Test Plan for LTE Carrier Aggregation Interoperability

Version 1.1

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CTIA Certification Program

1400 16th Street, NW

Suite 600

Washington, DC 20036

certification@ctia.org

1.202.785.0081

www.ctia.org/certification

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Section 1 Introduction

1.1 Purpose

This document lists the test cases for the interoperability testing of the Carrier Aggregation feature defined in 3GPP Rel. 10 and above. These tests cover the following broad areas:

- Basic Carrier Aggregation Configuration and Activation Functionality
- Connected Mode Mobility in Carrier Aggregation Enabled Cells
- Idle Mode Mobility in Carrier Aggregation Enabled Cells
- Data Throughput Performance in Carrier Aggregation Enabled Cells
- Carrier Aggregation Interaction with Legacy Network Features

1.2 Scope

This document is intended for use by LTE Device, Network and Equipment vendors and Wireless Operators to conduct device to network interoperability testing specifically related to LTE Carrier Aggregation (CA). The tests defined in this document contain recommended suite of test cases that apply to the CA features.

This test plan is to be executed in addition to the CTIA Test Plan for LTE Interoperability [1] for all Carrier Aggregation capable UEs.

This version of test plan specifies test instructions for two Component Carriers. Updates for two or more Component Carriers will be in new version in the future.

1.3 Applicable Documents

The following documents are referenced in this test plan:

CTIA Related References:

Note: All CTIA specifications can be found at the following location:

http://www.ctia.org/policy-initiatives/certification/certification-test-plans

[1] CTIA Test Plan for LTE Interoperability

3GPP Related References:

[2] 3GPP TS 36.101: "E-UTRA UE radio transmission and reception" (Rel 12)

[3] 3GPP TS 36.331 Radio Resource Control (RRC); Protocol Specification (Release 11)"

[4] 3GPP TS 36.523-1 E-UTRA and EPC; UE Conformance Specification; Protocol Conformance Specification

[5] 3GPP TS 24.301 UMTS; LTE; NAS Protocol for EPS; Stage 3

[6] 3GPP TS 36.321 LTE; E-UTRA; MAC Protocol Specification

1.4 Acronyms and Definitions

Acronym	Definition
1xCSFB	1x Circuit Switched Fallback
1xRTT	1x (single-carrier) Radio Transmission Technology
3GPP	3rd Generation Partnership Project
CDMA	Code Division Multiple Access
CQI	Channel Quality Indicator
CSI	Channel State Information
CSIM	CDMA Subscriber Identity Module
DL	Down Link
DRB	Data Radio Bearer
ECGI	EUTRAN Cell Global ID
eCSFB	Enhanced Circuit Switched Fallback
e1xCSFB	Enhanced 1x Circuit Switched Fallback
eHRPD	evolved High Rate Packet Data
eNodeB	Evolved Node B
EPS	Evolved Packet System
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
EVDO	cdma2000 1xRTT EVolution – Data Only
FGI	Feature Group Indicator
ICMP	Internet Control Message Protocol
IE	Information Element
IOT	Interoperability Testing

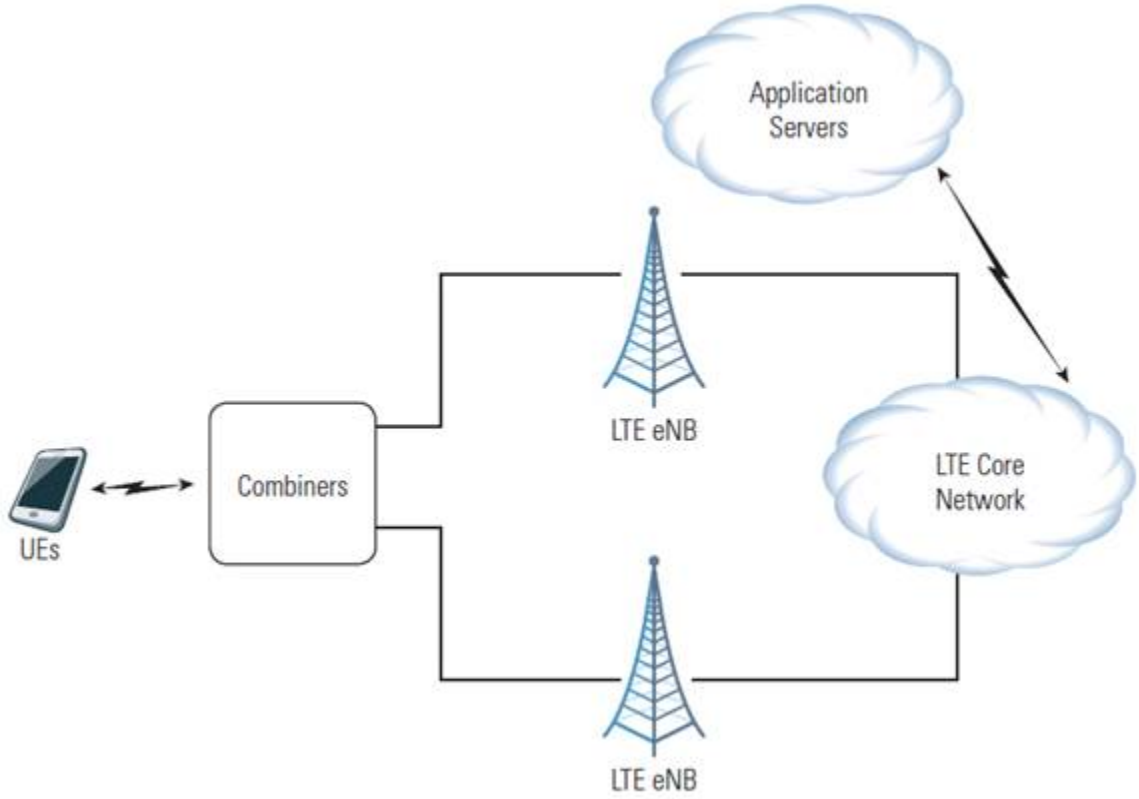
IP	Internet Protocol
IPv4	Internet Protocol version 4 (32 bit address)
IPv6	Internet Protocol version 6 (128bit address)
IWS	Interworking Solution
LCID	Logical Channel ID
LTE	Long Term Evolution
MAC	Medium Access Control
MCC	Mobile Country Code
MIMO	Multiple Input - Multiple Output
MMSS	MultiMode System Selection
MO	Mobile Originated
MT	Mobile Terminated
NAS	Non-Access-Stratum
MNC	Mobile Network Code
OEM	Original Equipment Manufacturer
PCC	Primary Component Carrier
pCell	Primary Cell
PCS	Personal Communications Service
PDCCH	Physical Downlink Control Channel
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PMI	Precoding Matrix Indicator
PRI	Program Release Instructions
PTI	Procedure Transaction Identity
QAM	Quadrature Amplitude Modulation
RAT	Radio Access Technology

RI	Rank Indicator
RLF	Radio Link Failure
RRC	Radio Resource Control
RSRP	Reference Signal Receive Power
SCC	Secondary Component Carrier
sCell	Secondary Cell
SIB	System Information Block
SMS	Short Message Services
SRB	Signaling Radio Bearer
TAU	Tracking Area Update
TCP	Transmission Control Protocol
TS	Technical Standard
UDP	User Datagram Protocol
UE	User Equipment
UHDM	Universal Handoff Direction Message
UICC	USIM Integrated Circuit Card
UL	Up Link
USIM	Universal Subscriber Identity Modules

1.5 Basic Lab Configuration

Figure 1-1 below shows the basic lab configuration, which reflects the network implementation of the LTE Wireless 3GPP network deployment.

FIGURE 1-1 BASIC LAB CONFIGURATION



1.6 Network Requirements

The network shall provide the following key functions to execute all test cases listed in this document. If execution of only a subset of the test cases is planned, the network requirements should be adjusted accordingly.

The network must be able to support multiple carriers for Carrier Aggregation feature.

Unless otherwise noted, the following are default configuration:

- All eNodeBs must use Open Loop Spatial Multiplexing with a DL modulation of 64QAM.
- All amplification and attenuation is executed using attenuators.

For eCSFB interaction related test cases:

- The E-UTRAN shall support SystemInformationBlockType8 (SIB8) compliant with 3GPP Release 9 if the E-UTRAN supports 3GPP Release 9 e1xCSFB.
- The E-UTRAN shall support tunneling procedures for 1xRTT registration.

- The E-UTRAN shall support the e1xCSFB (UHDM-based) for MO/MT calls if the E-UTRAN supports 3GPP Release 9 e1xCSFB.
- The IWS shall support and set the GCSNAOption value to 0x01 in GCSNA messages. (Release 9)
- IWS supports SMS over S102 tunnel.

For 1x/LTE Hybrid related test cases:

- The E-UTRAN shall support SystemInformationBlockType8 (SIB8) compliant with 3GPP Release 9 if the E-UTRAN does not support 3GPP 1xCSFB.
- The E-UTRAN shall not have an S102 interface.

1.7 UE and UICC Setup Details

To execute this test plan, the UE must be configured for Carrier Aggregation – defined below in Section 1.10.

For data connectivity verification over LTE, Iperf or ICMP ping application can be used from the tethered equipment, or from the embedded application or OS.

