



Test Plan

Plan Name: LTE Band 13 IOT Test Plan

Plan Id: LTEB13IOT

Version Number: 3.3

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Revision History VZ_TC_LTEB13IOT_2129575

| Rev. | Author | Definition of Changes | Date |
|------|------------------|---|-------------|
| 1.0 | Verizon Wireless | Initial Release | May 2010 |
| 1.1 | Verizon Wireless | <p>1. Changed Reference Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Procedures to Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process</p> <p>2. Removed test case 4.16 since it is a duplicate of test case 3.21</p> <p>3. Changed modulation levels of test cases</p> <p>4. Added dual stack to the tests in section 5</p> <p>5. Retitled sections 5.1, 5.2, 5.3 and 5.4 to indicate performance.</p> | June 2010 |
| 1.2 | Verizon Wireless | | August 2010 |

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|-----|------------------|--|----------------|
| | | 1. Clarified that the IMS Registration is required and that the IMS Test mode is off during testing. | |
| 1.3 | Verizon Wireless | Clarified Section 3.6. Modified test case 3.25 Updated reference document DG.11 to TS.11 | June 2011 |
| 1.4 | Verizon Wireless | Modified TC 3.6 & 3.7 Modified the round trip delay time to 30ms | September 2011 |
| 1.5 | Verizon Wireless | Added clarification to Section 2.1 Corrected UDP setting in Section 2.4 Modified the following TCs: 3.1, 3.16, 3.17, 3.18, 3.19, 3.24, 4.3, 5.1.3, 5.1.5 Added clarification to Section 6 | April 2012 |
| 1.6 | Verizon Wireless | Added Section 4.7 | July 2012 |

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|-----|------------------|--|---------------|
| 1.7 | Verizon Wireless | <p>Clarified Section 4.7</p> <p>Added Pass/Fail Criteria to Sections 5.2, 5.4</p> <p>Modified TCs: 5.1.3, 5.1.6, 5.1.9, 5.1.12, 5.3.3, 5.3.6, 5.3.9, 5.3.12</p> <p>Removed TCs: 4.12, 5.1.1, 5.1.2, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.10, 5.1.11, 5.3.1, 5.3.2, 5.3.4, 5.3.5, 5.3.7, 5.3.8, 5.3.10, 5.3.11, 6-3.1, 6-4.1.1</p> | February 2013 |
| 1.8 | Verizon Wireless | Added Test Case 4.8.1 | June 2013 |
| 1.9 | Verizon Wireless | Added Test Case 4.5.3 | October 2013 |
| 2.0 | Verizon Wireless | <p>Removed the following test cases: 3.24, 4.1.3, 4.1.4, 5.1.3, 5.1.6, 5.1.9, 5.1.12, 5.3.3, 5.3.6, 5.3.9, 5.3.12, 5.2.4, 5.2.5, 5.2.6, 5.2.7, 5.2.8, 5.2.9, 5.2.10, 5.2.11, 5.2.12, 5.2.1, 5.2.2, 5.2.3, 5.4.1, 5.4.2, 5.4.3.</p> <p>Modified the following Test cases:</p> <p>5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10, 5.4.11, 5.4.12</p> | May 2015 |

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|-----|------------------|--|---------------|
| | | Modified UICC section Added TC 73 & 74 | |
| 2.1 | Verizon Wireless | <p>Removed following Test Case:</p> <p>5.4.4, 5.4.5</p> <p>Updated UICC section.</p> <p>Removed section 6.</p> <p>Updated Test Report Template to reflect it with Updated Test Plan.</p> <p>Added CRS-IC Test Cases and created section 8(8.1, 8.2, 8.3 and 8.4)</p> | October 2015 |
| 2.2 | Verizon Wireless | <p>Updated test report template.</p> <p>Updated TC 3.8 to reference GSMA TS11 in the Pre-Condition and Expected results sections.</p> | February 2016 |
| 2.3 | Verizon Wireless | <p>Updated Version of GSMA TS.11 in references</p> <p>Updated the "Test and Tools:" section to allow for the use of additional tools</p> <p>Modified Test cases: 5.4.6, 4.7.1, 4.7.2, 4.7.4</p> | October 2016 |

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|-----|------------------|--|---------------|
| | | <p>(C-RNTI value changes during test)</p> <p>Retired test cases: 4.7.3, 3.5,</p> <p>Updated descriptions in 5.4.6 through 5.4.12</p> <p>Modified Results template</p> <p>Changed MCS requirements to 'NW default' except in test cases where it is specified</p> <p>Added text allowing radiated testing in VzW internal lab</p> <p>3.5, 4.3.1 and 4.7.3 retired as they cannot be executed, as per all IOT labs</p> | |
| 2.4 | Verizon Wireless | <p>Updated test report template.</p> <p>3.11 and 3.12 retired. 3.10, 3.13 and 3.14 updated to reflect changes in GSMA TS.11</p> | February 2017 |
| 2.5 | Verizon Wireless | <p>Updated pre-conditions for the following tests: 3.2-3.4, 3.6-3.10, 3.13-3.23</p> | June 2017 |

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|-----|------------------|---|---------------|
| | | Updated references from test plan to GSMA TS. 11 | |
| 2.6 | Verizon Wireless | Reduced R11 feICIC Test scope to support eICIC | Oct 2017 |
| 2.7 | Verizon Wireless | Test cases 5.4.6, 5.4.9, 5.4.12 are modified to make the modulation dynamic. | June 2018 |
| 2.8 | Verizon Wireless | Updated the test result template | October 2019 |
| 2.9 | Verizon Wireless | Retired following test cases: 3.2, 3.3, 3.4, 3.7, 3.10, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.23, 4.15 Updated result template formatting | February 2020 |
| 3.0 | Verizon Wireless | Removed Test Cases 3.6, 3.8, 3.20, 4.1.1, 4.5.1, 4.5.2, 5.4.6, 5.4.9, 5.4.12 Updated result template formatting | June 2020 |
| 3.1 | Verizon Wireless | Updated result template formatting | October 2020 |
| 3.2 | Verizon Wireless | Added new TC 9.1 for 5MHz operation | February 2021 |
| 3.3 | Verizon Wireless | Updated results template. Test cases updated due to DL 256 QAM and UL 64 QAM Modulation | October 2021 |

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|--|--|---|--|
| | | related throughput changes: 5.4.7, 5.4.8, 5.4.10, 5.4.11, 9.1 | |
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Introduction VZ_TC_LTEB13IOT_1338997

1. Introduction

Verizon Wireless requires all devices designed to operate on the Verizon Wireless LTE 3GPP Band 13 network to meet Verizon Wireless performance requirements as detailed in the Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements.

This publication is part of Verizon Wireless compliance with the FCC's rules for 700 MHz C Block (47 C.F.R. § 27.16), as explained in the FCC's Second Report and Order in WT Docket No. 06-150, "Service Rules for the 698-746, 747-762 and 777-792 MHz Bands" released on August 10, 2007.

