing	X		X
4.16	Intra-frequency inter- eNodeB Handover when UE and Both eNodeBs Support 64 QAM	X		X
4.17	Intra-frequency Inter eNodeB Handover when UE and Only One eNodeB Supports 64 QAM	X		X
4.18	Intra-frequency X2 Handover in an MFBI Capable Cell	X	X	X
4.19	Intra-frequency Handover from SRS Disabled Cell to an SRS Enabled Cell	X	X	X

5	Intra-LTE Mobility (Inter-Freq)			
5.1	Idle Mode E-UTRA Inter-Frequency Intra-Band (Same BW) Reselection	X		
5.2	Idle Mode E-UTRA Inter-Frequency Intra-Band Inter-BW Reselection	X		
5.3	Idle Mode E-UTRA Inter-Frequency Inter-Band (Same BW) Reselection	X	X	X
5.4	Idle Mode E-UTRA Inter-Frequency Inter-Band Inter-BW Reselection	X	X	X
5.5	Idle Mode Mobility to a Different Frequency in Same LTE Band with Different Priority	X		X
5.6	Idle Mode Mobility to Different LTE Band with Different Priority	X		X
5.7	Idle Mode Load Balancing	X		X
5.8	Inter-frequency Intra Band RSRQ based Cell Reselection	X		X
5.9	Inter band RSRQ based cell reselection	X		X
5.10	E- UTRA Handover (with measurements), Inter-Frequency Intra-Band (same BW) – Default Bearer with Data Transfer	X		
5.11	E-UTRA Handover (with Measurements), Inter-Frequency Intra-Band Inter-BW – Default Bearer with Data Transfer	X		
5.12	E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band (Same BW) – Default Bearer with Data Transfer	X	X	X
5.13	E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band Inter-BW – Default Bearer with Data Transfer	X	X	X
5.14	Intra-LTE inter-eNB inter-frequency handover with Multiple PDNs	X		X
5.15	Inter-frequency Intra-LTE Automatic Neighbor Relations Function	X	X	X
5.16	RRC Connection Release with Redirect to a Different Frequency at the Same LTE Band	X		X
5.17	RRC Connection Release with redirect to a Different LTE Band	X		X
5.18	RSRQ triggered inter-frequency handover	X		X
5.19	RSRQ triggered inter-band inter-frequency handover	X		X
5.20	Inter-frequency S1 HO in a MFBI Capable Cell	X	X	X
5.21	Inter-frequency X2 Handover in a MFBI Capable Cell	X		
5.22	MFBI Cell Trigger's RRC Connection Release with Redirection	X		
5.23	Inter eNodeB E-UTRAN Handover from 4x2 DL MIMO Cell to a 2x2 DL MIMO Cell	X		
5.24	Inter eNodeB E-UTRAN Handover from 4x4 DL MIMO Cell to a 2x2 DL MIMO Cell	X		
5.25	Inter-Frequency Event Based (Network Specified) Load Balancing	X		X
5.26	Inter-Frequency Handover from non MBSFN cell to a cell Configured with MBSFN	X		X

