



## Requirement Plan

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| Verizon Wireless | <p>Version 9.00<br/>         Updates/Clarifications/Additions to the following sections:<br/>         2.1.1, 2.2.2.1, 3.2.1.1, 3.2.4.3, 3.2.4.6, 3.2.4.7, 3.2.6,<br/>         3.2.10, 3.2.10.1, 3.2.10.2.1, 3.2.10.3, 3.2.15, 3.2.16,<br/>         4.1.2.1.2, 4.1.4.1, 5.4.2, 5.5.1, 6.2.4.2, 8</p>  |
| Verizon Wireless | <p>Version 10.00<br/>         Updates/Clarifications/Additions to the following sections:<br/>         3.1.2.7.1, 3.1.2.7.2, 3.1.2.7.5, 3.2.4.4.3, 3.2.4.7,<br/>         3.2.8.5, 4.1.4.2.1, 5.4.1, 8</p>  |
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|                  | 3.1.2.7.5, 3.1.2.7.6, 3.2.1.1, 3.2.1.2, 3.2.1.3, 3.2.8.7, 3.2.9, 3.2.17, 4.1.2.4.1, 4.1.2.4.4, 4.1.11, 6.2.1.2, 6.2.3.2.1, 6.2.3.2.2, 6.2.3.2.3  |
| Verizon Wireless | Version 14.00<br>Added section 6.4   |
| Verizon Wireless | Version 15.00<br>Updates/Clarifications/Additions to the following sections:<br>3.1.2.7, 3.1.3.3, 3.1.3.7, 3.2.4.4.3, 3.2.4.8, 4.1.2.4.2, 4.1.2.4.5, 4.1.3, 4.1.3.3.1, 4.1.3.3.2, 4.1.6, 4.1.12  |
| Verizon Wireless | Version 16.00<br>Updates/Clarifications/Additions to the following sections:<br>2.2.3, 3.1.2.7, 3.1.3.3, 3.1.3.4, 3.2.4.7.1, 3.2.4.7.2, 4.1.2.4.2, 4.1.2.4.6, 4.1.3.3.1, 4.1.4.1, 4.1.8.1.1, 4.1.13, 5.4.1, 8  |
| Verizon Wireless | Version 17.00<br>Updates/Clarifications/Additions to the following sections:<br>1.2, 2.1.1, 2.2.1.3, 3.1.3, 3.1.3.3, 3.1.3.8, 3.2.4.7.2, 3.2.4.8, 3.2.9, 3.2.10 Added IMS registration requirements from LTE SMS Requirements, 3.2.10.4.1, 3.2.10.4.4, 3.2.10.4.6, 3.2.10.4.7, 3.2.11, 3.2.18, 4.1.2.4, 4.1.2.4.2, 4.1.2.4.5, 4.1.3.3, 4.1.3.3.1, 4.1.3.3.2, 4.1.5.1, 4.1.10, 4.1.12.1.3, 4.1.14, 4.1.15, 4.1.16, 4.1.17, 4.1.18, 5.4.1, 6.4.1.1, 6.4.1.2, 6.4.2.1, 6.4.2.2, 8 |
| Verizon Wireless | Version 18.00<br>Updates/Clarifications/Additions to the following sections:<br>1.2, 2.2.1.1, 3.1.3.9, 3.2.10.5.8, 3.2.10.8, 4.1.18.1, 4.1.18.5, 6.2.1.2, 6.2.1.2.1, 6.2.2.2, 6.2.3.2, 6.2.3.2.1, 6.2.3.2.2, 6.2.3.2.3   |

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| Verizon Wireless | <p>Version 19.00</p> <p>Updates/Clarifications/Additions to the following sections:</p> <p>3.1.3.10, 3.2.10.4.3, 3.2.10.4.4, 3.2.10.4.6, 3.2.10.5.1, 3.2.10.5.9, 3.2.10.6, 5.4.1, 6.2.1.2.1</p>  |
| Verizon Wireless | <p>Version 20.00</p> <p>Updates/Clarifications/Additions to the following sections:</p> <p>3.2.10.4.3, 3.2.10.4.6, 3.2.10.4.7, 3.2.10.5.9, 3.2.10.9</p>  |
| Verizon Wireless | <p>Version 21.00</p> <p>Updates to sections:</p> <p>3.1.3.10.1 (VZ_REQ_LTEB13NAC_6461)<br/>         3.1.3.11.1 (VZ_REQ_LTEB13NAC_6482)<br/>         3.2.10.5.8.1 (VZ_REQ_LTEB13NAC_6439)<br/>         4.1.4.3.1 (VZ_REQ_LTEB13NAC_6370)<br/>         4.1.6.2.1 (VZ_REQ_LTEB13NAC_6375)</p>   |
| Verizon Wireless | <p>Version 22.00</p> <p>Updates to sections: 2.2.1.3.1 (VZ_REQ_LTEB13NAC_6270), 2.2.1.3.2 (VZ_REQ_LTEB13NAC_6271), 3.1.3.5.1 (VZ_REQ_LTEB13NAC_6299), 3.1.3.13.1 (VZ_REQ_LTEB13NAC_36250), 3.2.4.2.1 (VZ_REQ_LTEB13NAC_22716), 3.2.4.3.2.1 (VZ_REQ_LTEB13NAC_6311), 3.2.9.1 (VZ_REQ_LTEB13NAC_6334), 3.2.10.5.3.1 (VZ_REQ_LTEB13NAC_6434), 3.2.10.5.6.1 (VZ_REQ_LTEB13NAC_6437), 3.2.10.5.11.1 (VZ_REQ_LTEB13NAC_6442), 3.2.10.5.13.1 (VZ_REQ_LTEB13NAC_35804), 3.2.10.6.1.1 (VZ_REQ_LTEB13NAC_6444), 3.2.10.6.2.1 (VZ_REQ_LTEB13NAC_6452), 3.2.10.6.7.1 (VZ_REQ_LTEB13NAC_6457), 3.2.10.6.10.1 (VZ_REQ_LTEB13NAC_36128), 3.2.10.10.1 (VZ_REQ_LTEB13NAC_33802), 3.2.10.11 (VZ_REQ_LTEB13NAC_36124, VZ_REQ_LTEB13NAC_36125, VZ_REQ_LTEB13NAC_36126), 4.1.7.2 (VZ_REQ_LTEB13NAC_35805), 4.1.19.1 (VZ_REQ_LTEB13NAC_35802), 4.1.20.1 (VZ_REQ_LTEB13NAC_36238), 5.5.1 (VZ_REQ_LTEB13NAC_23654)</p> |
| Verizon Wireless | <p>Version 23.00</p> <p>Updates to sections: VZ_REQ_LTEB13NAC_6264, VZ_REQ_LTEB13NAC_6268, VZ_REQ_LTEB13NAC_6269, VZ_REQ_LTEB13NAC_6270, VZ_REQ_LTEB13NAC_6274, VZ_REQ_LTEB13NAC_6275, VZ_REQ_LTEB13NAC_6277, VZ_REQ_LTEB13NAC_6461, VZ_REQ_LTEB13NAC_6482, VZ_REQ_LTEB13NAC_36250, VZ_REQ_LTEB13NAC_6317, VZ_REQ_LTEB13NAC_6433, VZ_REQ_LTEB13NAC_6435, VZ_REQ_LTEB13NAC_6439, VZ_REQ_LTEB13NAC_6442, VZ_REQ_LTEB13NAC_6444, VZ_REQ_LTEB13NAC_33802, VZ_REQ_LTEB13NAC_36124, VZ_REQ_LTEB13NAC_36125,</p>  |

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|                             | <p>VZ_REQ_LTEB13NAC_36126, VZ_REQ_LTEB13NAC_23543,<br/>         VZ_REQ_LTEB13NAC_36843, VZ_REQ_LTEB13NAC_36950,<br/>         VZ_REQ_LTEB13NAC_36951, VZ_REQ_LTEB13NAC_36952,<br/>         VZ_REQ_LTEB13NAC_36953, VZ_REQ_LTEB13NAC_36954,<br/>         VZ_REQ_LTEB13NAC_36957, VZ_REQ_LTEB13NAC_36959,<br/>         VZ_REQ_LTEB13NAC_36960, VZ_REQ_LTEB13NAC_36963,<br/>         VZ_REQ_LTEB13NAC_36964, VZ_REQ_LTEB13NAC_36965,<br/>         VZ_REQ_LTEB13NAC_36966, VZ_REQ_LTEB13NAC_36967,<br/>         VZ_REQ_LTEB13NAC_36968, VZ_REQ_LTEB13NAC_36969,<br/>         VZ_REQ_LTEB13NAC_6370, VZ_REQ_LTEB13NAC_6375,<br/>         VZ_REQ_LTEB13NAC_23623, VZ_REQ_LTEB13NAC_36995,<br/>         VZ_REQ_LTEB13NAC_6392, VZ_REQ_LTEB13NAC_6401,<br/>         VZ_REQ_LTEB13NAC_6402, VZ_REQ_LTEB13NAC_6403,<br/>         VZ_REQ_LTEB13NAC_6404, VZ_REQ_LTEB13NAC_6405,<br/>         VZ_REQ_LTEB13NAC_6412, VZ_REQ_LTEB13NAC_6413</p>   |
| <p>Verizon<br/>Wireless</p> | <p>Version 24.00<br/>         Updates to sections: VZ_REQ_LTEB13NAC_6264,<br/>         VZ_REQ_LTEB13NAC_6268, VZ_REQ_LTEB13NAC_6269,<br/>         VZ_REQ_LTEB13NAC_6270, VZ_REQ_LTEB13NAC_37889,<br/>         VZ_REQ_LTEB13NAC_6434, VZ_REQ_LTEB13NAC_6435,<br/>         VZ_REQ_LTEB13NAC_6437, VZ_REQ_LTEB13NAC_6439,<br/>         VZ_REQ_LTEB13NAC_6485, VZ_REQ_LTEB13NAC_36948,<br/>         VZ_REQ_LTEB13NAC_36950, VZ_REQ_LTEB13NAC_36952,<br/>         VZ_REQ_LTEB13NAC_36957, VZ_REQ_LTEB13NAC_37714,<br/>         VZ_REQ_LTEB13NAC_37808, VZ_REQ_LTEB13NAC_37809,<br/>         VZ_REQ_LTEB13NAC_37810, VZ_REQ_LTEB13NAC_37812,<br/>         VZ_REQ_LTEB13NAC_37813, VZ_REQ_LTEB13NAC_37814,<br/>         VZ_REQ_LTEB13NAC_36238, VZ_REQ_LTEB13NAC_36995,<br/>         VZ_REQ_LTEB13NAC_37647, VZ_REQ_LTEB13NAC_37648,<br/>         VZ_REQ_LTEB13NAC_37649, VZ_REQ_LTEB13NAC_37650,<br/>         VZ_REQ_LTEB13NAC_36963, VZ_REQ_LTEB13NAC_36964,<br/>         VZ_REQ_LTEB13NAC_36965, VZ_REQ_LTEB13NAC_36966,<br/>         VZ_REQ_LTEB13NAC_36969, VZ_REQ_LTEB13NAC_37651,<br/>         VZ_REQ_LTEB13NAC_37816, VZ_REQ_LTEB13NAC_37817</p> <p>Updated "CTIA Test Plan for Wireless Device Over the Air Performance"<br/>         references throughout the document.</p> |
| <p>Verizon<br/>Wireless</p> | <p>Version 25.00<br/>         Updates to sections: VZ_REQ_LTEB13NAC_6274,<br/>         VZ_REQ_LTEB13NAC_6332, VZ_REQ_LTEB13NAC_6433,<br/>         VZ_REQ_LTEB13NAC_6435, VZ_REQ_LTEB13NAC_35804,<br/>         VZ_REQ_LTEB13NAC_6453, VZ_REQ_LTEB13NAC_6459,<br/>         VZ_REQ_LTEB13NAC_33802, VZ_REQ_LTEB13NAC_37806,<br/>         VZ_REQ_LTEB13NAC_38376, VZ_REQ_LTEB13NAC_6465,<br/>         VZ_REQ_LTEB13NAC_6466, VZ_REQ_LTEB13NAC_38228,</p>  |

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|                  | <p>VZ_REQ_LTEB13NAC_38230, VZ_REQ_LTEB13NAC_38231,<br/>         VZ_REQ_LTEB13NAC_38232, VZ_REQ_LTEB13NAC_38233,<br/>         VZ_REQ_LTEB13NAC_38234, VZ_REQ_LTEB13NAC_38235,<br/>         VZ_REQ_LTEB13NAC_38236, VZ_REQ_LTEB13NAC_38756,<br/>         VZ_REQ_LTEB13NAC_38757, VZ_REQ_LTEB13NAC_38238,<br/>         VZ_REQ_LTEB13NAC_38239, VZ_REQ_LTEB13NAC_38240,<br/>         VZ_REQ_LTEB13NAC_38241, VZ_REQ_LTEB13NAC_38242,<br/>         VZ_REQ_LTEB13NAC_38243, VZ_REQ_LTEB13NAC_38244,<br/>         VZ_REQ_LTEB13NAC_35802, VZ_REQ_LTEB13NAC_36238,<br/>         VZ_REQ_LTEB13NAC_38507, VZ_REQ_LTEB13NAC_38508,<br/>         VZ_REQ_LTEB13NAC_6385, VZ_REQ_LTEB13NAC_38378</p>   |
| Verizon Wireless | <p>Version 26.00<br/>         Updates to sections:<br/>         VZ_REQ_LTEB13NAC_6467, VZ_REQ_LTEB13NAC_6412<br/>         VZ_REQ_LTEB13NAC_39982</p>   |
| Verizon Wireless | <p>Version 27.00<br/>         Updates to sections: VZ_REQ_LTEB13NAC_6269,<br/>         VZ_REQ_LTEB13NAC_6277, VZ_REQ_LTEB13NAC_6336,<br/>         VZ_REQ_LTEB13NAC_6455, VZ_REQ_LTEB13NAC_6458,<br/>         VZ_REQ_LTEB13NAC_6459, VZ_REQ_LTEB13NAC_33802,<br/>         VZ_REQ_LTEB13NAC_39731, VZ_REQ_LTEB13NAC_39749,<br/>         VZ_REQ_LTEB13NAC_39732, VZ_REQ_LTEB13NAC_39733,<br/>         VZ_REQ_LTEB13NAC_6467, VZ_REQ_LTEB13NAC_36995,<br/>         VZ_REQ_LTEB13NAC_6395, VZ_REQ_LTEB13NAC_6412,<br/>         VZ_REQ_LTEB13NAC_39752, VZ_REQ_LTEB13NAC_39982</p>   |
| Verizon Wireless | <p>Version 28.00<br/>         Updates to sections: VZ_REQ_LTEB13NAC_6299,<br/>         VZ_REQ_LTEB13NAC_6308, VZ_REQ_LTEB13NAC_6311,<br/>         VZ_REQ_LTEB13NAC_6313, VZ_REQ_LTEB13NAC_6314,<br/>         VZ_REQ_LTEB13NAC_6317, VZ_REQ_LTEB13NAC_6326,<br/>         VZ_REQ_LTEB13NAC_6327, VZ_REQ_LTEB13NAC_6332,<br/>         VZ_REQ_LTEB13NAC_6334, VZ_REQ_LTEB13NAC_6336,<br/>         VZ_REQ_LTEB13NAC_6338, VZ_REQ_LTEB13NAC_6434,<br/>         VZ_REQ_LTEB13NAC_6439, VZ_REQ_LTEB13NAC_6440,<br/>         VZ_REQ_LTEB13NAC_6442, VZ_REQ_LTEB13NAC_6445,<br/>         VZ_REQ_LTEB13NAC_39731, VZ_REQ_LTEB13NAC_6350,<br/>         VZ_REQ_LTEB13NAC_6351, VZ_REQ_LTEB13NAC_6352,<br/>         VZ_REQ_LTEB13NAC_6353, VZ_REQ_LTEB13NAC_6356,<br/>         VZ_REQ_LTEB13NAC_6359, VZ_REQ_LTEB13NAC_6360,<br/>         VZ_REQ_LTEB13NAC_6361, VZ_REQ_LTEB13NAC_6365,<br/>         VZ_REQ_LTEB13NAC_6367, VZ_REQ_LTEB13NAC_6368,</p> |

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|                  | <p>VZ_REQ_LTEB13NAC_40649, VZ_REQ_LTEB13NAC_6373,<br/>         VZ_REQ_LTEB13NAC_35802, VZ_REQ_LTEB13NAC_36995,<br/>         VZ_REQ_LTEB13NAC_40930, VZ_REQ_LTEB13NAC_40797,<br/>         VZ_REQ_LTEB13NAC_6385, VZ_REQ_LTEB13NAC_6386,<br/>         VZ_REQ_LTEB13NAC_6388, VZ_REQ_LTEB13NAC_6395,<br/>         VZ_REQ_LTEB13NAC_6412</p>  |
| Verizon Wireless | <p>Version 29.00<br/>         Updates to sections: VZ_REQ_LTEB13NAC_6274,<br/>         VZ_REQ_LTEB13NAC_6299, VZ_REQ_LTEB13NAC_6424,<br/>         VZ_REQ_LTEB13NAC_41271, VZ_REQ_LTEB13NAC_41272,<br/>         VZ_REQ_LTEB13NAC_41328, VZ_REQ_LTEB13NAC_6332,<br/>         VZ_REQ_LTEB13NAC_6433, VZ_REQ_LTEB13NAC_6455,<br/>         VZ_REQ_LTEB13NAC_6349, VZ_REQ_LTEB13NAC_35802,<br/>         VZ_REQ_LTEB13NAC_6384, VZ_REQ_LTEB13NAC_6392,<br/>         VZ_REQ_LTEB13NAC_6401, VZ_REQ_LTEB13NAC_6402,<br/>         VZ_REQ_LTEB13NAC_6403, VZ_REQ_LTEB13NAC_41335,<br/>         VZ_REQ_LTEB13NAC_36995, VZ_REQ_LTEB13NAC_6480</p> |
| Verizon Wireless | <p>Version 30.00:<br/>         Updates/Additions/Clarifications to requirements related to:<br/>         Device category<br/>         UICC and eUICC<br/>         4 Rx and 4x4 MIMO<br/>         Uplink 64-QAM<br/>         IMS registration<br/>         Data over control plane<br/>         Blind data interference cancellation<br/>         UE-assisted adaptive DRX<br/>         IMS-less operation<br/>         Low priority access</p>  |
| Verizon Wireless | <p>Version 31.00:<br/>         Updated MIMO OTA requirements and added notes on retirement of ECC.<br/>         Updated 4 receive antenna requirement.<br/>         Updated MTU size requirement.<br/>         Updated requirement on SIP 403/404 handling.</p>   |
| Verizon Wireless | <p>Version 32.00:<br/>         Added LTE Category M1 requirements.<br/>         Added eDRX requirements.</p>  |