In this document, the terms LTE (Long Term Evolution) and E-UTRA (Evolved Universal Terrestrial Radio Access) are considered equivalent.

1. Definitions

The following terms are used in this document:

| Acronym/Term | Definition |
|--------------|--|
| 3GPP | 3 rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards |
| APN | Access Point Name |
| Cell | A portion of an eNB. |

| | |
|--------|--|
| E-UTRA | Evolved Universal Terrestrial Radio Access |
| eNB | Evolved Node B. An eNB can consist of multiple Cells. |
| EPs | Evolved Packet System |
| FTP | File Transfer Protocol |
| FFS | For Future Study |
| 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 |
| Mbps | Mega Bits Per Second |
| NAS | Non Access Stratum |
| PDN | Packet Data Network |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| RAN | Radio Access Network |
| SIMO | Single Input Multiple Output |
| UDP | User Datagram Protocol |
| UE | User Equipment |
| UICC | Universal Integrated Circuit Card (sometimes also referred to as a SIM card) |
| VZW | Verizon Wireless |

Note that in 3GPP2, the terms "Cell" and "sector" are used where 3GPP uses the terms "eNB" and "Cell." In this document, the terms are as specified by 3GPP.

2. Test Environment and Equipment

Verizon Wireless LTE 3GPP Band 13 Interoperability Testing is conducted in the labs of the two Radio Access Network infrastructure vendors, Alcatel-Lucent and Ericsson. Reference 3 contains the contact information for the labs.

The labs contain the Radio Access Network equipment provided to Verizon Wireless by the two vendors.

3. Entrance Criteria

1. The Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process (Reference 3) lists the Entrance Criteria for testing. This document adds no Entrance Criteria; however, the Infrastructure Vendors may have additional Entrance Criteria.%%

2. Traceability

Verizon Wireless LTE 3GPP Band 13 operation requirements are specified in Reference 1 and the device conformance test processes are specified in Reference 3.

4. Test Plan Sources

The overall LTE Interoperability Test Plan is comprised of test cases from two sources:

- TS.111 Device Field and Lab Test Guidelines, published by The GSM Association (see Reference 5). A copy of TS.111 is available at: http://www.gsmworld.com/newsroom/document-library/technical_documents.htm)
- Verizon Wireless internally created test cases.

This document contains the Verizon Wireless internally created test cases and a listing of the required test cases from TS.111.

5. Message Contents

In 3GPP documents, there is a specific method for denoting "Most Significant Bit" and "Least Significant Bit." In this document, we have noted the specific contents of a message where the test case requires a specific value. In all cases, the method of determining the Most Significant Bit and Least Significant Bit shall be as per 3GPP documents.

6. Throughput Versus Transmit Time

In the test cases listed in this document, pass/fail criteria are often listed in terms of the average data rate (e.g. Mbps). The tools used in executing these tests often provide the amount of time it takes for a file to be transmitted from the source to the destination (and it is a simple calculation to determine the transmission rate). In this document, the term "throughput" is the measure for pass/fail criteria and it is acceptable to calculate this based on the output of the tools.

7. Test Report Template

See the attached spreadsheet for the test report template (Reference 4). It shall be submitted in Excel format in addition to the standard .pdf test report format

Configuration Information

1. Lab Configuration

The attached image shows the lab configuration, which reflects the network implementation of the Verizon Wireless 3GPP Band 13 network deployment. Any variations from this or any specific configurations (e.g. Tracking Areas) are detailed in the test cases themselves. The UE is connected to the eNodeBs via cables or via over the air transmission during IOT testing.

The UE is connected to the enodeB and CDMA cells sites either

- a) via RF cables at the infrastructure labs. There is no over the air transmissions during IOT testing at these labs.
- b) radiated using isolated RF in a shield room at the Verizon Wireless internal labs.. There is no interference from unwanted LTE or CDMA cell sites during IOT testing at these labs.

2. Network Features

Each network element used in this test plan shall operate with the current Verizon Wireless commercially deployed software/hardware installed.

In addition, the following features shall be enabled in the network during the execution of each test:

- FGI 2, 3, 4, 5, 6, 7, 14, 16, 17, 20, 21, 28, 29 as defined in "3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification" (Reference 11)

| Index of indicator | Definition |
|--------------------|---|
| 2 | <ul style="list-style-type: none"> - Simultaneous CQI and ACK/NACK on PUCCH, i.e. PUCCH format 2a and 2b - Absolute TPC command for PUSCH - Resource allocation type 1 for PDSCH - Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-0 UE selected subband CQI without PMI - Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-1 UE selected subband CQI with single PMI |
| 3 | <ul style="list-style-type: none"> - 5bit RLC UM SN - 7bit PDCP SN |
| 4 | - Short DRX cycle |
| 5 | <ul style="list-style-type: none"> - Long DRX cycle - DRX command MAC control element |
| 6 | - Prioritised bit rate |
| 7 | - RLC UM |
| 14 | <ul style="list-style-type: none"> - Measurement reporting event: Event A4 Neighbour > threshold - Measurement reporting event: Event A5 Serving < threshold1 & Neighbour > threshold2 |
| 16 | <ul style="list-style-type: none"> - Intra-frequency periodical measurement reporting where <i>triggerType</i> is set to <i>periodical</i> and <i>purpose</i> is set to <i>reportStrongestCells</i>, - Inter-frequency periodical measurement reporting where <i>triggerType</i> is set to |

| | |
|----|---|
| | <p><i>periodical</i> and <i>purpose</i> is set to <i>reportStrongestCells</i>, if the UE has set bit number 25 to 1; and</p> <ul style="list-style-type: none"> - Inter-RAT periodical measurement reporting where <i>triggerType</i> is set to <i>periodical</i> and <i>purpose</i> is set to <i>reportStrongestCells</i> for UTRAN, GERAN, 1xRTT or HRPD, if the UE has set bit number 22, 23, 24 or 26 to 1, respectively. <p>NOTE: Event triggered periodical reporting (i.e., with <i>triggerType</i> set to <i>event</i> and with <i>reportAmount</i> > 1) is a mandatory functionality of event triggered reporting and therefore not the subject of this bit.</p> |
| 17 | <p>Intra-frequency ANR features including:</p> <ul style="list-style-type: none"> - Intra-frequency periodical measurement reporting where <i>triggerType</i> is set to <i>periodical</i> and <i>purpose</i> is set to <i>reportStrongestCells</i> - Intra-frequency periodical measurement reporting where <i>triggerType</i> is set to <i>periodical</i> and <i>purpose</i> is set to <i>reportCGI</i> |
| 20 | <p>If bit number 7 is set to 0:</p> <ul style="list-style-type: none"> - SRB1 and SRB2 for DCCH + 8x AM DRB <p>If bit number 7 is set to 1:</p> <ul style="list-style-type: none"> - SRB1 and SRB2 for DCCH + 8x AM DRB - SRB1 and SRB2 for DCCH + 5x AM DRB + 3x UM DRB <p>NOTE: UE which indicate support for a DRB combination also support all subsets of the DRB combination. Therefore, release of DRB(s) never results in an unsupported DRB combination.</p> |
| 21 | <ul style="list-style-type: none"> - Predefined intra- and inter-subframe frequency hopping for PUSCH with $N_{sb} > 1$ - Predefined inter-subframe frequency hopping for PUSCH with $N_{sb} > 1$ |
| 28 | <ul style="list-style-type: none"> - TTI bundling |
| 29 | <ul style="list-style-type: none"> - Semi-Persistent Scheduling |

3. UICC Configuration

The UICCs used in the IOT testing have the same configuration as the commercial UICC used in the Verizon Wireless LTE 3GPP Band 13 network. The various tables (e.g. PLMN lists) that are unique to the IOT labs will be programmed by the IOT labs.