6	**System Loss and State Transition**			
6.1	System Lost – LTE System Lost in RRC_IDLE	X	X	X
6.2	System Lost – LTE System Lost in RRC_ACTIVE	X	X	X
6.3	UE Radio Link Failure Triggers RRC Connection Re-establishment	X		X
6.4	UE Triggers RRC Connection Re-establishment to Another Cell in Same eNodeB	X		X
6.5	UE Triggers RRC Connection Re-establishment to Another Cell in a Different eNodeB	X		X
6.6	Transition – Idle to Active Transition – Service Request	X	X	X
6.7	Transition – Idle to Active Transition – Paging	X	X	X
7	**PS Data**			
7.1	Ipv4 – Without Mobility – SIMO Delay of Ping	X		
7.2	Ipv4 – Without Mobility – Transmit diversity (MIMO) Delay of Ping	X		
7.3	Ipv4 – Without Mobility – Open Loop Multiplexing – Delay of Ping	X		
7.4	Ipv4 – Without Mobility – Close Loop Multiplexing – Delay of Ping	X		
7.5	Ipv6 – Without Mobility – SIMO Delay of Ping	X		
7.6	Ipv6 – Without Mobility – Transmit Diversity (MIMO) Delay of Ping	X		
7.7	Ipv6 – Without Mobility – Open Loop Multiplexing – Delay of Ping	X		
7.8	Ipv6 – Without Mobility – Close Loop Multiplexing – Delay of Ping	X		
7.9	PDN Connectivity Request –ESM Information transfer flag=TRUE	X		
7.10	PDN Connectivity Reject, ESM Cause #27 Missing or Unknown APN	X		
7.11	PDN Disconnect Procedure – UE Initiated	X		
7.12	Detach Procedure – Network Initiated	X		
7.13	Multiple PDN Connections – Second PDN Connectivity Request (UE Initiated)	X		
7.14	Multiple PDN Connections – Second PDN Connectivity Disconnect	X		
7.15	Detach Procedure – UE Initiated	X		
7.16	HTTP Browsing	X		

8	Peak Throughput Validation with Different PDSCH Transmission Mode			
8.1	DL UDP Data Transfer in SIMO with Default Ipv4 Bearer	X	X	X
8.2	DL UDP Data Transfer in Tx Diversity with Default Ipv4 Bearer	X	X	X
8.3	DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer	X		
8.4	DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer	X		
8.5	DL FTP Data Transfer in SIMO with Default Ipv4 Bearer	X		
8.6	DL FTP Data Transfer in Tx Diversity with Default Ipv4 Bearer	X		
8.7	DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer	X	X	X
8.8	DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer	X		
8.9	UL UDP Data Transfer with Default Ipv4 Bearer	X	X	X
8.10	UL FTP Data Transfer with Default Ipv4 Bearer	X	X	X
8.11	DL UDP Data Transfer in SIMO with Default Ipv6 Bearer	X		
8.12	DL UDP Data Transfer in Tx Diversity with Default Ipv6 Bearer	X		
8.13	DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer	X	X	X
8.14	DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer	X		
8.15	DL FTP Data Transfer in SIMO with Default Ipv6 Bearer	X		
8.16	DL FTP Data Transfer in Tx Diversity with Default Ipv6 Bearer	X		
8.17	DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer	X		
8.18	DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer	X		
8.19	UL UDP Data Transfer with Default Ipv6 Bearer	X		
8.20	UL FTP Data Transfer with Default Ipv6 Bearer	X		
8.21	DL UDP Transfer when both UE and eNodeB Support DL 256QAM	X		
8.22	UL UDP Transfer when both UE and eNodeB support UL 64QAM	X		
8.23	DL/UL UDP Transfer with DL256QAM/UL64QAM	X	X	X
8.24	DL TCP Transfer when both UE and eNodeB Support DL 256QAM	X		X
8.25	UL TCP Transfer when both UE and eNodeB support UL 64QAM	X		X
8.26	Link adaptation with different radio conditions when support DL 256QAM	X		X
8.27	Link Adaptation under Different Radio Condition when using UL 64QAM	X		X
8.28	Inter eNodeB E-UTRAN Handover DL 256QAM	X		X
8.29	Inter eNodeB E-UTRAN Handover with DL256QAM/UL64QAM	X		X
8.30	Inter eNodeB E-UTRAN Handover when UE and only one eNodeB Support DL 256QAM	X		X
8.31	DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		
8.32	DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		X