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|                  | <p>Added clarifications on attach APN behavior for IMS-less data devices.</p> <p>Updated MTU size requirement.</p> <p>Removed antenna imbalance requirement.</p> <p>Removed ECC and antenna test application requirements.</p>   |
| Verizon Wireless | <p>Version 33.00:</p> <p>Added clarifications for category M1, IMS-less operation, PSM, and single receive antenna operation.</p> <p>Updates to eUICC, MTU size, IMS registration, and feICIC requirements.</p>  |
| Verizon Wireless | <p>Version 34.00:</p> <p>Updates to eUICC, IMS registration SIP 403/404 error handling, and attach accept NAS messaging requirements.</p>  |
| Verizon Wireless | <p>Version 35.00:</p> <p>Added 5 MHz channel BW, UL 256QAM.</p> <p>Added features for IMS-less Category M1 and below devices.</p> <p>Updated UICC requirements.</p> <p>Updated TIS requirements.</p> <p>Updated single Rx requirements.</p> <p>Removed SIP 503 with "Outage Text".</p> |
| Verizon Wireless | <p>Version 36.00:</p> <p>Updates for NAS features for low priority/low complexity devices.</p> <p>Clarifications to cat M1 RF OTA requirements.</p>  |
| Verizon Wireless | <p>Version 37.00:</p> <p>Minor clarifications to the PSM, eDRX requirements.</p>   |



## 1.1 INTRODUCTION VZ\_REQ\_LTEB13NAC\_1869

Verizon Wireless has launched LTE network service in the 3GPP Band 13 frequency band (700 MHz C Block). 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.

### 1.1.1 APPLICABILITY VZ\_REQ\_LTEB13NAC\_1870

These requirements apply to all devices designed to operate on the Verizon Wireless LTE 3GPP Band 13 network. 3GPP Band 13 is per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

For any questions related to this document, please contact Verizon Wireless through the Verizon Wireless Open Development website.

### 1.1.2 ~~3GPP RELEASE 9 SPECIFICATIONS~~ VZ\_REQ\_LTEB13NAC\_1871

#### 1.1.2.1 ~~3GPP RELEASE 9 SPECIFICATIONS~~ VZ\_REQ\_LTEB13NAC\_6264

~~In this document, the term "3GPP Release 9 Specifications" refers to all 3GPP specifications that have been updated for Release 9 as of the September 2010 baseline with the exceptions noted below:~~

- ~~• The following CRs and features from later releases shall be included:~~
  - ~~• 3GPP RP-101431, CR#532: Splitting FGI bit 3 (CR to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*)~~

- ~~SIB16 per the Release 11 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC).~~
- ~~RRC Connection Reject with Deprioritization per the Release 11 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC).~~
- ~~SON support (i.e. radio link failure reporting, handover failure reporting, and RACH information reporting) per the Release 10 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification.~~
- ~~Support for EMM Cause Value #42 "Service Network Failure" per the Release 11 version of 3GPP TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3.~~
- ~~Cell selection with hybrid cells per section 5.2.4.9 of the Release 10 version of 3GPP TS 36.304: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode.~~
- ~~Timers T3245, T3346, and T3396 per the Release 10 version of 3GPP TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3.~~
- ~~T3402 value in the ATTACH REJECT message per the Release 10 version of 3GPP TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3.~~
- ~~Low priority access/delay tolerant UE support and extended access barring per the Release 11 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification.~~
- ~~eICIC (and associated features) per 3GPP Release 10.~~
- ~~Transmission mode 9 (TM9) downlink CoMP per 3GPP Release 10.~~
- ~~Transmission mode 10 (TM10) downlink CoMP per 3GPP Release 11.~~

The versions for all referenced 3GPP documents shall be as per the September 2010 Release 9 baseline with the exceptions noted above.

For a complete list of 3GPP documents, refer to 3GPP TS 21.201: *Technical Specifications and Technical Reports relating to an Evolved Packet System (EPS) based 3GPP system*.

Please refer to <http://www.3gpp.org> for the latest version of the 3GPP Specifications.

### 1.1.3 ACRONYMS/GLOSSARY/DEFINITIONS VZ\_REQ\_LTEB13NAC\_1872

This section defines acronyms and terms used throughout the document.

| Acronym/Term | Definition   |
|--------------|--|
| 3GPP         | 3rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards |

|          |   |
|----------|---|
| A-MPR    | Additional Maximum Power Reduction  |
| APN      | Access Point Name   |
| ATSC     | Advanced Television Systems Committee                                       |
| BW       | Bandwidth   |
| CAT      | Card Application Toolkit  |
| CMAS     | Commercial Mobile Alert Service   |
| CR       | Change Request  |
| DHCP     | Dynamic Host Configuration Protocol   |
| DNS      | Domain Name System  |
| EMM      | EPS Mobility Management   |
| EPS      | Evolved Packet System   |
| ETSI     | European Telecommunications Standards Institute                             |
| E-UTRA   | Evolved Universal Terrestrial Radio Access                                  |
| E-UTRAN  | Evolved Universal Terrestrial Radio Access Network                          |
| FCC      | Federal Communications Commission   |
| FDD      | Frequency-Division Duplex   |
| FQDN     | Fully Qualified Domain Name   |
| GCF      | Global Certification Forum  |
| IEC      | International Electrotechnical Commission                                   |
| IMEI     | International Mobile station Equipment Identity                             |
| IMEISV   | International Mobile station Equipment Identity and Software Version Number |
| IMS      | IP Multimedia Subsystem   |
| IMS-Less | Without IMS client  |
| IMSI     | International Mobile Subscriber Identity                                    |
| ISIM     | IP Multimedia Services Identity Module                                      |
| ISO      | International Organization for Standardization                              |

|         |   |
|---------|---|
| LTE     | Long Term Evolution                                 |
| MCC     | Mobile Country Code                                 |
| MIMO    | Multiple Input-Multiple Output                      |
| MNC     | Mobile Network Code                                 |
| MPR     | Maximum Power Reduction                             |
| MTC     | Machine Type Communications (Cat 1, Cat-M1, NB-IoT) |
| NAI     | Network Access Identifier                           |
| NAS     | Non-Access Stratum                                  |
| NI      | Network Identifier (part of APN)                    |
| NIDD    | Non-IP Data Delivery                                |
| OI      | Operator Identifier (part of APN)                   |
| OTADM   | Over-the-Air Device Management                      |
| PCO     | Protocol Configuration Options                      |
| P-CSCF  | Proxy-Call Session Control Function                 |
| PDN     | Packet Data Network                                 |
| PDP     | Packet Data Protocol                                |
| PLMN    | Public Land Mobile Network                          |
| PUCCH   | Physical Uplink Control Channel                     |
| PUSCH   | Physical Uplink Shared Channel                      |
| QoS     | Quality of Service                                  |
| RAT     | Radio Access Technology                             |
| RB      | Resource Block                                      |
| REFSENS | Reference Sensitivity                               |
| ROHC    | Robust Header Compression                           |
| RRC     | Radio Resource Control                              |
| RSS     | Received Signal Strength                            |

|      |  |
|------|--|
| SMS  | Short Message Service                          |
| SNR  | Serial Number (part of IMEI and IMEISV)        |
| SVN  | Software Version Number (part of IMEISV)       |
| TAC  | Type Allocation Code (part of IMEI and IMEISV) |
| TDD  | Time-Division Duplex                           |
| TIS  | Total Isotropic Sensitivity                    |
| TRP  | Total Radiated Power                           |
| TTL  | Time-to-Live                                   |
| UE   | User Equipment                                 |
| UICC | Universal Integrated Circuit Card              |
| USIM | Universal Subscriber Identity Module           |
| VZW  | Verizon Wireless                               |

### 1.1.4 FCC COMPLIANCE VZ\_REQ\_LTEB13NAC\_1873

#### 1.1.4.1 FCC COMPLIANCE VZ\_REQ\_LTEB13NAC\_6265

Please note that devices submitted to the Verizon Wireless Open Development Initiative for conformance testing must have previously completed U.S. Federal Communications Commission equipment authorization procedures and comply with relevant FCC rules and regulations. It is the responsibility of the developer to comply with relevant FCC requirements.

#### 1.1.5 LTE SERVICES VZ\_REQ\_LTEB13NAC\_1874

Initially, Verizon Wireless will be providing packet data service over the Verizon Wireless LTE 3GPP Band 13 network.

## 1.1.6 REQUIREMENTS LANGUAGE VZ\_REQ\_LTEB13NAC\_1875

This document uses the following verbal forms in conjunction with requirements:

- "*Shall*" or "*Shall not*" indicates the requirement is mandatory
- "*Should*" indicates the requirement is recommended but not mandatory
- "*May*" indicates the requirement is optional

## 1.1.7 DEVICE TESTING ON THE VERIZON WIRELESS LTE 3GPP BAND 13 NETWORK VZ\_REQ\_LTEB13NAC\_1876

### 1.1.7.1 DEVICE TESTING ON THE VERIZON WIRELESS LTE 3GPP BAND 13 NETWORK VZ\_REQ\_LTEB13NAC\_6266

Prior to any testing on the "live" Verizon Wireless LTE network, the device shall pass the Verizon Wireless LTE Band 13 Safe for Network Test Plan.

## 1.2 HARDWARE SPECIFICATIONS VZ\_REQ\_LTEB13NAC\_1877

### 1.2.1 MECHANICAL VZ\_REQ\_LTEB13NAC\_1878

#### 1.2.1.1 UICC SUPPORT - FORM FACTOR VZ\_REQ\_LTEB13NAC\_22654

##### 1.2.1.1.1 UICC SUPPORT - FORM FACTOR VZ\_REQ\_LTEB13NAC\_6267

The device shall support one of the following UICC form factors:

- 2FF, or Plug-in, UICC, as specified in clause 4.2 of ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics, Release 8*
- 3FF, or Mini, UICC, as specified in clause 4.3 of ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics, Release 8*
- 4FF UICC, as specified in clause 4.0.4 of ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics, Release 11*

Verizon Wireless strongly recommends support of the 4FF UICC, with mechanical provisions in the device for easy insertion and removal of the card.

## 1.2.2 ELECTRICAL VZ\_REQ\_LTEB13NAC\_1879

### 1.2.2.1 LTE SUPPORT VZ\_REQ\_LTEB13NAC\_22655

#### 1.2.2.1.1 LTE SPECIFICATION VZ\_REQ\_LTEB13NAC\_22657

##### 1.2.2.1.1.1 LTE SPECIFICATION - LTE CATEGORY 1 AND HIGHER

VZ\_REQ\_LTEB13NAC\_6268

#### **LTE Category 1 and Higher Devices:**

LTE category 1 and higher devices shall support Frequency-Division Duplex (FDD) LTE operation as defined in the 3GPP Release 9 Specifications, September 2010 baseline. Time-Division Duplex (TDD) operation is not required for LTE in 3GPP Band 13. The device may support Frequency-Division Duplex (FDD) LTE operation as defined in the 3GPP Release 10 Specifications, June 2011 baseline. The device may support LTE operation as defined in later 3GPP releases and baselines (i.e. later than 3GPP Release 10, June 2011 baseline).

If the device supports 3GPP Release 9 (September 2010 baseline), support for the following CRs to Release 9 and the following features from Release 10 and Release 11 shall be included:

- 3GPP RP-101431, CR#532: Splitting FGI bit 3 (CR to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*)
- SIB16 per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*.
- RRC Connection Reject with Deprioritization per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*.
- SON support (i.e. radio link failure reporting, handover failure reporting, and RACH information reporting) per the Release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*.
- Support for EMM Cause Value #42 "Service Network Failure" per the Release 11 version of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.
- Cell selection with hybrid cells per section 5.2.4.9 of the Release 10 version of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode*.
- Timers T3245, T3346, and T3396 per the Release 10 version of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.
- T3402 value in the ATTACH REJECT message per the Release 10 version of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.
- Low priority access/delay tolerant UE support and extended access barring per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*.
- eICIC (and associated features) per 3GPP Release 10.
- Transmission mode 9 (TM9) downlink CoMP per 3GPP Release 10.
- Transmission mode 10 (TM10) downlink CoMP per 3GPP Release 11.

If the device supports 3GPP Release 10 (June 2011 baseline), support for the following features from Release 11 shall be included:

- SIB16 per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*.
- RRC Connection Reject with Deprioritization per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*.
- Support for EMM Cause Value #42 "Service Network Failure" per the Release 11 version of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.
- Low priority access/delay tolerant UE support and extended access barring per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*.
- eICIC (and associated features) per 3GPP Release 10.
- Transmission mode 10 (TM10) downlink CoMP per 3GPP Release 11 (including TM9 downlink CoMP per 3GPP Release 10).



## 1.2.2.1.1.2 LTE SPECIFICATION - LTE CATEGORY M1 VZ\_REQ\_LTEB13NAC\_4297753

### LTE Category M1 Devices:

LTE category M1 devices shall support either a) frequency-division duplex (FDD) category M1 LTE operation, or b) Type B half-duplex frequency-division duplex (HD-FDD) category M1 LTE operation, as defined in the 3GPP Release 13 Specifications. The device may support later 3GPP releases.

## 1.2.2.1.2 LTE DEVICE CATEGORY VZ\_REQ\_LTEB13NAC\_22658

### 1.2.2.1.2.1 LTE DEVICE CATEGORY VZ\_REQ\_LTEB13NAC\_6269

The device shall be either 1) an LTE category M1 device, or 2) an LTE category 1 or higher device per 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*.

All smartphones and tablets shall be LTE category 2 or higher.

**NOTE:** Depending on the modem features supported by the device, the device may need to report separate device categories for downlink and uplink using the *ue-CategoryDL* and *ue-CategoryUL* fields in the *UE-EUTRA-Capability* information element. Refer to the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, and the Release 12 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification* for additional details.

## 1.2.2.1.3 RRC UE FEATURE GROUP SUPPORT VZ\_REQ\_LTEB13NAC\_22659

### 1.2.2.1.3.1 RRC UE FEATURE GROUP SUPPORT - MANDATORY FGI'S VZ\_REQ\_LTEB13NAC\_6270

The device shall support the following feature groups defined in section B.1 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification: 2, 3, 4, 5, 6, 7, 14, 16, 17, 20, 21, and 103.*

### 1.2.2.1.3.2 RRC UE FEATURE GROUP SUPPORT - OPTIONAL FGI'S

VZ\_REQ\_LTEB13NAC\_6271

The device may support the following additional feature groups defined in section B.1 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification: 28 and 29.*

### 1.2.2.1.3.3 RRC UE FEATURE GROUP SUPPORT - RRC MESSAGING

VZ\_REQ\_LTEB13NAC\_6272

When responding to the *UECapabilityEnquiry* RRC message (refer to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, clause 5.6.3 for additional details), the indicators for all feature groups that are not supported by the device and the indicators for all feature groups with capabilities that have not been tested as a part of 3GPP standard conformance testing or VZW-specific testing shall be set to "0" (i.e. indicating that the UE does not support them). Refer to the *Performance and Required Verizon Wireless Device Compliance Test Plans* sections of this document for additional details on 3GPP standard conformance testing and VZW-specific testing.

### 1.2.2.1.4 LTE FREQUENCY BAND VZ\_REQ\_LTEB13NAC\_22660

#### 1.2.2.1.4.1 LTE FREQUENCY BAND VZ\_REQ\_LTEB13NAC\_6273

The device shall support LTE in 3GPP Band 13 using 5 MHz and 10 MHz channel bandwidths as defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception.*

#### 1.2.2.1.5 UPLINK 64-QAM SUPPORT VZ\_REQ\_LTEB13NAC\_1275530

Downlink LTE category 16 and higher devices shall support uplink 64-QAM. Devices that are less than downlink LTE category 16 may support uplink 64-QAM. If the device supports uplink 64-QAM, the device shall implement uplink 64-QAM per 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation*, 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*, and 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

**NOTE:** When operating in uplink 64-QAM mode, the MPR, configured output power, A-MPR, and GPS emissions requirements in VZ\_REQ\_LTEB13NAC\_6391, VZ\_REQ\_LTEB13NAC\_6393, VZ\_REQ\_LTEB13NAC\_6395, and VZ\_REQ\_LTEB13NAC\_6398 shall apply.