UICC cards with the following setup and details need to be prepared for Carrier Aggregation IOT:

- UICC card with USIM application should be used.
- UICC card with both CSIM applications should be used for the test cases that require interaction with 1Xrtt system or 1x-eCSFB cases.
- RRC security settings
- NAS security settings
- MMSS provisioning such that LTE is the highest preferred RAT

UE Capabilities

UE Capabilities shall be set in the rf-Parameters-v1020 parameter found in the UE Capability Information message for the following parameters:

bandEUTRA-r10: to include the LTE Band(s) which will be used for CA cells as per CA configuration in [2]

ca-BandwidthClassUL-r10: to specify the UL bandwidth as per CA configuration in [2]

ca-BandwidthClassDL-r10: to specify the combined DL bandwidth as per CA configuration in [2]

supportedMIMO-CapabilityDL-r10→twoLayers

Also UE should include ue-CategoryDL parameter which will determine the expected throughput in DL direction as indicated in

value UE-EUTRA-Capability ::= { accessStratumRelease rel10,ue-Category <X>,}

The UE must support carrier aggregation for at least two downlink component carriers as stated in 3GPP Rel-10 or above.

1.8 E-UTRAN Diagnostic Logging Requirements

For debugging issues encountered in IOT, specific logging might be required.

1.9 UE Diagnostic Logging Requirements

UE logging or Layer 1 to 3 and/or Debug messages, Events, and Log Packets may be required to log.

1.10 E-UTRAN Carrier Aggregation Configuration

Both the E-UTRAN and the UE must support carrier aggregation for at least two downlink component carriers as stated in 3GPP Rel-10 or above.

For detailed information of the possible configuration of the following permutation, please see Appendix B.

- Intra-band contiguous CA operating bands and channel bandwidths
- Inter-band CA operating bands (two bands) and channel bandwidths
- Intra-band non-contiguous CA operating bands (with two sub-blocks) and channel bandwidths

1.11 E-UTRAN SIB8 Default Configuration

The following minimum fields in the SIB8 message must be configured and transmitted for eCSFB related test cases.

- systemTimeInfo
- searchWindowSizecsfb-RegistrationParam1xRTT
- cellReselectionParametersCDMA2000
- longCodeState1XRTT
- csfb-RegistrationParam1xRTT-v920
- cellReselectionParametersCDMA2000-v920
- ac-BarringConfig1XRTT

1.12 Passing Throughput Criteria

Throughput of UE that is configured and activated for CA depends on UE Category, Band class and bandwidth. For calculated maximum throughput please check 3GPP TS 36.306 Section 4.1 and 3GPP TS 36.101 Annex A.3.

Section 2 Basic Two Carrier Aggregation Functionality

2.1 Attach in CA Configured Cell

Definition and Purpose

The purpose of this test is to verify that the UE can be successfully configured with RRC Connection Re-configuration procedure to a secondary component carrier (SCC) for carrier aggregation, during UE's initial access procedure to the primary component carrier (PCC).

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC is active.
- SCC is inactive.
- UE is powered off.

Procedure

1. Power up the UE.
2. Wait for the UE to attach to the PCC, according to 3GPP TS 36.523-1 [4] clause 9.2.1.1.1.
3. Cause an SCC to be configured by sending an *RRCConnectionReconfiguration* message containing *sCellToAddModList* with a SCell addition, according to 3GPP TS 36.523-1 [4] clause 8.2.2.3.1.

Expected Results

After Step 1, verify that:

- The UE attaches to the PCC and receives an attach accept message from the network, as per 3GPP TS 24.301 [5], clauses 5.3.1.2 and 3GPP TS 36.331 [3] clauses 5.3.3.3 and 5.3.3.4.
- The UE has flags set to indicate support of CA and the band combinations enlisted in the contents of the *rf-Parameters-v1020* parameter found in the UE Capability Information message by Section 1.7.
- The UE has the correct setup as defined by Section 1.7.
- After Step 3, verify that:
- The UE is successfully configured with SCC configuration through the contents of the *sCellToAddModList-r10* parameter found in the *RRCConnectionReconfiguration* message as per 3GPP TS 36.331 [3], clause 5.3.10.3b.
- The UE transmits an *RRCConnectionReconfigurationComplete* message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

2.2 SCC Configuration after RRC IDLE to RRC CONNECTED Transition

Definition and Purpose

The purpose of this test is to verify that the UE can be successfully re-configured with RRC Connection Re-configuration procedure to an SCC for carrier aggregation, after UE transitioned from RRC Idle to RRC connected state.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- Test Case 2.1. has been successfully executed.
- PCC is active.
- SCC is inactive.
- UE is idle camped on the PCC.

Procedure

1. Use ICMP to ping the UE from the network.
    - UE performs Service Request procedure, according to 3GPP TS 36.523-1 [4], clause 8.1.1.1.
2. Send an *RRCConnectionReconfiguration* message containing *sCellToAddModList* with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1[4], clause 8.2.2.3.1.

Expected Results

After Step 1, verify that:

- The UE transitions to RRC connected state by Service Request procedure and responds to the ping from the network, as defined by 3GPP TS 36.331 [3], 5.3.3.
- The UE has flags set to indicate support of carrier aggregation and the band combinations enlisted in the contents of the *rf-Parameters-v1020* parameter found in the UE Capability Information message.

After Step 2, verify that:

- The UE is successfully configured with SCC configuration through the contents of the *sCellToAddModList-r10* parameter found in the *RRCConnectionReconfiguration* message as per 3GPP TS 36.331 [3], clause 5.3.10.3b.
- The UE shall transmit an *RRCConnectionReconfigurationComplete* message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

2.3 SCC De-Configuration after RRC CONNECTED to RRC IDLE transition

Definition and Purpose

The purpose of this test is to verify that the SCC can be successfully de-configured from the UE with *rrcConnectionRelease* for CA, after UE transitions from RRC Connected to RRC Idle state.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC is active.
- SCC is inactive.
- UE is attached to the PCC and SCC in the RRC Connected state.

Procedure

1. Send an *RRCConnectionRelease* message with release cause 'other' to the UE.
   - UE shall begin the RRC Connection Release procedure, according to 3GPP TS 36.523-1 [4], clause 8.1.3.1.
2. Let the UE inactivity timer expire.
   - UE shall complete the RRC Connection Release procedure, according to 3GPP TS 36.523-1 [4], clause 8.1.3.1.

Expected Results

After Step 1, verify that:

- The eNodeB sends *rrcConnectionRelease* message.
- The inactivity timer starts as per 3GPP TS 36.331 [3], clause 5.3.8.3.

After Step 2, verify that:

- The UE connection has been released at the expiry of the inactivity timer.
- RRCConnectionRelease procedure is completed as per 3GPP TS 36.331 [3], clause 5.3.8.3.
- All radio resources have been released.
- The UE is idle on the PCC.
- The SCC has been de-configured from the UE.

2.4 SCC Activation with Timer Deactivation

Definition and Purpose

The purpose of this test is to verify that the UE can successfully activate an SCC, using Activation MAC control element, and deactivate an SCC, due to timer expiry, for CA when instructed by eNodeB.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC is active.
- SCC is inactive.
- UE is attached to the PCC in the RRC Idle state.
- UE is in good radio conditions for both the PCC and SCC.
- Set *sCellDeactivationTimer* to rf4 (4 radio frames).

Procedure

1. Page the UE for RRC connection.
   - UE performs Service Request procedure, according to 3GPP TS 36.523-1 [4], clause 8.1.1.1.
2. Send an *RRCConnectionReconfiguration* message containing *sCellToAddModList* with a SCell addition to the UE.
   - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1 [4], clause 8.2.2.3.1.
3. Send the activation/deactivation MAC control element from the eNodeB to activate the configured SCC.
   - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.
4. Start sCellDeactivationTimer.
5. Let the sCellDeactivationTimer expire.
   - Deactivate SCC due to expired timer, according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.

Expected Results

After Step 1, verify that:

- The UE transitions to RRC connected state by Service Request procedure and responds to the ping from the network, as per 3GPP TS 36.331 [3], clause 5.3.3.

After Step 2, verify that:

- The UE is successfully configured with SCC configuration through the contents of the *sCellToAddModList-r10* parameter found in the *RRCConnectionReconfiguration* message as per 3GPP TS 36.331 [3], clause 5.3.10.3b.
- The UE shall transmit an *RRCConnectionReconfigurationComplete* message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

After Step 3, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element.
- When the UE received the MAC control element with LCID equal to 11011 (27), it started monitoring the SCC according to was configured in the rrcReconfiguration message, as per 3GPP TS 36.321 [6], clause 5.13.
- The UE sends CQI for both PCC and SCC after activation.

After Step 5, verify that:

- The UE de-activated the SCC and all SCC CSI reporting and monitoring has stopped, as per 3GPP TS 36.321 [6], clause 5.13.

2.5 SCC Activation/De-Activation

Definition and Purpose

The purpose of this test is to verify that the UE can successfully activate and then de-activate, by Activation/Deactivation MAC control element, an SCC for CA when instructed by eNodeB, that the UE can report periodic measurement for both of PCC and SCC after the SCC is configured, and that the UE can start and stop CSI reporting successfully after SCC is activated and de-activated.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- Enable periodic measurements on the eNodeB.
- PCC is active.
- SCC is inactive.
- UE is attached to PCC and is RRC Idle.
- UE is in good radio conditions for both PCC and SCC.

Procedure

1. Send an RRCConnectionReconfiguration message containing sCellToAddModList with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1 [4], clause 8.2.2.3.1.
2. eNodeB to send activation MAC control element, to trigger the UE to activate the configured SCC.
    - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.
3. De-activate the SCC by sending the activation/deactivation MAC control element.
    - Deactivate SCC by MAC control element, according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.