4. UE Configuration

The UE shall be configured as per the Verizon Wireless LTE 3GPP Band 13 Network Access

Requirements (see Reference 1). Data contents such as the APN entries which are unique to the IOT labs will be communicated by the labs themselves. In no case will there be any changes to the base configuration of the UE that violate the Verizon Wireless Requirements. The IMS Test Mode (see Reference 1) shall be disabled during the testing (i.e. the IMS Client shall not be disabled).

In addition, some UEs that are presented for IOT testing will have other Radio Access Technology capability. In that situation, the devices shall be configured as they will be used in normal operation, regardless of the fact that these test cases do not have any other RAT in operation.

5. Test Tools

This section describes the settings on tools that are used in the executing of this test plan.

1. UDP

Various tests which depend on measuring performance using UDP can be executed using iPerf (iPerf is an open source tool available at <http://sourceforge.net/projects/iperf>). Details on the configuration of iPerf in both the server and client are described below:

- Version of Server IPERF (Unix/Linux): 2.0.4 and onwards
- Version of Client IPERF (Windows): 2.02 and onwards
- Type of transport protocol used: UDP (-u); otherwise it is FTP
- UDP Packet size: 1418 bytes for IPv4 and 1300 for IPv6 (-l) to avoid fragmentation
- Transmit Time: 65 Seconds (-t)
- UDP Bandwidth: Will be adjusted per case to avoid packet loss (-b)
- Bidirectional testing where applicable (-d)
- Report Interval: 1 sec (-i)
- Format: Kilobits (-f)
- IP: -V is used for IPv6; if not, then IPv4

For example for IPv4: `iperf -c <Server IP Address> -u -i 1 -p <Server Port> -l 1418.0B -f k -b <UDP BW> -t 65`

For example for IPv6: `iperf c <server IP Address> -i 5 t 300 l 1300 u b 5m -V`

2. FTP

Various tests which depend on measuring performance using FTP shall be executed using DOS FTP

commands. If the DUT does not support tethering and DOS commands, other tools or apps can be used, such as:

- iPERF for TCP
- Adb commands
- FTP Express
- FTP Cafe

References

Verizon Wireless LTE 3GPP Band 13 specifications are available at <http://opennetwork.verizonwireless.com>.

Verizon Wireless LTE Device Requirements:

1. Verizon Wireless LTE 3GPP Band 13 Network Access
- Verizon Wireless LTE SMS Requirements

Verizon Wireless LTE Process Documents:

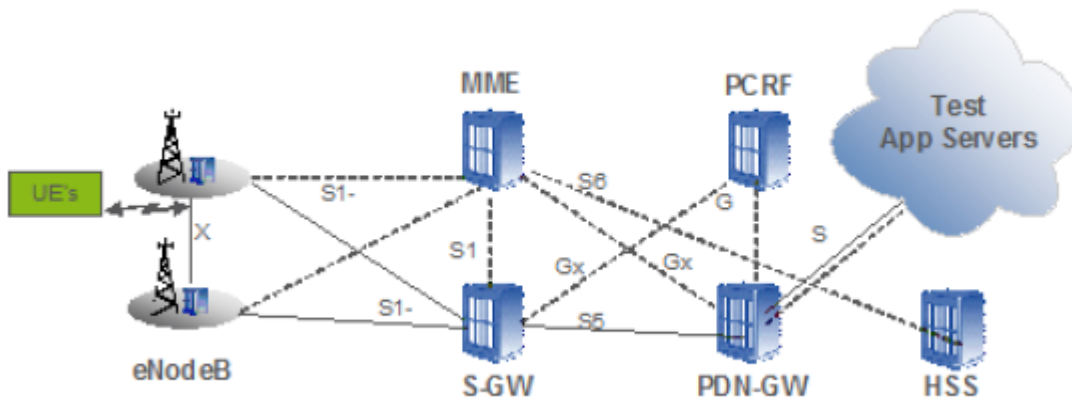
3. Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process
- Verizon Wireless LTE Device Interoperability Test Report Template

Industry Documents (specific versions as per Reference 1 above):

5. GSM Association. Official Document TS. 11. Device Field and Lab Test Guidelines. Use the latest version from following link: <http://www.gsma.com/newsroom/all-documents/ts-11-device-field-and-lab-test-guidelines/>
6. 3GPP TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3
7. 3GPP TS 36.211: Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation
8. 3GPP TS 36.213: Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Process
9. 3GPP TS 36.300: Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2
10. 3GPP TS 36.306: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE)

radio access capabilities

11. 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification



LTE Band 13 Device
Interoperability Test F

LTE Band 13
Device Interoperability Test Report
Template1.xls



LTE Band 13 Device
IOT Test Report Tem

3.9 Periodic Tracking Area Update; Successful VZ_TC_LTEB13IOT_610

See GSMA TS.11, section 30.2.2.1.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| If the Device Under Test (DUT) cannot be Tethered then User Data Traffic can be transferred via a different mechanism, such as commands in the ADB shell, an App, etc. |
| Procedures |
| <p>I. Periodic Tracking Area Update; Successful</p> <p>See GSMA TS.11, section 30.2.2.1.</p> |
| Expected Results |

3.2.1 PDN Connectivity Reject cause #27 Missing or unknown APN VZ_TC_LTEB13IOT_622

See GSMA TS.11, section 32.1.4.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| If the Device Under Test (DUT) cannot be Tethered then User Data Traffic can be transferred via a different mechanism, such as commands in the ADB shell, an App, etc. |
| Procedures |
| <p>I. PDN Connectivity Reject cause #27 Missing or unknown APN</p> <p>See GSMA TS.11, section 32.1.4.</p> |
| Expected Results |

3.2.2 Multiple PDN Connections secondary PDN connectivity Request VZ_TC_LTEB13IOT_623

See GSMA TS.11, section 32.1.2. Perform the test with either an embedded browser or using a browser on a connected PC; do not execute the test using a DUN connection.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| If the Device Under Test (DUT) cannot be Tethered then User Data Traffic can be transferred via a different mechanism, such as commands in the ADB shell, an App, etc. |
| Procedures |
| <p>1. Multiple PDN Connections secondary PDN connectivity Request</p> <p>See GSMA TS.11, section 32.1.2. Perform the test with either an embedded browser or using a browser on a connected PC; do not execute the test using a DUN connection.</p> |
| Expected Results |