8.33	DL/UL UDP Transfer in a Cell configured with 4x4 DL MIMO	X		X
8.34	UL UDP data at the maximum UL throughput when UE Configured for SRS	X	X	X
9	**Dedicated Bearer**			
9.1	Network Initiated Dedicated Ipv4 Bearer Establishment and Data Connectivity	X		
9.2	Network Initiated Dedicated Ipv6 Bearer Establishment and Data Connectivity	X		
10	**DRX**			
10.1	Long and Short DRX	X	X	X
10.2	Activation and Deactivation of TTI bundling	X		X
10.3	UE Switch to TTI Bundling followed by Inter-Frequency Handover	X		X
10.4	UE Switch to Frequency Hopping Mode	X		X
10.5	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		
10.6	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		X
11	**TDD Specific Test Cases**			
11.1	Simultaneous UL and DL Data throughput with Default IPV4 Bearer	X		
11.2	Simultaneous UL and DL Data throughput with Default IPV6 Bearer	X		
11.3	E-UTRA Handover, Default IPV4 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv4 Bearer is Used)	X		
11.4	E-UTRA Handover, Default IPV6 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv6 Bearer is Used)	X		
11.5	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based Between Frame Config (1:4) and Frame Config (2:4) (Ipv4 Bearer is Used)	X		
11.6	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based between Frame Config (1:9) and Frame Config (2:9) (Ipv6 Bearer is Used)	X		
12	**High Power UE**			
12.1	HPUE Uses Power Class 2 when attached in PCell that is configured for Power Class 2			X
12.2	HP UE Transmit power per Broadcasted P-Max value in SIB1			X
12.3	HPUE Cell Reselection from TDD to FDD using SIB5 to determine the Power Class of target neighbor cell			X
12.4	HPUE Power Head Room Reported Based on Cell Power Class During Handover			X
12.5	HPUE UL Throughput Gain Comparison between Power Class 2 and Class 3 at Cell Edge			X
12.6	HPUE Attach at Cell Edge Comparison between Power Class 2 then Class 3			X

13	**Minimization of Drive Test**			
13.1	UE Configured to Report A2 Event based MDT – Logged MDT (UE Idle State)	X		X
13.2	UE Configured to Report Location based MDT – Logged MDT (UE Idle State)	X		X
13.3	UE Configured to Report of MDT after Handover – Logged MDT (UE Idle State)	X		X
13.4	UE Configured to Report of MDT after RRC Connection Re-Establishment	X		X
14	**Commercial Mobile Alert Service**			
14.1	CMAS Message Reception with SIB12 Reading in Idle Mode. of Messages of Different Priority presidential, Extreme, and Severe and Child Abduction	X	X	X
14.2	CMAS Message Reception in RRC Connected Mode	X	X	X
14.3	CMAS Notifications Replacement of Current Notification with New Notifications	X	X	X

17.1 Basic Test Cases

Note: Band(s) to be tested per Operator Market Endorsement

TABLE 17.1-1 BASIC TEST CASES (FOR VERSION 2.1 TEST PLAN ONLY, VERSION 3.0 TBD)

Test ID	Test Title	Primary Band 25	Secondary Band 26	Tertiary Band 41
2	**Basic LTE Attach and Handling of SIB Messages**			
2.7	UE attach to MFBI Mapped Band	X	X	X
2.8	UE in Idle Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.9	UE in Connected Mode Reception and Response to SIB Change of an MFBI Capable Cell	X	X	X
2.10	UE Attach in a Cell configured with 4x2 DL MIMO	X		
2.11	UE Attach in a Cell configured with 4x4 DL MIMO	X		X
2.12	UE Attach in a Cell Configured with MBSFN	X		X
3	**Network Access Test Cases**			

4	Intra-LTE Mobility (Intra-Freq)			
4.2	Intra frequency RSRQ cell reselection	X		
4.7	E-UTRA Handover, Default Ipv6 Bearer – Intra eNodeB Handover	X	X	X
4.8	E-UTRA Handover, Default Ipv6 Bearer – X2 Based	X	X	X
4.13	Intra-frequency Handover with Multiple PDNs	X		X
4.14	Intra-frequency Automatic Neighbor Relations Function	X	X	X
4.15	Intra-Frequency Event Based (Network Specified) Load Balancing	X		
4.16	Intra-frequency inter- eNodeB Handover when UE and Both eNodeBs Support 64 QAM	X	X	X
4.17	Intra-frequency Inter eNodeB Handover when UE and Only One eNodeB Supports 64 QAM	X	X	X
4.18	Intra-frequency X2 Handover in an MFBI Capable Cell	X	X	X
4.19	Intra-frequency Handover from SRS Disabled Cell to an SRS Enabled Cell	X	X	X