Expected Results

After Step 1, verify that:

- The UE is successfully configured with SCC configuration through the contents of the *sCellToAddModList-r10* parameter found in the *RRCConnectionReconfiguration* message as per 3GPP TS 36.331 [3], clause 5.3.10.3b.
- The UE shall transmit an *RRCConnectionReconfigurationComplete* message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

After Step 2, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element with LCID equal to 11011 (27).
- The starts monitoring the SCC according to the configuration in the rrcReconfiguration message as per 3GPP TS 36.321 [6], clause 5.13.
- The UE sends CSI reporting (CQI, RI, PTI, and PMI) for both the PCC and SCC as per 3GPP TS 36.321 [6], clause 5.13.
- A periodic measurement report configuration is sent to UE by RRCConnectionReconfiguration message.
- The UE reports the periodic measurement for both the PCC and SCC by an RRC measurement report message containing the RSRP values.

After Step 3, verify that:

- The UE de-activated the SCC, stopped SCC CSI reporting, and stopped monitoring SCC as per 3GPP TS 36.321 [6], clause 5.13.

2.6 PCC Re-establishment and SCC Activation after RLF

Definition and Purpose

The purpose of this test is to verify that the UE can be successfully re-established and activate an SCC for CA after brief UE loss of the LTE system and radio link failure (RLF). All bearer timers do not expire in this test case.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC is active.
- SCC is inactive.
- UE is attached to the PCC and is RRC Connected.
- Timers T310 and T311 in the eNodeB are set to a minimum of two seconds.
- The eNodeB supports the RRC connection re-establishment procedure.

Procedure

1. Send an RRCConnectionReconfiguration message containing *sCellToAddModList* with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1[4], clause 8.2.2.3.1.
2. Send the activation MAC control element to trigger the eNodeB to activate the configured SCC.
    - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.
3. Rapidly attenuate PCC and SCC signals until are both are completely non-accessible by the UE for the 3 seconds.
    - SCC is released, in accordance with 5.3.10.3a
4. After 3 seconds, rapidly increase the PCC and SCC signals until the RSRP of both component carriers are -70 dB or stronger.
5. Allow UE to perform system selection and attach to PCC.
    - UE completes RRC connection reconfiguration Re-establishment according to 3GPP TS 36.523-1 [4], clause 8.2.4.7
6. Send an RRCConnectionReconfiguration message containing *sCellToAddModList* with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1 [4] clause 8.2.2.3.1.
7. Cause UE to connect to and re-active SCC by sending the activation MAC control element to trigger the eNodeB to activate the configured SCC.
    - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.

Expected Results

After Step 1, verify that:

- The UE transmits an RRCConnectionReconfigurationComplete message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

After Step 2, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element.
- When the UE received the MAC control element with LCID equal to 11011 (27), it started monitoring the SCC according to was configured in the rrcReconfiguration message, as per 3GPP TS 36.321 [6], clause 5.13.

After Step 3, verify that:

- After signal loss, the UE acquires the PCC and sends an *RRCConnectionReestablishmentRequest* message to the cell.

Upon RRC connection re-establishment procedure initiation, verify that:

- The SCC is released as per 3GPP TS 36.331 [3], clause 5.3.7.2.

After Step 5, verify that:

- The PCC sends an RRCConnectionReestablishment message and the UE responds with RRCConnectionReestablishmentComplete message.
- The RRC message exchange is successful and that the re-establishment cause is set the value "OtherFailure".

After Step 6, verify that:

- The UE is successfully configured with SCC configuration through the contents of the sCellToAddModList-r10 parameter found in the *RRCConnectionReconfiguration* message
- The UE shall transmit an *RRCConnectionReconfigurationComplete* message after the successful attachment to the SCC
- SRB1 has been reconfigured

After Step 7, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element.
- When the UE received the MAC control element with LCID equal to 11011 (27), it started monitoring the SCC according to was configured in the *rrcReconfiguration* message, as per 3GPP TS 36.321 [6], clause 5.13.
- SRB1 has been reconfigured and data traffic is resumed on both cells after reestablishment completed

2.7 PCC Re-Configuration and SCC Activation PCC System Loss

Definition and Purpose

The purpose of this test is to verify that the UE can be successfully re-configured and activate an SCC for CA after system loss. All bearer timers expire in this test case.

Initial Settings

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC is active.
- SCC is inactive.
- UE is attached to the PCC and is RRC Connected.
- Timers T310 and T311 in the eNodeB are set to a minimum of two seconds.
- The eNodeB supports the RRC connection re-configuration procedure.

Procedure

1. Send an *RRCConnectionReconfiguration* message containing *sCellToAddModList* with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1 [4], clause 8.2.2.3.1.
2. Initiate maximum data downlink throughput, by sending the activation MAC control element with LCID equal to 11011 (27), to trigger the eNodeB to activate the configured SCC.
    - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.
3. Rapidly attenuate PCC and SCC signals until are both are completely non-accessible by the UE for the 5 seconds.
4. After 5 seconds, rapidly increase the PCC and SCC signals until the RSRP of both component carriers are -70 dB or stronger.
5. Wait for the UE to trigger attach or service request to the PCC, according to 3GPP TS 36.523-1 [4], clause 9.2.1.1.1 or clause 9.3.1.1.1
6. Send an RRCConnectionReconfiguration message containing *sCellToAddModList* with a SCell addition to the UE.
    - UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1, [4] clause 8.2.2.3.1.
7. Cause to reactivate SCC by sending the activation MAC control element to trigger the eNodeB.
    - SCC is activated according to 3GPP TS 36.523-1 [4], clause 7.1.9.1.

Expected Results

After Step 1, verify that:

- The UE transmits an RRCConnectionReconfigurationComplete message after the successful attachment to the SCC as per 3GPP TS 36.331 [3], clause 5.3.10.3b.

After Step 2, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element.
- When the UE received the MAC control element with LCID equal to 11011 (27), it started monitoring the SCC according to was configured in the rrcReconfiguration message, as per 3GPP TS 36.321 [6], clause 5.13.

After Step 3, verify that:

- After T311 expires the UE will go to idle mode and may perform RRC Connection Request.

After Step 5, verify that:

- The UE triggers attach request or service request to the PCC and receives an attach accept message or RRC E-RAB modification Request from the network, as per 3GPP TS 24.301 [5], clauses 5.3.1.2 and 3GPP TS 36.331 [3], clauses 5.3.3.3 and 5.3.3.4.
- The UE acquires the PCC and sends an *RRCConnectionRequest* message to the cell.
- The PCC sends an *RRCConnection* message and the UE responds with *RRCConnectionSetupComplete* message as defined by 3GPP TS 36.331 [3], 5.3.3.

After Step 6, verify that:

- The UE is successfully configured with SCC configuration through the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message
- The UE shall transmit an RRCConnectionReconfigurationComplete message after the successful attachment to the SCC
- SRB1 has been reconfigured

After Step 7, verify that:

- The eNodeB activates the configured SCC by sending the Activation MAC control element.
- When the UE received the MAC control element with LCID equal to 11011 (27), it started monitoring the SCC according to was configured in the rrcReconfiguration message, as per 3GPP TS 36.321 [6], clause 5.13.
- SRB1 has been reconfigured and data traffic is resumed on both cells.

Section 3 Connected Mode Mobility in CA Configured Cells

3.1 Intra-Band Intra-Frequency Handover between CA Cells

Definition and Purpose

This test verifies that the UE can successfully handover based on pCell coverage and the previously configured sCell will be removed and de-configured. After successful handover to the target primary cell the UE will be verified to successfully configure and activate an sCell if the CA conditions are satisfied. The UE will be verified to successfully hand over and configure and activate an sCell with the RRCConnectionReconfiguration message and MAC control element.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2
- Both eNodeBs are configured with PCCs and SCCs as defined in Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbour cells to one another.
- The eNodeBs have been configured with the appropriate measurement events, i.e. A3 events.
- PCC1 is the PCC of eNodeB1. SCC1 is the SCC of eNodeB1.
- PCC2 is the PCC of eNodeB2. SCC2 is the SCC of eNodeB2
- PCC1 RSRP is stronger than PCC2 RSRP.
- PCC1 is inactive.
- SCC1 is inactive.

Procedure

1. Attach the UE to the PCC1, according to 3GPP TS 36.523-1 [4] clause 9.2.1.1.1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
    - eNodeB1 sends an RRCConnectionReconfiguration message containing sCellToAddModList with a SCell addition to the UE and the UE performs RRC Connection Reconfiguration according to 3GPP TS 36.523-1 [4] clause 8.2.2.3.1.
    - eNodeB1 sends the activation MAC control element to activate the configured SCC, according to 3GPP TS 36.523-1 [4] clause 7.1.9.1.
3. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.

- UE successfully hands over from PCC1 to PCC2, according to 3GPP TS 36.523-1 [4], clause 8.2.4.19.
- UE successfully hands over from SCC1 to SCC2, according to 3GPP TS 36.523-1 [4] clause 8.2.4.20.

4. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
   - UE successfully hands over from SCC2 to SCC1, according to 3GPP TS 36.523-1 [4] clause 8.2.4.19.
   - UE successfully hands over from PCC2 to PCC1, according to 3GPP TS 36.523-1 [4] clause 8.2.4.20.
5. Repeat Steps 3 through 4 two more times.

Expected Results

After Step 1, verify that:

- The UE attaches to PCC1 and receives an attach accept message from the network, as per 3GPP 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.

After Step 2, verify that:

- The PCC sends an RRCConnection message and the UE responds with RRCConnectionSetupComplete message as defined by 3GPP TS 36.331 [3], 5.3.3.
- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- SCC1 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC2/eNodeB2 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC1.
- The UE configured and activated SCC2 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 4, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.

- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).
- When repeating Step 3 and Step 4, verify that:
- All subsequent handovers follow expected results described above.

3.2 Intra-Band Intra-Frequency Handover between CA to Non-CA Cells

Definition and Purpose

This test will verify that the UE can successfully handover based on PCC coverage and the previously configured SCC will be removed and de-configured. After the successful handover to the target PCC the UE will be verified to successfully configure and activate an SCC if the carrier aggregation conditions are satisfied. This test will verify that the UE can be successfully handed over, configure and activate carrier aggregation procedures with the RRCConnectionReconfiguration messages and Activation/Deactivation MAC control element.

Initial Settings

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2
- eNodeB1 is configured with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- eNodeB2 has only one component carrier active.
- PCC1, the PCC of eNodeB1, is configured as a neighbour cell to eNodeB2.
- The eNodeBs have been configured with appropriate measurement event, i.e. A3 events.
- PCC1 RSRP is stronger than the RSRP of eNodeB2.

Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Attenuate the signal level of PCC1 and amplify the signal level of eNodeB2.
4. Attenuate the signal level of eNodeB2 and amplify the signal level of PCC1.
5. Repeat Steps 3 through 4 two more times.

Expected Results

After step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After step 3, verify that:

- SCC1 is deactivated and de-configured.
- The UE has been successfully handed over to eNodeB2 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC1.
- All bearers are correctly reconfigured and the UE resumed the traffic with maximum throughput.
- The UE used "full reconfiguration" RRC signalling mechanism to release its current dedicated configuration and to re-configure with the full configuration of the eNodeB2 cell. The RRCConnectionReconfiguration message sent to UE at handover execution contains the flag fullConfig-r9 set to TRUE, and also includes complete configurations for SRBs, DRBs, MAC, and Physical layer for the UE in eNodeB2 cell.

After Step 4, verify that:

- eNodeB2 cell is de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from the eNodeB2 cell.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 3 and Step 4, verify that:

- All subsequent handovers follow expected results described above.

3.3 Intra-Band Inter-Frequency S1 handover within CA Cells

Definition and Purpose

This test will verify that the UE can successfully handover based on PCC coverage and the previously configured SCC will be removed and de-configured. After successful handover to the target PCC, the UE will be verified to successfully configure and activate an SCC if CA conditions are satisfied. The UE will be verified to successfully handed over, configure and activate CA procedures with the RRCConnectionReconfiguration messages and Activation/Deactivation MAC control element.

Initial Settings

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB3.
- Both eNodeBs are configured with PCCs and SCCs as defined in Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbour cells to one another.
- The eNodeBs have been configured with the appropriate measurement events, i.e. A2 and A5 events.
- The eNodeBs are configured to use S1 for an inter-eNodeB handover.
- The RSRP of PCC1 is stronger than the RSRP of PCC2.
- Configure the PCCs to have two different frequencies in the same band.

Procedure

1. Attach the UE to the PCC of eNodeB1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.
4. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
5. Repeat Steps 3 through 4 two more times.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and the SCC1 is activated.

After Step 3, verify that:

- SCC1 is deactivated and de-configured.
- The UE has been successfully handed over to PCC2/eNodeB3 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from the PCC1.
- The UE configures and activates SCC2 and all bearers are correctly reconfigured.
- The UE has resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

- All subsequent handovers are following expected steps described above.

After Step 4, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 3 and Step 4, verify that:

- All subsequent handovers follow expected results described above.

3.4 Intra-Band Inter-Frequency Handover between PCC and SCC

Definition and Purpose

This test will verify that the UE can successfully handover based on PCC coverage and the previously configured SCC will be removed and de-configured. After successful handover to the target PCC the UE will be verified to successfully configure and activate a SCC if the CA conditions are satisfied. The UE will be verified to successfully handed over, configure and activate CA procedures with the RRCConnectionReconfiguration messages and Activation/Deactivation MAC control element.

Initial Settings

- Configure the UE per Section 1.7.
- Configure one available eNodeB configured with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- The Carrier1 and Carrier2 are configured as neighbor cells to one another.
- The eNodeB is configured with the appropriate measurement event, i.e. A2 or blind handover in this test.
- The RSRP of Carrier1 is stronger than the RSRP of Carrier 2.

Procedure

1. Attach the UE to the Carrier1 – Carrier1 is now the PCC.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Attenuate the signal level of Carrier1 and amplify the signal level of Carrier2.

4. Attenuate the signal level of Carrier2 and amplify the signal level of Carrier1.

5. Repeat Steps 3 through 4 two more times.

Expected Results

After Step 2, verify that:

- The UE attaches to Carrier1 and starts traffic with maximum throughput.
- Carrier2 is activated as the SCC.

After Step 3, verify that:

- Carrier2 is deactivated and de-configured as the SCC.
- The UE has successfully handed over to Carrier2 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from Carrier1 or RRC Release with Redirection. The UE has configured and activated Carrier1 as the SCC all bearers correctly reconfigured.
- The UE has resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 4, verify that:

- Carrier1 is deactivated and de-configured as the SCC.
- The UE has been successfully handed over to the Carrier1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from Carrier2 or RRC Release with Redirection.
- The UE has configured and activated Carrier2 as the SCC and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 3 and Step 4, verify that:

- All subsequent handovers follow expected results described above.

3.5 Intra-Band Intra-Frequency A6 Triggered Handover Between SCCs

Definition and Purpose

This test will verify that the UE can successfully handover based on reconfiguration message from network triggered by an A6 event. The UE will be verified to successfully hand back over to the source, configure and activate CA procedures with the RRCConnectionReconfiguration messages and Activation/Deactivation MAC control element.

Initial Settings

- Configure the UE per Section 1.7.
- eNodeB is configured with a PCC and two SCCs as defined in Appendix C or by operator endorsed combination
- PCC1 is the PCC of the eNodeB.
- SCC1 and SCC2 are the SCCs of the eNodeB.
- SCC1 and SCC2 are configured as a neighbour cells.
- The eNodeB has been configured with measurement event A6.
- The RSRP of SCC1 is stronger than -70 dB
- The RSRP of SCC2 is weaker than -100 dB.

Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (dependent upon BW combination used).
3. Attenuate the signal level of SCC1 so the RSRP is weaker than -105 dB and amplify the signal level of SCC2 so the RSRP is stronger than -70 dB.
4. Attenuate the signal level of SCC2 so the RSRP is weaker than -105 dB and amplify the signal level of SCC1 so the RSRP is stronger than -70 dB.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- SCC1 is deactivated and de-configured.
- The SCC has been successfully handed over to SCC2 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC1.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 4, verify that:

- SCC2 is de-configured.
- The SCC has been successfully handed over to SCC1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC1.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

3.6 CA Intra-Band Intra-Frequency Handover with ANR

Definition and Purpose

This test will verify that the UE can successfully handover based on PCC coverage and the configured SCC will be removed and de-configured. After successful handover to the target cell the UE will be verified to successfully configure an SCC.

Initial Settings

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- eNodeB1 and eNodeB2 are configured with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC1 is the PCC of eNodeB1. SCC1 is the SCC of the eNodeB1.
- PCC2 is the PCC of eNodeB2. SCC2 is the SCC of the eNodeB2.
- PCC1 is NOT configured as a neighbour cell to PCC2 or SCC2.
- The eNodeBs have been configured with appropriate measurement events, i.e. A2/B2.
- PCC1 RSRP is stronger than the RSRP of PCC1.

Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Attenuate the signal level of PCC1 and SCC1 and amplify the signal level of PCC2 and PCC2.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- UE reports Event A2 based on PCC1 becoming worse than configured threshold.
- SCC1 is deactivated and de-configured.
- UE detects PCC2 and reports the unknown PCI to eNodeB1 via RRC Measurement Report message.
- eNodeB1 requests UE to report EUTRAN Cell Global ID (ECGI).
- UE reports ECGI by reading BCCH channel.
- eNodeB1 retrieves the IP address from MME to further setup the x2 interface.
- The UE has been successfully handed over to PCC2 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC1.
- All bearers are correctly reconfigured and the UE resumed the traffic with maximum throughput (dependent upon bandwidth configuration).

Section 4 Performance in CA Configured Cells

4.1 Open Loop Spatial Multiplexing Throughput using UDP and Downlink 64QAM

Definition and Purpose

The purpose of this test is to verify that a downlink data transfer with maximum traffic can be successfully performed for both the PCC and SCC and the throughput is proportional to the aggregate bandwidth.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.
- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. Using Iperf, initiate maximum IPv4 UDP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
4. Record the two minute average DL throughput value of the aggregated cells.
5. Using Iperf, initiate maximum IPv6 UDP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
6. Record the two minute average DL throughput value of the aggregated cells.

Expected Results

After Step 3, verify that:

- The UE is successfully configured with the SCC according to the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message.
- UE listens for PDCCH and transmit data and activates CA when requested by the eNodeB.

- UE sends CQI for both the PCC and the SCC after activation.

After Step 4, verify that:

- Record average DL throughput value of the aggregated cells.
- Ensure average DL throughput value is greater than the corresponding required value in Table C-7 or operator endorsed values

After Step 6, verify that:

- Record average DL throughput value of the aggregated cells.
- Ensure average DL throughput value is greater than the corresponding required value in Table C-7 or operator endorsed values

4.2 Open Loop Spatial Multiplexing FTP Throughput with Downlink 64QAM

Definition and Purpose

The purpose of this test is to verify that a downlink data transfer with maximum traffic can be successfully performed for both primary cell and secondary cell and the throughput is proportional to the aggregate bandwidth.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.
- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. By starting DL FTP initiate maximum IPv4 TCP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
4. Record the two minute average DL throughput value of the aggregated cells.