### 1.2.2.1.6 UPLINK 256-QAM SUPPORT VZ\_REQ\_LTEB13NAC\_8364374

Downlink LTE category 20 and higher devices shall support uplink 256-QAM. Devices that are less than downlink LTE category 20 may support uplink 256-QAM. If the device supports uplink 256-QAM, the device shall implement uplink 256-QAM per 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation*, 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*, and 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

**NOTE:** When operating in uplink 256-QAM mode, the MPR, configured output power, A-MPR, and GPS emissions requirements in VZ\_REQ\_LTEB13NAC\_6391, VZ\_REQ\_LTEB13NAC\_6393, VZ\_REQ\_LTEB13NAC\_6395, and VZ\_REQ\_LTEB13NAC\_6398 shall apply.

### 1.2.2.2 MIMO SUPPORT VZ\_REQ\_LTEB13NAC\_22661

#### 1.2.2.2.1 MIMO ANTENNA REQUIREMENTS VZ\_REQ\_LTEB13NAC\_22664

##### 1.2.2.2.1.1 MIMO ANTENNA REQUIREMENTS VZ\_REQ\_LTEB13NAC\_6274

LTE category 1 and higher devices shall support one transmitter and two receivers for LTE 3GPP Band 13 operation. The device shall have a primary antenna for transmit and receive functions, and a secondary antenna for MIMO/receive diversity functions. When receiving LTE 3GPP Band 13 signals, the device shall always support dual receiver operation. At no time when receiving LTE 3GPP Band 13 signals shall the device autonomously cease dual receiver operation for any purpose.

**NOTE:** This requirement applies to all device categories except category M1, including category 1 with the following exception:

- A single receive antenna (i.e., no secondary antenna for MIMO/received diversity functions) is permissible for the follow devices:
  - Low data rate machine-to-machine (M2M) and internet of things (IoT) devices that are category 1 or higher
  - Wearable devices that are category 1 or higher
  - Devices that are category 1 or higher and are primarily uplink data where greater than 80% of the data traffic for the device is uplink traffic (e.g. streaming camera)
- If operating with a single receive antenna:
  1. The device shall at all times report a rank indicator of 1 to the network.
  2. The device shall meet all 3GPP and Verizon Wireless LTE RF and RRM performance requirements. The receive antenna shall meet the radiated performance requirements for the "primary receiver" as defined in requirement VZ\_REQ\_LTEB13NAC\_6401 of this document.
  3. The device SHALL support LTE operation when the eNB is transmitting on 4 antenna ports.
  4. When implementing single receiver using a chipset/modem that supports 2 or more receivers, the device shall disable the un-used receiver(s) at the chipset/modem. If possible, all active components within the un-used receivers (i.e. LNA, downconverter, demodulator, ADC) shall be powered off.

**NOTE: For devices with a single receive antenna, the device receiver performance will be negatively affected by up to 4 dB. Verizon Wireless cannot guarantee that device field performance with single receive antenna operation will be comparable to device field performance with dual receive antenna operation. Verizon Wireless strongly recommends against single receive antenna operation for mission critical devices. Verizon Wireless will monitor any increased interference to other users devices arising from devices operating with a single receive antenna, and reserves the right to terminate network access for a device that causes increased interference to other users while operating with a single receive antenna until the device manufacturer, owner, or user implements corrective action to come back into compliance with these requirements or otherwise to the satisfaction of Verizon Wireless. Additionally, devices designed for other use cases must adhere to the standard for two receive antennas.**

### 1.2.2.2.1.2 TX ANTENNA SWITCHING VZ\_REQ\_LTEB13NAC\_6275

The device shall not allow the transmitter output to be switched between the primary and secondary antennas.

### 1.2.2.2.2 MIMO SUPPORT REQUIREMENTS VZ\_REQ\_LTEB13NAC\_22665

#### ~~1.2.2.2.2.1 TRANSMIT DIVERSITY (APPLIES TO ALL DEVICE CATEGORIES)~~ VZ\_REQ\_LTEB13NAC\_22666

#### 1.2.2.2.2.2 Transmit Diversity (Applies to All Device Categories) VZ\_REQ\_LTEB13NAC\_6276

All LTE category 1 and higher devices shall support downlink 2x2 and 4x2 transmit diversity as defined in the 3GPP Release 9 Specifications.

#### 1.2.2.2.2.3 SPATIAL MULTIPLEXING VZ\_REQ\_LTEB13NAC\_22667

#### 1.2.2.2.2.4 Spatial Multiplexing VZ\_REQ\_LTEB13NAC\_6277

As defined in the 3GPP Release 9 Specifications, Category 2 and higher devices shall support:

- downlink 2x2 and 4x2 open loop spatial multiplexing
- downlink 2x2 and 4x2 closed loop spatial multiplexing (single layer and 2 layers).

Category 1 devices shall support downlink 2x2 and 4x2 single layer spatial multiplexing using transmission modes 3 and 4.

### 1.2.2.2.3 4 RECEIVE ANTENNAS VZ\_REQ\_LTEB13NAC\_1231230

#### 1.2.2.2.3.1 4 RECEIVE ANTENNA SUPPORT VZ\_REQ\_LTEB13NAC\_1231233

All LTE category 1 and higher devices may support 4 receive antennas on Band 13. Devices that support 4 receive antennas on Band 13 shall support one transmitter and four receivers for LTE 3GPP Band 13 operation. Devices that support 4 receive antennas shall support downlink 2x2 and downlink 4x2 operation per requirements VZ\_REQ\_LTEB13NAC\_6276 and VZ\_REQ\_LTEB13NAC\_6277 with all 4 receivers enabled. Devices that are category 2 or higher and support 4 receive antennas shall operate with all 4 antennas enabled while in RRC\_CONNECTED mode.

#### 1.2.2.2.3.2 4x4 MIMO SUPPORT VZ\_REQ\_LTEB13NAC\_1232098

Devices that support 4 receive antennas and are a device category that allows 4 layer spatial multiplexing per 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, shall support downlink 4x4 spatial multiplexing (both open and closed loop) as defined in the 3GPP standard.

### 1.2.2.3 TESTABILITY VZ\_REQ\_LTEB13NAC\_22662

#### 1.2.2.3.1 TESTABILITY VZ\_REQ\_LTEB13NAC\_6278

~~External RF connectors shall be provided for all antenna paths including all MIMO antenna paths. The RF connectors shall be easily accessible, e.g. not behind the battery.~~

The RF connectors shall be placed such that only the antenna and the antenna matching circuit are disconnected. The conducted path through the RF connectors shall include all elements of the transceiver chain (e.g. filters, active components) except the antenna and the antenna matching circuit.

## 1.2.2.4 UICC SUPPORT VZ\_REQ\_LTEB13NAC\_22663

### 1.2.2.4.1 ~~ACTIVATION/DE-ACTIVATION OF CONTACTS TO THE UICC~~ VZ\_REQ\_LTEB13NAC\_22671

#### 1.2.2.4.1.1 ~~ACTIVATION/DE-ACTIVATION OF CONTACTS TO THE UICC~~ VZ\_REQ\_LTEB13NAC\_6279

Electrical and mechanical interface contacts for activation and de-activation of the UICC shall be compliant with ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics* (Release 8). All mandatory procedures, commands and files shall be supported. Support for contacts c4, c6, and c8 as specified in ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics* (Release 8) is optional.

### 1.2.2.4.2 ~~POWER SUPPLY~~ VZ\_REQ\_LTEB13NAC\_22672

#### 1.2.2.4.2.1 ~~POWER SUPPLY~~ VZ\_REQ\_LTEB13NAC\_6280

The device shall support Class C as specified in ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics* (Release 8). The device may support Class B as specified in ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics* (Release 8).

### 1.2.2.4.3 DEVICE INTERFACE VZ\_REQ\_LTEB13NAC\_22673

#### 1.2.2.4.3.1 DEVICE INTERFACE VZ\_REQ\_LTEB13NAC\_6281

The device shall be compliant to the interface defined in ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics* (Release 8). As ETSI 102 221 is generic for an IC card implementation, the device shall also be compliant to the 3GPP application as specified in 3GPP 31.101: *UICC-terminal interface; Physical and logical characteristics*.

### 1.2.2.4.4 ISO/IEC-7816 SPEED VZ\_REQ\_LTEB13NAC\_22675

#### 1.2.2.4.4.1 ISO/IEC-7816 SPEED VZ\_REQ\_LTEB13NAC\_6282

The device shall support all ISO/IEC-7816-2: 1999/ AM1: 2004, *Identification cards - Integrated circuit(s) cards with contacts - Part 2: Dimension and location of the contacts, Amendment 1: Assignment of contacts for C4 and C8* and ISO/IEC-7816-3: *Information technology - Identification cards - Integrated circuit(s) cards with contacts - Part 3: Electronic signals and transmission protocols* communication speeds (as defined by the value of TA1 in the Protocols and Parameters Selection) up to and including TA = 97h.

If the UICC requests a speed not supported by the device, the device shall use the highest speed supported by the device.

### 1.2.2.4.5 FALLBACK SUPPORT VZ\_REQ\_LTEB13NAC\_22676

#### 1.2.2.4.5.1 FALLBACK SUPPORT VZ\_REQ\_LTEB13NAC\_6283



The device shall support fallback policy as specified in ISO/IEC-7816-2: 1999/ AM1: 2004, *Identification cards - Integrated circuit(s) cards with contacts - Part 2: Dimension and location of the contacts, Amendment 1: Assignment of contacts for C4 and C8* and ISO/IEC-7816-3: *Information technology - Identification cards - Integrated circuit(s) cards with contacts - Part 3: Electronic signals and transmission protocols* for cases where the highest speed is not supported.

### 1.3 SOFTWARE SPECIFICATIONS VZ\_REQ\_LTEB13NAC\_1880

#### 1.3.1 DEVICE BASED VZ\_REQ\_LTEB13NAC\_1881

##### 1.3.1.1 ~~RRC\_CONNECTED TO RRC\_IDLE TIMERS~~ (INFORMATIVE) VZ\_REQ\_LTEB13NAC\_22677

~~In normal operation, the device transition from the RRC\_CONNECTED state to the RRC\_IDLE state occurs when the network (i.e. E-UTRAN) sends a RRCConnectionRelease message to the device (refer to 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2* and 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details). As a result, in normal operation any timers for triggering the transition from the RRC\_CONNECTED state to the RRC\_IDLE state will be network based timers as opposed to device based timers (a local RRC connection release is supported in 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* upon a request from the UEs upper layers).~~

#### 1.3.1.2 TESTABILITY VZ\_REQ\_LTEB13NAC\_22678

##### 1.3.1.2.1 ~~LTE TEST APPLICATION PROTOCOL SUITE~~ VZ\_REQ\_LTEB13NAC\_22681

### 1.3.1.2.1.1 LTE TEST APPLICATION PROTOCOL SUITE VZ\_REQ\_LTEB13NAC\_6284

The device shall support 3GPP TS 36.509: *Evolved Universal Terrestrial Radio Access (E-UTRA); Special conformance testing function for User Equipment (UE)*.

### 1.3.1.2.2 ~~LTE TEST MODE SUPPORT~~ VZ\_REQ\_LTEB13NAC\_22682

#### 1.3.1.2.2.1 ~~LTE TEST MODE SUPPORT~~ VZ\_REQ\_LTEB13NAC\_6285

The device shall support a test mode in which the device is configured for LTE only operation. In this test mode, the device shall disable any non-LTE radio access technologies supported in the device, and the device shall not perform any interRAT functions while attached to the LTE network. By default, this test mode shall be disabled, i.e. by default the device is configured for normal operation.

This test mode shall be enabled and disabled using a non-volatile memory setting. Upon changing this memory setting, the device shall perform a soft reset. The vendor shall provide a lab application to modify this memory setting during device acceptance testing. The device vendor shall not allow the user to modify this memory setting through the device user interface or the remote access user interface for tethered devices.

### 1.3.1.2.3 ~~LTE DIAGNOSTIC MONITOR CAPABILITY~~ VZ\_REQ\_LTEB13NAC\_22683

#### 1.3.1.2.3.1 ~~LTE DIAGNOSTIC MONITOR CAPABILITY~~ VZ\_REQ\_LTEB13NAC\_6286

The device should have diagnostic logging capability, which will enable diagnostic tools to log diagnostic packets such as, but not limited to the following:

*Diagnostic tool requirement details are in development and will be available in a later release.*

#### **1.3.1.2.4 FIELD TEST MENU**

VZ\_REQ\_LTEB13NAC\_22684

##### **1.3.1.2.4.1 FIELD TEST MENU**

VZ\_REQ\_LTEB13NAC\_6287

*The device should support a field test menu through the diagnostic interface. Field test menu details are in development and will be available in a later release.*

#### **1.3.1.2.5 AT COMMAND SUPPORT**

VZ\_REQ\_LTEB13NAC\_22685

To facilitate device testing, the device shall support AT commands per the Verizon Wireless LTE AT Commands for Test Automation Requirements. Compliance to AT command requirements shall be per the Verizon Wireless LTE AT Commands for Test Automation Test Plan.

#### **1.3.1.2.6 USB DEVICE DRIVER**

VZ\_REQ\_LTEB13NAC\_22686

##### **1.3.1.2.6.1 USB DEVICE DRIVER**

VZ\_REQ\_LTEB13NAC\_6288

The device vendor shall provide a USB device driver to allow a PC host to communicate with the device over a USB interface. This interface shall allow the device to act as a tethered data device during testing. This interface shall also support communication of the AT command set defined in the *AT Command Support* section of this document. This driver shall be compatible with the following versions of the Microsoft Windows operating system: XP, Vista, 7.

#### **1.3.1.2.7 LTE TEST APPLICATION FOR ANTENNA TESTING**

VZ\_REQ\_LTEB13NAC\_22687

VOID

### 1.3.1.2.7.1 ~~LTE Test Application for Antenna Testing Requirements~~ VZ\_REQ\_LTEB13NAC\_6289

**NOTE: Any device that enters device certification on or after April 17th, 2017, is required to perform MIMO OTA per the latest "in force" version of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance. As of April 17th, 2017, ECC using complex pattern data is RETIRED.**

~~To enable radiated receiver performance testing, the device shall support RSS-based TIS measurements as described in section 6.16 of the CTIA Test Plan for Wireless Device Over the Air Performance. The device vendor shall provide a test application to support LTE over the air radiated performance testing. This test application shall allow a test platform to:~~

- ~~• Independently enable/disable each receiver path~~
- ~~• Retrieve complex antenna pattern data (i.e. RSSI and phase) for each receiver path~~

~~For data-centric devices that are normally plugged into a host laptop (e.g. USB modem), the test application shall be designed to run on the host laptop. The test application shall be compatible with the following versions of the Microsoft Windows operating system: XP, Vista, 7.~~

~~For handset form factor devices, the test application shall be preloaded by the vendor on the devices provided to the test lab for over-the-air radiated performance testing.~~

~~On launch of this test application, the test application shall support two options for initiating communication with the test platform:~~

- ~~• Option 1 UE initiated: The test application shall open up a UDP port on the test platform based on an IP address and port number for the test platform.~~
- ~~• Option 2 Test platform initiated: The test application shall listen on the IP address and UDP port configured on the test platform and wait for the test platform to initiate communication with the test application.~~

~~The test application shall communicate with the test platform using the commands detailed in the subsections below. The test application shall be capable of a minimum polling rate of 100 ms (i.e. minimum time between requests from the test platform). For the commands detailed in the subsections below, the following shall apply:~~

- ~~• "Presence"~~
  - ~~• M= Mandatory~~
  - ~~• O= Optional~~

- "Format" is the same as for L3 messaging per section 11.2.1.1 of 3GPP TS 24.007: *Mobile radio interface signalling layer 3; General Aspects*
- "Length" is in octets

The test application may also support local data storage. If local storage is supported and enabled:

- The test application shall not attempt to communicate with the test platform.
- The test application shall continuously log complex antenna pattern data (i.e. both magnitude and phase) for both antennas used in the reception of LTE signals and store the data on the device in the format specified in section 6.16.4.1 of the CTIA Test Plan for Wireless Device Over the Air Performance until the application is terminated by the user.
- The device vendor shall provide a PC client to download the stored antenna pattern data into a .csv file on the PC (for downloading, the device shall be tethered to a PC via a USB connection) after test completion. If local storage is disabled, the test application shall behave normally.

The test application shall have a user interface. Through the user interface, the test application shall allow the user to:

- Configure the IP address and port number for the test platform. This configuration shall be stored across power cycles.
- Configure the test application option for initiating communication with the test platform, i.e. option 1 (UE initiated) or option 2 (test platform initiated). This configuration shall be stored across power cycles.
- Enable/Disable auto-launch for the test application. If auto-launch is enabled, the test application shall automatically launch on device power-up or soft reset. If auto-launch is disabled, user intervention shall be required to launch the test application. This setting shall be stored across power cycles. The default setting shall be "enabled".
- Enable/Disable local data storage if local data storage is supported by the application. This setting shall be stored across power cycles. The default setting shall be "disabled".

The test application shall be installed on a device submitted for device certification testing that is running the commercial software submitted for device certification. The test application shall not be installed on any devices other than those submitted for device certification testing.