5	Intra-LTE Mobility (Inter-Freq)			
5.5	Idle Mode Mobility to a Different Frequency in Same LTE Band with Different Priority	X		X
5.6	Idle Mode Mobility to Different LTE Band with Different Priority	X		X
5.7	Idle Mode Load Balancing	X		X
5.8	Inter-frequency Intra Band RSRQ based Cell Reselection	X		X
5.9	Inter band RSRQ based cell reselection	X		X
5.10	E- UTRA Handover (with measurements), Inter-Frequency Intra-Band (same BW) – Default Bearer with Data Transfer	X	X	X
5.12	E- UTRA Handover (with Measurements), Inter-Frequency Inter-Band (Same BW) – Default Bearer with Data Transfer	X	X	X
5.14	Intra-LTE inter-eNB inter-frequency handover with Multiple PDNs	X		X
5.16	RRC Connection Release with Redirect to a Different Frequency at the Same LTE Band	X	X	X
5.17	RRC Connection Release with redirect to a Different LTE Band	X	X	X
5.18	RSRQ triggered inter-frequency handover	X		X
5.19	RSRQ triggered inter-band inter-frequency handover	X		X
5.20	Inter-frequency S1 HO in a MFBI Capable Cell	X		
5.21	Inter-frequency X2 Handover in a MFBI Capable Cell	X	X	X
5.22	MFBI Cell Trigger's RRC Connection Release with Redirection	X		X
5.23	Inter eNodeB E-UTRAN Handover from 4x2 DL MIMO Cell to a 2x2 DL MIMO Cell	X		
5.24	Inter eNodeB E-UTRAN Handover from 4x4 DL MIMO Cell to a 2x2 DL MIMO Cell	X		X
5.25	Inter-Frequency Event Based (Network Specified) Load Balancing	X		X
5.26	Inter-Frequency Handover from non MBSFN cell to a cell Configured with MBSFN	X	X	X

6	**System Loss and State Transition**			
6.1	System Lost – LTE System Lost in RRC_IDLE	X	X	X
6.2	System Lost – LTE System Lost in RRC_ACTIVE	X	X	X
6.3	UE Radio Link Failure Triggers RRC Connection Re-establishment	X		X
6.4	UE Triggers RRC Connection Re-establishment to Another Cell in Same eNodeB	X		X
6.5	UE Triggers RRC Connection Re-establishment to Another Cell in a Different eNodeB	X		X
7	**PS Data**			
7.3	Ipv4 – Without Mobility – Open Loop Multiplexing – Delay of Ping	X	X	X
7.4	Ipv4 – Without Mobility – Close Loop Multiplexing – Delay of Ping	X	X	X
7.13	Multiple PDN Connections – Second PDN Connectivity Request (UE Initiated)	X	X	X
7.16	HTTP Browsing	X	X	X

