verizon

Test Plan

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Introduction VZ_TC_LTEB13DATATHRU_1203137

Revision History

Rev.	Author	Description of Changes	Date
1.0	Verizon Wireless	Initial Release.	February 2010
2.0	Verizon Wireless	Version 2.0 Updates/Clarifications/Additions to the following sections: 1.4, 1.5, 1.5.1, 1.5.12, 2.1.2, 2.2.2.1, 2.2.2.2, 2.3.2.1, 2.3.2.2, 3.1.2.9, 3.3.2.1, 3.4.2.9, 3.6.2.1, 3.9.2.1, 6	March 2010
3.0	Verizon Wireless	Version 3.0 Updates/Clarifications/Additions to the following sections: 1.4, 1.5.13, 2.1.2, 2.2.2.1, 2.2.2.2, 2.3.2.1, 2.3.2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8, 3.9, 3.10, 4.1.3, 6	June 2010
4.0	Verizon Wireless	Version 4.0 Updates/Clarifications/Additions to the following sections:	September 2010

		1.5.3, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.13, 1.5.14, 1.5.15, 1.5.16, 1.5.17, 2.1.2, 3.1.1, 3.1.2.1, 3.1.2.11, 3.1.3, 3.2.2.2, 3.2.3, 3.3.2.3, 3.3.3, 3.4.1, 3.4.2.1, 3.4.2.11, 3.4.3, 3.5.2.2, 3.5.3, 3.6.2.3, 3.6.3, 3.7, 3.8.2.2, 3.8.3, 3.9.2.1, 3.9.2.2, 3.9.3, 3.11, 3.12, 3.13, 4.1.4, 5, 6	
5.0	Verizon Wireless	Version 5.0 Updates/Clarifications/Additions to the following sections: 1.3, 4.1.1, 4.1.4.1, 4.1.4.2 Updates to Release 9 throughout the document.	December 2010
6.0	Verizon Wireless	Version 6.0 Updates/Clarifications/Additions to the following sections: 1.5.6, 3.1.2, 3.4.2, 3.11.2, 3.12.2.1, 3.12.2.4, 3.12.3.4, 3.12.4.4, 3.12.4.5	March 2011
7.0	Verizon Wireless	Version 7.0 Updates/Clarifications/Additions to the following sections: 1.5.15, 1.5.17, 1.5.17.2, 3.1.2.9, 3.3.2.1, 3.4.2.9, 3.6.2.1, 3.7.1.4, 3.7.1.5, 3.7.2.4, 3.7.2.5, 3.7.3.4,	June 2011

		3.7.3.5, 3.8.2.1, 3.9.2.1, 3.11.2, 3.12.3, 3.12.3.1, 3.12.3.4, 3.12.3.5, 3.13.3.5, 4.1.1, 4.1.3, 4.1.4.1, 4.1.4.2	
8.0	Verizon Wireless	Version 8.0 Updates/Clarifications/Additions to the following sections: 1.5.13, 3.12.2.4, 3.12.2.5, 3.12.3.4, 3.12.3.5, 3.12.4.4, 3.12.4.5, 4.1.1, 6	September 2011
9.0	Verizon Wireless	Version 9.0 Updates/Clarifications/Additions to the following sections: 1.5.13, 1.5.16, 1.5.18, 3.1.3, 3.2.3, 3.3.3, 3.8.2.1, 3.8.3, 3.9.2.2, 3.10.2, 3.12.1.4, 3.12.2.4, 3.12.3, 3.12.3.5, 3.12.4, 3.12.4.5	December 2011
10.0	Verizon Wireless	Version 10.0 Updates/Clarifications/Additions to the following sections: 3.11.1, 3.11.2, 3.11.3, 3.13, 3.13.1, 3.13.2, 3.13.3, 4.1.4.1, 4.1.4.2, 5, 6	April 2012
11.0	Verizon Wireless	Version 11.0 Updates/Clarifications/Additions to the following	February 2013

		sections: 1.5.1.1	
12.0	Verizon Wireless	Version 12.0 Updates/Clarifications/Additions to the following sections: 1.5.1, 1.5.8, 1.5.15, 1.5.16.1, 1.5.19, 1.6, 3.11, 5 Removed closed loop, single layer spatial multiplexing tests throughout. Removed test cases 3.7.1 and 3.7.3. Added test case 2.4. Reduced test iterations from 5 to 3 throughout.	October 2013
13.0	Verizon Wireless	Version 13.0: Fixed typo in section reference as part of CR 2709 (section 3.12.4)	February 2014
14.0	Verizon Wireless	Version 14.0: Fixed type-o's in 3.1, 3.4, 3.9, 3.11, 3.12.2, and 3GPP TR 37.901 section reference. Added Category 1 throughout the document.	October 2014
15.0	Verizon Wireless	Version 15.0: Updated criteria for test case 2.1. Added FeICIC test cases 3.13, 3.14, 3.15.	February 2015

16.0	Verizon Wireless	Version 16.0: All test cases changed to embedded for smartphones/tablets. Test reduction - reduced IP type "both" test cases to IPv4 only. Updated test applicability to include UE category greater than 3. Updated criteria for test case 2.1. Updated test procedure for test case 2.4. Added a section in Test Equipment Configuration to address routers. Added feICIC test cases 3.16, 3.17, 3.18, 3.19. Added DL CoMP test cases 3.20, 3.21, 3.22.	June 2015
17.0	Verizon Wireless	Version 17.0: Added EPDCCH test case 3.23. Added 256QAM test case 3.24.	October 2015
18.0	Verizon Wireless	Version 18.0: Updated test case applicability table to address test case applicability for single antenna M2M devices.	February 2016
19.0	Verizon Wireless	Version 19.0: Updated Expected Result tables for test case 3.1 through test case 3.11 based on IPv4/IPv6 test applicability.	October 2016

		Test case 3.12.3 is voided.	
20.0	Verizon Wireless	Version 20.0: Updated Test 2 of test case 3.8 and Test 2 of test case 3.9 to use full RB allocation.	June 2017
21.0	Verizon Wireless	Version 21.0: Retired Test 1 and Test 2 of test case 3.24 as GCF tests become ready. Reduced R11 feICIC Test scope to support eICIC	October 2017
22.0	Verizon Wireless	Version 22.0: Added a section in Test Equipment Configuration to address the testing of M2M/IoT devices without USB tethering capability. Modified TC 3.13, 3.14	February 2018
23.0	Verizon Wireless	Version 23.0 Added a new test case for devices that support single Antenna	October 2019
24.0	Verizon Wireless	Version 24.0: Keep throughput stress TC 3.8, 3.9, 3.24, and single antenna TC 3.12.4 Remove all other test cases from this test plan	June 2020
25.0	Verizon Wireless	Version 25.0: Un-retired TC 2.4.	June 2022
26.0	Verizon Wireless	Version 26.0: Retired TC 3.12.4.	February 2023

27.0	Verizon Wireless	Updated 2.4.1 - 2.4.4	February 2024
28.0	Verizon Wireless	Attributes clean in few TCs	June 2024
29.0	Verizon Wireless	Updated Applicability for TCs 3.8 & 3.9 Updated test procedure for TC 3.9 Test 2	Oct 2024

Introduction

Verizon Wireless requires all device manufacturers to comply with the following controlled lab test plan for measuring the LTE data throughput performance of LTE devices. This document describes the test procedures and the minimum test "pass/fail" criteria. This test plan and its minimum test criteria follow from the Verizon Wireless LTE 3GPP Band 13 Network Access Device Requirements.