### 1.3.1.2.7.2 ANTENNA INFORMATION REQUEST VZ\_REQ\_LTEB13NAC\_22689

### 1.3.1.2.7.3 Antenna Information Request Message VZ\_REQ\_LTEB13NAC\_6290

This message is only sent in the direction test platform to UE.

| Information Element     | Presence | Format | Length |
|-------------------------|----------|--------|--------|
| Message type            | M        | V      | 4      |
| Antenna/Receiver Number | M        | V      | 4      |

where message type is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
|---|---|---|---|---|---|---|---|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | octet 1 |

where antenna/receiver number is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2  | 1  | bit no. |
|---|---|---|---|---|---|----|----|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | A1 | A0 | octet 1 |

Upon receipt of an ANTENNA INFORMATION REQUEST message, the UE shall:

1. Perform a new (i.e. the UE shall not cache RSSI results) RSSI measurement on the primary receiver if A0=1 in the antenna/receiver number IE, and report the result to the test platform using the ANTENNA INFORMATION RESPONSE message. If A0=0, then the UE shall not perform an RSSI measurement on the primary receiver.
2. Perform a new (i.e. the UE shall not cache RSSI results) RSSI measurement on the secondary/MIMO receiver if A1=1 in the antenna/receiver number IE, and report the result to the test platform using the ANTENNA INFORMATION RESPONSE message. If A1=0, then the UE shall not perform an RSSI measurement on the secondary/MIMO receiver.
3. If both receivers are enabled, perform a new (i.e. the UE shall not cache phase results) relative phase measurement between the two receivers, and report the result to the test platform using the ANTENNA INFORMATION RESPONSE message.

The UE shall not send an ANTENNA INFORMATION RESPONSE message while it is performing the RSSI and/or relative phase measurements on either the primary or secondary/MIMO receivers.

If an ANTENNA INFORMATION REQUEST message is sent to the UE for a receiver that is currently disabled, the UE test application shall respond with an ANTENNA ERROR RESPONSE message (as defined in section **ANTENNA ERROR RESPONSE** of this document).

### 1.3.1.2.7.4 ANTENNA INFORMATION RESPONSE VZ\_REQ\_LTEB13NAC\_22690

### 1.3.1.2.7.5 Antenna Information Response Message VZ\_REQ\_LTEB13NAC\_6291

This message is only sent in the direction UE to test platform.

**Case 1:** Both receivers are enabled (i.e. the UE is reporting RSSI for both receivers and the relative phase between the receivers).

| Information Element                                  | Presence | Format | Length |
|--|----------|--------|--------|
| Message type   | M        | V      | 1      |
| Date   | M        | V      | 4      |
| Time   | M        | V      | 4      |
| Reserved   | M        | V      | 1      |
| Antenna/Receiver number<br>(Primary receiver)        | M        | V      | 1      |
| RSSI<br>(Primary receiver)                           | M        | V      | 2      |
| Relative Phase<br>(between the receivers)            | M        | V      | 2      |
| Antenna/Receiver number<br>(Secondary/MIMO receiver) | M        | V      | 1      |
| RSSI<br>(Secondary/MIMO receiver)                    | M        | V      | 2      |

**Case 2:** Only one receiver is enabled (i.e. the UE is only reporting RSSI for the enabled receiver).

| Information Element     | Presence | Format | Length |
|-------------------------|----------|--------|--------|
| Message type            | M        | V      | 1      |
| Date                    | M        | V      | 4      |
| Time                    | M        | V      | 4      |
| Reserved                | M        | V      | 1      |
| Antenna/Receiver number | M        | V      | 1      |
| RSSI                    | M        | V      | 2      |

where message type is:

|   |   |   |   |   |   |   |   |         |
|---|---|---|---|---|---|---|---|---------|
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | octet 1 |

where date is:

|    |    |    |    |    |     |    |    |         |
|----|----|----|----|----|-----|----|----|---------|
| 8  | 7  | 6  | 5  | 4  | 3   | 2  | 1  | bit no. |
| 0  | 0  | 0  | 0  | 0  | Y10 | Y9 | Y8 | octet 1 |
| Y7 | Y6 | Y5 | Y4 | Y3 | Y2  | Y1 | Y0 | octet 2 |
| 0  | 0  | 0  | 0  | M3 | M2  | M1 | M0 | octet 3 |
| 0  | 0  | 0  | D4 | D3 | D2  | D1 | D0 | octet 4 |

Y10..Y0 is the year and binary coded with Y10 as the most significant bit and Y0 as the least significant bit.

M3..M0 is the month and binary coded with M3 as the most significant bit and M0 as the least significant bit.

D4..D0 is the day and binary coded with D4 as the most significant bit and D0 as the least significant bit.

where time is:

| 8   | 7   | 6   | 5   | 4   | 3   | 2   | 1   | bit no. |
|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| 0   | 0   | 0   | 0   | H3  | H2  | H1  | H0  | octet 1 |
| 0   | 0   | MN5 | MN4 | MN3 | MN2 | MN1 | MN0 | octet 2 |
| S15 | S14 | S13 | S12 | S11 | S10 | S9  | S8  | octet 3 |
| S7  | S6  | S5  | S4  | S3  | S2  | S1  | S0  | octet 4 |

H3..H0 is the hour and binary coded with H3 as the most significant bit and H0 as the least significant bit.

MN5..M0 is the minutes and binary coded with MN5 as the most significant bit and MN0 as the least significant bit.

S15..S0 is the seconds. The seconds value in xx.xxx format shall be multiplied by 1000 and binary coded with S15 as the most significant bit and S0 as the least significant bit.

where reserved is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
|---|---|---|---|---|---|---|---|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | octet 1 |

where antenna/receiver number is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1  | bit no. |
|---|---|---|---|---|---|---|----|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | B0 | octet 1 |

B0 = the antenna/receiver number for which results are being reported, i.e.:

- B0=0 for the primary receiver
- B0=1 for the secondary/MIMO receiver

where RSSI is:

| 8  | 7  | 6   | 5   | 4   | 3   | 2  | 1  | bit no. |
|----|----|-----|-----|-----|-----|----|----|---------|
| 0  | 0  | R13 | R12 | R11 | R10 | R9 | R8 | octet 1 |
| R7 | R6 | R5  | R4  | R3  | R2  | R1 | R0 | octet 2 |

R13..R0 is the RSSI value measured for the receiver in the preceding antenna/receiver number IE. The RSSI value in -xxx.xx dBm shall be multiplied by -100 and binary coded with R13 as the most significant bit and R0 as the least significant bit. The RSSI value shall be in the range of 0.00 to -120.00 dBm.

where relative phase is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
|---|---|---|---|---|---|---|---|---------|
|   |   |   |   |   |   |   |   |         |



|     |     |     |     |     |     |    |    |         |
|-----|-----|-----|-----|-----|-----|----|----|---------|
| P15 | P14 | P13 | P12 | P11 | P10 | P9 | P8 | octet 1 |
| P7  | P6  | P5  | P4  | P3  | P2  | P1 | P0 | octet 2 |

P15..P0 is the relative phase value measured between the receivers. The relative phase value in xxx.xx degrees shall be multiplied by 100 and binary coded with P15 as the most significant bit and P0 as the least significant bit. The relative phase value shall be in the range of 0.00 to 360.00 degrees.

### 1.3.1.2.7.6 ANTENNA CONFIGURATION REQUEST VZ\_REQ\_LTEB13NAC\_22691

### 1.3.1.2.7.7 Antenna Configuration Request Message VZ\_REQ\_LTEB13NAC\_6292

This message is only sent in the direction test platform to UE.

| Information Element     | Presence | Format | Length |
|-------------------------|----------|--------|--------|
| Message type            | M        | ∇      | 1      |
| Antenna/Receiver Enable | M        | ∇      | 1      |

where message type is:

|   |   |   |   |   |   |   |   |         |
|---|---|---|---|---|---|---|---|---------|
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | octet 1 |

where antenna/receiver enable is:

|   |   |   |   |   |   |    |    |         |
|---|---|---|---|---|---|----|----|---------|
| 8 | 7 | 6 | 5 | 4 | 3 | 2  | 1  | bit no. |
| 0 | 0 | 0 | 0 | 0 | 0 | E1 | E0 | octet 1 |

Upon receipt of an ANTENNA CONFIGURATION REQUEST message, the UE shall enable/disable the antennas/receivers on the device as follows:

| E1 | E0 | UE Behaviour   |
|----|----|--|
| 0  | X  | Normal dual receiver operation (default UE behaviour)                                    |
| 1  | 0  | Single receiver operation enable primary receiver only (disable secondary/MIMO receiver) |
| 1  | 1  | Single receiver operation enable secondary/MIMO receiver only (disable primary receiver) |

### 1.3.1.2.7.8 ANTENNA ERROR RESPONSE VZ\_REQ\_LTEB13NAC\_22692

### 1.3.1.2.7.9 Antenna Error Response Message VZ\_REQ\_LTEB13NAC\_6293

This message is only sent in the direction UE to test platform.

| Information Element | Presence | Format | Length |
|---------------------|----------|--------|--------|
| Message type        | M        | V      | 1      |
| Error               | M        | V      | 1      |

where message type is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
|---|---|---|---|---|---|---|---|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | octet 1 |

where antenna/receiver number is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1    | bit no. |
|---|---|---|---|---|---|---|------|---------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR0 | octet 1 |

ERR0 = an error occurred while processing an ANTENNA INFORMATION REQUEST or ANTENNA CONFIGURATION REQUEST message, i.e.:

- ERR0=0 for error during processing of ANTENNA INFORMATION REQUEST message
- ERR0=1 for error during processing of ANTENNA CONFIGURATION REQUEST message

### 1.3.1.2.7.10 ANTENNA CONFIGURATION STATUS REQUEST VZ\_REQ\_LTEB13NAC\_22693

### 1.3.1.2.7.11 Antenna Configuration Status Request Message VZ\_REQ\_LTEB13NAC\_6294

This message is only sent in the direction test platform to UE.

| Information Element | Presence | Format | Length |
|---------------------|----------|--------|--------|
| Message type        | M        | V      | 1      |

where message type is:

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
|---|---|---|---|---|---|---|---|---------|
|   |   |   |   |   |   |   |   |         |

|   |   |   |   |   |   |   |   |         |
|---|---|---|---|---|---|---|---|---------|
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | octet 1 |
|---|---|---|---|---|---|---|---|---------|

**1.3.1.2.7.12 ANTENNA CONFIGURATION STATUS RESPONSE**  
VZ\_REQ\_LTEB13NAC\_22695

**1.3.1.2.7.13 Antenna Configuration Status Response Message**  
VZ\_REQ\_LTEB13NAC\_6295

This message is only sent in the direction UE to test platform.

| Information Element     | Presence | Format | Length |
|-------------------------|----------|--------|--------|
| Message type            | M        | V      | 1      |
| Antenna/Receiver Status | M        | V      | 1      |

where message type is:

|   |   |   |   |   |   |   |   |         |
|---|---|---|---|---|---|---|---|---------|
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | bit no. |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | octet 1 |

where antenna/receiver status is:

|   |   |   |   |   |   |     |     |         |
|---|---|---|---|---|---|-----|-----|---------|
| 8 | 7 | 6 | 5 | 4 | 3 | 2   | 1   | bit no. |
| 0 | 0 | 0 | 0 | 0 | 0 | ST1 | ST0 | octet 1 |

| ST1 | ST0 | UE Behaviour   |
|-----|-----|--|
| 0   | X   | Normal dual receiver operation (both receivers enabled)                                    |
| 1   | 0   | Single receiver operation primary receiver enabled only (secondary/MIMO receiver disabled) |
| 1   | 1   | Single receiver operation secondary/MIMO receiver enabled only (primary receiver disabled) |

**1.3.1.2.7.14 RSSI AND RELATIVE PHASE MEASUREMENTS, ACCURACY, AND AVERAGING**  
VZ\_REQ\_LTEB13NAC\_22696

### 1.3.1.2.7.15 ~~RSSI and Relative Phase Measurements, Accuracy, and Averaging~~ VZ\_REQ\_LTEB13NAC\_6296

~~For each receiver, RSSI measurements shall be averaged across at least one subframe but not more than 10 subframes. RSSI shall be as defined in section 5.1.3 of 3GPP TS 36.214: Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements. The absolute accuracy of RSSI measurements shall be  $\pm 6$  dB or better (i.e. consistent with the RSRP absolute accuracy requirement in 3GPP TS 36.133: Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management). The relative accuracy of RSSI measurements shall be  $\pm 1$  dB or better.~~

~~The relative phase between the receivers shall be measured based on the I-Q values for the reference symbols. The relative phase measurements between the receivers shall be averaged across all the reference symbols in at least one subframe but not more than 10 subframes, i.e. the relative phase shall be measured for each reference symbol and then these relative phase measurements shall be averaged for all the reference symbols in at least one subframe but not more than 10 subframes. The relative accuracy of phase measurements shall be  $\pm 2$  degrees or better.~~

~~All RSSI and relative phase measurements shall be averaged over the same time interval (i.e. number of subframes, the averaging interval in subframes is the same for both receivers). When both receivers are enabled and an ANTENNA INFORMATION REQUEST message is sent to the device and the device measures RSSI for both receivers and relative phase between the receivers, the RSSI measurements for both receivers and the relative phase measurement between the receivers shall be computed from the same period in time (i.e.  $t_1$  and  $t_2$  are the same for both receivers where  $t_1$  and  $t_2$  are absolute time, the averaging interval in subframes is the same for both receivers).~~

### 1.3.1.3 UICC SUPPORT VZ\_REQ\_LTEB13NAC\_22679

Device compliance to Verizon Wireless UICC device requirements is validated through the Verizon Wireless LTE Device-UICC (USIM, ISIM) Interaction Test Plan.

#### 1.3.1.3.1 USIM and ISIM VZ\_REQ\_LTEB13NAC\_6470

Ø The UICC supports USIM and ISIM profiles. In order to support the USIM and ISIM, the device shall be compliant to the specifications in the subsections

below. The device shall use the service table to determine the list of files and functionalities supported on the USIM and ISIM.

### 1.3.1.3.2 NAA applications on the UICC VZ\_REQ\_LTEB13NAC\_6471

∅ The device shall select the NAA applications on the UICC by use of the EF<sub>DIR</sub> file. If an NAA application is listed more than once in EF<sub>DIR</sub>, only the first application on the list shall be selected.

### 1.3.1.3.3 SUPPORT FOR USIM VZ\_REQ\_LTEB13NAC\_22697

Device compliance to Verizon Wireless UICC device requirements is validated through the Verizon Wireless LTE Device-UICC (USIM, ISIM) Interaction Test Plan.

#### 1.3.1.3.3.1 SUPPORT FOR USIM VZ\_REQ\_LTEB13NAC\_6297

The device shall support the software to interact with the USIM module on the UICC as described in 3GPP TS 31.102: *Characteristics of the USIM application* and 3GPP TS 31.101: *UICC-terminal interface; Physical and logical characteristics*. The device shall support the security procedures as specified in 3GPP TS 33.401: *3GPP System Architecture Evolution (SAE); Security architecture*. All mandatory procedures, commands, and files shall be supported.

### 1.3.1.3.4 SUPPORT FOR ISIM VZ\_REQ\_LTEB13NAC\_22698

#### 1.3.1.3.4.1 SUPPORT FOR ISIM VZ\_REQ\_LTEB13NAC\_6298

The device shall support the software to interact with the ISIM module on the UICC as described in 3GPP TS 31.103: *Characteristics of the IP Multimedia Services Identity Module (ISIM) application* and 3GPP TS 31.101: *UICC-terminal interface; Physical and*

*logical characteristics*. All mandatory procedures, commands and files shall be supported.

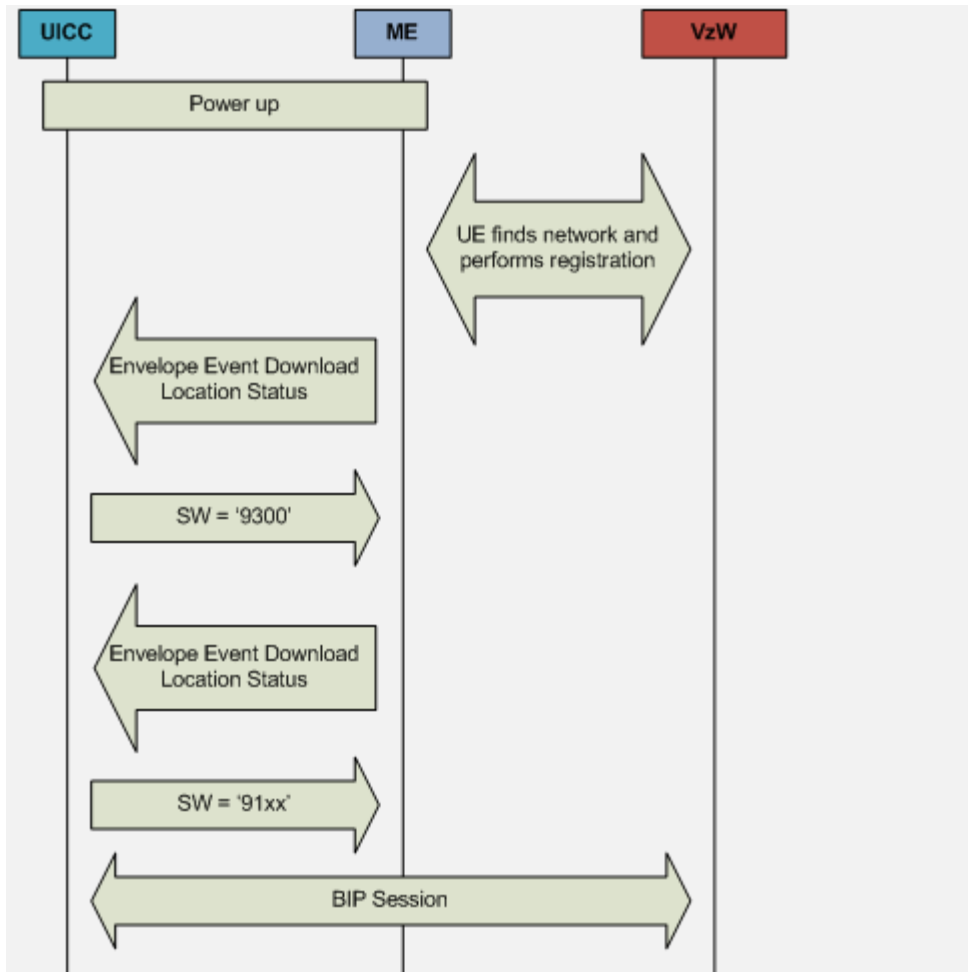
### 1.3.1.3.5 SUPPORT FOR APPLICATION TOOLKIT VZ\_REQ\_LTEB13NAC\_22699

#### 1.3.1.3.5.1 SUPPORT FOR APPLICATION TOOLKIT VZ\_REQ\_LTEB13NAC\_6299

The device shall support Card Application Toolkit (CAT) as specified in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT), Release 8* and the USIM Application Toolkit (USAT) as described in 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)*.