4.2.1 PDN Gateway Disconnect Procedure Network Initiated VZ_TC_LTEB13IOT_630

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

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. PDN Gateway Disconnect Procedure Network Initiated</p> <p style="text-align: center;">1. Definition</p> <p>This test verifies that the UE can successfully detach from the network upon receipt of a Detach Request from the network.</p> <p style="text-align: center;">1. Traceability</p> <ul style="list-style-type: none"> • 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 <p style="text-align: center;">2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">2. Initial Configuration</p> <ul style="list-style-type: none"> • UE is connected to the network • UE is connected to the IMS PDN Gateway with both default and dedicated bearers <p style="text-align: center;">3. Test procedure</p> <ol style="list-style-type: none"> 1. Network initiates a Detach Request 2. UE responds with the Detach Acknowledge <p style="text-align: center;">4. Expected Results</p> <ul style="list-style-type: none"> • In step 2, verify that the UE is detached from the network. |
| Expected Results |

4.2.2 PDN Gateway Disconnect Procedure UE Initiated VZ_TC_LTEB13IOT_631

This test verifies that the UE can successfully initiate a detach from the network.

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. PDN Gateway Disconnect Procedure UE Initiated</p> <p style="text-align: center;">1. Definition</p> <p>This test verifies that the UE can successfully initiate a detach from the network.</p> <p style="text-align: center;">1. Traceability</p> <ul style="list-style-type: none"> • 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 <p style="text-align: center;">2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">2. Initial Configuration</p> <ul style="list-style-type: none"> • UE is connected to the network • UE is connected to the IMS PDN Gateway with both default and dedicated bearers <p style="text-align: center;">3. Test procedure</p> <ol style="list-style-type: none"> 1. The UE initiates a Detach Request 2. The Network responds with the Detach Acknowledge <p style="text-align: center;">4. Expected Results</p> <ul style="list-style-type: none"> • In step 2, verify that the UE is detached from the network. |
| Expected Results |

4.4.1 LTE System Lost in RRC_IDLE VZ_TC_LTEB13IOT_633

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

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. LTE System Lost in RRC_IDLE</p> <p style="text-align: center;">1. Definition</p> <p>Verify the UEs behavior when an RRC_IDLE UE loses a Cell and subsequently finds another Cell.</p> <p style="text-align: center;">1. Traceability</p> <ul style="list-style-type: none"> • 3GPP TS 24.301, clause 5.5.1 • 3GPP TS 36.331 <p style="text-align: center;">2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">2. Initial Configuration</p> <ul style="list-style-type: none"> • Configure the network to have at least two active Cells • Designate one Cell as Cell #1 and the other as Cell #2 • Configure the network to ensure that the UE will find Cell #1 first • UE is powered off <p style="text-align: center;">3. Test Procedure</p> <ol style="list-style-type: none"> 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 <p style="text-align: center;">4. Expected Results</p> <ul style="list-style-type: none"> • In step 1, verify that the UE attaches to Cell #1 • In step 3, verify that the UE loses its connection to Cell #1 • In step 4, verify that the UE attaches to Cell #2 within FFS seconds |
| Expected Results |

4.4.2 LTE System Lost in RRC_CONNECTED VZ_TC_LTEB13IOT_634

Verify the UEs behavior when an RRC_CONNECTED UE loses connection to a Cell and subsequently finds another Cell in the same tracking area.

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p>1. LTE System Lost in RRC_CONNECTED</p> <p>1. Definition</p> <p>Verify the UEs behavior when an RRC_CONNECTED UE loses connection to a Cell and subsequently finds another Cell in the same tracking area.</p> <p>1. Traceability</p> <ul style="list-style-type: none"> • 3GPP TS 24.301, clause 5.5.1, 5.6.1 • 3GPP TS 36.331 <p>2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p>2. Initial Configuration</p> <ul style="list-style-type: none"> • Configure the network to have at least two active Cell • Designate one Cell as Cell #1 and the other as Cell #2 • Configure the network to ensure that the UE will find Cell #1 first • UE supports browsing or is connected to a PC that supports HTTP browsing • UE is powered off <p>3. Test Procedure</p> <ol style="list-style-type: none"> 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 4. The UE finds Cell #2 5. Direct the browser to a different available web page <p>4. Expected Results</p> <ul style="list-style-type: none"> • In step 2, verify that the UE attaches to Cell #1 and that the UE connects to the internet • In step 3, verify that the UE loses its connection to Cell #1 • In step 4, verify that the UE attaches to Cell #2 and maintains all contexts • In step 5, verify that the browser session still works |
| Expected Results |

4.5.3 SUCCESSFUL HANDOVER FROM CELL WITH SRS ENABLED TO A CELL WITH SRS DISABLED WITH ONGOING UDP TRAFFIC

VZ_TC_LTEB13IOT_6659

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p>1. Successful Handover from cell with SRS enabled to a cell with SRS disabled with ongoing UDP traffic</p> <p>1. Definition</p> <p>This test verifies that the UE can successfully perform handover while has both simultaneous upload and download UDP traffic with acceptable throughput rates, and SRS feature is enabled.</p> <p>1. Traceability</p> <ul style="list-style-type: none"> 3GPP TS36.306 clause 4, 3GPP TS36.213 clause 7.1.7, 3GPP TS36.211 clause 6.3.3 and 6.3.4 <p>1. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p>2. Initial Configuration</p> <ul style="list-style-type: none"> Configure the network to have two cells on different eNBs The antenna configuration is Open Loop Spatial Multiplexing in both cells The modulation is set to default, i.e. downlink modulation is 64 QAM and uplink modulation is 16 QAM in both cells. Set up one cell to have SRS enabled and the other cell has SRS disabled. Set up the cell with SRS enabled to have also Uplink Frequency-Selective Scheduling (ULFSS) feature turned on. The other cell should have ULFSS disabled. The UE is connected to the Internet PDN Gateway with the default bearer (Best Effort) and IPv4v6 dual stack addressing <p>3. Test Procedure</p> <ol style="list-style-type: none"> Set up an application to generate pings over IPv4 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings Setup two UDP sessions to a test UDP server over IPv6 or IPv4 <ol style="list-style-type: none"> In one of the UDP session, transfer the test data from the remote host to the UE In the other UDP session, transfer the test data from the UE to the remote host Ensure that both transfers are occurring at the same time Record the average throughput rates for the first cell with SRS enabled. Move the UE to the cell with no SRS disabled and repeat step 2. Record the average throughput rates for the cell with SRS disabled. Restart UDP transfers by repeating step 2. Start on from one cell with SRS is disabled and perform an S1 handover to the other cell where SRS is enabled during the data transfer |

8. Repeat step 7 (handover) for and additional four times and make sure with UDP traffic is ongoing
9. Record the average throughput rates

4. Expected Results

- Verify the number of pings sent by the application and received by the application has been always equals to the received before, during and after the handovers.
- Verify the SRS is enabled by checking
 - i. The cell specific SRS configuration is broadcasted in the cell in the RRC on SIB2.
 - ii. The UE specific SRS configuration is setup by RRC during initial entry by SoundingRS-UL-ConfigDedicated section of the IE SoundingRS-UL-Config.
- In steps 3 & 4, verify that the UE is able to maintain simultaneous uplink and downlink sessions with throughput should be close to the maximum for the bandwidth under testing cell where SRS is enabled.
- In steps 7 & 8, verify that the all handovers have always been successful and no handover failure in all attempts.
- In steps 7 & 8, verify that the UE is able to maintain simultaneous Uplink and Downlink sessions with acceptable throughput

Expected Results

4.6.1 Intra-LTE Frequency Automatic Neighbor Relation (ANR) Function

VZ_TC_LTEB13IOT_637

Verify that neighbor relations can be discovered automatically by means of UE measurement reporting.