This publication is part of Verizon Wireless compliance with the FCCs rules for 700 MHz C Block (47 C.F.R. § 27.16), as explained in the FCCs 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.

1.1 Test Objectives

The objective of this document is to define the Verizon Wireless LTE data throughput performance testing procedures for lab-based testing of devices designed to operate on the Verizon Wireless LTE 3GPP Band 13 network. By completing these tests in a controlled lab environment, the devices data throughput performance can be verified without the introduction of variables associated with "live network" testing.

This document will be used by employees of device manufacturers, test labs, and Verizon Wireless to guide the execution of Verizon Wireless LTE data throughput performance testing. This document

will also be used to define the Verizon Wireless LTE data throughput performance test procedures for test automation development.

Specifically, this document includes:

- Latency test cases
- Data throughput test cases

Wherever possible, this test plan uses 3GPP standard test procedures for LTE as defined in 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing.*

Definitions

The following terms are used in this document:

Acronym/Term	Definition
3GPP	3rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards
AWGN	Additive White Gaussian Noise
BW	Bandwidth
CoMP	Coordinated Multi-Point
CQI	Channel Quality Indicator

DL	Downlink
EMM	EPS Mobility Management
EPDCCH	Enhanced Physical Downlink Control Channel
E-UTRA	Evolved Universal Terrestrial Radio Access
FFS	For Future Study
FTP	File Transfer Protocol
IP	Internet Protocol
LTE	Long Term Evolution
Mbps	Mega (106)-bits-per-second
MCS	Modulation and Coding Scheme
MHz	Mega-Hertz (106 cycles per second)
ms	Milli (10-3)-second
MIMO	Multiple Input-Multiple Output
NAS	Non-Access Stratum
PDN	Packet Data Network

PMI	Precoding Matrix Indicator
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase-Shift Keying
RAT	Radio Access Technology
RB	Resource Block
RI	Rank Indicator
RRC	Radio Resource Control
TCP	Transmission Control Protocol
SNR	Signal-to-Noise Ratio
UDP	User Datagram Protocol
UE	User Equipment
UL	Uplink
VZW	Verizon Wireless

3GPP Release 9 Specifications

Refer to the *3GPP Release 9 Specifications* section of the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements for details on the correct version for all 3GPP specification documents referenced in this test plan.

Entrance Criteria

All devices shall successfully pass this test plan per the Verizon Wireless LTE 3GPP Band 13 Lab Conformance Test Plan and in accordance with the Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process. Prior to testing, Verizon Wireless strongly recommends that all devices pass 3GPP standard RF conformance per 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing.*

Test Equipment Configuration

For details on test equipment currently approved by Verizon Wireless, refer to the Verizon Wireless LTE 3GPP Band 13 Test Equipment List.

5.1 Tethered Operation

Minimum laptop configuration details are FFS and will be included in a future release of this document.

5.1.1 Windows Settings for Tethered Operation

When the device is tethered to a Windows-based laptop, the laptop operating system's dynamic TCP/IP setting shall be enabled for all data throughput testing if the laptop operating system supports dynamic TCP/IP. If the laptop operating system does not support dynamic TCP/IP, the following TCP-related Windows settings shall be used on the laptop during data throughput testing:

- TCPWindowSize and GlobalMaxTcpWindowSize shall be set to 262,800 bytes.
- Selective Acknowledgements (SACK) shall be turned on
- TCP 1323 options for time stamps and window scaling shall be set as follows:

o time stamps shall be turned off
o window scaling shall be turned on
- The QoS packet scheduler shall be turned on.
- The socket send and receive buffer sizes shall be set to a multiple of 1460 bytes.

5.2 IP Header Compression

During LTE data throughput testing, IP header compression shall not be used.

5.3 File Sizes

The downlink and uplink files sizes used in the FTP and UDP throughput tests shall be large enough such that each transfer takes a minimum of 60 seconds (to insure adequate transfer time for averaging). The test platform may use a file size larger than required and terminate the transfer after 60 seconds.

5.4 LTE-Only UE Operation

For the current version of this test plan, the UE shall be configured for LTE-only operation.

5.5 Scheduler Behavior

For the current version of this test plan, the UE shall be configured for LTE-only operation.

5.6 Over-the-Air Performance Simulation

Where indicated in section 3.12 of this test plan, the test platforms fader shall simulate the impact of the UEs antenna by incorporating the complex antenna pattern data for the UE. The test platform shall be capable of accepting UE complex antenna pattern data in the format specified in section 6.16.4.1 of the CTIA Test Plan for Mobile Station Over the Air Performance, Revision 3.1.

Device vendors shall provide complex antenna pattern data in the format specified in section 6.16.4.1 of the CTIA Test Plan for Mobile Station Over the Air Performance, Revision 3.1 (LTE radiated performance testing is per the Verizon Wireless LTE Over-the-Air Radiated Performance Test Plan).

5.7 Ciphering and Integrity Protection

For the current version of this test plan, ciphering (applied to RRC messages, NAS messages, and user plane data) shall not be used. In the future, Verizon Wireless plans to require ciphering for RRC messages, NAS messages, and user plane data.

Integrity protection shall be enabled using the AES algorithm for RRC messages, NAS messages, and user plane data.

5.8 IPv6/IPv4 Operation

VOID Refer to section 6 (Test Case Applicability).

5.9 Bearer Support

All test cases in this test plan with the exception of *Multi-Flow Throughput* section shall use a default bearer only, i.e. no dedicated bearers shall be used.

5.10 Temperature and Voltage Test Requirements

5.10.1 Ambient Temperature

The ambient temperature shall be per the normal conditions as defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* and 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing.*

5.10.2 UE Power Supply/Battery Voltage

The UE power supply/battery voltage shall be per the normal operating conditions as defined by the device manufacturer, 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, and 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.

5.11 Reference Measurement Channels

Reference measurement channels used in this test plan shall be per 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* and the *Reference Channels and MIMO Correlation Matrices* section of this document.

5.12 IMS Test Mode Operation

Unless indicated otherwise in the test case procedure, IMS Test Mode shall be enabled in the device for the test cases in this test plan. IMS Test Mode operation is per the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.

5.13 Data Throughput Calculation

For LTE data throughput testing, the data throughput for each test case shall be calculated as follows:

1. The time needed to transfer/stream a file for a given iteration is measured.
2. Based on the time measured in A.) and the file size, the average throughput for the iteration is calculated.
3. The average throughput values for all iterations are averaged to determine the final throughput value which needs to meet the pass/fail criteria.