The following events, envelope commands, and corresponding procedures shall be supported:

- Envelope SMS-PP Data Download as per 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)*
  - In the case where the UICC is busy (9300) or provides exceptions, the device shall resend the Envelope SMS-PP to the UICC until a successful response (9000/91xx) from the UICC is received.
- Envelope Timer Expiration
- Envelope Event Download
  - Data available
  - Channel Status
  - Location Status
    - The device shall send the Download Location Status (DLS) Event as per 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)*.
    - In the case where the UICC is busy (9300) or provides exceptions, the device shall resend the DLS Event to the UICC until a successful response (9000/91xx) from the UICC is received.



- Access Technology Change
  - If more than one access technology is available, only the access technology for the data connection shall be reported.

| Data Access Technology | Value                  |
|------------------------|------------------------|
| LTE                    | '08'                   |
| Non-LTE                | '00', '03', '06', '07' |

- In the case where the UICC is busy (9300) or provides exceptions, the device shall resend the Download Access Technology Change Event (DATC) to the UICC until a successful response (9000/91xx) from the UICC is received.

- EVENT PROFILE DOWNLOAD
- STATUS (The device shall send the STATUS command only on logical channel 0.)

- The device shall support the IMS Registration Event as specified in the ETSI TS 131 111: *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)*, v.10.7.0 section 7.5.21, using Event Download IMS Registration to communicate the IMS registration status and changes in the IMS registration status to the UICC.
- The device shall provide the contents of the 000EH PCO container (i.e. MSISDN) provided in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the attach PDN to the UICC via a proprietary envelope as specified in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT)*, Release 8 and 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* as described below:

- The PCO container 000EH shall be sent to the UICC via: EVENT\_UNRECOGNIZED\_ENVELOPE, using the following syntax:

80 C2 00 00 0F EF 0D 02 02 82 81 4C 07 91 51 16 33 13 90 F5

- where the dialing number/MSISDN is 15613331095 (i.e. the dialing number/MSISDN is in swapped format in the envelope)

The following proactive commands and corresponding procedures shall be supported:

- REFRESH (support for 7 modes) as specified in 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* and ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT)*, Release 8
- Send Short Message as specified in 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* and ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT)*, Release 8
- OPEN CHANNEL
- CLOSE CHANNEL
- RECEIVE DATA
- SEND DATA
- GET CHANNEL STATUS
- POLL INTERVAL
- TIMER MANAGEMENT
- MORE TIME
- PROVIDE LOCAL INFORMATION (following tags shall be supported)
  - location information
  - terminal identity (IMEI, IMEISV)
  - network measurement results



- current date, time, and time zone
- current access technology
  - If more than one access technology is available, only the access technology for the data connection shall be reported.
- current network search mode

All other events, commands, and procedures defined in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT), Release 8* and 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* are highly recommended and should be supported.

**NOTE:** All SMS requirements specified for UICC in 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* and ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT), Release 8* shall supersede the specifications in section 5.1.2 of the Verizon Wireless LTE SMS Requirements (i.e. requirement VZ\_REQ\_LTESMS\_30278).

### 1.3.1.3.6 LOGICAL CHANNELS VZ\_REQ\_LTEB13NAC\_22700

#### 1.3.1.3.6.1 LOGICAL CHANNELS VZ\_REQ\_LTEB13NAC\_6300

The device shall support standard and extended logical channels as specified in ETSI TS 102 221: *Smart Cards UICC-Terminal Interface; Physical and Logical Characteristics, Release 8*.

### 1.3.1.3.7 PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_22701

#### 1.3.1.3.7.1 PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_6301

The device shall support at least 70 entries and the PLMNwAcT, OPLMNwAcT, HPLMNwAcT, LOCIGPRS, PNN, and OPL files related to roaming and PLMN lists as specified in 3GPP 31.102: *Characteristics of the USIM application*. Only Verizon Wireless will update the PLMN lists on the USIM (as needed).

### 1.3.1.3.8 LTE AUTHENTICATION VZ\_REQ\_LTEB13NAC\_22702

#### 1.3.1.3.8.1 LTE AUTHENTICATION VZ\_REQ\_LTEB13NAC\_6302

The device shall support the authenticate commands and mechanisms to interact with the USIM as specified in 3GPP TS 31.102: *Characteristics of the USIM application*. The EPS security context, procedures, and files shall be supported.

### 1.3.1.3.9 BIP OVER THE CLASS 2 APN VZ\_REQ\_LTEB13NAC\_22703

#### 1.3.1.3.9.1 BIP OVER THE CLASS 2 APN VZ\_REQ\_LTEB13NAC\_6424

If the device receives an OPEN CHANNEL command from the UICC with an APN NI equal to "VZWADMIN", then the device shall behave as follows:

- If no PDN connection using the class 2 APN\* currently exists, the device shall establish a PDN connection for the class 2 APN\* using standard 3GPP messaging. The device shall not release the PDN connection prior to receiving a CLOSE CHANNEL command from the UICC.
- If a PDN connection using the class 2 APN\* already exists, the device shall report terminal status as "success" to the UICC and use the existing PDN connection. The device shall not release the PDN connection prior to receiving a CLOSE CHANNEL command from the UICC.

\* **NOTE 1:** The device shall use the class 2 APN NI provisioned on the device regardless of whether the APN NI for the class 2 APN provisioned on the device equals "VZWADMIN".

When the device receives a CLOSE CHANNEL command from the UICC (for the class 2 APN), the device shall behave as follows:

- If the PDN connection for the class 2 APN is being used by other applications, then the device shall not release the PDN connection. The device shall report terminal status "success" to the UICC and leave the PDN connection intact.
- If the PDN connection for the class 2 APN is not being used by any other applications, then the device shall release the PDN connection using standard 3GPP messaging.

**NOTE 2:** The device shall implement the BIP connection establishment and processing exclusively on the baseband processor of the modem (as opposed to on an application processor in the device).

### 1.3.1.3.10 DEVICE BEHAVIOR IN RESPONSE TO REFRESH COMMAND VZ\_REQ\_LTEB13NAC\_22704

#### 1.3.1.3.10.1 DEVICE BEHAVIOR IN RESPONSE TO REFRESH COMMAND VZ\_REQ\_LTEB13NAC\_6461

Upon receipt of a UICC REFRESH type 0 command, the device shall detach from the LTE network and then re-attach to the LTE network using all updated USIM/ISIM parameters.

If the device has a valid IMS registration when the UICC REFRESH type 0 command is received, the device shall terminate the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message. This shall be done before sending a NAS DETACH REQUEST message. Upon the IMS client generating the initial SIP REGISTER message with expires=0, the device shall start an implementation specific timer with a value of 4 seconds. While this implementation specific timer is running, the device shall respond to all SIP messaging from the network, e.g. if the network challenges the de-registration request with a 401 Unauthorized. Upon expiration of this implementation specific timer, the device shall take no further action with respect to SIP messages from the network and execute the NAS detach procedure. The device shall stop the implementation specific timer and immediately execute the NAS detach procedure if a SIP 200 OK or a SIP 481 or a SIP 501 is received in response to the SIP REGISTER (with expires=0) before the implementation specific timer expires.

**NOTE:** The implementation specific timer is started when the IMS client generates the initial SIP REGISTER message with expires=0. The implementation specific timer shall

run even if the IMS client cannot send the SIP REGISTER message to the modem for transmission because an IMS signaling connection could not be established.

### 1.3.1.3.11 DEVICE BEHAVIOR IF UICC IS NOT PRESENT OR REMOVED

VZ\_REQ\_LTEB13NAC\_22705

#### 1.3.1.3.11.1 DEVICE BEHAVIOR IF UICC IS NOT PRESENT OR REMOVED

VZ\_REQ\_LTEB13NAC\_6482

If no UICC is present or if the device cannot detect a UICC that is present, the device shall not attempt to access any LTE network.

If the device detects that the UICC has been removed while the device is connected to a LTE network, the device shall detach from the LTE network. If the device has a valid IMS registration when the UICC is removed, the device shall terminate the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message. This shall be done before sending a NAS DETACH REQUEST message. Upon the IMS client generating the initial SIP REGISTER message with expires=0, the device shall start an implementation specific timer with a value of 4 seconds. While this implementation specific timer is running, the device shall respond to all SIP messaging from the network, e.g. if the network challenges the de-registration request with a 401 Unauthorized. Upon expiration of this implementation specific timer, the device shall take no further action with respect to SIP messages from the network and execute the NAS detach procedure. The device shall stop the implementation specific timer and immediately execute the NAS detach procedure if a SIP 200 OK or a SIP 481 or a SIP 501 is received in response to the SIP REGISTER (with expires=0) before the implementation specific timer expires.

Upon detaching from the LTE network, the device shall not attempt to access any LTE network until the UICC is re-inserted in the device or a new UICC is inserted in the device.

**NOTE 1:** This requirement only applies to non-emergency access to an LTE network. Emergency access to an LTE network shall be allowed regardless of whether a UICC is present or not per 3GPP Release 9 Specifications. The device shall implement emergency access to an LTE network per 3GPP Release 9 Specifications.

**NOTE 2:** The implementation specific timer is started when the IMS client generates the initial SIP REGISTER message with expires=0. The implementation specific timer

shall run even if the IMS client cannot send the SIP REGISTER message to the modem for transmission because an IMS signaling connection could not be established.

### 1.3.1.3.12 APPLET DOWNLOAD TO UICC VZ\_REQ\_LTEB13NAC\_22706

#### 1.3.1.3.12.1 APPLET DOWNLOAD TO UICC VZ\_REQ\_LTEB13NAC\_6486

For non-interrupted BIP sessions, the device shall support over the air download to the UICC's Secure Element of applets at least 100 kilobytes in size in less than two minutes (which is the timing between the OPEN CHANNEL and CLOSE CHANNEL commands).

### 1.3.1.3.13 UICC DNS ADDRESS RETRIEVAL FROM THE NETWORK VZ\_REQ\_LTEB13NAC\_36248

#### 1.3.1.3.13.1 UICC DNS IP Address Retrieval from the Network VZ\_REQ\_LTEB13NAC\_36250

The device shall support DNS server IP address retrieval from the network as defined in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT)* and below:

- The device shall indicate the support of the DNS feature by using bit 1 in Byte 33 of the Terminal Profile.
- When the device receives a DNS resolution request from the UICC (UPD OPEN CHANNEL) with no IP address defined, the device shall establish a session with the PDN for the APN defined in the OPEN CHANNEL command.
- Upon receiving the DNS IP address(es) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST for the PDN connection, the device shall pass the IP address(es) of the DNS server(s) to the UICC in the Terminal Response.
- The device shall support the notification bit as defined in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT)* sections 6.4.28 and 8.6:

- 6.4.28 : If class "yy" is supported, the UICC may indicate to the terminal that the next CAT command will be an OPEN CHANNEL command using the same setting for the APN, i.e. requesting a channel to the same gateway entity. The device may use this information to keep the channel to the gateway established until the next CAT command.
- 8.6: CLOSE CHANNEL for packet data service:
  - bit 1: 0 = no indication;
  - 1 = indication to device that the next CAT command will be OPEN CHANNEL using same APN as channel to be closed.
- If the device receives a CLOSE CHANNEL with bit 1 set to 1, the device shall not close the connection to the PDN unless one of the following occurs:
  - The next UICC command received by the device is not a OPEN CHANNEL using the same APN as the previous command that originally established the PDN connection.
  - The network forced the PDN to be closed due to any reason (i.e. network Idle time out, etc.)
  - The UICC has been idle for more than 30 seconds.

### 1.3.1.3.14 UICC RE-ACTIVATION VZ\_REQ\_LTEB13NAC\_37887

#### 1.3.1.3.14.1 Power Cycle for UICC Re-activation VZ\_REQ\_LTEB13NAC\_37889

To support UICC re-activation, the device shall support a mechanism via the device user interface or the remote access user interface (for tethered devices) for the user to initiate a power cycle of the device.

### 1.3.1.3.15 eUICC VZ\_REQ\_LTEB13NAC\_41270

This section describes the requirements for eUICC using a Consumer RSP v2.2 device Local Profile Assistant in support of eUICC. A Consumer RSP v2.2 implementation entails Verizon's second launch for eUICC remote provisioning feature using GSMA's Consumer RSP v2.2 Specifications.

Device vendors should contact Verizon Wireless prior to implementing eUICCs with RSP support on any device.

| Term [Abbreviation (if Applicable)] | Definition                             |
|-------------------------------------|--|
| eUICC                               | Embedded UICC (eUICC)                  |
| LPA                                 | Local Profile Assistant                |
| LPD                                 | Local Profile Download                 |
| LUI                                 | Local User Interface                   |
| RSP                                 | Remote SIM Provisioning                |
| SM-DP+                              | Subscription Manager Data Preparation+ |

### 1.3.1.3.15.1 LPA and eUICC VZ\_REQ\_LTEB13NAC\_41271

Devices may support eUICC in the context of RSP functionality. If the device supports eUICC, then the device shall support the following requirements:

The device shall support the eUICC remote provisioning feature using GSMA Consumer RSP v2.2 Specifications. The device shall implement a Local profile Assistant (LPA) for profile management including a Local User Interface (LUI) enabling user interaction.

All the RSP related device requirements and LPA requirements defined in the SGP21 Architecture document sections 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.11, Annex G and related device and LPA Certification requirements (in section 4.14.2) shall be supported unless superseded by a requirement specified in this document. All the RSP related device and LPA requirements in the SGP22 Technical specification including Annex C shall be supported unless superseded by a requirement specified in this document.

The LPA shall detect removal and insertion of a UICC while the device is powered on, and if the LPA detects that the UICC in the device is not an eUICC, then it shall not attempt to execute any local profile management processes on the UICC and shall not make any LUI options available to the user.

### 1.3.1.3.15.2 eUICC and Companion Devices VZ\_REQ\_LTEB13NAC\_41272

For devices that support eUICC and can operate as a companion device (e.g. a wearable that operates as a companion device to a smartphone), v2.2 of the Consumer eUICC Remote SIM Provisioning specification includes profile download into a companion device (e.g. a wearable) using the initial network connectivity provided by a primary device (e.g. a smartphone). The companion device LPA shall access SM-DP+ through the data connectivity provided by the primary device. For a Consumer RSP v2.2 implementation, more than one profile download, and corresponding local profile management operations, shall be supported by the device and LPA implementation.

### 1.3.1.3.15.3 MF-only eUICC's VZ\_REQ\_LTEB13NAC\_535613

For devices that support eUICCs using GSMA Consumer RSP v2.2, the device shall properly handle eUICCs that have MF as the only file contents for the following cases:

- Before initial profile download
- For cases where a profile is downloaded but not enabled
- For cases where a single remaining profile in an eUICC has been deleted
- For cases where an eUICC memory reset has been executed

Devices supporting MF-only eUICCs shall not power off the eUICC and shall allow communication to the eUICC as needed. Refer to Section 3.4.3 of GSMA SGP.22: *RSP Technical Specification* for more information on eUICC File Structure.

### 1.3.1.3.16 GROUP IDENTIFIERS VZ\_REQ\_LTEB13NAC\_41327

#### 1.3.1.3.16.1 GID1 and GID2 VZ\_REQ\_LTEB13NAC\_41328

When USIM fields EF<sub>GID1</sub> and EF<sub>GID2</sub> are present and enabled, the device shall read ALL bytes of these files (not just the first bytes).

The device shall re-read these files in their entirety upon modem power cycle, modem reset, and after a REFRESH command is issued by the UICC.

### 1.3.2 LTE NETWORK TO/FROM VZ\_REQ\_LTEB13NAC\_1882



### 1.3.2.1 SYSTEM SELECTION/RESELECTION VZ\_REQ\_LTEB13NAC\_22707

#### 1.3.2.1.1 SYSTEM SELECTION/RESELECTION VZ\_REQ\_LTEB13NAC\_6303

If a UICC is inserted in the device, then the device shall support system selection/reselection based on the Verizon Wireless PLMN information stored in the UICC and per 3GPP Release 9 Specifications. For additional details refer to:

- a. 3GPP TS 23.122: *Non-Access Stratum (NAS) functions related to Mobile Station (MS) in idle mode*
- b. 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*
- c. 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode*

#### 1.3.2.1.2 MULTIPLE PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_22708

##### 1.3.2.1.2.1 MULTIPLE PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_6304

The device shall be capable of supporting multiple PLMNs for LTE on 3GPP Band 13. The device shall be capable of decoding up to 6 PLMN ids broadcasted in the System Information Block Type 1.

This includes the use case(s) below. (NOTE: These use case(s) are included for informational purposes only and do not include all possible scenarios associated with this requirement.)