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p>I. Intra-LTE/Frequency Automatic Neighbor Relation (ANR) Function</p> <p>1. Definition</p> <p>Verify that neighbor relations can be discovered automatically by means of UE measurement reporting.</p> <p>1. Traceability</p> <ul style="list-style-type: none"> 3GPP TS 36.300, clauses 22.3.2a and 22.3.3 3GPP TS 36.331 <p>2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p>2. Initial Configuration</p> <ul style="list-style-type: none"> Configure the network to have two active Cells: Cell #1 and Cell #2 UE shall be in RRC_CONNECTED state to Cell #1. <p>3. Test Procedure</p> <ol style="list-style-type: none"> Slowly increase the RF level for Cell #2 and decrease the RF level Cell #1 Wait until the UE sends a measurement report regarding eNB #2, which contains the physical Cell id (PCI) for Cell #2 The Cell #1 commands the UE to perform an additional measurement using the newly discovered PCI (in order to retrieve the E-UTRAN Global Cell ID (EGCI) of Cell #2) The UE reports the detected ECGI of Cell #2 <p>4. Expected Results</p> <ul style="list-style-type: none"> In step 2, verify that the UE reports the PCI for Cell #1 In step 4, verify that the UE reports the EGCI of Cell #2 |
| Expected Results |

4.7.1 CBRA, Re-Synchronization of UL VZ_TC_LTEB13IOT_670

Verify the contention-based random access procedure that is used by the UE to re-synchronization of UL. The UE will use this feature when it becomes in out of sync state due to released PUCCH resources after Time Alignment Timer has expired due to user data inactivity.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. CBRA, Re-Synchronization of UL</p> <p style="text-align: center;">1. Definition</p> <p>Verify the contention-based random access procedure that is used by the UE to re-synchronization of UL. The UE will use this feature when it becomes in out of sync state due to released PUCCH resources after Time Alignment Timer has expired due to user data inactivity.</p> <p style="text-align: center;">1. Traceability</p> <ul style="list-style-type: none"> • 3GPP TS 36.321, clauses 5.1 & 6.1.5 <p style="text-align: center;">2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">2. Initial Configuration</p> <ul style="list-style-type: none"> • DRX is enabled in the eNB and the UE with the following RRC timers for Long and Short DRX are configured as per Verizon Wireless instructions: onDurationTimer, drx-InactivityTimer, longDRX-CycleStartOffset, shortDRX-Cycle, drxShortCycleTimer • UE has successfully attached and has been able to initiate UL traffic • TA timer in the eNB can be set to shorter than periodic UL grants so UE may lose synch with UL after time alignment timer expiry <p style="text-align: center;">3. Test procedure</p> <ol style="list-style-type: none"> 1. Change the eNB configuration so that TA timer is set to shorter than periodic UL grants so UE loses synch with UL, by setting TA timer for 1920 ms. 2. After UE has been in connected state, cease all the DL and UL traffic between the UE and network so inactivity timer can start and UE loses UL synchronization 3. Record the C-RNTI value of the UE 4. Initiate UL data traffic by for example sending ping from the UE for at least 5 minutes and |

- every 4 seconds, where the UE will lose sync after almost 2 seconds after ping
5. Continuously observe the C-RNTI value of the UE

4. Expected Results

- In step 2, verify that the UE has no UL or DL traffic
- In step 4 verify that UE sends a random access to re-synchronize UL whenever the ping request is sent and receives RRC Connection Reconfiguration which allocates PUCCH resources for SR
- In step 5 verify that despite the change in the value for the Temporary C-RNTI (from that in Step 3) Uplink Synchronization was successfully achieved.

Expected Results

4.7.2 PDCCH Ordered Re-synchronization VZ_TC_LTEB13IOT_671

Verify that when the UE receives a PDCCH transmission with its C-RNTI from eNB to ordered UL re-synchronization, it shall initiate a Random Access procedure.

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p>1. PDCCH Ordered Re-synchronization</p> <p>1. Definition</p> <p>Verify that when the UE receives a PDCCH transmission with its C-RNTI from eNB to ordered UL re-synchronization, it shall initiate a Random Access procedure.</p> <p>1. Traceability</p> <ul style="list-style-type: none"> 3GPP TS 36.321, clauses 5.1 & 6.1.5 <p>2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p>2. Initial Configuration</p> <ul style="list-style-type: none"> DRX is enabled in the eNB and the UE with the following RRC timers for Long and Short DRX are configured as per Verizon Wireless instructions: onDurationTimer, drx-InactivityTimer, longDRX-CycleStartOffset, shortDRX-Cycle, drxShortCycleTimer UE has successfully attached and has been able to initiate UL traffic TA timer in the eNB can be set to shorter than periodic UL grants so UE may lose synch with UL after time alignment timer expiry <p>3. Test procedure</p> <ol style="list-style-type: none"> Change the eNB configuration so that TA timer is set to shorter than periodic UL grants so UE loses synch with UL, by setting TA timer for 1920 ms. After UE has been in connected state, cease all the DL and UL traffic between the UE and network so inactivity timer can start and UE loses UL synchronization Record the C-RNTI value of the UE Initiate DL data traffic by for example sending ping from the network for at least 5 minutes and every 4 seconds, where the UE will lose sync after almost 2 seconds after ping Continuously observe the C-RNTI value of the UE <p>4. Expected Results</p> |

- In step 2, verify that the UE has no UL or DL traffic
- In step 4 verify that UE sends a random access to re-synchronize UL whenever the ping request is received and receives RRC Connection Reconfiguration which allocates PUCCH resources for SR
- In step 5 verify that despite the change in the value for the Temporary C-RNTI (compared to value recorded in Step 3) Uplink Synchronization was successfully achieved.