8	**Peak Throughput Validation with Different PDSCH Transmission Mode**			
8.7	DL FTP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv4 Bearer	X	X	X
8.8	DL FTP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv4 Bearer	X	X	X
8.10	UL FTP Data Transfer with Default Ipv4 Bearer	X	X	X
8.13	DL UDP Data Transfer in Open Loop MIMO (TM=3) with Default Ipv6 Bearer	X	X	X
8.14	DL UDP Data Transfer in Close Loop MIMO (TM=4) with Default Ipv6 Bearer	X	X	X
8.19	UL UDP Data Transfer with Default Ipv6 Bearer	X	X	X
8.21	DL UDP Transfer when both UE and eNodeB Support DL 256QAM	X		
8.22	UL UDP Transfer when both UE and eNodeB support UL 64QAM	X		
8.23	DL/UL UDP Transfer with DL256QAM/UL64QAM	X	X	X
8.24	DL TCP Transfer when both UE and eNodeB Support DL 256QAM	X		X
8.25	UL TCP Transfer when both UE and eNodeB support UL 64QAM	X		X
8.26	Link adaptation with different radio conditions when support DL 256QAM	X		X
8.27	Link Adaptation under Different Radio Condition when using UL 64QAM	X		X
8.28	Inter eNodeB E-UTRAN Handover DL 256QAM	X		
8.29	Inter eNodeB E-UTRAN Handover with DL256QAM/UL64QAM	X		X
8.30	Inter eNodeB E-UTRAN Handover when UE and only one eNodeB Support DL 256QAM	X		X
8.31	DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		
8.32	DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		
8.33	DL/UL UDP Transfer in a Cell configured with 4x4 DL MIMO	X		X
8.34	UL UDP data at the maximum UL throughput when UE Configured for SRS	X	X	X
9	**Dedicated Bearer**			
9.1	Network Initiated Dedicated Ipv4 Bearer Establishment and Data Connectivity	X	X	X

10	**DRX**			
10.1	Long and Short DRX	X	X	X
10.2	Activation and Deactivation of TTI bundling	X		X
10.3	UE Switch to TTI Bundling followed by Inter-Frequency Handover	X		X
10.4	UE Switch to Frequency Hopping Mode	X		X
10.5	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 DL MIMO	X		X
10.6	Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 DL MIMO	X		X
11	**TDD Specific Test Cases**			
11.1	Simultaneous UL and DL Data throughput with Default IPV4 Bearer	X	X	X
11.2	Simultaneous UL and DL Data throughput with Default IPV6 Bearer	X	X	X
11.3	E-UTRA Handover, Default IPV4 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv4 Bearer is Used)	NA	NA	NA
11.4	E-UTRA Handover, Default IPV6 Bearer – X2 BASED Between Frame Config (1:3) and Frame Config (2:3) (Ipv6 Bearer is Used)	NA	NA	NA
11.5	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based Between Frame Config (1:4) and Frame Config (2:4) (Ipv4 Bearer is Used)	NA	NA	NA
11.6	E-UTRA Handover, Default IPV4 Bearer (With Measurements), Inter-Frequency – S1 Based between Frame Config (1:9) and Frame Config (2:9) (Ipv6 Bearer is Used)	NA	NA	NA
12	**High Power UE**			
12.1	HPUE Uses Power Class 2 when attached in PCell that is configured for Power Class 2			X
12.2	HP UE Transmit power per Broadcasted P-Max value in SIB1			X
12.3	HPUE Cell Reselection from TDD to FDD using SIB5 to determine the Power Class of target neighbor cell			X
12.4	HPUE Power Head Room Reported Based on Cell Power Class During Handover			X
12.5	HPUE UL Throughput Gain Comparison between Power Class 2 and Class 3 at Cell Edge			X
12.6	HPUE Attach at Cell Edge Comparison between Power Class 2 then Class 3			X

13	**Minimization of Drive Test**			
13.1	UE Configured to Report A2 Event based MDT – Logged MDT (UE Idle State)	X		X
13.2	UE Configured to Report Location based MDT – Logged MDT (UE Idle State)	X		X
13.3	UE Configured to Report of MDT after Handover – Logged MDT (UE Idle State)	X		X
13.4	UE Configured to Report of MDT after RRC Connection Re-Establishment	X		X
14	**Commercial Mobile Alert Service**			
14.1	CMAS Message Reception with SIB12 Reading in Idle Mode. of Messages of Different Priority presidential, Extreme, and Severe and Child Abduction	X	X	X
14.2	CMAS Message Reception in RRC Connected Mode	X	X	X
14.3	CMAS Notifications Replacement of Current Notification with New Notifications	X	X	X

Appendix A Device Checklist and UE Information Summary

A.1 Checklist Document

Complete the attached checklist.