*For the use case(s) below, the term UE refers to the combination of the device and the UICC inserted in the device containing the subscriber information.*

**Use Case #1:** One network (A) broadcasting two PLMNs, adjacent to network (B) broadcasting single PLMN where network A broadcasts the PLMN for network A and the PLMN for network B. Networks A and B and are in different geographic regions.

- UE is homed to network B and begins there, i.e. the subscriber/UICC in the UE is homed to network B.
  - When the UE enters network A (two PLMNs), it is required to perform a tracking area update.
  - When the UE returns from network A to network B, it is required to perform a tracking area update.
- UE is homed to network A and begins there, i.e. the subscriber/UICC in the UE is homed to network A.
  - When the UE enters network B (single PLMN), it is required to perform a tracking area update.
  - When UE returns to network A, it is required to perform a tracking area update.

### 1.3.2.1.3 SERVICE AREA RESOLUTION IN M-PLMN VZ\_REQ\_LTEB13NAC\_22709

#### 1.3.2.1.3.1 SERVICE AREA RESOLUTION IN M-PLMN VZ\_REQ\_LTEB13NAC\_6415

The device shall be capable of determining its serving area based on the UICC configuration as opposed to direction from the network.

### 1.3.2.1.4 UICC EFS FOR M-PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_22710

#### 1.3.2.1.4.1 UICC EFS FOR M-PLMN SUPPORT VZ\_REQ\_LTEB13NAC\_6416

The device shall support use of the following USIM Elementary Files pursuant to 3GPP TS 31.102: *Characteristics of the USIM application*: PLMN Network Name (PNN), Operator PLMN List (OPL), Equivalent Home PLMN (EHPLMN), Operator Controlled PLMN Selector with Access Technology (OPLMNwACT), HPLMN Selector with Access Technology (HPLMNwACT), User Controlled PLMN Selector with Access Technology (PLMNwACT), and Forbidden PLMNs (FPLMN).

## 1.3.2.2 LTE-TO-LTE HANDOVERS VZ\_REQ\_LTEB13NAC\_22711

### 1.3.2.2.1 LTE-TO-LTE HANDOVERS VZ\_REQ\_LTEB13NAC\_6305

The device shall support LTE-to-LTE handovers per the 3GPP Release 9 Specifications. Refer to 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access*, 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management*, and 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.

## 1.3.2.3 LTE SIGNALING VZ\_REQ\_LTEB13NAC\_22712

### 1.3.2.3.1 LTE SIGNALING VZ\_REQ\_LTEB13NAC\_6306

The device shall be in conformance with all LTE signaling requirements in the 3GPP Release 9 Specifications. Refer to 3GPP TS 23.122: *Non-Access Stratum (NAS) functions related to Mobile Station (MS) in idle mode*, 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, and 3GPP TS 36.321: *Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification* for additional details.

### 1.3.2.3.2 MAC Padding VZ\_REQ\_LTEB13NAC\_36970

When MAC padding is required (per 3GPP TS 36.321: *Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification*), the device shall use PN31 data for the MAC padding.

### 1.3.2.4 LTE IPV6/IPV4 AND BEARER SUPPORT VZ\_REQ\_LTEB13NAC\_22713

#### 1.3.2.4.1 IPV6/IPV4 SUPPORT VZ\_REQ\_LTEB13NAC\_22714

##### 1.3.2.4.1.1 IPV6/IPV4 SUPPORT VZ\_REQ\_LTEB13NAC\_6307

The device shall support both IPv6 and IPv4. IPv6 and IPv4 support shall be per the 3GPP Release 9 Specifications unless indicated otherwise in this document. The device shall be capable of simultaneously supporting at least one unique IPv6 address and a unique IPv4 address for each PDN connection. Refer to 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

#### 1.3.2.4.2 PDN SUPPORT VZ\_REQ\_LTEB13NAC\_22715

*Verizon Wireless PDN implementation details are in development. Additional PDNs and other PDN-related requirements may be included in a future release.*

##### 1.3.2.4.2.1 NETWORK PDN SUPPORT (INFORMATIVE) VZ\_REQ\_LTEB13NAC\_22716

The Verizon Wireless LTE network will support multiple PDNs:

- ~~IMS PDN for IMS applications (IPv6 only with support for both default and dedicated bearers, IPv4 support is reserved for future use)~~
- ~~Internet PDN for access to the public internet (IPv4v6 with support for both default and dedicated bearers)~~
- ~~Administrative PDN for administrative functions such as updates to the UICC/USIM and OTADM (IPv4v6 with support for default bearers only)~~
- ~~VZW Application PDN for VZW-branded applications (IPv4v6 with support for default bearers only)~~

### 1.3.2.4.2.2 ~~UE PDN SUPPORT~~ VZ\_REQ\_LTEB13NAC\_22717

### 1.3.2.4.2.3 UE PDN Support VZ\_REQ\_LTEB13NAC\_6308

The device shall connect to the appropriate PDN as follows:

- The device shall connect to the IMS PDN for IMS applications only (applies to IMS capable devices ONLY).
- The device shall connect to the Administrative PDN for UICC/USIM updates and OTADM functions only.
- The device shall connect to the VZW Application PDN for VZW-branded applications only. This PDN applies to handset form factor devices only (i.e. devices that support operation against the head).
- The device shall connect to the Internet PDN for all other applications. When tethered to a laptop, the device shall connect to the Internet PDN for all applications running on the laptop.

### 1.3.2.4.2.4 ~~UE BEARER AND PDN SUPPORT~~ VZ\_REQ\_LTEB13NAC\_22718

### 1.3.2.4.2.5 UE BEARER AND PDN SUPPORT VZ\_REQ\_LTEB13NAC\_6309

The device shall support a minimum of six simultaneous bearers (default bearers plus dedicated bearers). The device may support up to eight simultaneous bearers (default bearers plus dedicated bearers). The device shall support a minimum of four simultaneous PDN connections.

### 1.3.2.4.3 PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_22719

#### 1.3.2.4.3.1 PDN TYPE VZ\_REQ\_LTEB13NAC\_22720

#### 1.3.2.4.3.2 PDN Type VZ\_REQ\_LTEB13NAC\_6310

In all PDN CONNECTIVITY REQUEST messages, the device shall populate the "PDN Type" information element as IPv4v6 (including the IMS PDN). Refer to the *Scenarios* section of this document for additional details.

#### 1.3.2.4.3.3 IMS PDN CONNECTION VZ\_REQ\_LTEB13NAC\_22721

#### 1.3.2.4.3.4 IMS PDN Bearer VZ\_REQ\_LTEB13NAC\_6311

As part of the attach procedure to the Verizon Wireless LTE network for IMS capable devices, the device shall establish a default bearer to the IMS PDN. While attached to the Verizon Wireless LTE network, the device shall maintain a default bearer to the IMS PDN and the associated IP address(es). For the bearers to the IMS PDN, the device shall associate one IPv6 address, one IPv4 address, or both an IPv6 and IPv4 address as directed by the network. The device shall be capable of supporting a dual IP bearer to the IMS PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the bearers to the IMS PDN.

#### 1.3.2.4.3.5 PDN Connection Request During Attach VZ\_REQ\_LTEB13NAC\_6312

During the initial attach procedure for IMS capable devices, the PDN CONNECTIVITY REQUEST message in the ESM Container of the ATTACH REQUEST message shall not contain the APN (per section 6.5.1.2 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*), but shall include the PCO (for requesting DNS IP addresses and P-CSCF IP addresses). The APN shall be included in the ESM INFORMATION RESPONSE message later in the attach procedure.

Refer to the *Scenarios, APN Support for LTE, DNS, and SMS over IMS* sections of this document and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

### 1.3.2.4.3.6 ON-DEMAND PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_22722

### 1.3.2.4.3.7 On-Demand PDN Bearer VZ\_REQ\_LTEB13NAC\_6313

IMS capable devices shall establish a default bearer to the Internet PDN, the Administrative PDN, or the VZW Application PDN if an application requires a bearer to any of these PDNs. If a connection to an on-demand PDN is no longer required (i.e. the application(s) using the on-demand PDN have been closed), the device shall release the default bearer to the PDN by sending a PDN DISCONNECT REQUEST message. For the default bearer to an on-demand PDN, the device shall associate an IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address as directed by the network. The device shall be capable of supporting a dual IP bearer to any on-demand PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the default bearer to any on-demand PDN connection.

**NOTE 1:** In a data retry scenario where an IMS capable device attaches to the LTE network using the internet PDN (or PDN identified by the class 3 APN), the device shall consider the internet PDN (or PDN identified by the class 3 APN) as an "always on" connection as opposed to an "on-demand" PDN connection. If the device successfully attaches to the LTE network using the internet PDN (or PDN identified by the class 3 APN), the device shall consider the IMS PDN to be an "on-demand" PDN for the duration of the attach.

Devices that do NOT support IMS shall NOT specify an APN when attaching to the LTE network (i.e. the device shall allow the network to choose the attach APN). The network will typically use the Internet PDN (or PDN identified by the class 3 APN) as the attach PDN for devices that do not support IMS. The device may consider the attach Internet PDN (or PDN identified by the class 3 APN) as an "always on" connection as opposed to an "on-demand" PDN connection. For the bearers to the attach Internet PDN, the device shall associate one IPv6 address, one IPv4 address, or both an IPv6 and IPv4 address as directed by the network. The device shall be capable of supporting a dual IP bearer to the Internet PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the bearers to the Internet PDN. If the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table, devices that do not support IMS shall treat this attach APN the same as the class 3 APN and route all internet traffic to this PDN. Devices that do not support IMS shall NOT make a PDN connection request using the class 3 APN in the APN table when the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table.

Devices that do NOT support IMS shall establish a default bearer to the Administrative PDN or the VZW Application PDN if an application requires a bearer to any of these PDNs. If a connection to an on-demand PDN is no longer required (i.e. the application(s) using the on-demand PDN have been closed), the device shall release the default bearer to the PDN by sending a PDN DISCONNECT REQUEST message. For the default bearer to an on-demand PDN, the device shall associate an IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address as directed by the network. The device shall be capable of supporting a dual IP bearer to any on-demand PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the default bearer to any on-demand PDN connection.

**NOTE 2:** Devices that do NOT support IMS shall NOT request a connection to the IMS PDN at any time.

#### 1.3.2.4.3.8 On-Demand PDN Connection Request VZ\_REQ\_LTEB13NAC\_6314

The APN shall be included in the PDN CONNECTIVITY REQUEST message for all on-demand PDN connections established after the initial attach.

Refer to the *Scenarios* and the *APN Support for LTE* sections of this document and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

**NOTE 1:** In a data retry scenario where an IMS capable device attaches to the LTE network using the internet PDN (or PDN identified by the class 3 APN), the device shall support requirement VZ\_REQ\_LTEB13NAC\_6312 when attaching to the LTE network using the Internet PDN (or PDN identified by the class 3 APN).

**NOTE 2:** Devices that do NOT support IMS shall NOT specify an APN when attaching to the LTE network per VZ\_REQ\_LTEB13NAC\_6313. Any PDN connection after attach shall be considered an on-demand PDN connection (this could be the original attach APN is that PDN is disconnected but the device is still attached).

#### 1.3.2.4.4 IP MOBILITY VZ\_REQ\_LTEB13NAC\_22723



#### 1.3.2.4.4.1 IP MOBILITY VZ\_REQ\_LTEB13NAC\_6315

When establishing default bearers and their associated IP addresses, the device shall use the Attach Procedure to create the first default bearer and the PDN Connectivity Request procedure to request subsequent default bearers. Refer to 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

IP mobility shall be handled by GTP and/or Proxy Mobile IPv6, which are network capabilities (i.e. no device impact). Refer to 3GPP TS 29.274: *3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3* and 3GPP TS 29.275: *Proxy Mobile IPv6 (PMIPv6) based Mobility and Tunnelling protocols; Stage 3* for additional details.

#### 1.3.2.4.5 IP HEADER COMPRESSION VZ\_REQ\_LTEB13NAC\_22724

##### 1.3.2.4.5.1 IP HEADER COMPRESSION VZ\_REQ\_LTEB13NAC\_6316

The device may support ROHC IP header compression. If the device supports ROHC IP header compression, the device shall support the following ROHC IP header compression profiles defined in section 5.5.1 of 3GPP TS 36.323: *Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification*:

- 0x0000
- 0x0001
- 0x0002

If the device supports ROHC IP header compression, the device may also support the following ROHC IP header compression profiles defined in section 5.5.1 of 3GPP TS 36.323: *Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification*:

- 0x0101
- 0x0102

#### 1.3.2.4.6 BEARER QOS VZ\_REQ\_LTEB13NAC\_22725

### 1.3.2.4.6.1 BEARER QOS VZ\_REQ\_LTEB13NAC\_6317

The device shall support network initiated quality of service (QoS) for both default and dedicated bearers including the creation of new dedicated bearer(s) using 3GPP standard network initiated bearer context activation procedures defined in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. The device shall support changes to the QoS of a default or dedicated bearer using 3GPP standard network initiated bearer context modification procedures defined in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. The device shall support the removal of a dedicated bearer using 3GPP standard network initiated bearer context deactivation procedures defined in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

The device shall support the use of all 3GPP defined QCI values in the range of 1-127. The device shall support the use of any operator-specific QCI value in the range of 128-254.

If the network establishes dedicated bearers, the device shall route packets to these dedicated bearers based on the traffic flow template information provided by the network in the ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST messages or the MODIFY EPS BEARER CONTEXT REQUEST messages (these messages are per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*).

The device shall support the use of a traffic flow template on any default bearer if the network provides a traffic flow template for a default bearer using 3GPP standard network initiated bearer context modification procedures defined in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. If the network assigns a traffic flow template for a default bearer, the device shall route packets on the default bearer per the traffic flow template.

The device shall not initiate QoS establishment or initiate changes to the QoS level for a given bearer. The device shall NOT request a dedicated bearer for any PDN (i.e. all dedicated bearer activation will be initiated by the network).

Refer to 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2*, 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, and 3GPP TS 36.321: *Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification* for additional details.

#### 1.3.2.4.6.2 BEARER QOS and TESTING VZ\_REQ\_LTEB13NAC\_6318

During any conformance or performance testing (e.g. 3GPP standard signaling conformance per 3GPP TS 36.523-1: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification*), the device shall not attempt to initiate QoS even if the device receives an AT command to initiate QoS.

#### 1.3.2.4.6.3 TRAFFIC FLOW TEMPLATE SUPPORT VZ\_REQ\_LTEB13NAC\_22726

#### 1.3.2.4.6.4 Traffic Flow Template Support VZ\_REQ\_LTEB13NAC\_6428

The device shall support all traffic flow template requirements as defined in section 15.3 of 3GPP TS 23.060: *General Packet Radio Service (GPRS); Service description; Stage 2* and section 10.5.6.12 of 3GPP TS 24.008: *Mobile radio interface Layer 3 specification; Core network protocols; Stage 3*.

The device shall support a total of 16 packet filters/traffic flows per bearer. These 16 packet filters/traffic flows may be all uplink, all downlink, or any combination of uplink and downlink that adds up to a total of 16.

At a minimum, the device shall support the following protocols in the "Next Header" if the "Next Header" is a packet filter attribute: UDP, TCP, ICMP, ESP, and AH.

The device is only required to support non-zero values for the "TOS/Traffic Class" packet filter attribute.

#### 1.3.2.4.6.5 UPLINK TRAFFIC SHAPING VZ\_REQ\_LTEB13NAC\_22727

### 1.3.2.4.6.6 Uplink Traffic Shaping VZ\_REQ\_LTEB13NAC\_22729

The device's modem shall not enforce maximum bit rates (MBR's) on any uplink bearer or any uplink APN aggregate maximum bit rates (APN-AMBR's). Enforcement of uplink MBR's and uplink APN-AMBR's will be handled by the network.

The device's modem shall prioritize the routing of uplink packets to their destination bearers based on the priority and prioritized bit rate assigned for each bearer by the network through the RRC *LogicalChannelConfig* information element. For packets destined for the same bearer, the device's modem shall prioritize packets based on their DSCP marking. If the packet has no DSCP marking then a DSCP marking of 0 (i.e. best effort) shall be assumed. Refer to 3GPP TS 23.203: *Policy and charging control architecture*, 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2*, and 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.

### 1.3.2.4.7 MTU SIZE VZ\_REQ\_LTEB13NAC\_22728

#### 1.3.2.4.7.1 MTU SIZE VZ\_REQ\_LTEB13NAC\_6319

For each PDN connection, the MTU size shall be configurable via the Protocol Configuration Options during PDN connection setup, i.e. the device shall request the MTU size as part of the PCO in the PDN CONNECTIVITY REQUEST message. If the network fails to send an MTU size as part of the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN, the device shall set the MTU size for that PDN to 1428 bytes. The device shall apply the configured MTU size for the given PDN to both IPv4 and IPv6 packets. The device shall be capable of supporting a different MTU size setting for each PDN. The device shall be capable of supporting an MTU size of up to 3000 bytes for each PDN.

The device vendor shall not allow the user to modify the MTU size settings through the device user interface or the remote access user interface for tethered devices.

### 1.3.2.5 DNS VZ\_REQ\_LTEB13NAC\_22730

### 1.3.2.5.1 DNS Server Support VZ\_REQ\_LTEB13NAC\_6320

The device shall be capable of supporting 2 IPv6 DNS server addresses and 2 IPv4 DNS server addresses for each PDN connection. The device shall be capable of supporting unique DNS server addresses for each PDN connection. DNS server addresses are provided to the device by the network (refer to the *Scenarios* section of this document for additional details) and shall not be hard coded on the device. The device shall not store DNS server addresses across power cycles.