Expected Results

Patvi15s

4.7.4 Time Alignment Timer Expiry VZ_TC_LTEB13IOT_673

Verify that the UE's time alignment timer has expired, the UE shall do a random access procedure to restore the timing.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. Time Alignment Timer Expiry</p> <p style="text-align: center;">1. Definition</p> <p>Verify that the UE's time alignment timer has expired, the UE shall do a random access procedure to restore the timing.</p> <p style="text-align: center;">1. Traceability</p> <ul style="list-style-type: none"> • 3GPP TS 36.321, clause 5.2 • 3GPP TS 36.331 <p style="text-align: center;">2. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">2. Initial Configuration</p> <ul style="list-style-type: none"> • DRX is enabled in the eNB and the UE with the following RRC timers for Long and Short DRX are configured as per Verizon Wireless instructions: onDurationTimer, drx-InactivityTimer, longDRX-CycleStartOffset, shortDRX-Cycle, drxShortCycleTimer • UE has successfully attached and has been able to initiate UL traffic • TA timer in the eNB can be set to shorter than periodic UL grants so UE may lose synch with UL after time alignment timer expiry <p style="text-align: center;">3. Test procedure</p> <ol style="list-style-type: none"> 1. Change the eNB configuration so that TA timer is set to shorter than periodic UL grants so UE loses synch with UL, by setting TA timer for 1920 ms. 2. After UE has been in connected state, cease all the DL and UL traffic between the UE and network so inactivity timer can start and UE loses UL synchronization 3. Record the C-RNTI value of the UE 4. Wait for the UE to initiate UL re-synchronization; if that did not happen trigger UL data traffic by for example sending pings from the UE 5. Observe the C-RNTI value of the UE |

4. Expected Results

- In step 2, verify that the UE has no UL or DL traffic
- In step 4 verify that UE sends a random access to re-synchronize UL and restore synchronization
- In step 5 verify that despite the change in the value for the Temporary C-RNTI (compared to value recorded in Step 3) Uplink Synchronization was successfully achieved.

Expected Results

Patvi5s

4.8.1 PDN MTU SIZE VZ_TC_LTEB13IOT_6660

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| Procedures |
| <p style="text-align: center;">1. PDN MTU Size</p> <p style="text-align: center;">1. DEFINITION</p> <p>This test verifies UE meets requirements for maximum MTU size for the specified PDN.</p> <p style="text-align: center;">2. Traceability</p> <p>" 3GPP TS24.301 " Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements, section 3.2.4.8</p> <p style="text-align: center;">3. Applicability</p> <p>This test case applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.</p> <p style="text-align: center;">4. Initial Configuration</p> <p>" The Internet PDN Gateway is configured to send the PCO IPv4 Link MTU parameter set to 1500 bytes when requested by the UE. " The UE is RRC_CONNECTED " The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing</p> <p style="text-align: center;">5. Test Procedure</p> <ol style="list-style-type: none"> 1) Initiate an IPv4 Ping from the UE to the Internet server with a payload of 1500 bytes and with the Do Not Fragment option enabled. 2) Confirm that the Ping was sent successfully without fragmentation. 3) Repeat step 1 with a payload of 1501 bytes and with the Do Not Fragment option enabled. 4) Confirm that the Ping failed because the packet was too big/needed to be fragmented. 5) Power off the UE. 6) Re-configure the PDN Gateway to not send the PCO IPv4 Link MTU parameter to the device. 7) Power on the UE. 8) Confirm that the UE attaches to the LTE network and connects to the Internet PDN Gateway. 9) Initiate an IPv4 Ping from the UE to the Internet server with a payload of 1428 bytes and with the Do Not Fragment option enabled. 10) Confirm that the Ping was sent successfully without fragmentation. 11) Repeat step 1 with a payload of 1429 bytes and with the Do Not Fragment option enabled. 12) Confirm that the Ping failed because the packet was too big/needed to be fragmented. 13) Power off the UE. 14) Repeat steps 1 through 13 using an IPv6 Ping command. <p style="text-align: center;">6. Expected Results</p> <p>Ping command returns results as specified in steps 2, 4, 10, and 12.</p> |

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| Expected Results |
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Patvi5s

5.2.4 Transmit Diversity Throughput Measure Downlink QPSK - FTP and UDP

VZ_TC_LTEB13IOT_645

Patvis

5.2.5 Transmit Diversity Throughput Measure - Uplink QPSK - FTP and UDP

VZ_TC_LTEB13IOT_646

Patvis

5.2.6 Transmit Diversity Throughput Measure - Downlink QPSK & Uplink QPSK - FTP and UDP

VZ_TC_LTEB13IOT_647

Patvis

5.4.7 Open Loop Spatial Multiplexing Throughput Measure - Downlink - FTP

VZ_TC_LTEB13IOT_664

This test verifies that the UE can successfully complete an FTP download with acceptable throughput rates.

| Design Steps |
|--|
| Step Name |
| HCL_MIGRATED |
| Pre-Conditions |
| <ul style="list-style-type: none"> • Configure the network to have two Cells on different eNBs (with no X2 interface) in the same Tracking Area with the same SGW • The Antenna configuration is Open Loop Spatial Multiplexing in both Cells • The Downlink Modulation is 256 QAM and Uplink Modulation is 64 QAM in both Cells • The UE is RRC_CONNECTED • The UE is connected to Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing |
| Procedures |
| <ol style="list-style-type: none"> 1. Set up an application to generate pings over IPv4 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings 2. Setup an FTP session with an FTP server over IPv6 3. Transfer the test file from the remote host to the UE <ol style="list-style-type: none"> I. 4. Record the average throughput 5. Repeat steps 2 through 4 an additional four times 6. End the FTP session 7. Average all five iterations |
| Expected Results |

- Verify the number of pings sent by the application and received by the application:
 1. Prior to the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 2. After the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 3. During the handover itself, any pings sent, but not received by the application are not counted
- In step 7, verify that the average throughput for the FTP transfer is greater than 88Mbps.

PatV15S

5.4.7 A. Downlink FTP Measured Rate VZ_TC_LTEB13IOT_3578766

Patvi5s

5.4.7 B. Downlink UDP Measured Rate VZ_TC_LTEB13IOT_3578767

Patvi5s

5.4.8 Open Loop Spatial Multiplexing Throughput Measure - Uplink - UDP

VZ_TC_LTEB13_IOT_665

This test verifies that the UE can successfully complete a UDP upload with acceptable throughput rates.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| <ul style="list-style-type: none"> • Configure the network to have two Cells on different eNBs (with no X2 interface) in the same Tracking Area with the same SGW • The Antenna configuration is Open Loop Spatial Multiplexing in both Cells • The Downlink Modulation is 256 QAM and Uplink Modulation is 64 QAM in both Cells • The UE is RRC_CONNECTED • The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing |
| Procedures |
| <ol style="list-style-type: none"> 1. Set up an application to generate pings over IPv6 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings 2. Setup an UDP session with an UDP server over IPv4 3. Transfer the test file from the UE to the remote host <ol style="list-style-type: none"> 1. 4. Record the average throughput rate 5. Repeat steps 2 through 4 and additional four times 6. End the UDP session 7. Average all 5 iterations |
| Expected Results |
| <ul style="list-style-type: none"> • Verify the number of pings sent by the application and received by the application: <ol style="list-style-type: none"> 1. Prior to the handover in step 4, verify that the number of pings sent by the application equals the number of pings received 2. After the handover in step 4, verify that the number of pings sent by the application equals the number of pings received 3. During the handover itself, any pings sent, but not received by the application are not counted • In step 7, verify that the average throughput for the UDP transfer is greater than 27Mbps. |