The test platform shall report the FTP and UDP layer throughput results with the TCP/UDP headers removed. Pass/fail criteria shall be applied to the FTP/UDP layer throughput measurements with the

TCP/UDP headers removed. The test platform shall also report throughput results at the SDU PDCP layer with the TCP/UDP headers included for informational purposes.

For LTE data throughput tests, a throughput iteration shall be invalid if the LTE data call drops during the iteration. If the LTE data call drops during a throughput iteration, the iteration shall be repeated. If the LTE data call drops again in the repeated iteration or in two iterations of the same test, then the entire test shall be failed.

5.14 IMS Support

For test cases requiring IMS support, the test platform shall comply with Verizon Wireless requirements for IMS PDN support and SMS over IMS support as detailed in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements and the Verizon Wireless LTE SMS Requirements. During network attachment using the IMS PDN, the test platform shall establish both a default bearer and a dedicated bearer to the IMS PDN. The dedicated bearer shall be used for all SIP signaling. The dedicated bearer shall have a QoS level of QCI=5.

5.15 RRC Connection Parameters

For LTE data throughput testing, the test platform shall set the following RRC parameters during RRC configuration:

- The *periodicBSR-Timer* field in the *MAC-MainConfig* radio resource control information element shall be set to "sf80", i.e. the timer for buffer status reporting shall be set to 80 subframes.
- The *periodicPHR-Timer* field in the *MAC-MainConfig* radio resource control information element shall be set to "sf100", i.e. the timer for power headroom reporting shall be set to 100 subframes.
- The *RLC-Config* radio resource control information element shall indicate acknowledged mode for both uplink and downlink.
- The *t-StatusProhibit* field in the *RLC-Config* radio resource control information element shall be set to "ms30", i.e. the timer for RLC status reporting shall be set to 30 ms.

- The *statusReportRequired* field in the *PDCP-Config* radio resource control information element shall be set to "0", i.e. the PDCP status report shall not be sent.

Refer to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.

5.16 Procedures During Network Attach

For all test cases in this test plan, the test platform shall include the following NAS and RRC procedures in the network attachment:

- Identification Procedure
- Authentication
- Security Mode Control Procedure for NAS Security Activation
    - o The NAS integrity algorithm shall be set to "128-EIA2" (i.e. "AES").
    - o The NAS ciphering algorithm shall be set to "128-EEA2" (i.e. "AES").
- ESM Information Request Procedure (network initiated)
- AS Security Activation for RRC signaling and user plane data
    - o The AS integrity algorithm shall be set to "128-EIA2" (i.e. "AES").
    - o The AS ciphering algorithm shall be set to "128-EEA2" (i.e. "AES").
- UE Capability Transfer
- RRC Connection Reconfiguration
- The network emulator shall assign both an IPv4 and an IPv6 address for the internet PDN on attach.

Refer to 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, 3GPP TS 33.401: *3GPP System Architecture Evolution (SAE); Security architecture*, and 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.

5.16.1 Internet PDN MTU Size

Unless indicated otherwise in the test case, if the device requests the "IPv4 MTU Size" in the PCO of the PDN CONNECTIVITY REQUEST message for the internet PDN (during the attach

sequence), the network emulator shall not return a value for the "IPv4 MTU Size" in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the internet PDN.

5.17 Partial RB Allocations on Downlink

5.17.1 OCNG

For data throughput test cases where the network emulator does not assign the device under test a full downlink RB allocation, the network emulator shall fill all unused downlink RBs with PDSCH data for "virtual UEs" using the two sided dynamic OCNG Pattern OP.2 FDD described in Annex A.5.1.2 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, i.e. the network emulator shall simulate a fully loaded cell where are downlink RBs are allocated for PDSCH data. The power per RB shall be the same across the channel. The downlink signal strength shall refer to the power of the entire channel.

5.17.2 Resource Allocation Type

For data throughput test cases where the network emulator is required to allocate 2 RBs in the downlink to the device, the network emulator shall use resource allocation type 1 as defined in 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures.*

5.18 Setting Downlink Channel Power

For test cases in this test plan which specify downlink channel power in terms of total downlink channel power across the entire downlink channel bandwidth, the test platform shall maintain the physical channel ratios to EPRE defined for the underlying 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* test case and adjust the RS EPRE as needed to achieve the desired total downlink channel power level.

5.19 Embedded Operation

For smartphone and tablet devices, the test platform shall support embedded operation, i.e. the test platform shall include a data client test application that is installed on the device for data throughput measurements. This embedded data client test application shall meet the minimum requirements specified in Annex E of 3GPP TR 37.901: *User Equipment (UE) application layer data throughput performance*. Refer to section 1.6 for the test cases that require embedded operation. The embedded data client test application shall support FTP, UDP, IPv4, IPv6, test type (i.e. downlink, uplink, bidirectional), and the minimum file sizes specified in this document for the test cases that require embedded operation. The embedded data client test application shall also support ping packets to test proper MTU size enforcement by the modem. The embedded data client test application shall support different ping packet sizes and the setting of the packet "Do Not Fragment" bit refer to test case 2.4 for additional details.

5.19.1 Test Platform Mobile OS Support

The test platform shall support embedded data client test applications for the Android, Windows Mobile, iOS, and RIM mobile operating systems.

5.20 Router Support

To support testing of router devices, the test platform shall support the option where the test client resides on a laptop connected to the LAN side (i.e. Wi-Fi or Ethernet) of the router. See attached illustration (Figure 1.5.20) for detail. The test laptop settings shall follow same requirements as in "5.1.1 Windows Settings for Tethered Operation". It shall be ensured that the Wi-Fi and/or Ethernet interface of the test laptop is not limiting factor for the data throughput testing.

5.21 Consideration for M2M/IoT Devices without USB Tethering

This section applies to M2M/IoT devices that USB tethering is not possible. If the devices have data volume less than 1MB per month, data throughput tests in this test plan can be waived for these devices. Otherwise, to overcome the challenge of no USB tethering for testing data throughput, these devices shall provide an embedded test application, which supports configuration of server address, FTP download/upload and Ping, and shows the test results. Tests shall be run in live network per VZ_TC_DFIT_6436 and VZ_TC_DFIT_6437, while DUT is not tethered via USB. The reference device can be put in either tethered or embedded mode. The RF condition validation and monitoring should be done on reference device via a DM tool. DUT is not required to connect to DM tool.

Test Case Applicability

The test cases in this test plan shall be executed by the following UE Categories and in embedded/tethered mode and IPv4/IPv6 mode based on the table below. Further, the test case applicability for single antenna Machine-to-Machine (M2M) devices is indicated in the last column, where "Y" indicates the test case is applicable to single antenna M2M devices.