### 1.3.2.5.2 CACHING VZ\_REQ\_LTEB13NAC\_22731

#### 1.3.2.5.2.1 Applications and DNS Results Caching VZ\_REQ\_LTEB13NAC\_6321

Embedded applications on the device and any other applications that use the DNS resolver software in the device shall not cache DNS results. All caching for such applications shall take place in the DNS resolver software in the device. The applications shall never store IP addresses past the end of a session.

#### 1.3.2.5.2.2 Device DNS Resolver Software Caching VZ\_REQ\_LTEB13NAC\_6322

The following rules shall apply to the DNS resolver software in the device in the event that the resolver caches the results of a DNS query:

- DNS caches shall be cleared when the device experiences a hard power cycle (i.e. the device is powered off by the user and eventually powered back on, the battery is pulled, etc.) or soft reset (software instigates a power cycle). In other words, any cache of DNS results shall be stored in volatile memory only and shall not be stored in non-volatile memory.
- No DNS result shall be cached by the resolver longer than the Time-To-Live (TTL) field that is returned with the result. For example, if the DNS result indicates a Time-To-Live of 30 minutes, then that result shall not be cached by the device for longer than 30 minutes. If no TTL value is available in a particular response, the embedded application may use the result for the duration of that PDN connection but shall not cache the value after the PDN connection ends.

- In the event that the source software offers an option for setting the maximum cache time (e.g. via a compile-time static variable), the time shall be set to a value of 24 hours. However, if the TTL value is less than the maximum cache time, then the TTL value shall always take precedence over the maximum cache time. For instance, if the maximum cache time is 24 hours and the TTL for a result is 2 hours, then the resolver shall cache the result for 2 hours only. If the maximum cache time is 24 hours and the TTL for a result is 48 hours, then the resolver shall cache the result for 24 hours.

### 1.3.2.5.3 DOMAIN NAME MAXIMUM LENGTH VZ\_REQ\_LTEB13NAC\_22732

#### 1.3.2.5.3.1 DOMAIN NAME MAXIMUM LENGTH VZ\_REQ\_LTEB13NAC\_6323

As per RFC 1034, the maximum domain name length shall be 255 octets. If an application requests resolution of a domain name longer than 255 octets, the DNS resolver software in the device shall return an error to the application.

### 1.3.2.6 ~~DATA RETRY REQUIREMENTS~~ VZ\_REQ\_LTEB13NAC\_22733

#### 1.3.2.6.1 ~~DATA RETRY REQUIREMENTS~~ VZ\_REQ\_LTEB13NAC\_6324

~~The device shall comply with all 3GPP Release 9 Specifications (refer to TS 24.301: Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 for additional details) and the Verizon Wireless LTE Data Retry Requirements.~~

~~Compliance to data retry requirements shall be per the Verizon Wireless LTE Data Retry Test Plan.~~

### 1.3.2.7 IMSI SUPPORT FOR LTE VZ\_REQ\_LTEB13NAC\_22734

### 1.3.2.7.1 IMSI SUPPORT FOR LTE VZ\_REQ\_LTEB13NAC\_6325

The device shall retrieve the IMSI stored in the USIM as per 3GPP 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application* for operation on the Verizon Wireless 3GPP Band 13 LTE network. The IMSI will be coded as per 3GPP TS 23.003: *Numbering, addressing and identification*. The IMSI will be used as the subscriber identity when interacting with the Verizon Wireless LTE network.

### 1.3.2.8 APN SUPPORT FOR LTE VZ\_REQ\_LTEB13NAC\_22741

#### 1.3.2.8.1 PDN CONNECTION REQUESTS VZ\_REQ\_LTEB13NAC\_22742

##### 1.3.2.8.1.1 PDN CONNECTION REQUESTS VZ\_REQ\_LTEB13NAC\_6326

When requesting a connection to a PDN, the device shall use the APN associated with that PDN based on the APN class as described below.

- The device shall use the Class 1 APN for the IMS PDN (applies to IMS capable devices ONLY).
- The device shall use the Class 2 APN for the Administrative PDN.
- The device shall use the Class 3 APN for the Internet PDN.
- The device shall use the Class 4 APN for the VZW Application PDN.

Refer to the *LTE IPv6/IPv4 and Bearer Support, Scenarios*, and the *Factory LTE Programming* sections of this document and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

#### 1.3.2.8.2 APN ENABLE/DISABLE VZ\_REQ\_LTEB13NAC\_22743

### 1.3.2.8.2.1 APN ENABLE/DISABLE VZ\_REQ\_LTEB13NAC\_6327

The device shall support an enable/disable control parameter for each APN.

The device shall only use an APN if the APN is enabled. The device shall not request a PDN connection if the associated APN is disabled or not present (e.g. deleted). If the Class 1 APN (i.e. APN for the IMS PDN) is disabled or not present (e.g. deleted) on an IMS capable device, or the Class 2 APN (i.e. APN for the Administrative PDN) is disabled or not present (e.g. deleted) on any device, then the device shall not attempt to attach to the Verizon Wireless LTE network.

### 1.3.2.8.3 APN CONTENT VZ\_REQ\_LTEB13NAC\_22744

#### 1.3.2.8.3.1 APN CONTENT VZ\_REQ\_LTEB13NAC\_6328

When sending the APN as an information element in a NAS message, the device shall only include the APN Network Identifier (NI). The network will append the APN Operator Identifier (OI) to complete the FQDN of the APN, and the network will perform the DNS resolution.

### 1.3.2.8.4 UICC APN VERIFICATION VZ\_REQ\_LTEB13NAC\_22745

#### 1.3.2.8.4.1 UICC APN VERIFICATION ENABLED VZ\_REQ\_LTEB13NAC\_22746

#### 1.3.2.8.4.2 UICC APN Verification Enabled VZ\_REQ\_LTEB13NAC\_6329



If the APN Control List feature is enabled in the UICC (i.e. USIM service table), then the device shall check that the entire APN of any PDP context is listed in EF<sub>ACL</sub> under USIM before requesting this PDP context activation from the network. If the APN is not present in EF<sub>ACL</sub>, the device shall not request the corresponding PDP context activation from the network. If the Class 1 APN (i.e. APN for the IMS PDN) is not present in EF<sub>ACL</sub>, the device shall not attempt to attach to the Verizon Wireless LTE network until the UICC is removed and replaced. If the device is attached to the Verizon Wireless LTE network and needs to establish a connection to the Administrative PDN and the Class 2 APN (i.e. APN for the Administrative PDN) is not present in EF<sub>ACL</sub>, the device shall detach from the LTE network using standard 3GPP messaging and shall not attempt to re-attach to the Verizon Wireless LTE network until the UICC is removed and replaced. Refer to 3GPP TS 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application*, 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, and the *LTE Network Detachment* section of this document for additional details.

The interpretation of the APN TLV shall be as per 3GPP TS 23.003: *Numbering, addressing and identification*.

#### 1.3.2.8.4.3 UICC APN VERIFICATION DISABLED VZ\_REQ\_LTEB13NAC\_22747

#### 1.3.2.8.4.4 UICC APN Verification Disabled VZ\_REQ\_LTEB13NAC\_6330

If the APN Control List feature is disabled in the UICC (i.e. the USIM service table), then the device shall use the APN without any verification from the UICC.

#### 1.3.2.8.5 APN STORAGE ON THE DEVICE VZ\_REQ\_LTEB13NAC\_22748

##### 1.3.2.8.5.1 APN STORAGE VZ\_REQ\_LTEB13NAC\_6331

APN network identifiers and their associated parameters shall be stored on the device in non-volatile memory. Refer to the *Factory LTE Programming* section of this document for additional details.

### 1.3.2.8.5.2 APN STORAGE AND UPDATES VZ\_REQ\_LTEB13NAC\_6332

If the Verizon Wireless UICC is removed from the device, the device shall remember all APN parameter settings used with the Verizon Wireless UICC prior to removal, and the device shall restore all APN parameters to these settings when a Verizon Wireless UICC is re-inserted into the device.

**NOTE:** The device shall consider the UICC to be a Verizon Wireless UICC if the ICCID begins with "891480".

When the device is operated with a Verizon Wireless UICC, the device shall comply with the following requirements:

1. The device may provide the capability for the user to update the class 3 APN network identifier through the device user interface or the remote access user interface for tethered devices.
2. The device may provide the capability to update all APN network identifiers through a diagnostic menu (for use during device acceptance/field testing). This diagnostic mode shall not be accessible to the end user, i.e. this diagnostic menu shall only be accessible by the device vendor and/or Verizon Wireless.
3. The device shall not allow the user to update any other existing APN NI's (except the class 3 APN NI) through the device user interface or the remote access user interface for tethered devices. The device shall not allow the user to create a new APN entry in the APN table through the device user interface or the remote access user interface for tethered devices (e.g. the device shall not allow the end user to create an additional class 3 APN entry in the APN table).
4. The device shall provide the capability of updating all APN network identifiers and their associated parameters through OTADM except MAX\_CONN, MAX\_CONN\_T, and WAIT\_TIME (i.e. MAX\_CONN, MAX\_CONN\_T, and WAIT\_TIME are NOT OTADM configurable). Refer to the *OTADM* section of this document for additional details. The device shall not allow the user to update the following APN related parameters through the device user interface or the remote access user interface for tethered devices:
  - APN Class
  - APN IP Type
  - APN Bearer
  - APN Enable/Disable
  - APN MAXCONN, MAXCONN\_T, WAIT\_TIME
5. If an APN network identifier or APN-related parameter is updated after a PDN connection using the APN has been established, the device shall release the

PDN connection and then immediately re-establish the PDN connection using the updated APN parameter(s). If any APN network identifier or APN-related parameter is updated for an APN for which the device has no current PDN connection, the device shall use the updated APN parameter(s) in all future PDN connections using the APN. Refer to the *Scenarios* section of this document for additional details.

### **1.3.2.8.6 MULTIPLE PDN CONNECTIONS USING THE SAME APN**

VZ\_REQ\_LTEB13NAC\_22749

#### **1.3.2.8.6.1 MULTIPLE PDN CONNECTIONS USING THE SAME APN**

VZ\_REQ\_LTEB13NAC\_6333

The device shall only support one PDN connection for a given APN. After successful establishment of a PDN connection using a given APN, the device shall not attempt to establish additional PDN connections using the same APN, i.e. the device shall not send another PDN CONNECTIVITY REQUEST message with the same APN.

### **1.3.2.8.7 APPLICATION ACCESS TO APN PARAMETERS**

VZ\_REQ\_LTEB13NAC\_22750

#### **1.3.2.8.7.1 APPLICATION ACCESS TO APN PARAMETERS**

VZ\_REQ\_LTEB13NAC\_6417

The device shall not allow any applications to access or modify APN parameters stored on the device with the exception of the device's OTADM application and any lab applications provided the vendor for device certification/acceptance testing.

### **1.3.2.9 DEVICE EQUIPMENT IDENTIFIER**

VZ\_REQ\_LTEB13NAC\_22751

### 1.3.2.9.1 IMEI and IMEISV VZ\_REQ\_LTEB13NAC\_6334

The device shall use the IMEI and the IMEISV as the device equipment identifiers when operating in LTE. The IMEI (including the IMEI check digit) shall be stored on the device in secure, non-volatile, read-only memory populated at the time of device manufacture. The device shall not be capable of modifying the IMEI. The device shall not be capable of modifying the Type Allocation Code (TAC) and Serial Number (SNR) components of the IMEI or IMEISV. The device shall not allow the user to modify the SVN component of the IMEISV. The device shall only be capable of updating the Software Version Number (SVN) component of the IMEISV as part of a software update to the device. Refer to 3GPP TS 23.003: *Numbering, addressing and identification* and 3GPP TS 22.016: *International Mobile Equipment Identities (IMEI)* for additional details.

The IMEI and IMEISV shall always be read from the device (as opposed to the UICC). When the IMEI is requested by the network, the UICC, or an application on the device, the device shall retrieve the IMEI from the secure, non-volatile, read-only memory whose value was populated at the time of the device manufacture (as opposed to retrieving from any volatile, unsecure memory which may be changed or modified after initial device manufacture). When the IMEISV is requested by the network, the UICC, or an application on the device, the device shall retrieve the 14 digit IMEI (i.e. TAC+SNR) from the secure, non-volatile, read-only memory whose value was populated at the time of the device manufacture (as opposed to retrieving from any volatile, unsecure memory which may be changed or modified after initial device manufacture) and concatenate the 14 digit IMEI (i.e. TAC+SNR) with the SVN to form the IMEISV, i.e. only the SVN portion of the IMEISV may be retrieved from any volatile, unsecure memory which may be changed or modified after initial device manufacture.

The value for the SVN component of the IMEISV shall be 01 for the software version on the device at device launch. The SVN component of the IMEISV shall be incremented by at least one for every released post-launch software update for the device.

### 1.3.2.9.2 IMEI Display VZ\_REQ\_LTEB13NAC\_6335

When displaying the IMEI to the end user through the device user interface or the remote access user interface for tethered devices, the device shall include the IMEI check digit. Per the 3GPP Release 9 Specifications, the IMEI check digit shall not be included in messaging between the device and the network. Refer to 3GPP TS 23.003: *Numbering, addressing and identification* and 3GPP TS 22.016: *International Mobile Equipment Identities (IMEI)* for additional details.

### 1.3.2.10 IMS SUPPORT VZ\_REQ\_LTEB13NAC\_23507

### 1.3.2.10.1 SMS over IMS Support VZ\_REQ\_LTEB13NAC\_6336

All devices that support voice shall support SMS over IMS when operating on the Verizon Wireless LTE network as per the Verizon Wireless LTE SMS Requirements. Compliance to LTE SMS requirements shall be per the Verizon Wireless LTE SMS Test Plan. Compliance to IMS registration and IMS registration retry requirements shall be per the Verizon Wireless LTE IMS Registration and IMS Registration Retry Test Plan.

Data-centric devices shall support either SMS over IMS or SMS over NAS when operating on the Verizon Wireless LTE network. Refer to VZ\_REQ\_LTEB13NAC\_39731 for additional details on SMS over NAS.

**NOTE 1:** Data-centric or IMS-less devices that support SMS over NAS (and do NOT support SMS over IMS) are NOT required to support any IMS-related requirements in this document.

**NOTE 2:** *Data-centric or IMS-less device vendors should contact Verizon Wireless prior to implementing SMS over NAS on any devices.*

### 1.3.2.10.2 SMS TRANSPORT LAYER MESSAGE FORMAT VZ\_REQ\_LTEB13NAC\_23508

Refer to the Verizon Wireless LTE SMS requirements.

### 1.3.2.10.3 IMS CLIENT VZ\_REQ\_LTEB13NAC\_23509

#### 1.3.2.10.3.1 IMS CLIENT VZ\_REQ\_LTEB13NAC\_6337

The IMS client shall be embedded in the device (as opposed to residing on a laptop for tethered devices). In logical terms, the device shall only have one IMS client which communicates with the network.

**1.3.2.10.3.2 IMS TEST MODE** VZ\_REQ\_LTEB13NAC\_23510

**1.3.2.10.3.3 IMS Test Mode** VZ\_REQ\_LTEB13NAC\_6338

IMS capable devices shall support an IMS test mode in which the IMS client is disabled. By default, this test mode shall be disabled, i.e. the IMS client is enabled.

This test mode shall be enabled and disabled using a non-volatile memory setting. Upon changing this memory setting, the device shall perform a soft reset. The vendor shall provide a lab application to modify this memory setting during device acceptance testing. The device vendor shall not allow the user to modify this memory setting through the device user interface or the remote access user interface for tethered devices.

The IMS test mode shall operate independently of the setting of the `SMS_Over_IP_Networks_Indication` parameter defined in the *SMS over IMS Control* section of the LTE SMS Requirements. Refer to the *LTE Network Attachment* section of this document for additional details.

**1.3.2.10.4 SMS STORAGE** VZ\_REQ\_LTEB13NAC\_23511

**1.3.2.10.4.1 3GPP FORMATTED SMS TEXT MESSAGES** VZ\_REQ\_LTEB13NAC\_23512

Refer to the Verizon Wireless LTE SMS Requirements.

**1.3.2.10.4.2 3GPP2 FORMATTED SMS TEXT MESSAGES** VZ\_REQ\_LTEB13NAC\_23513

Refer to the Verizon Wireless LTE SMS Requirements.

### 1.3.2.10.5 IMS REGISTRATION REQUIREMENTS VZ\_REQ\_LTEB13NAC\_23514

#### 1.3.2.10.5.1 ~~PDN AND BEARER SELECTION~~ VZ\_REQ\_LTEB13NAC\_23515

#### 1.3.2.10.5.2 PDN and Bearer Selection VZ\_REQ\_LTEB13NAC\_6432

The device shall use the IMS PDN for all messaging and traffic associated with the device's embedded IMS client. No other PDN's shall be used for messaging and traffic associated with the device's embedded IMS client.

The device shall proceed with IMS registration when all of the criteria below are met:

- The device has established a default bearer with the IMS PDN.
- The device has established a globally routable IPv6 address for the IMS PDN.
- The device has received the P-CSCF IP addresses in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.

The device shall use the IMS PDN default bearer for all SIP signaling unless the network indicates otherwise.

#### 1.3.2.10.5.3 ~~PROXY-CSCF DISCOVERY~~ VZ\_REQ\_LTEB13NAC\_23516

#### 1.3.2.10.5.4 Proxy-CSCF Discovery VZ\_REQ\_LTEB13NAC\_6433

The device shall obtain the IP address(es) of the IMS Proxy-CSCF as one of the Protocol Configuration Option (PCO) parameters that is provided by the network in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN during the LTE attach procedure. The device shall be capable of supporting a minimum of three P-CSCF IP addresses. For requirements on IMS registration and the use of the three P-CSCF IP address values, see section 3.2.10.5 "IMS Registration Errors." The device shall NOT use cached P-CSCF IP addresses from a previous IMS PDN context - i.e. when a new IMS PDN connection/context is established the device shall use the P-CSCF IP addresses provided in that IMS PDN bearer activation.