DEVICE CHECKLIST R1.doc

Appendix B Revision History

Date	Revision	Description
December 2011	1.0	• Initial Publication
June 2012	1.1	• Editorial changes • AS and NAS test cases added in section 2
August 2013	1.2	• Changes to test cases 2.5 and 2.6 • Added regression test cases • Added additional band(s) test cases
November 2015	2.0	• Defined and Added Level 2,Level 1 and Basic • Added TDD Testcases • Editorial Changes to the document
June 2016	2.1	• Corrections and updates to test cases 3.14, 3.15, 5.9, 7.8, 7.16 and section 8
February 2017	2.1	• Converted to new template • Updated document with November 2016 TS.11version reference
April 2018	3.0	• Updates based on contributions CPWG160303-1_R1 and HPUE CPWG170414-2_R1 • Update Table of Content • Update section 1.3, References 7 to 14 • Update Section 1.4 Glossary • Update section 2 Title name to add Handling for SIB Messages • Update to test case 2.6 AS Security • Add test cases 2.7 UE attach to MFBI Mapped Band • Add test case 2.8 UE in Idle Mode Reception and Response to SIB Change of an MFBI Capable Cell • Add test case 2.9 UE in Connected Mode Reception and Response to SIB Change of an MFBI Capable Cell • Add test case 2.10 UE Attach in a Cell configured with 4x2 DL MIMO • Add test case 2.11 UE Attach in a Cell configured with 4x4 DL MIMO • Add test case 2.12 UE Attach in a Cell Configured with MBSFN • Add test case 4.2 Intra frequency RSRQ cell reselection • Renumber the remaining test cases in the section • Add test case 4.13 Intra-frequency Handover with Multiple PDNs • Add test case 4.15 Intra-Frequency Event Based (Network Specified) Load Balancing • Add test case 4.16 Intra-frequency inter- eNodeB Handover when UE and Both eNodeBs Support 64 QAM • Add test case 4.17 Intra-frequency Inter eNodeB Handover when UE and Only One eNodeB Supports 64 QAM • Add test case 4.18 Intra-frequency X2 Handover in an MFBI Capable Cell • Add test case 4.19 Intra-frequency Handover from SRS Disabled Cell to an SRS Enabled Cell • Add test case 5.5 Idle Mode Mobility to a Different

		Frequency in Same LTE Band with Different Priority • Add test case 5.6 Idle Mode Mobility to Different LTE Band with Different Priority • Add test case 5.7 Idle Mode Load Balancing • Add test case 5.8 Inter-frequency Intra Band RSRQ based Cell Reselection • Add test case 5.9 Inter band RSRQ based cell reselection • Add test case 5.14 Intra-LTE inter-eNB inter-frequency handover with Multiple PDNs • Add test case 5.16 RRC Connection Release with Redirect to a Different Frequency at the Same LTE Band • Add test case 5.17 RRC Connection Release with redirect to a Different LTE Band • Add test case 5.18 RSRQ triggered inter-frequency handover • Add test case 5.19 RSRQ triggered inter-band inter-frequency handover • Add test case 5.20 Inter-frequency S1 HO in a MFBI Capable Cell • Add test case 5.21 Inter-frequency X2 Handover in a MFBI Capable Cell • Add test case 5.22 MFBI Cell Trigger's RRC Connection Release with Redirection • Add test case 5.23 Inter eNodeB E-UTRAN Handover from 4x2 DL MIMO Cell to a 2x2 DL MIMO Cell • Add test case 5.24 Inter eNodeB E-UTRAN Handover from 4x4 DL MIMO Cell to a 2x2 DL MIMO Cell • Add test case 5.25 Inter-Frequency Event Based (Network Specified) Load Balancing • Add test case 5.26 Inter-Frequency Handover from non MBSFN cell to a cell Configured with MBSFN • • Add test case 6.3 UE Radio Link Failure Triggers RRC Connection Re-establishment • Add test case 6.4 UE Triggers RRC Connection Re-establishment to Another Cell in Same eNodeB • Add test case 6.5 UE Triggers RRC Connection Re-establishment to Another Cell in a Different eNodeB • Update Section 8 title name • Add test case 8.21 DL UDP Transfer when both UE and eNodeB Support DL 256QAM • Add test case 8.22 UL UDP Transfer when both UE and eNodeB support UL 64QAM • Add test case 8.23 DL/UL UDP Transfer with DL256QAM/UL64QAM • Add test case 8.24 DL TCP Transfer when both UE and eNodeB Support DL 256QAM • Add test case 8.25 UL TCP Transfer when both UE and eNodeB support UL 64QAM • Add test case 8.26 Link adaptation with different radio conditions when support DL 256QAM • Add test case 8.27 Link Adaptation under Different Radio Condition when using UL 64QAM • Add test case 8.28 Inter eNodeB E-UTRAN Handover DL 256QAM • Add test case 8.29 Inter eNodeB E-UTRAN Handover with DL256QAM/UL64QAM