5. By starting DL FTP initiate maximum IPv6 TCP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.

6. Record the two minute average DL throughput value of the aggregated cells.

Expected Results

After Step 3, verify that:

- The UE is successfully configured with the SCC according to the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message.
- UE listens for PDCCH, transmit data and activates CA when requested by the eNodeB.
- UE sends CQI for both the PCC and the SCC after activation.

After Step 4:

- Record the average DL throughput value of the aggregated.
- Ensure average DL throughput value is greater than the corresponding required value in Table C-7 or operator endorsed values

After Step 6:

- Record the average DL throughput value of the aggregated.
- Ensure average DL throughput value is greater than the corresponding required value in Table C-7 or operator endorsed values

4.3 Open Loop Spatial Multiplexing UDP IPv4 Throughput with Downlink 64QAM and Uplink 16QAM

Definition and Purpose

The purpose of this test is to verify that simultaneous downlink and uplink data transfer with maximum traffic can be successfully performed for both the PCC and the SCC and the throughput is proportional to the aggregate bandwidth. Also to verify that maximum downlink traffic is not affecting UE's maximum traffic.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.

- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. Using Iperf, initiate both maximum UDP uplink & downlink throughput (DL dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
4. Record the two minute average UL&DL throughput values of the aggregated cells.

Expected Results

After Step 3, verify that:

- The UE is successfully configured with the SCC according to the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message.
- UE listens for PDCCH and transmit data and activates CA when requested by the eNodeB.
- UE sends CQI for both the PCC and the SCC after activation.

After Step 4:

- Record the average DL throughput value of the aggregated cells.
- Record the UL throughput value.
- Ensure average throughput values are greater than the corresponding required values in Table C-7 or operator endorsed values

4.4 Transmit Diversity UDP IPV4 Throughput with Downlink 64QAM

Definition and Purpose

The purpose of this test is to verify that a downlink data transfer with maximum traffic can be successfully performed for both the PCC and SCC and the throughput is proportional to the aggregate bandwidth.

Initial Conditions

- Configure the UE per Section 1.7.

- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.
- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. Using Iperf, initiate maximum UDP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
4. Record the two minute average DL throughput value of the aggregated cells.

Expected Results

After Step 3, verify that:

- The UE is successfully configured with the SCC according to the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message.
- UE listens for PDCCH and transmit data and activates CA when requested by the eNodeB.
- UE sends CQI for both the PCC and the SCC after activation.

After Step 4:

- Record the average DL throughput value of the aggregated cells.
- Ensure average DL throughput value is greater than the corresponding required value in TableC-7 or operator endorsed values

4.5 SIMO UDP IPV4 Throughput with Downlink 64QAM

Definition and Purpose

The purpose of this test is to verify that a downlink data transfer with maximum traffic can be successfully performed for both the PCC and the SCC and the throughput is proportional to the aggregate bandwidth.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.
- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. Using Iperf, initiate maximum UDP downlink throughput (dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.
4. Record the two minute average DL throughput value of the aggregated cells.

Expected Results

After Step 3, verify that:

- The UE is successfully configured with the SCC according to the contents of the sCellToAddModList-r10 parameter found in the RRCConnectionReconfiguration message.
- UE listens for PDCCH and transmit data and activates CA when requested by the eNodeB.
- UE sends CQI for both the PCC and the SCC after activation.

After Step 4:

- Record the average DL throughput value of the aggregated.
- Ensure average DL throughput value is greater than the corresponding required value in Table C-7 or operator endorsed values

Section 5 CA Interaction with Other Network Features

5.1 Interaction with Basic LTE Features

Definition and Purpose

TBD – the following two features (CDRX and SRS) are just as an example

This test verifies that the UE can successfully comply with basic LTE features while simultaneously has download traffic with acceptable CA throughput rates.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- eNodeB1 is configured with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- eNodeB1 has short and long DRX and SRS enabled.
- eNodeB2 has only one component carrier active.
- PCC1, the PCC of eNodeB1, is configured as a neighbour cell to eNodeB2.
- The eNodeBs have been configured with appropriate measurement event, i.e. A3 events.
- PCC1 RSRP is stronger than the RSRP of eNodeB2.

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Attenuate the signal level of PCC1 and amplify the signal level of eNodeB2.
4. Attenuate the signal level of eNodeB2 and amplify the signal level of PCC1.
5. Repeat Steps 3 through 4 two more times.
6. Record the average DL throughput value of the aggregated.

Expected Results

- The device is not impacted by the configuration of the features in the initial configuration on handover and performance in the CA activated cells.

- The device shall pass all the criteria as per Intra-Band Intra-Frequency Handover between CA to non-CA Cell found in Section 3.2.

5.2 MO eCSFB Call while UE is CA Activated

Definition and Purpose

This test verifies that the UE can successfully perform a MO eCSFB call while in CA activated and has DL Data transfer on-going.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- Configure EUTRAN support for eCSFB as defined in Section 1.6.
- Configure the E-UTRAN to transmit the SIB-8 that contains the information in Section 1.11
- Both eNodeBs are configured with PCCs and SCCs as defined in Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbour cells to one another.
- The eNodeBs have been configured with the appropriate measurement events, i.e. A3 events.
- PCC1 is the PCC of eNodeB1. SCC1 is the SCC of eNodeB1.
- PCC2 is the PCC of eNodeB2. SCC2 is the SCC of eNodeB2
- PCC1 RSRP is stronger than PCC2 RSRP.

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Make a MO voice call.
4. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.
5. Terminate the voice call after 30 seconds.
6. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
7. Repeat Steps 4 and 6 one more time.
8. Record the average DL throughput value of the aggregated.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- E-UTRAN suspends the LTE data session.
- The voice call is not impacted by the configuration of CA

After Step 5, verify that:

- The UE returns to LTE, performs a TAU, and successfully attaches to PCC2.
- Upon reattaching to the LTE network, the data session is restored.
- The UE configured and activated SCC2 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 6, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 4 and Step 6, verify that:

- All subsequent handovers follow expected results described above.

5.3 MT eCSFB Call while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully perform a MT eCSFB call from an RRC_Connected with CA activated state.

Initial Conditions

- Configure the UE per Section 1.7.

- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- Configure EUTRAN support for eCSFB as defined in Section 1.6
- Configure the E-UTRAN to transmit the SIB-8 that contains the information in 1.11
- Both eNodeBs are configured with PCCs and SCCs as defined in Section Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbor cells to one another.
- The eNodeBs have been configured with the appropriate measurement events, i.e. A3 events.
- PCC1 is the PCC of eNodeB1. SCC1 is the SCC of eNodeB1.
- PCC2 is the PCC of eNodeB2. SCC2 is the SCC of eNodeB2
- PCC1 RSRP is stronger than PCC2 RSRP.

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Make a MT voice call.
4. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.
5. Terminate the voice call after 30 seconds.
6. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
7. Repeat Steps 4 and 6 one more time.
8. Record the average DL and UL throughput value of the aggregated.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- E-UTRAN suspends the LTE data session.
- The voice call is not impacted by the configuration of CA

After Step 5, verify that:

- The UE returns to LTE, performs a TAU, and successfully attaches to PCC2.
- Upon reattaching to the LTE network, the data session is restored.
- The UE configured and activated SCC2 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 6, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 4 and Step 6, verify that:

- All subsequent handovers follow expected results described above.

5.4 MO eCSFB SMS while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully receive a MO eCSFB SMS from an RRC_Connected with CA activated state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure one available eNodeB with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- Configure EUTRAN support for eCSFB as defined in Section 1.6
- Configure the E-UTRAN to transmit the SIB-8 that contains the information in Section 1

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Record the average DL and UL throughput value of the aggregated.

4. Trigger a large MO SMS over 240 characters.

Expected Results

After Step 2, verify that:

- The UE attaches to the LTE network successfully.
- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 4, verify that:

- GCSNA (DBM) message fields are populated properly and Ack_Req=0.
- The GCSNA TL Ack is received.
- The SMS is successfully sent.
- The CA data session is not impacted by the MO SMS.

5.5 MT eCSFB SMS while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully receive a MT eCSFB SMS from an RRC_Connected with CA activated state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure one available eNodeB with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- Configure EUTRAN support for eCSFB as defined in Section 1.6
- Configure the E-UTRAN to transmit the SIB-8 that contains the information in Section 1.11

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Record the average DL and UL throughput value of the aggregated.
4. Make a large MT SMS over 240 characters.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- The GCSNA (DBM) is delivered to the 1X stack.
- The GCSNA TL Ack is sent by the UE for each segment of the SMS.
- GCSNA (DBM) message fields are populated properly and Ack_Req=0.
- All segments of the SMS are successfully received
- The CA data session is not impacted by the MT SMS.

5.6 Interaction with IRAT to eHRPD

Definition and Purpose

This test verifies that the UE can successfully report HRPD measurements, maintain session continuity, and transition from LTE to eHRPD when instructed by e-NodeB with CA activated.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure the UE to make eHRPD power measurements during the measurement gaps while on the LTE network.
- Configure the LTE network so that the eNodeB transmits system information and schedules measurement gaps with SIB3/SIB8 pointing to an available eHRPD Cell.
- Configure PCC and SCC as defined in Appendix C or by operator endorsed combination
- PCC and SCC are both available.
- RSRP of the PCC is strong.
- SCC is completely attenuated and UE cannot read it.