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Patvi5s

5.4.8 A. Uplink FTP Measured Rate VZ_TC_LTEB13IOT_3578879

Patvi5s

5.4.8. B. Uplink UDP Measured Rate VZ_TC_LTEB13IOT_357888o

Patvi5s

5.4.10 Closed Loop Spatial Multiplexing Throughput Measure - Downlink - UDP

VZ_TC_LTEB13IOT_667

This test verifies that the UE can successfully complete an UDP download with acceptable throughput rates.

| Design Steps |
|---|
| Step Name |
| HCL_MIGRATED |
| Pre-Conditions |
| <ul style="list-style-type: none"> • Configure the network to have two Cells on different eNBs (with no X2 interface) in the same Tracking Area with the same SGW • The Antenna configuration is Closed Loop Spatial Multiplexing in both Cells • The Downlink Modulation is 256 QAM and Uplink Modulation is 64 QAM in both Cells • The UE is RRC_CONNECTED • The UE is connected to Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing |
| Procedures |
| <ol style="list-style-type: none"> 1. Set up an application to generate pings over IPv4 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings 2. Setup an UDP session with an UDP server over IPv6 3. Transfer the test file from the remote host to the UE <ol style="list-style-type: none"> 1. 4. Record the average throughput rate 5. Repeat steps 2 through 4 an additional four times 6. End the UDP session 7. Average all 5 iterations |
| Expected Results |
| <ul style="list-style-type: none"> • Verify the number of pings sent by the application and received by the application: |

1. Prior to the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 2. After the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 3. During the handover itself, any pings sent, but not received by the application are not counted
- In step 7, verify that the average throughput for the UDP transfer is greater than 88 Mbps.

PatV15S

5.4.10. A. Downlink FTP Measured Rate VZ_TC_LTEB13IOT_3579360

Patv15s

5.4.10. B. Downlink UDP Measured Rate VZ_TC_LTEB13IOT_3579365

PatV15S

5.4.1.1 Closed Loop Spatial Multiplexing Throughput Measure - Uplink - FTP

VZ_TC_LTEB13IOT_668

This test verifies that the UE can successfully complete an FTP upload with acceptable throughput rates.

| Design Steps |
|--|
| Step Name |
| HCL_MIGRATED |
| Pre-Conditions |
| <ul style="list-style-type: none"> • Configure the network to have two Cells on different eNBs (with no X2 interface) in the same Tracking Area with the same SGW • The Antenna configuration is Closed Loop Spatial Multiplexing in both Cells • The Downlink Modulation is 256 QAM and Uplink Modulation is 64 QAM in both Cells • The UE is RRC_CONNECTED • The UE is connected to the Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing |
| Procedures |
| <ol style="list-style-type: none"> 1. Set up an application to generate pings over IPv6 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings 2. Setup an FTP session with an FTP server over IPv4 3. Transfer the test file from the UE to the remote host <ol style="list-style-type: none"> 1. 4. Record the average throughput rate 5. Repeat steps 2 through 4 an additional four times 6. End the FTP session 7. Average all 5 iterations |
| Expected Results |
| <ul style="list-style-type: none"> • Verify the number of pings sent by the application and received by the application: |

1. Prior to the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 2. After the handover in step 4, verify that the number of pings sent by the application equals the number of pings received
 3. During the handover itself, any pings sent, but not received by the application are not counted
- In step 7, verify that the average throughput for the FTP transfer is greater than 27Mbps.

PatV15S

5.4.11. A. Uplink FTP Measured Rate vz_TC_LTEB13IOT_3579367

Patvi5s

5.4.11. B. Uplink UDP Measured Rate VZ_TC_LTEB13IOT_3579542

Patvi5s

73. Loss of One eNodeB Antenna Path While Device is in Idle Mode VZ_TC_LTEB13IOT_9442

The objective of this test is to verify device behaviour when it receives only one antenna path in an LTE cell which is configured with 2x2 DL MIMO. In this case device in Idle Mode is expected to be able to receive the synchronization signals and does not lose the camped on cell.

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| <ol style="list-style-type: none"> 1. Device supports 2x2 DL MIMO. 2. LTE cell is configured with 2x2 DL MIMO. In cabled lab, the two RF antennas are connected to ports of a hybrid combiner or a MIMO box that supports 2x2 MIMO. 3. Device receivers are connected to the MIMO box or hybrid combiners ports 4. Cell is configured with LTE band and bandwidths as required for the test report. 5. RF paths between the eNodeB and hybrid combiner ports can be disconnected, attenuated, or blocked so that cell's RF signal path is considered lost by the device. 6. Device is receiving good signals from both eNodeB antennas |
| Procedures |
| <ol style="list-style-type: none"> 1. Attach the device to the LTE network and maintain the device in RRC Idle Mode 2. While the device is in Idle Mode, disconnect or completely attenuate first antenna path between the eNodeB and the hybrid combiner or the MIMO box. Do not attenuate any of the antenna paths between the device and the hybrid combiner 3. Trigger few ping or ICMP messages to the network. 4. Re-connect or decrease the attenuation on the antenna path so both paths are at close and good RSRP levels and maintain the device is in Idle Mode 5. Repeat steps 2 to 4 but switch the attenuation or disconnection to the other antenna path between the eNodeB and the hybrid combiner 6. Re-connect or decrease the attenuation on the antenna path so both paths are at close and good RSRP levels 7. Disconnect or attenuate the first antenna path between the eNodeB and the MIMO box or hybrid combiner. 8. Switch the device to air-plane mode, then switch Off air-plane mode to trigger the new attach 9. Re-connect or decrease the attenuation on the antenna path so both paths are at close and good RSRP levels 10. Repeat steps 6-10 but switch the attenuation to the other antenna path |
| Expected Results |
| <p>After step 2, the device is still able to acquire the primary and secondary sync signals of the cell and stay camped on the LTE cell.</p> <p>After step 3, the device is verified to change from Idle Mode camped on the cell to Connected Mode</p> <p>After step 5, the device is still able to acquire and stay in cell and also verified when device was able to stay on the cell when ping is triggered</p> <p>After step 8, the device is able to acquire the primary and secondary sync signals, read the MIB and SIBs and trigger attach in the LTE cell</p> <p>After step 10, the device is able to acquire the primary and secondary sync signals, read the MIB and SIBs and trigger attach in the LTE cell</p> |

74. Loss of one eNodeB antenna path While Device is in Connected Mode

VZ.TC.LTEB13IOT_9443

The objective of this test is to verify device behaviour when it receives only one antenna path in an LTE cell which is configured with 2x2 DL MIMO. In this case the device in Connected Mode is expected to be able to maintain RRC connection and dose not lose the cell.