Test Case		Embedded, Tethered, or Both *	IPv4, IPv6, or Both	UE Category	Applicable to Single Antenna M2M Devices
2.1	Average Network Attach Time (i.e. control plane latency)	Embedded	IPv6	>=1	Y
2.2	RRC_IDLE to RRC_CONNECTED Control Plane Latency Test 1	Embedded	IPv6	>=1	Y
	RRC_IDLE to RRC_CONNECTED Control Plane Latency Test 2	Embedded	IPv6	>=1	Y
2.3	User Plane Round Trip Delay Test 1	Embedded	IPv6	>=1	Y
	User Plane Round Trip Delay Test 2	Embedded	IPv6	>=1	Y
2.4	Internet PDN MTU Size Enforcement Test 1	Embedded	Both	>=1	Y
	Internet PDN MTU Size Enforcement Test 2	Embedded	Both	>=1	Y
3.1	Downlink FTP Throughput Test 1	Embedded	IPv4	>=1	Y

	Downlink FTP Throughput Test 2	Embedded	IPv4	>=2	Y
	Downlink FTP Throughput Test 3	Embedded	IPv4	>=1	Y
	Downlink FTP Throughput Test 4	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 5 (VOID)	-	-	-	
	Downlink FTP Throughput Test 6 (VOID)	-	-	-	
	Downlink FTP Throughput Test 7	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 8	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 9	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 10	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 11	Embedded	IPv4	>=2	
	Downlink FTP Throughput Test 12	Embedded	IPv4	>=2	
3.2	Uplink FTP Throughput Test 1	Embedded	IPv4	>=2	Y
	Uplink FTP Throughput Test 2	Embedded	IPv4	>=1	Y
	Uplink FTP Throughput Test 3	Embedded	IPv4	>=1	Y
	Uplink FTP Throughput Test 4	Embedded	IPv4	>=1	Y

	Uplink FTP Throughput Test 5	Embedded	IPv4	>=1	Y
3.3	Bidirectional FTP throughput Test 1	Embedded	IPv4	>=2	
	Bidirectional FTP throughput Test 2	Embedded	IPv4	>=2	
	Bidirectional FTP throughput Test 3	Embedded	IPv4	>=1	Y
3.4	Downlink UDP Throughput Test 1	Embedded	IPv6	>=1	Y
	Downlink UDP Throughput Test 2	Embedded	IPv6	>=2	Y
	Downlink UDP Throughput Test 3	Embedded	IPv6	>=1	Y
	Downlink UDP Throughput Test 4	Embedded	IPv6	>=2	
	Downlink UDP Throughput Test 5 (VOID)	-	-	-	
	Downlink UDP Throughput Test 6 (VOID)	-	-	-	
	Downlink UDP Throughput Test 7	Embedded	IPv6	>=2	
	Downlink UDP Throughput Test 8	Embedded	IPv6	>=2	
	Downlink UDP Throughput Test 9	Embedded	IPv6	>=2	
	Downlink UDP Throughput Test 10	Embedded	IPv6	>=2	
	Downlink UDP Throughput Test 11	Embedded	IPv6	>=2	

	Downlink UDP Throughput Test 12	Embedded	IPv6	>=2	
3.5	Uplink UDP Throughput Test 1	Embedded	IPv6	>=2	Y
	Uplink UDP Throughput Test 2	Embedded	IPv6	>=1	Y
	Uplink UDP Throughput Test 3	Embedded	IPv6	>=1	Y
	Uplink UDP Throughput Test 4	Embedded	IPv6	>=1	Y
	Uplink UDP Throughput Test 5	Embedded	IPv6	>=1	Y
3.6	Bidirectional UDP throughput Test 1	Embedded	IPv6	>=2	
	Bidirectional UDP throughput Test 2	Embedded	IPv6	>=2	
	Bidirectional UDP throughput Test 3	Embedded	IPv6	>=1	Y
3.7.2	Simultaneous IPv4 and IPv6 UDP Data Transfers	Embedded	Both	>=2	
3.8	Stress Test FTP Throughput (Downlink) Test 1	Embedded	IPv4	>=2	
	Stress Test FTP Throughput (Downlink) Test 2	Embedded	IPv4	>=1	Y
3.9	Stress Test UDP Throughput (Bidirectional) Test 1	Embedded	IPv6	>=2	
	Stress Test UDP Throughput (Bidirectional) Test 2	Embedded	IPv6	>=1	Y

3.10	Downlink Power Sweep UDP Throughput	Embedded	IPv6	>=2	
3.11	Downlink UDP Throughput with Variable Reference Measurement Channels	Embedded	IPv6	>=2	
3.12	Downlink UDP Throughput with Advanced Channel Models	Embedded	IPv6	>=2	
3.13	feICIC Downlink FTP Throughput in Victim Cell Test 1	Embedded	IPv6	>=1	Y
	feICIC Downlink FTP Throughput in Victim Cell Test 2	Embedded	IPv6	>=1	Y
	feICIC Downlink FTP Throughput in Victim Cell Test 3	Embedded	IPv6	>=1	Y
	feICIC Downlink FTP Throughput in Victim Cell Test 4	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 5	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 6	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 7	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 8	Embedded	IPv6	>=2	

	feICIC Downlink FTP Throughput in Victim Cell Test 9	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 10	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 11	Embedded	IPv6	>=2	
	feICIC Downlink FTP Throughput in Victim Cell Test 12	Embedded	IPv6	>=2	
3.14	feICIC Downlink UDP Throughput in Victim Cell Test 1	Embedded	IPv6	>=1	Y
	feICIC Downlink UDP Throughput in Victim Cell Test 2	Embedded	IPv6	>=1	Y
	feICIC Downlink UDP Throughput in Victim Cell Test 3	Embedded	IPv6	>=1	Y
	feICIC Downlink UDP Throughput in Victim Cell Test 4	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 5	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 6	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 7	Embedded	IPv6	>=2	

	feICIC Downlink UDP Throughput in Victim Cell Test 8	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 9	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 10	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 11	Embedded	IPv6	>=2	
	feICIC Downlink UDP Throughput in Victim Cell Test 12	Embedded	IPv6	>=2	
3.15	feICIC FTP Downlink Throughput in Aggressor Cell Test 1	Refer to test cases in Section 3.1, 3.2 and 3.3			
	feICIC FTP Downlink Throughput in Aggressor Cell Test 2	Refer to test cases in Section 3.1, 3.2 and 3.3			
3.16	Single Cell Data Throughput Test while CRS-AssistanceInfoList-r11 is Present	Embedded	IPv6	>=2	
3.17	CRS IC (non-Colliding CRS) Downlink FTP Throughput, Neighbour NOT Loaded	Embedded	IPv6	>=2	
3.18	CRS IC (non-Colliding CRS) Downlink FTP Throughput, Neighbour Fully Loaded with OCNG	Embedded	IPv6	>=2	
3.19	CRS IC (Colliding CRS) Downlink FTP	Embedded	IPv6	>=2	

	Throughput, Neighbour NOT Loaded				
3.20	DL CoMP Data Throughput Tests with Two Transmission Points Test 1	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 2	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 3	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 4	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 5	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 6	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 7	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 8	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 9	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with Two Transmission Points Test 10	Embedded	IPv4	>=1	Y

DL CoMP Data Throughput Tests with Two Transmission Points Test 11	Embedded	IPv4	>=1	Y
DL CoMP Data Throughput Tests with Two Transmission Points Test 12	Embedded	IPv4	>=2	
DL CoMP Data Throughput Tests with Two Transmission Points Test 13	Embedded	IPv4	>=2	
DL CoMP Data Throughput Tests with Three Transmission Points Test 1	Embedded	IPv4	>=2	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 2	Embedded	IPv4	>=2	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 3	Embedded	IPv4	>=2	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 4	Embedded	IPv4	>=2	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 5	Embedded	IPv6	>=1	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 6	Embedded	IPv6	>=1	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 7	Embedded	IPv6	>=1	Y
DL CoMP Data Throughput Tests with Three Transmission Points Test 8	Embedded	IPv4	>=2	

Note: Section number 3.21 spans the "Three Transmission Points" rows.