Test Procedure

1. Attach the UE to the PCC.
2. Amplify the SCC RSRP so it is stronger than -70 dBm.
3. Using Iperf, initiate both maximum UDP uplink & downlink throughput (DL dependent upon the sum of the bandwidth combination tested) and ensure that the eNodeB activates the configured SCC by sending the activation MAC control element.

4. While the UE is receiving down link UDP transfer, attenuate both LTE signals so the LTE network will request the UE to report the HRPD signal and then redirects the UE to the eHRPD Cell

Expected Results

After Step 2, verify that:

- The device successfully starts UDP data transfer in CA configuration

After Step 4, verify that:

- The device successfully reports the HRPD signal when requested by eNodeB during the measurement gap.
- The SCC is deactivated and de-configured.
- The device successfully transitions to eHRPD while maintaining session continuity.

5.7 MO 1x/LTE Hybrid Call while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully perform a 1X/LTE Hybrid MO call from an RRC_Connected with CA activated state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- Configure UE to support 1x/LTE Hybrid mode
- Both eNodeBs are configured with PCCs and SCCs as defined in Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbour cells to one another.
- A single 1xRTT cell site is available.

Test Procedure

1. Ensure that the UE is Hybrid 1X/LTE capable and can register on the 1xRTT network (for voice services) and LTE network (for data services) prior to executing any steps beyond powering up the device.
2. Attach the UE to PCC1.
3. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).

4. Make a MO voice call.
5. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.
6. Terminate the voice call after 30 seconds.
7. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
8. Repeat Steps 4 and 6 one more time.

Expected Results

- Verify that the device maintains 1xRTT registration throughout the test case.

After Step 1, verify that:

- The UE attaches successfully registers on the 1x network.

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 4, verify that:

- E-UTRAN suspends the LTE data session.
- The voice call is not impacted by the configuration of CA

After Step 6, verify that:

- The UE returns to LTE and successfully preforms TAU request to PCC2.
- Upon reattaching to the LTE network, the data session is restored.
- The UE configured and activated SCC2 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 7, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 4 and Step 6, verify that:

- All subsequent handovers follow expected results described above.

5.8 MT 1x/LTE Hybrid Call while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully perform a 1X/LTE Hybrid MT call from an RRC_Connected with CA activated state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure two available eNodeBs: eNodeB1 and eNodeB2.
- Configure UE to support 1x/LTE Hybrid mode
- Both eNodeBs are configured with PCCs and SCCs as defined in Appendix C or by operator endorsed combination
- The two PCCs are configured as neighbour cells to one another.
- A single 1xRTT cell site is available.

Test Procedure

1. Ensure that the UE is Hybrid 1X/LTE capable and can register on the 1xRTT network (for voice services) and LTE network (for data services) prior to executing any steps beyond powering up the device.
2. Attach the UE to PCC1.
3. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
4. Make a MT voice call.
5. The UE should receive a page for the 1x MT call.
6. Attenuate the signal level of PCC1 and amplify the signal level of PCC2.
7. Terminate the voice call after 30 seconds.
8. Attenuate the signal level of PCC2 and amplify the signal level of PCC1.
9. Repeat Steps 4 and 6 one more time.

Expected Results

- Verify that the device maintains 1xRTT registration throughout the test case.

After Step 1, verify that:

- The UE attaches successfully registers on the 1x network.

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 4, verify that:

- E-UTRAN suspends the LTE data session.
- The voice call is not impacted by the configuration of CA.

After Step 6, verify that:

- The UE returns to LTE and successfully performs TAU requestto PCC2.
- Upon reattaching to the LTE network, the data session is restored.
- The UE configured and activated SCC2 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

After Step 7, verify that:

- SCC2 is deactivated and de-configured.
- The UE has been successfully handed over to the PCC1/eNodeB1 by the RRCConnectionReconfiguration message containing the mobilityControlInfo IE sent from PCC2.
- The UE configured and activated SCC1 and all bearers are correctly reconfigured.
- The UE resumed the traffic with maximum throughput (dependent upon aggregated bandwidth).

When repeating Step 4 and Step 6, verify that:

- All subsequent handovers follow expected results described above.

5.9 MO 1x/LTE Hybrid SMS while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully receive a MO SMS over 1xRTT in RRC_Connected with CA in activate state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure one available eNodeB with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- Configure UE to support 1x/LTE Hybrid

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).
3. Make a MO SMS.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- The MO SMS is sent successfully.
- The CA data session is not impacted by the MO SMS.

5.10 MT 1x/LTE Hybrid SMS while CA RRC_Connected

Definition and Purpose

This test verifies that the UE can successfully receive a MT SMS over 1xRTT in RRC_Connected with CA in activate state.

Initial Conditions

- Configure the UE per Section 1.7.
- Configure one available eNodeB with a PCC and SCC as defined in Appendix C or by operator endorsed combination
- Configure UE to support 1x/LTE Hybrid mode

Test Procedure

1. Attach the UE to PCC1.
2. Initiate maximum UDP bidirectional traffic (Dependent upon BW combination used).

3. Make a MT SMS.

Expected Results

After Step 2, verify that:

- The UE attaches and starts traffic with maximum throughput and SCC1 is activated.

After Step 3, verify that:

- The MT SMS is received successfully.
- The CA data session is not impacted by the MT SMS.

Appendix A Device Checklist and UE Information Summary

A.1 General Information

Item	Vendor Provided Information	Comments
UE Manufacturer:		
UE Model:		
UE Software Version		
UE Hardware Version		
UE Protocol Version (if applicable)		
Chipset Manufacturer		
Chipset Number / Name		
Chipset Firmware Version		
UE Serial Number		
List the targeted Carrier(s)		

A.2 Contact Information

Item	Vendor Provided Information	Comments
UE Vendor Representative		
Phone Number:		
Email Address:		

A.3 Testing Requirements

Please indicate the testing required:	List the type of testing, test suites and/or specifications per testing should be executed. ☐ Full Testing ☐ Regression Testing ☐ Debug / Development Testing ☐ CTIA LTE INTEROPERABILITY TEST PLAN ☐ CTIA LTE CARRIER AGGREGATION INTEROPERABILITY - TEST PLAN

List all LTE bands supported by the UE	
List all bandwidth supported by the UE	
Indicate the primary band class for testing	
Indicate the primary bandwidth for testing	
Please list all other feature	
RF Connection	
External Power Supply Required	☐ Yes ☐ Volts ☐ Amps ☐ No

A.4 UE Capabilities

3GPP Compliance Level:	Provide Release information for following: 3GPP TS 36.211: _____ 3GPP TS 36.213:_____ 3GPP TS 36.321:_____ 3GPP TS 36.322:_____ 3GPP TS 36.323:_____ 3GPP TS 36.331:_____ 3GPP TS 36.301:_____
Device Radio Capabilities:	☐ UE Category supported
Device Network Capabilities:	
UICC or S/W USIM Interface:	☐ Supports USIM on UICC ☐ Supports CSIM on UICC

A.5 Programming and Tool Requirements

Item	Vendor Provided Information	Comments
DM tools		
Programming tools		
UE USIM / UICC Card and programming instruction		
Other tools		
AT commands		List/provide tool required or AT commands necessary to program
USB Driver version (if supported)		
RF Cables supplied (minimum 2)		
Data and DM cables provided		

A.6 Interoperability Lab Specific Requirements

Item	Vendor Provided Information	Comments

A.7 Test Cases Not Supported

Reference: CTIA Interoperability Test Plan	Please list all test cases not supported in the chapter	Comments

A.8 General List Of Equipment Required

Checklist to include with Submission.

Item	Comments
☐ 2 to 5 mobile stations with valid ID as defined by FCC ***(Keypads must have alpha-numeric characters correctly labeled.)***	
☐ Two Mobile Batteries ***(minimum)***	
☐ Battery Charger ***(compatible with 110 V connection)***	
☐ Newest version of the Diagnostic Monitor (DM) Software on CD-ROM	
☐ Diagnostic Monitor (DM) Interface Cable	
☐ Diagnostic Monitor Key "dongle"	
☐ 3 RF Cables	
☐ Data Services Interface Cable ***(if different from DM cable)***	
☐ AT Commands needed for set up	
☐ Programming instructions in American English for Mobile and DM	
☐ USB Driver	

Appendix B CA Configurations and Bandwidth Combination Sets as Defined in 3GPP TS 36.101(rel 12) Section 5

TABLE B-1 INTRA-BAND CONTIGUOUS CA

E-UTRA CA Configuration / Bandwidth Combination Set						
E-UTRA CA configuration	Uplink CA configurations[3]	Component carriers in order of increasing carrier frequency			Maximum aggregated bandwidth [MHz]	Bandwidth combination set
		Channel bandwidths for carrier [MHz]	Channel bandwidths for carrier [MHz]	Channel bandwidths for carrier [MHz]		
CA_1C	CA_1C	15	15		40	0
		20	20			
CA_2C		5	20		40	0
		10	15, 20			
		15	10, 15, 20			
		20	5, 10, 15, 20			
CA_3C	CA_3C	5, 10, 15	20		40	0
		20	5, 10, 15, 20			
CA_7C	CA_7C	15	15		40	0
		20	20			
		10	20		40	1
		15	15, 20			
		20	10, 15, 20			
CA_12B	-	5	5, 10		15	0
CA_23B	-	10	10		20	0
		5	15			
CA_27B	-	1.4, 3, 5	5		13	0
		1.4, 3	10			
CA_38C	CA_38C	15	15		40	0
		20	20			
CA_39C	CA_39C	5,10,15	20		35	0
		20	5, 10, 15			
CA_40C	CA_40C	10	20		40	0
		15	15			
		20	10, 20			
		10, 15	20		40	1
		15	15			
		20	10, 15, 20			
CA_40D	CA_40C	10, 15, 20	20	20	60	0
		20	10, 15	20		
		20	20	10, 15		
CA_41C	CA_41C	10	20		40	0
		15	15, 20			
		20	10, 15, 20			

E-UTRA CA Configuration / Bandwidth Combination Set						
E-UTRA CA configuration	**Uplink CA configurations[3]**	**Component carriers in order of increasing carrier frequency**			**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
		Channel bandwidths for carrier [MHz]	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**		
		5, 10	20		40	1
		15	15, 20			
		20	5, 10, 15, 20			
		10	15, 20		40	2
		15	10, 15, 20			
		20	10, 15, 20			
CA_41D	CA_41C	10	20	15	60	0
		10	15, 20	20		
		15	20	10, 15		
		15	10, 15, 20	20		
		20	15, 20	10		
		20	10, 15, 20	15, 20		
CA_42C	CA_42C	5, 10, 15, 20	20		40	0
		20	5, 10, 15			

NOTE 1: The CA configuration refers to an operating band and a CA bandwidth class specified in Table B-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.