| Design Steps |
|---|
| Step Name |
| Step 1 |
| Pre-Conditions |
| <ol style="list-style-type: none"> 1. Device supports 2x2 DL MIMO. 2. LTE cell is configured with 2x2 DL MIMO. In cabled lab, the two RF antennas are connected to ports of a hybrid combiner or a MIMO box that supports 2x2 MIMO. 3. Device receivers are connected to the MIMO box or hybrid combiners ports 4. Cell is configured with LTE band and bandwidths as required for the test report. 5. RF paths between the eNodeB and hybrid combiner ports can be disconnected or attenuated or blocked so that cell's RF signal path is considered lost by the device. 6. Device is receiving good signals from both eNodeB antennas |
| Procedures |
| <ol style="list-style-type: none"> 1. Attach the device to the LTE network and start down link ftp or high rate UDP throughout the duration of the test. 2. Observe the downlink throughput and the Rank Indication 3. While the device is transferring DL data, disconnect or completely attenuate first antenna path between the eNodeB and the hybrid combiner or the MIMO box. Do not attenuate or disconnect any of the antenna paths between the device and the hybrid combiner 4. Observe the downlink throughput and the Rank Indication 5. Re-connect or decrease the the attenuation on the antenna path so that both paths are at close and good RSRP levels and restart the downlink transfer 6. Repeat steps 3 to 4 but switch the attenuation or disconnection to the other antenna path between the eNodeB and the hybrid combiner or MIMO box |
| Expected Results |
| <p>After step 2, the device starts down link transfer and the observed median of Rank Indication is 2</p> <p>After step 4, the device continues down link transfer and the observed median of Rank Indication is 1 and the throughput is about half the rate before the loss of one antenna path.</p> <p>After step 6, the device continues down link transfer and the observed median of Rank Indication is 1 and the throughput is about half the rate before the loss of one antenna path.</p> |

9.1 Throughput in 5MHz Bandwidth for B13 cell VZ_TC_LTEB13IOT_4105999311929689

This test verifies that the UE can successfully complete an FTP download with acceptable throughput rates in a Band 13 cell with 5MHz bandwidth

| Design Steps |
|--|
| Step Name |
| Step 1 |
| Pre-Conditions |
| <ul style="list-style-type: none"> • Configure the network to have one Band 13 Cell with 5MHz Bandwidth • The Downlink Modulation is 256 QAM and Uplink Modulation is 64 QAM in the Cell • The UE is RRC_CONNECTED • The UE is connected to Internet PDN Gateway with the Default Bearer (Best Effort) and IPv4v6 dual stack addressing |
| Procedures |
| <ol style="list-style-type: none"> 1. Set up an application to generate pings over IPv4 to the Internet PDN Gateway. The pings shall be one at a time with approximately 5 seconds between pings 2. Setup an FTP session with an FTP server over IPv6 3. Transfer the test file from the remote host to the UE 4. Record the average throughput 5. Repeat steps 2 through 4 an additional four times 6. End the FTP session 7. Average all five iterations 8. Rerun the test steps 1 through 7 above introducing an NB-IoT interferer. Enable in-band NB-IoT carrier in same cell. |
| Expected Results |

- Verify the number of pings sent by the application and received by the application:
- Verify that the number of pings sent by the application equals the number of pings received
- In step 7, verify that the average throughput for the FTP transfer is greater than 44Mbps.

Patvi15s

Requirement Coverage For Test Plan

3.9 Periodic Tracking Area Update; Successful VZ_TC_LTEB13IOT_610

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

3.21 PDN Connectivity Reject cause #27 Missing or unknown APN VZ_TC_LTEB13IOT_622

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

3.22 Multiple PDN Connections secondary PDN connectivity Request VZ_TC_LTEB13IOT_623

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

4.2.1 PDN Gateway Disconnect Procedure Network Initiated VZ_TC_LTEB13IOT_630

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.2.2 PDN Gateway Disconnect Procedure UE Initiated VZ_TC_LTEB13IOT_631

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.4.1 LTE System Lost in RRC_IDLE VZ_TC_LTEB13IOT_633

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.4.2 LTE System Lost in RRC_CONNECTED VZ_TC_LTEB13IOT_634

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.6.1 Intra-LTE Frequency Automatic Neighbor Relation (ANR) Function
VZ_TC_LTEB13IOT_637

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.7.1 CBRA, Re-Synchronization of UL VZ_TC_LTEB13IOT_670

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.7.2 PDCCH Ordered Re-synchronization VZ_TC_LTEB13IOT_671

| Requirement Name | Requirement Plan | Created | Created Date |
|------------------|------------------|---------|--------------|
|------------------|------------------|---------|--------------|

| | Id | By | |
|---|-----------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

4.7.4 Time Alignment Timer Expiry VZ_TC_LTEB13IOT_673

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.2.4 Transmit Diversity Throughput Measure Downlink QPSK - FTP and UDP VZ_TC_LTEB13IOT_645

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.2.5 Transmit Diversity Throughput Measure - Uplink QPSK - FTP and UDP VZ_TC_LTEB13IOT_646

| Requirement Name | Requirement Plan | Created | Created Date |
|------------------|------------------|---------|--------------|
|------------------|------------------|---------|--------------|

| | Id | By | |
|---|-----------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.2.6 Transmit Diversity Throughput Measure - Downlink QPSK & Uplink QPSK - FTP and UDP
VZ_TC_LTEB13IOT_647

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.4.7 Open Loop Spatial Multiplexing Throughput Measure - Downlink - FTP
VZ_TC_LTEB13IOT_664

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.4.8 Open Loop Spatial Multiplexing Throughput Measure - Uplink - UDP
VZ_TC_LTEB13IOT_665

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.4.10 Closed Loop Spatial Multiplexing Throughput Measure - Downlink - UDP
VZ_TC_LTEB13IOT_667

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|---|---------------------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |

5.4.11 Closed Loop Spatial Multiplexing Throughput Measure - Uplink - FTP
VZ_TC_LTEB13IOT_668

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|------------------|---------------------|------------|--------------|
|------------------|---------------------|------------|--------------|

| | | | |
|---|-----------|------------|------------------------|
| LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER | LTEB13NAC | Admin User | 11-07-0013 14:24:26 |
|---|-----------|------------|------------------------|

73. Loss of One eNodeB Antenna Path While Device is in Idle Mode VZ_TC_LTEB13IOT_9442

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|--|---------------------|------------|------------------------|
| PRIMARY AND SECONDARY SYNCHRONIZATION SIGNAL RECEPTION | LTEB13NAC | Admin User | 11-07-0013 14:26:19 |

74. Loss of one eNodeB antenna path While Device is in Connected Mode VZ_TC_LTEB13IOT_9443

| Requirement Name | Requirement Plan Id | Created By | Created Date |
|--|---------------------|------------|------------------------|
| PRIMARY AND SECONDARY SYNCHRONIZATION SIGNAL RECEPTION | LTEB13NAC | Admin User | 11-07-0013 14:26:19 |