3.22	DL CoMP Data Throughput Tests with PDSCH in MBSFN Subframes Test 1	Embedded	IPv4	>=2	Y
	DL CoMP Data Throughput Tests with PDSCH in MBSFN Subframes Test 2	Embedded	IPv4	>=2	Y
3.23	Data Throughput Stress Test with EPDCCH Scheduling Test 1	Embedded	IPv4	>=1	Y
	Data Throughput Stress Test with EPDCCH Scheduling Test 2	Embedded	IPv6	>=1	Y
3.24	256QAM Data Throughput Test 1 (retired)	Embedded	IPv4	>=11 **	
	256QAM Data Throughput Test 2 (retired)	Embedded	IPv4	>=11 **	
	256QAM Data Throughput Test 3	Embedded	IPv6	>=11 **	

* **NOTE:** Embedded vs. Tethered mode applies to smartphones and tablet devices only. If the smartphone or tablet does not support tethering to a laptop via USB, then all test cases shall be executed in embedded mode. All other devices shall be tested in tethered mode for all test cases.

** **NOTE:** The test cases apply when either UE Category or DL UE Category is 11 or above. Refer to the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities.*
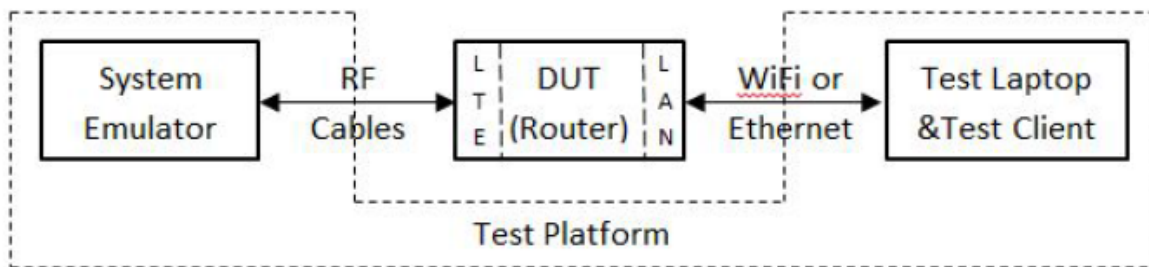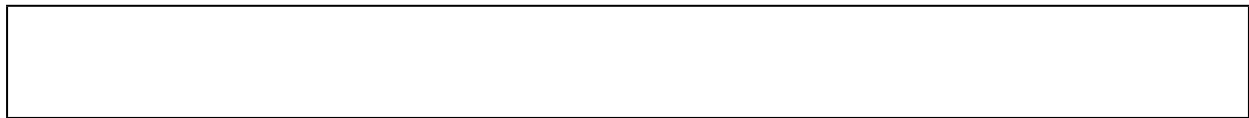
Figure 1.5.20: Test equipment configuration to support router

2.4 INTERNET PDN MTU SIZE ENFORCEMENT VZ_TC_LTEB13DATATHRU_602

Definition
This test confirms the UE meets Verizon Wireless requirements for MTU size on the internet PDN.

Traceability

- Verizon Wireless LTE 3GPP Band 13 Network Access Requirements, section *MTU Size*
- 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*

Applicability
This test applies to all UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

Design Steps
Step Name
Step 1
Pre-Conditions
Procedures

Test Procedure

Test 1

1. Power on the UE and connect the UE to the network emulator.
2. Configure the network simulator for single cell signaling conformance testing per 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*. The network emulator shall verify:
   a. The UE attaches to the network using the internet PDN.
   b. The UE requests the "IPv4 MTU Size" in the PCO of the PDN CONNECTIVITY REQUEST message for the internet PDN.
   c. The network does not return a value for the "IPv4 MTU Size" in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the internet PDN.
3. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:
   a. Each ping shall consist of one IPv4 packet that is 1428 bytes in size.
   b. Each ping packet shall have the "Do Not Fragment" bit set.
4. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway.
5. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:
   a. Each ping shall consist of one IPv4 packet that is 1429 bytes in size.
   b. Each ping packet shall have the "Do Not Fragment" bit set.
6. The test platform shall verify that no pings are transmitted by the UE.
7. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:
   a. Each ping shall consist of one IPv4 packet that is 1429 bytes in size.
   b. Each ping packet shall not set the "Do Not Fragment" bit.
8. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway and that each ping is fragmented into two packets.

9. Power off the UE.

10. Repeat steps 1.) through 9.) with an IPv6 ping packet with following exceptions:
    a. Skip Steps 5 and 6.
    b. Ignore the "Do Not Fragment" bit setting in Steps 3b and 7b.

Test 2

1. Power on the UE and connect the UE to the network emulator.

2. Configure the network simulator for single cell signaling conformance testing per 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing.* The network emulator shall verify:

   a. The UE attaches to the network using the internet PDN.

   b. The UE requests the "IPv4 MTU Size" in the PCO of the PDN CONNECTIVITY REQUEST message for the internet PDN.

   c. The network does returns a value of 1500 for the "IPv4 MTU Size" in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the internet PDN.

3. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

   a. Each ping shall consist of one IPv4 packet that is 1500 bytes in size.

   b. Each ping packet shall have the "Do Not Fragment" bit set.

4. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway.

5. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

   a. Each ping shall consist of one IPv4 packet that is 1501 bytes in size.

   b. Each ping packet shall have the "Do Not Fragment" bit set.

6. The test platform shall verify that no pings are transmitted by the UE.

7. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

   a. Each ping shall consist of one IPv4 packet that is 1501 bytes in size.

   b. Each ping packet shall not set the "Do Not Fragment" bit.

8. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway and that each ping is fragmented into two packets.

9. Power cycle the UE.

10. Configure the network simulator for single cell signaling conformance testing per 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing.* The network emulator shall verify:

    a. The UE attaches to the network using the internet PDN.

    b. The UE requests the "IPv4 MTU Size" in the PCO of the PDN CONNECTIVITY REQUEST message for the internet PDN.

    c. The network does returns a value of 3000 for the "IPv4 MTU Size" in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the internet PDN.

11. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

    a. Each ping shall consist of one IPv4 packet that is 3000 bytes in size.

    b. Each ping packet shall have the "Do Not Fragment" bit set.

12. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway.

13. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

    a. Each ping shall consist of one IPv4 packet that is 3001 bytes in size.

    b. Each ping packet shall have the "Do Not Fragment" bit set.

14. The test platform shall verify that no pings are transmitted by the UE.

15. The test platform shall command the UE to send 100 pings to the internet PDN gateway with the following properties:

    a. Each ping shall consist of one IPv4 packet that is 3001 bytes in size.

b. Each ping packet shall not set the "Do Not Fragment" bit.

16. The test platform shall verify that all pings are transmitted by the UE and received by the internet PDN gateway and that each ping is fragmented into two packets.

17. Power off the UE.

18. Repeat steps 1.) through 17.) with an IPv6 ping packet with following exceptions:
    a. Skip Steps 5, 6, 13 and 14.
    b. Ignore the "Do Not Fragment" bit setting in Steps 3b, 7b, 11b and 15b.

Expected Results

Expected Result
The device shall apply the correct MTU size provided by the network or apply an MTU size of 1428 bytes if the network does not provide an MTU size.

2.4.1 INTERNET PDN MTU SIZE ENFORCEMENT - IPV4 -TEST 1

VZ_TC_LTEB13DATATHRU_3536274

2.4.2 INTERNET PDN MTU SIZE ENFORCEMENT - IPV4 -TEST 2

VZ_TC_LTEB13DATATHRU_3536277

2.4.3 INTERNET PDN MTU SIZE ENFORCEMENT - IPV4 -TEST 3

VZ_TC_LTEB13DATATHRU_3536278

2.4.4 INTERNET PDN MTU SIZE ENFORCEMENT - IPV4 -TEST 4

VZ_TC_LTEB13DATATHRU_3536279

3.8 STRESS TEST FTP THROUGHPUT (DOWNLINK) VZ_TC_LTEB13DATATHRU_594

Definition

These tests verify that during an LTE data call the expected downlink throughput rate (using FTP) is maintained over a twenty minute test period. These are stress tests for the unit under test. These tests will verify if the unit under test experiences any types of "lock-ups," resets, or temperature related issues due to severe time-use of its modem. These tests will include downlink transmit diversity and spatial multiplexing with AWGN and fading conditions. The test cases are summarized in Table below.

Table- Downlink FTP throughput stress test summary.

Test	Description
Test 1	Downlink closed loop spatial multiplexing (two layers) with 64-QAM modulation (based on Test Number 1 in Table 8.2.1.4.1.3-4 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance* testing.
Test 2	Transmit Diversity with low SNR on the downlink signal.

Traceability

- Verizon Wireless LTE 3GPP Band 13 Network Access Requirements, Section *Data Throughput Performance*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, section 8.2.1
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, section 8.2.1

Applicability

This test applies to UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network as follows:

- Test 1: Applies to category 1 and higher devices with two or more receivers (i.e. devices that support 2 layer downlink SU-MIMO).
- Test 2: Applies to all category 1 and higher devices, including devices that are single receiver (e.g. cat1 bis)

Design Steps
Step Name
Step 1
Pre-Conditions
Procedures
Test Procedure Test 1   1. Set the initial conditions as per section 8.2.1.4.1.4.1 of 3GPP TS 36.521-1: *Evolved Universal*

Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing for a 10 MHz channel in Band 13 with the following exceptions:

   a. Downlink channel power shall be -54 dBm.
   b. Noise shall not be added, i.e. N_{oc} at antenna port (in Table 8.2.1.4.1.3-1 of 3GPP TS 36.521-1: _Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing_) shall be ignored (AWGN shall not be included).
   c. Ensure the UE is in State 2 according to 3GPP TS 36.508: _Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing._

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, and the antenna configuration as specified below:

   a. MCS shall be 64-QAM with R=0.65 for Category 2 devices and R=0.93 for Category 3+ devices. The downlink reference channel shall be set as per section _**DOWNLINK REFERENCE CHANNELS WITH PARTIAL RB ALLOCATIONS, 64-QAM**_ of this document.
   b. MIMO correlation matrices shall be defined as in section _**MIMO CORRELATION MATRICES**_ of this document. The correlation matrix and antenna configuration shall be set to 2x2 Low.
   c. No fading shall be used.

3. Setup a FTP session to the test FTP server.
4. Transfer the test file from the remote host to the unit under test using the binary "get" command.
5. Record the average throughput at the TCP layer on the downlink channel during the file transfer.
6. Repeat steps 4.) and 5.) for twenty minutes.
7. End the FTP session.
8. The network emulator shall release the RRC connection to the UE.
9. Average all FTP throughputs for the downlink channel.

Test 2

1. Set the initial conditions as per section 8.2.1.2.1.4.1 of 3GPP TS 36.521-1: _Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing_ for a 10 MHz channel in Band 13 with the following exceptions:

   a. Ensure the UE is in State 2 according to 3GPP TS 36.508: _Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing._

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR as specified below:

   a. The downlink reference channel shall be set to QPSK with a full allocation as per Reference Measurement Channel R.10 FDD in Table A.3.3.2.1-1 of 3GPP TS 36.521-1: _Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1:_

conformance testing.

    b. MIMO correlation matrices shall be defined as in section **MIMO CORRELATION MATRICES** of this document. The correlation matrix and antenna configuration shall be set to 2x2 Low.

    c. No fading shall be used.

    d. SNR shall be set to -3.0 dB, except for devices with single Rx, which shall have SNR set to 0 dB.

3. Setup a FTP session to the test FTP server.
4. Transfer the test file from the remote host to the unit under test using the binary "get" command.
5. Record the average throughput at the TCP layer on the downlink channel during the file transfer.
6. Repeat steps 4.) and 5.) for twenty minutes.
7. End the FTP session.
8. The network emulator shall release the RRC connection to the UE.
9. Average all FTP throughputs for the downlink channel.

Expected Results

Expected Result

The average downlink throughput at the FTP layer for each test shall meet or exceed the values in Table below.

Table- Criteria for FTP downlink throughput (stress tests).

Test	Minimum Average Throughput (Mbps), Category 1 Device		Minimum Average Throughput (Mbps), Category 2 Device		Minimum Average Throughput (Mbps), Category 3+ Device	
	IPv4	IPv6	IPv4	IPv6	IPv4	IPv6
Test 1	-	-	41.0 Mbps	N/A	51.6 Mbps	N/A
Test 2	3.1 Mbps	N/A	3.1 Mbps	N/A	3.1 Mbps	N/A

3.8 STRESS TEST – FTP THROUGHPUT (DOWNLINK) -Test 1

VZ_TC_LTEB13DATATHRU_3532762

3.8 STRESS TEST – FTP THROUGHPUT (DOWNLINK) -Test 2

VZ_TC_LTEB13DATATHRU_3532768

3.9 STRESS TEST UDP THROUGHPUT VZ_TC_LTEB13DATATHRU_595

Definition

These tests verify that during an LTE data call the expected downlink and uplink throughput rates (using UDP) are maintained over a twenty minute test period. These are stress tests for the unit under test. These tests will verify if the unit under test experiences any types of "lock-ups", resets, or temperature related issues due to severe time-use of its modem. These tests will include downlink transmit diversity and spatial multiplexing with AWGN and fading conditions on the downlink signal. The test cases are summarized in Table below.