NOTE 2: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.

NOTE 3: Uplink CA configurations are the configurations supported by the present release of specifications.

Table B-2 Inter-band CA (Two Bands)

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
CA_1A-3A	CA_1A-3A	1			Yes	Yes	Yes	Yes	40	0
		3			Yes	Yes	Yes	Yes		
CA_1A-5A	CA_1A-5A	1				Yes			20	0
		5				Yes				
		1			Yes	Yes	Yes	Yes	30	1
		5			Yes	Yes				
CA_1A-7A	CA_1A-7A	1			Yes	Yes	Yes	Yes	40	0
		7				Yes	Yes	Yes		
CA_1A-8A	CA_1A-8A	1			Yes	Yes	Yes	Yes	30	0
		8			Yes	Yes				
		1			Yes	Yes			20	1
		8			Yes	Yes				
		1			Yes	Yes	Yes	Yes	30	2
		8		Yes	Yes	Yes				
CA_1A-11A	-	1			Yes	Yes	Yes	Yes	30	0
		11			Yes	Yes				
CA_1A-18A	-	1			Yes	Yes	Yes	Yes	35	0
		18			Yes	Yes	Yes			
		1			Yes	Yes			20	1
		18			Yes	Yes				
CA_1A-19A	CA_1A-19A	1			Yes	Yes	Yes	Yes	35	0
		19			Yes	Yes	Yes			
CA_1A-20A	-	1			Yes	Yes	Yes	Yes	40	0
		20			Yes	Yes	Yes	Yes		
CA_1A-21A	CA_1A-21A	1			Yes	Yes	Yes	Yes	35	0
		21			Yes	Yes	Yes			
CA_1A-26A	-	1			Yes	Yes	Yes	Yes	35	0
		26			Yes	Yes	Yes			
		1			Yes	Yes			20	1
		26			Yes	Yes				
CA_1A-28A	-	1			Yes	Yes	Yes	Yes	40	0
		28			Yes	Yes	Yes	Yes		
		1			Yes	Yes			20	1
		28			Yes	Yes				
CA_1A-41A	-	1			Yes	Yes	Yes	Yes	40	0
		41			Yes	Yes	Yes	Yes		
CA_1A-41C	-	1			Yes	Yes	Yes	Yes	60	0
		41	See CA_41C Bandwidth Combination Set 1 in Table B-1							
CA_1A-42A	-	1			Yes	Yes	Yes	Yes	40	0
		42			Yes	Yes	Yes	Yes		
CA_1A-42C	-	1			Yes	Yes	Yes	Yes	60	0
		42	See CA_42C Bandwidth Combination Set 0 in Table B-1							
CA_2A-4A	CA_2A-4A	2	Yes	Yes	Yes	Yes	Yes	Yes	40	0
		4			Yes	Yes	Yes	Yes		
		2			Yes	Yes			20	1
		4			Yes	Yes				

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
		2			Yes	Yes	Yes	Yes	40	2
		4			Yes	Yes	Yes	Yes		
CA_2A-4A-4A	-	2			Yes	Yes	Yes	Yes	60	0
		4	See CA_4A-4A Bandwidth Combination Set 0 in Table B-1							
CA_2A-5A	-	2			Yes	Yes	Yes	Yes	30	0
		5			Yes	Yes				
		2			Yes	Yes			20	1
		5			Yes	Yes				
CA_2A-2A-5A	-	2	See CA_2A-2A Bandwidth Combination Set 0 in Table B-1						50	0
		5			Yes	Yes				
CA_2A-12A	-	2			Yes	Yes	Yes	Yes	30	0
		12			Yes	Yes				
		2			Yes	Yes	Yes	Yes	30	1
		12		Yes	Yes	Yes				
CA_2A-12B	-	2			Yes	Yes	Yes	Yes	35	0
		12	See CA_12B Bandwidth Combination Set 0 in Table B-1							
CA_2A-13A	CA_2A-13A	2			Yes	Yes	Yes	Yes	30	0
		13				Yes				
		2			Yes	Yes			20	1
		13				Yes				
CA_2A-2A-13A	-	2	See CA_2A-2A Bandwidth Combination Set 0 in Table B-1						50	0
		13				Yes				
CA_2A-17A	-	2			Yes	Yes			20	0
		17			Yes	Yes				
CA_2A-29A	-	2			Yes	Yes			20	0
		29		Yes	Yes	Yes				
		2			Yes	Yes			20	1
		29			Yes	Yes				
		2			Yes	Yes	Yes	Yes	30	2
		29			Yes	Yes				
CA_2C-29A	-	2	See CA_2C Bandwidth Combination Set 0 in Table B-1						50	0
		29			Yes	Yes				
CA_2A-30A	-	2			Yes	Yes	Yes	Yes	30	0
		30			Yes	Yes				
CA_3A-5A	CA_3A-5A	3				Yes	Yes	Yes	30	0
		5			Yes	Yes				
		3				Yes			20	1
		5			Yes	Yes				
		3			Yes	Yes	Yes	Yes	30	2
		5			Yes	Yes				
CA_3A-7A	CA_3A-7A	3			Yes	Yes	Yes	Yes	40	0
		7				Yes	Yes	Yes		
CA_3A-7C	-	3			Yes	Yes	Yes	Yes	60	0

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
		7	See CA_7C Bandwidth combination set 1 in Table B-1							
CA_3C-7A	-	3	See CA_3C Bandwidth Combination Set 0 in Table B-1						60	0
		7			Yes	Yes	Yes	Yes		
CA_3A-8A	CA_3A-8A	3				Yes	Yes	Yes	30	0
		8			Yes	Yes				
		3				Yes			20	1
		8			Yes	Yes				
		3			Yes	Yes	Yes	Yes	30	2
		8		Yes	Yes	Yes				
CA_3A-19A	CA_3A-19A	3			Yes	Yes	Yes	Yes	35	0
		19			Yes	Yes	Yes			
CA_3A-20A	CA_3A-20A	3			Yes	Yes	Yes	Yes	30	0
		20			Yes	Yes				
		3			Yes	Yes	Yes	Yes	40	1
		20			Yes	Yes	Yes	Yes		
CA_3A-26A	CA_3A-26A	3			Yes	Yes	Yes	Yes	35	0
		26			Yes	Yes	Yes			
		3			Yes	Yes			20	1
		26			Yes	Yes				
CA_3A-27A	-	3			Yes	Yes	Yes	Yes	30	0
		27			Yes	Yes				
CA_3A-28A	-	3			Yes	Yes	Yes	Yes	40	0
		28			Yes	Yes	Yes	Yes		
CA_3A-42A	-	3			Yes	Yes	Yes	Yes	40	0
		42			Yes	Yes	Yes	Yes		
CA_3A-42C	-	3			Yes	Yes	Yes	Yes	60	0
		42	See Table B-1							
CA_4A-5A	-	4			Yes	Yes			20	0
		5			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	1
		5			Yes	Yes				
CA_4A-4A-5A	-	4	See CA_4A-4A Bandwidth Combination Set 0 in Table B-1						50	0
		5			Yes	Yes				
CA_4A-7A	CA_4A-7A	4			Yes	Yes			30	0
		7			Yes	Yes	Yes	Yes		
CA_4A-4A-7A	-	4			Yes	Yes			40	0
		4			Yes	Yes				
		7			Yes	Yes	Yes	Yes		
CA_4A-12A	CA_4A-12A	4	Yes	Yes	Yes	Yes			20	0
		12			Yes	Yes				
		4	Yes	Yes	Yes	Yes	Yes	Yes	30	1
		12			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	2
		12		Yes	Yes	Yes				
		4			Yes	Yes			20	3
		12			Yes	Yes				