		• Add test case 8.30 Inter eNodeB E-UTRAN Handover when UE and only one eNodeB Support DL 256QAM • Add test case 8.31 DL UDP Transfer in Cell Configured with 4x2 DL MIMO • Add test case 8.32 DL UDP Transfer in Cell Configured with 4x4 DL MIMO • Add test case 8.33 DL/UL UDP Transfer in a Cell configured with 4x4 DL MIMO • Add test case 8.34 UL UDP data at the maximum UL throughput when UE Configured for SRS • Update Section 10 title name from DRX to Radio Resources Configuration • Update test instructions in test case 10.1 • Add test case 10.2 Activation and Deactivation of TTI bundling • Add test case 10.3 UE Switch to TTI Bundling followed by Inter-Frequency Handover • Add test case 10.4 UE Switch to Frequency Hopping Mode • Add test case 10.5 Rank Indication Change while DL UDP Transfer in Cell Configured with 4x2 DL MIMO • Add test case 10.6 Rank Indication Change while DL UDP Transfer in Cell Configured with 4x4 DL MIMO • Add section 12 High Power UE • Add test case 12.1 HPUE Uses Power Class 2 when attached in PCell that is configured for Power Class 2 • Add test case 12.2 HP UE Transmit power per Broadcasted P-Max value in SIB1 • Add test case 12.3 HPUE Cell Reselection from TDD to FDD using SIB5 to determine the Power Class of target neighbor cell • Add test case 12.4 HPUE Power Head Room Reported Based on Cell Power Class During Handover • Add test case 12.5 HPUE UL Throughput Gain Comparison between Power Class 2 and Class 3 at Cell Edge • Add test case 12.6 HPUE Attach at Cell Edge Comparison between Power Class 2 then Class 3 • Add Section 13 Minimization of Drive Test • Add test case 13.1 UE Configured to Report A2 Event based MDT – Logged MDT (UE Idle State) • Add test case 13.2 UE Configured to Report Location based MDT – Logged MDT (UE Idle State) • Add test case 13.3 UE Configured to Report of MDT after Handover – Logged MDT (UE Idle State) • Add test case 13.4 UE Configured to Report of MDT after RRC Connection Re-Establishment • Add Section 14 Commercial Mobile Alert Service • Add test case 14.1 CMAS Message Reception with SIB12 Reading in Idle Mode. of Messages of Different Priority presidential, Extreme, and Severe and Child Abduction • Add test case 14.2 CMAS Message Reception in RRC Connected Mode • Add test case 14.3 CMAS Notifications Replacement of Current Notification with New Notifications
August 2018	3.1	• Added tests in 15.1, 16.1 and 17.1 test grid