Table- Bidirectional UDP throughput stress test summary.

Test	Description
Test 1	Closed loop spatial multiplexing (two layers) with 64-QAM modulation and fading (based on Test Number 1 in Table 8.2.1.4.1.3-4 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*). 16-QAM modulation on the uplink signal.
Test 2	Transmit diversity with low signal strength on the downlink signal. QPSK modulation on the uplink signal.

Traceability

- Verizon Wireless LTE 3GPP Band 13 Network Access Requirements, Section *Data Throughput Performance*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, section 8.2.1
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, section 8.2.1

Applicability

This test applies to UEs designed to operate on the Verizon Wireless LTE 3GPP Band 13 network as follows:

- Test 1: Applies to category 1 and higher devices with two or more receivers (i.e. devices that support 2-layer downlink SU-MIMO).
- Test 2: Applies to all category 1 and higher devices, including devices that are single receiver (e.g. cat 1bis).

Design Steps

Step Name

Step 1

Pre-Conditions

Procedures

Test Procedure

Test 1

1. Set the initial conditions as per section 8.2.1.4.1.4.1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* for a 10 MHz channel in Band 13 with the following exceptions:

   a. Ensure the UE is in State 2 according to 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR for the downlink signal as follows:
   a. MCS shall be 64-QAM with R=0.65 for Category 2 devices and R=3/4 for Category 3+ devices. The downlink reference channel shall be set as per section *DOWNLINK REFERENCE CHANNELS WITH PARTIAL RB ALLOCATIONS, 64-QAM* of this document.
   b. MIMO correlation matrices shall be defined as in section *MIMO CORRELATION MATRICES* of this document. The correlation matrix and antenna configuration shall be set to 2x2 Low.
   c. The propagation condition shall be EPA5.
   d. SNR shall be set to 25.0 dB.

3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR for the uplink signal as specified below:
   a. The uplink reference channel shall be set to a full allocation with 16-QAM modulation as defined in Table A.2.2.1.2-1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*.
   b. The network emulator shall send continuous power control "up" commands to the UE such that the UE is at maximum output power for the duration of the test.

4. Setup two UDP sessions to the test UDP server.

5. In one of the UDP sessions, stream the test file from the remote host to the unit under test. In the other UDP session, stream the test file from the unit under test to the remote host. Ensure that both transfers are occurring at the same time.

6. Record the average throughputs at the UDP layer on the downlink and uplink channels

during the file transfers.

7. Repeat steps 5.) and 6.) for 20 minutes.
8. End the UDP sessions.
9. The network emulator shall release the RRC connection to the UE.
10. Average all UDP throughputs for the downlink channel.
11. Average all UDP throughputs for the uplink channel.

Test 2

1. Set the initial conditions as per section 8.2.1.2.1.4.1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* for a 10 MHz channel in Band 13 with the following exceptions:

   a. For devices with 2 or more receivers, the ~~Dd~~ownlink total integrated channel power shall be -94 dBm. For devices with a single receiver (e.g. cat 1bis), the downlink total integrated channel power shall be -91 dBm.

   b. Noise shall not be added, i.e. N_{oc} at antenna port (in Table 8.2.1.2.1.3-1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*) shall be ignored (AWGN shall not be included).

   c. Ensure the UE is in State 2 according to 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, and the antenna configuration for the downlink and uplink signals as specified below:

   a. The downlink reference channel shall be set to QPSK with a full allocation as per Reference Measurement Channel R.10 FDD in Table A.3.3.2.1-1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*.

   b. The downlink MIMO correlation matrices shall be defined as in section *MIMO CORRELATION MATRICES* of this document. The correlation matrix and antenna configuration shall be set to 2x2 Low.

   c. No fading shall be used on the downlink channel.

   d. The uplink reference channel shall be set to QPSK with a full allocation as per Table A.2.2.1.1-1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*.

   e. The network emulator shall send continuous power control "up" commands to the UE such that the UE is at maximum output power for the duration of the test.

3. Setup two UDP sessions to the test UDP server.
4. In one of the UDP sessions, stream the test file from the remote host to the unit under test. In the other UDP session, stream the test file from the unit under test to the remote host. Ensure that both transfers are occurring at the same time.
5. Record the average throughputs at the IP layer on the downlink and uplink channels during the file transfers.
6. Repeat steps 4.) and 5.) for twenty minutes.
7. End the UDP sessions.
8. The network emulator shall release the RRC connection to the UE.
9. Average all UDP throughputs for the downlink channel.
10. Average all UDP throughputs for the uplink channel.

Expected Results

Expected Result

The average downlink and uplink throughputs at the UDP layer for each test shall meet or exceed the values in Table below.

Table- Criteria for UDP bidirectional throughput (stress tests).

Test	Minimum Average Throughput (Mbps), Category 1 Device		Minimum Average Throughput (Mbps), Category 2 Device		Minimum Average Throughput (Mbps), Category 3+ Device	
	IPv4	IPv6	IPv4	IPv6	IPv4	IPv6
Test 1	-	-	N/A	Downlink: 31.9 Mbps Uplink: 19.0 Mbps	N/A	Downlink: 35.6 Mbps Uplink: 19.0 Mbps
Test 2	N/A	Downlink: 3.1 Mbps Uplink: 4.0 Mbps	N/A	Downlink: 3.1 Mbps Uplink: 4.0 Mbps	N/A	Downlink: 3.1 Mbps Uplink: 4.0 Mbps

3.9 STRESS TEST – UDP THROUGHPUT- Test 1 VZ_TC_LTEB13DATATHRU_3533444

3.9 STRESS TEST – UDP THROUGHPUT- Test 2 VZ_TC_LTEB13DATATHRU_3533490

3.24 256QAM DATA THROUGHPUT TEST VZ_TC_LTEB13DATATHRU_9811

Definition

These tests verify that during an LTE data call with 256QAM modulation, the file transfer (using FTP or UDP) is successfully completed and the measured throughput rate at the TCP or UDP layer meets or exceeds the expected result. The test cases are summarized in table below.

Test	Description
Test 1 (retired)	Closed loop spatial multiplexing (two layers) with 256QAM modulation and fading (based on Test Number 1 in Table 8.2.1.4.1.3-4 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*)
Test 2 (retired)	Single-layer spatial multiplexing (User-specific DM-RS) with 256QAM modulation and fading (based on Test Number 1 in Table 8.3.1.1.1_D.3-2 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*)
Test 3	Bidirectional throughput stress test with 256QAM modulation in downlink (based on Test Number 3A in Table 8.7.1.1.3-2 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*), 16QAM modulation in uplink.