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
		4			Yes	Yes	Yes	Yes	30	4
		12			Yes	Yes				
CA_4A-4A-12A	-	4	See CA_4A-4A Bandwidth Combination Set 0 in Table B-1						50	0
		12			Yes	Yes				
CA_4A-12B	-	4			Yes	Yes	Yes	Yes	35	0
		12	See CA_12B Bandwidth Combination Set 0 in Table B-1							
CA_4A-13A	CA_4A-13A	4			Yes	Yes	Yes	Yes	30	0
		13				Yes				
		4			Yes	Yes			20	1
		13				Yes				
CA_4A-4A-13A	-	4	See CA_4A-4A Bandwidth Combination Set 0 in Table B-1						50	0
		13				Yes				
CA_4A-17A	CA_4A-17A	4			Yes	Yes			20	0
		17			Yes	Yes				
CA_4A-27A	-	4			Yes	Yes	Yes	Yes	30	0
		27		Yes	Yes	Yes				
CA_4A-29A	-	4			Yes	Yes			20	0
		29		Yes	Yes	Yes				
		4			Yes	Yes			20	1
		29			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	2
		29			Yes	Yes				
CA_4A-30A	-	4			Yes	Yes	Yes	Yes	30	0
		30			Yes	Yes				
CA_5A-7A	CA_5A-7A	5	Yes	Yes	Yes	Yes			30	0
		7				Yes	Yes	Yes		
CA_5A-12A	CA_5A-12A	5			Yes	Yes			20	0
		12			Yes	Yes				
CA_5A-13A	-	5			Yes	Yes			20	0
		13				Yes				
CA_5A-17A	-	5			Yes	Yes			20	0
		17			Yes	Yes				
CA_5A-25A	-	5			Yes	Yes			30	0
		25			Yes	Yes	Yes	Yes		
CA_5A-30A	-	5			Yes	Yes			20	0
		30			Yes	Yes				
CA_7A-8A	-	7				Yes	Yes	Yes	30	0
		8		Yes	Yes	Yes				
CA_7A-12A	-	7			Yes	Yes	Yes	Yes	30	0
		12			Yes	Yes				
CA_7A-20A	CA_7A-20A	7				Yes	Yes	Yes	30	0
		20			Yes	Yes				
		7				Yes	Yes	Yes	40	1
		20			Yes	Yes	Yes	Yes		
CA_7A-28A	CA_7A-28A	7			Yes	Yes	Yes	Yes	35	0
		28			Yes	Yes	Yes			

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
CA_8A-11A	-	8			Yes	Yes			20	0
		11			Yes	Yes				
CA_8A-20A	-	8			Yes	Yes			20	0
		20			Yes	Yes				
		8		Yes	Yes	Yes			20	1
		20			Yes	Yes				
CA_8A-40A	-	8			Yes	Yes			30	0
		40			Yes	Yes	Yes	Yes		
CA_11A-18A	-	11			Yes	Yes			25	0
		18			Yes	Yes	Yes			
CA_12A-25A	-	12			Yes	Yes			30	0
		25			Yes	Yes	Yes	Yes		
CA_12A-30A	-	12			Yes	Yes			20	0
		30			Yes	Yes				
CA_18A-28A	-	18			Yes	Yes	Yes		25	0
		28			Yes	Yes				
CA_19A-21A	CA_19A-21A	19			Yes	Yes	Yes		30	0
		21			Yes	Yes	Yes			
CA_19A-42A	-	19			Yes	Yes	Yes		35	0
		42			Yes	Yes	Yes	Yes		
CA_19A-42C	-	19			Yes	Yes	Yes		55	0
		42	See CA_42C Bandwidth Combination Set 0 in Table B-1							
CA_20A-32A	-	20			Yes	Yes			30	0
		32			Yes	Yes	Yes	Yes		
CA_23A-29A	-	23			Yes	Yes	Yes	Yes	30	0
		29		Yes	Yes	Yes				
		23			Yes	Yes			20	1
		29		Yes	Yes	Yes				
CA_25A-41A	-	25			Yes	Yes	Yes	Yes	40	0
		41			Yes	Yes	Yes	Yes		
CA_25A-41C	-	25			Yes	Yes	Yes	Yes	60	0
		41	See CA_41C Bandwidth Combination Set 1 in Table B-1							
CA_26A-41A	-	26			Yes	Yes	Yes		35	0
		41			Yes	Yes	Yes	Yes		
CA_26A-41C	-	26			Yes	Yes	Yes		55	0
		41	See CA_41C Bandwidth Combination Set 1 in Table B-1							
CA_29A-30A	-	29			Yes	Yes			20	0
		30			Yes	Yes				
CA_39A-41A	CA_39A-41A	39				Yes	Yes	Yes	40	0
		41						Yes		
CA_39A-41C	-	39				Yes	Yes	Yes	60	0
		41						Yes		
		41						Yes		
CA_39C-41A	-	39	See CA_39C Bandwidth Combination Set 0 in Table B-1						55	0
		41						Yes		

E-UTRA CA configuration / Bandwidth combination set										
E-UTRA CA Configuration	**Uplink CA configurations4**	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
CA_41A-42A	-	41				Yes	Yes	Yes	40	0
		42				Yes	Yes	Yes		

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table B-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.
NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.
NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.
NOTE 4: Uplink CA configurations are the configurations supported by the present release of specifications.

Table B-3 Non-contiguous Intra-band CA (with two sub-blocks)

E-UTRA CA configuration / Bandwidth combination set						
E-UTRACA configuration	**Uplink CA configurations [1]**	**Component carriers in order of increasing carrier frequency**			**Maximum aggregated bandwidth [MHz]**	**Bandwidth combination set**
		Channel bandwidths for carrier [MHz]	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**		
CA_2A-2A	-	5, 10, 15, 20	5, 10, 15, 20		40	0
CA_3A-3A	-	5, 10, 15, 20	5, 10, 15, 20		40	0
CA_4A-4A	CA_4A-4A	5, 10, 15, 20	5, 10, 15, 20		40	0
CA_7A-7A	-	5	15		40	0
		10	10, 15			
		15	15, 20			
		20	20			
CA_23A-23A	-	5	10		15	0
CA_25A-25A	-	5, 10	5, 10		20	0
		5, 10, 15, 20	5, 10, 15, 20		40	1
CA_41A-41A	-	10, 15, 20	10, 15, 20		40	0
		5, 10, 15, 20	5, 10, 15, 20		40	1
CA_41A-41C	-	5, 10, 15, 20	See CA_41C Bandwidth Combination Set 1 in Table B-1		60	0
CA_41C-41A	-	See CA_41C Bandwidth Combination Set 1 in Table B-1		5, 10, 15, 20	60	0
CA_42A-42A	-	5, 10, 15, 20	5, 10, 15, 20		40	0
NOTE 1: Uplink CA configurations are the configurations supported by the present release of specifications.						

Maximum Throughput per ue-Category

As in 3GPP TS 36.306

Table B-4 Downlink Physical Layer Parameter Values Set by the Field UE-Category

UE Category	Maximum number of DL-SCH transport block bits received within a TTI[1]	Maximum number of bits of a DL-SCH transport block received within a TTI	Total number of soft channel bits	Maximum number of supported layers for spatial multiplexing in DL
Category 1	10296	10296	250368	1
Category 2	51024	51024	1237248	2
Category 3	102048	75376	1237248	2
Category 4	150752	75376	1827072	2
Category 5	299552	149776	3667200	4
Category 6	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 7	301504	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	3654144	2 or 4
Category 8	2998560	299856	35982720	8
Category 9	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 10	452256	149776 (4 layers, 64QAM) 75376 (2 layers, 64QAM)	5481216	2 or 4
Category 11	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4
Category 12	603008	149776 (4 layers, 64QAM) 195816 (4 layers, 256QAM) 75376 (2 layers, 64QAM) 97896 (2 layers, 256QAM)	7308288	2 or 4

NOTE 1: In carrier aggregation operation, the DL-SCH processing capability can be shared by the UE with that of MCH received from a serving cell. If the total eNB scheduling for DL-SCH and an MCH in one serving cell at a given TTI is larger than the defined processing capability, the prioritization between DL-SCH and MCH is left up to UE implementation.

Appendix C Band 41 Recommendations

TDD subframe and special subframe configuration should mimic that of the deployed field network.

All SCCs should be directly configured unless otherwise stated by the test case.

The band combination used for testing must be supported by the UE and be comprised of a PCC and SCC defined in 3GPP 36.101 Section 5.

Table C-5 Default, eNodeB1, and eNodeB2 CA Configuration

Band Combination	DL PCC (BW)	DL SCC (BW)	UL PCC (BW)	UL SCC (BW)
CA_41C	40056 (20 MHz)	40254 (20 MHz)	40056 (20 MHz)	No Uplink CA Supported
CA_41D	40056 (20 MHz)	40254 40437 (20 MHz)	40056 (20 MHz)	No Uplink CA Supported

Table C-6 eNodeB3 CA Configuration

Band Combination	DL PCC (BW)	DL SCC (BW)	UL PCC (BW)	UL SCC (BW)
CA_41C	40650 (20 MHz)	40452 (20 MHz)	40650 (20 MHz)	No Uplink CA Supported
CA_41D	40650 (20 MHz)	40848 41031 (20 MHz)	40650 (20 MHz)	No Uplink CA Supported

Table C-7 Recommended Minimum Throughput for the Following Test Cases

Test Case Number	DL (Mbps)	UL (Mbps)
4.1	TBD	
4.2	TBD	
4.3	TBD	TBD
4.4	TBD	TBD
4.5	TBD	TBD

Refer to operator and / or operator's market endorsement for pass / fail criteria.

Appendix D Change History

Date	Version	Description
August 2016	1.0	• Initial Publication
February 2017	1.1	• Corrections and updates per CPWG161019-1 to indicates test scope for 2CC and higher CCs will be in future versions. • Corrections to test cases: o 2.2, 2.5, 2.7, 3.6, 5.5, 5.7-5.10