Traceability

- Verizon Wireless LTE 3GPP Band 13 Network Access Requirements, Section *Data Throughput Performance*
- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, Release 12, sections 8.2.1.4.2, 8.3.1.1, 8.7.1
- 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing*, Release 12, sections 8.2.1.4.1, 8.3.1.1, 8.7.1

Applicability

This test applies to all devices that support 256QAM and are designed to operate on the Verizon Wireless LTE 3GPP Band 13 network.

Design Steps
Step Name

Step 1
Pre-Conditions
Procedures

Test Procedure

Test 1 (retired)

1. Set the initial conditions as per section 8.2.1.4.1.4.1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* for a 10 MHz channel in Band 13 with the following exceptions:
    1. Set the parameters for the cell according to Test Number 3 in Table 8.2.1.4.2-1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12.
    2. Ensure the UE is in State 2 according to 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing*.
    3. UE is configured with higher layer parameter *altCQI-Table-r12* with the setting of *allSubframes*.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR as specified for Test Number 3 per Table 8.2.1.4.2-2 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12.
3. Setup a FTP session to the test FTP server.
4. Transfer the test file from the remote host to the unit under test using the binary "get" command.
5. Record the average throughput at the TCP layer on the downlink channel during the file transfer.
6. Repeat steps 4.) and 5.) for a total of 3 iterations.
7. End the FTP session.
8. The network emulator shall release the RRC connection to the UE.
9. Average all iterations.

Test 2 (retired)

1. Set the initial conditions as per section 8.3.1.1.1_D.4.1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* for a 10 MHz

channel in Band 13 with the following exceptions:

1. Set the parameters for the cell according to Test Number 3 in Table 8.3.1.1-1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12.
2. Ensure the UE is in State 2 according to 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing.*
3. UE is configured with higher layer parameter *altCQI-Table-r12* with the setting of *allSubframes*.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR as specified for Test Number 3 per Table 8.3.1.1-2 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12.
3. Setup a FTP session to the test FTP server.
4. Transfer the test file from the remote host to the unit under test using the binary "get" command.
5. Record the average throughput at the TCP layer on the downlink channel during the file transfer.
6. Repeat steps 4.) and 5.) for a total of 3 iterations.
7. End the FTP session.
8. The network emulator shall release the RRC connection to the UE.
9. Average all iterations.

Test 3

1. Set the initial conditions as per section 8.7.1.1.4.1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing* for a 10 MHz channel in Band 13 with the following exceptions:
   1. Ensure the UE is in State 2 according to 3GPP TS 36.508: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing.*
   2. UE is configured with higher layer parameter *altCQI-Table-r12* with the setting of *allSubframes*.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, and the antenna configuration for the downlink signal as specified by Test Number 1 in Tables 8.7.1-5 and 8.7.1-6 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12, with the following exceptions:
   1. The bandwidth shall be set to 10 MHz.

2. The reference channel shall be set to R.68-2 FDD according to Table A.3.9.1-3 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE); Radio Transmission and Reception*, Release 12.

3. Set the parameters for the uplink signal as specified below:

   1. The uplink reference channel shall be set to a full allocation with 16-QAM modulation as defined in Table A.2.2.1.2-1 of 3GPP TS 36.521-1: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: conformance testing.*

   2. The network emulator shall send continuous power control "up" commands to the UE such that the UE is at maximum output power for the duration of the test.

4. Setup two UDP sessions to the test UDP server.

5. In one of the UDP sessions, stream the test file from the remote host to the unit under test. In the other UDP session, stream the test file from the unit under test to the remote host. Ensure that both transfers are occurring at the same time.

6. Record the average throughputs at the UDP layer on the downlink and uplink channels during the file transfers.

7. Repeat steps 5.) and 6.) for 10 minutes.

8. End the UDP sessions.

9. The network emulator shall release the RRC connection to the UE.

10. Average all iterations for the downlink channel.

11. Average all iterations for the uplink channel.

Expected Results

Expected Result

The average throughput at the TCP or UDP layer for each test shall meet or exceed the values in Table below.

Table- Criteria for data throughput tests with 256QAM.

Test	Minimum Average Throughput (Mbps), Category 11+ (or DL Category 11+) Device	
	IPv4	IPv6
Test 1 (retired)	34.4 Mbps	N/A
Test 2 (retired)	21.6 Mbps	N/A
Test 3	N/A	Downlink: 72.3 Mbps Uplink: 19.0 Mbps

3.24 256QAM DATA THROUGHPUT TEST- Test 1 VZ_TC_LTEB13DATATHRU_3542890

3.24 256QAM DATA THROUGHPUT TEST- Test 2 VZ_TC_LTEB13DATATHRU_3542891

3.24 256QAM DATA THROUGHPUT TEST- Test 3 VZ_TC_LTEB13DATATHRU_3542893

RequirementCoverageForTestPlan

2.4 INTERNET PDN MTU SIZE ENFORCEMENT VZ_TC_LTEB13DATATHRU_602

Requirement Name	Requirement Plan Id	Created By	Created Date
MTU SIZE	LTEB13NAC	Admin User	11-07-0013 14:25:44

3.8 STRESS TEST FTP THROUGHPUT (DOWNLINK) VZ_TC_LTEB13DATATHRU_594

Requirement Name	Requirement Plan Id	Created By	Created Date
DOWNLINK DATA THROUGHPUT	LTEB13NAC	Admin User	11-07-0013 14:28:05
LTE DEVICE CATEGORY	LTEB13NAC	Admin User	11-07-0013 14:24:27
LTE DEVICE CATEGORY - DATA CENTRIC DEVICE (NO CA)	LTEDATA	Admin User	11-07-0013 14:37:47
LTE DEVICE CATEGORY - SUPPORTS OPERATION AGAINST THE HEAD (NO CA)	LTEDATA	Admin User	11-07-0013 14:34:51

3.9 STRESS TEST UDP THROUGHPUT VZ_TC_LTEB13DATATHRU_595

Requirement Name	Requirement Plan Id	Created By	Created Date
DOWNLINK DATA THROUGHPUT	LTEB13NAC	Admin User	11-07-0013 14:28:05
LTE DEVICE CATEGORY	LTEB13NAC	Admin User	11-07-0013 14:24:27
LTE DEVICE CATEGORY - DATA CENTRIC DEVICE (NO CA)	LTEDATA	Admin User	11-07-0013 14:37:47
LTE DEVICE CATEGORY - SUPPORTS OPERATION AGAINST THE HEAD (NO CA)	LTEDATA	Admin User	11-07-0013 14:34:51
UPLINK DATA THROUGHPUT	LTEB13NAC	Admin User	11-07-0013 14:28:06

3.24 256QAM DATA THROUGHPUT TEST VZ_TC_LTEB13DATATHRU_9811

Requirement Name	Requirement Plan Id	Created By	Created Date

256QAM RF Performance	LTEB13NAC	Admin User	09-17-0015 21:18:43
DL 256QAM Support	LTEB13NAC	Admin User	09-17-0015 20:31:06
DOWNLINK DATA THROUGHPUT	LTEB13NAC	Admin User	11-07-0013 14:28:05