The device shall use port 5060 as the default P-CSCF IMS SIP port number, i.e. the destination port number that the device's IMS SIP User Agent Client uses to send SIP messages to the P-CSCF (and the listening port number of the P-CSCF). The device shall also use port 5060 as the default port for the device's IMS SIP User Agent Servers listening port. When opening a new TCP socket for SIP, the device shall randomly select a source port that is equal to or above 32768. When opening up a new TCP socket, the device shall not re-use a source port that has been used in any of the previous 32 TCP sockets. The device vendor shall provide a lab application to modify the P-CSCF IMS SIP port setting during device acceptance testing. The device vendor shall not allow the user to modify the P-CSCF IMS SIP port setting through the device user interface or the remote access user interface for tethered devices.

### 1.3.2.10.5.5 ~~REGISTRATION WITH THE PROXY-CSCF AND S-CSCF~~

VZ\_REQ\_LTEB13NAC\_23517

### 1.3.2.10.5.6 Registration with the Proxy-CSCF and S-CSCF

VZ\_REQ\_LTEB13NAC\_6434

The device shall support the IMS registration functions with the IMS network as described in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*. Specifically, the device shall support the initial registration functions described in the section "*Initial Registration*" in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*.

- The device shall use SIP URIs in the FROM and TO Headers
- The device shall use the pre-provisioned Home Domain Name in the Request URI of the Registration Message.
- The P-Associated-URI will be returned to the device with both a SIP and a tel URI. The device shall use the SIP URI in the P-Preferred Identity and the FROM Headers.
- The device shall attempt IMS registration using the first P-CSCF IP address provided by the network in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN during the LTE attach procedure. The device shall attempt IMS registration using additional P-CSCF IP addresses provided by the network as indicated per section 3.2.10.5 of this document.
- As a part of the IMS registration process, the device shall set the registration expiration timer value to 600,000 seconds as defined in section 5.1.1.2, *Initial Registration*, of 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*. This applies to both the normal scenario where a 200 OK is received in response to the Register, and abnormal scenarios where a SIP error



code (such as a SIP 423 Interval Too Brief) is received. The device shall request the registration expiration timer value in either the "Contact" header or the "Expires" header but not both.

- The device shall include the 3GPP SMS feature tag (+g.3gpp.smsip).
- The device shall include the P-Access-Network-Info header in all SIP REGISTER requests per 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*. **NOTE:** The MCC, MNC, TAC, and ECI shall be for the current serving LTE network and serving cell.
- The device shall include the following feature tag in the Contact header of the SIP REGISTER request: "+sip.instance" with a value of the device IMEI in the form "urn:gsma:imei:<device IMEI>", e.g. Contact: +sip.instance= "urn:gsma:imei:<device\_IMEI>".

If the device receives a SIP 200 OK response from the network for its SIP REGISTER request, and the SIP 200 OK response contains more than one Contact header, then the device shall process each Contact header as follows:

- If the one of the URI's in the Contact headers matches the URI used in the Contact header of the SIP REGISTER request for establishing the current IMS registration, then the device shall process the Contact header in the SIP 200 OK response and take appropriate action.
- If none of the URI's in the Contact headers match the URI used in the Contact header of the SIP REGISTER message for establishing the current IMS registration, then the device shall disregard the SIP 200 OK response (as if there was no response from the network) and follow a) all normal IMS registration re-transmissions and b) follow all normal IMS registration retry procedures as defined in requirement VZ\_REQ\_LTEB13NAC\_6444. **NOTE:** If the device does NOT receive a 200 OK matching the SIP REGISTER request and TimerF expires, then the device shall consider the SIP REGISTER request to have timed out and follow IMS registration retry procedures as defined in requirement VZ\_REQ\_LTEB13NAC\_6444.

If the device receives a SIP NOTIFY message from the network associated with IMS registration and the SIP NOTIFY message also contains an Instance-ID, then the device shall act as follows:

- If the Instance-ID matches the Instance-ID used in the original IMS REGISTER message for establishing the current IMS registration, then the device shall process the SIP NOTIFY message and take appropriate action.
- If the Instance-ID is different from the Instance-ID used in the original IMS REGISTER message for establishing the current IMS registration, then the device shall respond to the SIP NOTIFY message with a 200 OK message but take no further action (i.e. the device shall disregard the SIP NOTIFY message).

**NOTE:** In some cases, the SIP NOTIFY may contain multiple registration instances (each with a unique Instance-ID). The device shall process all registration instances (and their associated Instance-IDs) in the SIP NOTIFY before making a decision how to proceed based on the logic above.

### 1.3.2.10.5.7 AUTHENTICATION DURING REGISTRATION

VZ\_REQ\_LTEB13NAC\_23518

### 1.3.2.10.5.8 Authentication during registration

VZ\_REQ\_LTEB13NAC\_6435

Until further notice from Verizon Wireless, all devices shall use the Digest AKA<sub>v2</sub> method as the IMS authentication mechanism. The Digest AKA<sub>v2</sub> authentication method is per IETF RFC 4169.

Note the following items for Authentication:

- The REGISTER message will be challenged.
- Devices shall always send the "Authorization" header with username parameter even in the initial REGISTER messages.
- De-registrations will be challenged.
- SIP MESSAGE transactions may be challenged by the IMS network.

After a successful IMS registration, the device shall provide an indication of success to the connection manager if the device is tethered to a PC.

### 1.3.2.10.5.9 URI FORMATTING

VZ\_REQ\_LTEB13NAC\_23519

### 1.3.2.10.5.10 URI formatting

VZ\_REQ\_LTEB13NAC\_6436

The ISIM will contain multiple records for the IMS Public User Identity under EF<sub>IMPU</sub>. The first record will always be an IMSI-based SIP URI in the format: sip:<IMSI>@ims.mnc480.mcc311.3gppnetwork.org (NOTE: Verizon Wireless will add additional MNC-MCC combinations as needed.)

The ISIM will also contain an MSISDN-based SIP URI for the IMS Public User Identity in the format:

sip:+19085554321@vzims.com

where the 10 digit MDN (in E.164 format) is in the user part.

In normal operation, the device shall use the MSISDN-based SIP URI for its IMS Public User Identity. If a tel URI is also desired for the device, it shall not be permanently stored in the device. The tel URI will be downloaded to the device during registration from the IMS network using the P Associated URI Header.

Refer to the *Scenarios* section of the Verizon Wireless LTE SMS Requirements and 3GPP TS 31.103: *Characteristics of the IP Multimedia Services Identity Module (ISIM) application* for additional details.

### 1.3.2.10.5.11 ~~SUBSCRIPTION TO THE REG EVENT PACKAGE~~

VZ\_REQ\_LTEB13NAC\_23520

### 1.3.2.10.5.12 Subscription to the reg event package

VZ\_REQ\_LTEB13NAC\_6437

After successfully completing any new IMS registration (as opposed to a re-registration), the device shall always request a new subscription to the reg events package. The procedures for this subscription are described in the section "*Subscription to the Registration-State Event Package*" in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*. The device shall include the following feature tag in the Contact header of the SIP SUBSCRIBE request: "+sip.instance" with a value of the device IMEI in the form "urn:gsma:imei:<device IMEI>", e.g. Contact: +sip.instance="urn:gsma:imei:<device\_IMEI>". **NOTE:** This same "+sip.instance" feature tag shall be included in both the REGISTER message and the SUBSCRIBE (for the reg events package).

Per RFC 3261, the device shall use a "Call-ID" in the SUBSCRIBE message that is different from the "Call-ID" that was established during the registration procedure.

The device shall re-subscribe at the expiration of the subscription timer as described in the section "*Subscription to the Registration-State Event Package*" in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*. When sending a SUBSCRIBE message to initiate a re-subscribe to the reg events package, the device shall use the same dialog that was established at the initial SUBSCRIBE procedure.

The device shall include the P-Access-Network-Info header in all SIP SUBSCRIBE requests per 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3.*

#### 1.3.2.10.5.13 REREGISTRATION VZ\_REQ\_LTEB13NAC\_23521

#### 1.3.2.10.5.14 Reregistration VZ\_REQ\_LTEB13NAC\_6438

Either the device or the network may initiate a reregistration. The device shall reregister at the expiration of the registration timer as described in the section "User-initiated Reregistration" in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3.*

When sending a REGISTER message to initiate a re-registration, the device shall use the same "Call-ID" that was established at the initial registration.

#### 1.3.2.10.5.15 DEREGISTRATION VZ\_REQ\_LTEB13NAC\_23522

#### 1.3.2.10.5.16 Deregistration VZ\_REQ\_LTEB13NAC\_6439

Either the device or the network may request deregistration with the IMS network. The procedures are described in the sections "User-initiated Deregistration" and "Network-initiated Deregistration" in 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3.*

The device shall initiate deregistration if it has a current registration and the device is going to either initiate a detach from the LTE network (including device power down detach) or initiate a disconnection of the IMS PDN connection. To deregister, the device

shall 1) terminate the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by 2) sending an IMS de-registration request which shall consist of a REGISTER message with the value Expires= 0 in the header. This shall be done before sending a NAS DETACH REQUEST message or a NAS PDN DISCONNECT REQUEST message for the IMS PDN. Upon the IMS client generating the initial SIP REGISTER message with expires=0, the device shall start an implementation specific timer with a value of 4 seconds. While this implementation specific timer is running, the device shall respond to all SIP messaging from the network, e.g. if the network challenges the de-registration request with a 401 Unauthorized. Upon expiration of this implementation specific timer, the device shall take no further action with respect to SIP messages from the network and execute the NAS detach procedure or NAS PDN disconnect procedure. The device shall stop the implementation specific timer and immediately execute the NAS detach procedure or NAS PDN disconnect procedure if a SIP 200 OK or a SIP 481 or a SIP 501 is received in response to the SIP REGISTER (with expires=0) before the implementation specific timer expires.

**NOTE:** The implementation specific timer is started when the IMS client generates the initial SIP REGISTER message with expires=0. The implementation specific timer shall run even if the IMS client cannot send the SIP REGISTER message to the modem for transmission because an IMS signaling connection could not be established.

The device shall enter the de-registered state if the network sends a SIP NOTIFY message with one or more registration elements that have the state attribute set to "terminated" and the event attribute set to either "rejected" or "deactivated". In this case, the device shall wait 60 seconds and then attempt an initial IMS registration.

If the device receives a SIP NOTIFY message from the network indicating a network-initiated IMS de-registration and the SIP NOTIFY message also contains an Instance-ID, then the device shall act as follows:

- If the Instance-ID matches the Instance-ID used in the original IMS REGISTER message for establishing the current IMS registration, then the device shall process the request as a normal de-registration following the steps described in the preceding paragraph above.
- If the Instance-ID is different from the Instance-ID used in the original IMS REGISTER message for establishing the current IMS registration, then the device shall respond to the SIP NOTIFY message with a 200 OK message but take no further action (i.e. the device shall disregard the SIP NOTIFY message).

**NOTE:** In some cases, the SIP NOTIFY may contain multiple registration instances (each with a unique Instance-ID). The device shall process all registration instances

(and their associated Instance-IDs) in the SIP NOTIFY before making a decision how to proceed based on the logic above.

### 1.3.2.10.5.17 ~~DEVICE IDENTITY AND RELATED PARAMETERS~~ VZ\_REQ\_LTEB13NAC\_23523

### 1.3.2.10.5.18 **Device Identity and Related Parameters** VZ\_REQ\_LTEB13NAC\_6440

The device shall retrieve the following parameters from the ISIM/USIM:

- IMS Private User Identity: The IMS Private User Identity is a network identity with the format <IMSI>@vzims.com. This parameter is stored in the ISIM on the UICC.
- IMS Public User Identity: In normal SMS operation, the IMS Public User Identity shall be a MSISDN-based SIP URI with the format sip:+19085554321@vzims.com. The ten digit MDN (i.e. 9085554321) is in the user part. This parameter is stored in the ISIM on the UICC. The ISIM also contains an IMSI-based SIP URI of the format sip:<IMSI>@ims.mnc480.mcc311.3gppnetwork.org (NOTE: Verizon Wireless will add additional MNC-MCC combinations as needed.). The first record under EFIMPU will always be the IMSI-based SIP URI.
- Home Network Domain name: the home network domain name of the P-CSCF. This parameter has a default value of vzims.com.
- IMSI: The IMSI consists of 3 digits MCC, 2 or 3 digits MNC, and from 1 to 9 digits MSID that is formatted according to ITU-T E.212. The IMSI has a maximum length of 15 digits. This parameter is stored in the USIM on the UICC.
- IMS AKA: The IMS AKA password is stored in the ISIM on the UICC.

### 1.3.2.10.5.19 ~~SMS OVER IMS CONTROL~~ VZ\_REQ\_LTEB13NAC\_23524

### 1.3.2.10.5.20 **SMS over IMS Control** VZ\_REQ\_LTEB13NAC\_6441

The device shall support a configurable parameter that controls the operation of the SMS over IMS functions. The configurable parameter is defined as `SMS_Over_IP_Networks_Indication` and it is a Boolean parameter having a value of 1 or 0 (refer to 3GPP TS 24.167: *3GPP IMS Management Object (MO)*; Stage 3 for additional details). This configurable parameter shall not be accessible to the end user.

- When the `SMS_Over_IP_Networks_Indication` parameter is set to a value of 1, the device shall support SMS over IMS and shall attempt IMS registration as defined by the requirements in this section. The value of 1 shall be the default value and this value is used for normal operation in the LTE network.
- When the `SMS_Over_IP_Networks_Indication` parameter is set to a value of 0, the device shall not use the SMS over IMS feature to originate SMS messages, but the device shall attach to the LTE network and attempt IMS registration as defined by the requirements in this section. If IMS registration is successful, the device shall be able to receive and process MT SMS messages delivered over IMS, but shall not originate MO SMS messages over IMS.

Note that the `SMS_Over_IP_Networks_Indication` parameter is a parameter that operates independently of the IMS test mode parameter that is defined in this document.

### 1.3.2.10.5.21 ~~SIP TIMERS FOR IMS~~ VZ\_REQ\_LTEB13NAC\_23525

### 1.3.2.10.5.22 SIP Timers for IMS VZ\_REQ\_LTEB13NAC\_6442

The device shall support the following SIP timers for IMS:

- The value of the SIP T1 timer shall be controlled by the configuration parameter `T1Timer_ims`. This timer shall have a default value of 3 seconds.
- The value of the SIP Timer F (SIP timeout timer) shall be controlled by the configuration parameter `TFtimer_ims`. This timer shall have a default value of 30 seconds. Note that the Timer F value shall not be calculated from the formula in the SIP standard.
- The value of the SIP T2 timer shall be controlled by the configuration parameter `T2timer_ims`. This timer shall have a default value of 16 seconds.
- The device vendor shall provide a lab application to modify the values of `T1timer_ims`, `TFtimer_ims`, and `T2timer_ims` during device acceptance testing.
- The values of the other SIP timers shall be as documented in section 7.7 of 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP)*; Stage 3.

The device vendor shall not allow the user to modify any SIP timer settings through the device user interface or the remote access user interface for tethered devices.

### **1.3.2.10.5.23 ~~MSISDN AND MSISDN-BASED SIP URI VALIDITY~~**

VZ\_REQ\_LTEB13NAC\_23526

### **1.3.2.10.5.24 MSISDN and MSISDN-based SIP URI Validity**

VZ\_REQ\_LTEB13NAC\_6443

Before any IMS registration attempt, the device shall determine if the MSISDN under EF<sub>MSISDN</sub> in the USIM and the MSISDN-based SIP URI for the IMS Public User Identity under EF<sub>IMPU</sub> in the ISIM are valid using the procedure below:

- If all bytes of the dialing number/SSC string under EF<sub>MSISDN</sub> in the USIM are set to hexadecimal "FF" values, then the MSISDN shall be declared invalid. Otherwise, the MSISDN shall be declared valid. (NOTE: The dialing number/SSC string under EF<sub>MSISDN</sub> in the USIM is preceded by the TON/NPI byte which may or may not be set to a hexadecimal value of "FF" for an un-provisioned USIM. Only the 10 bytes allocated to the dialing number/SSC string shall be used to determine the validity of the MSISDN.)

If the MSISDN is valid and the MSISDN-based SIP URI for the IMS Public User Identity under EF<sub>IMPU</sub> in the ISIM contains the dialing number/SSC string read from the USIM EF<sub>MSISDN</sub>, then the MSISDN-based SIP URI for the IMS Public User Identity under EF<sub>IMPU</sub> shall be declared valid. Otherwise the MSISDN-based SIP URI for the IMS Public User Identity shall be declared invalid.

If the MSISDN-based SIP URI for the IMS Public User Identity is provisioned in the ISIM and is valid, then the device shall IMS register using the MSISDN-based SIP URI as its IMS Public User Identity. Upon successful IMS registration using the MSISDN-based SIP URI as the devices IMS Public User Identity, the device shall be capable of all SMS services detailed in the Verizon Wireless LTE SMS Requirements.

If the MSISDN-based SIP URI for the IMS Public User Identity is invalid, then the device shall IMS register using the IMSI-based SIP URI as its IMS Public User Identity. The device shall use the first record in the ISIM under EF<sub>IMPU</sub> as the IMSI-based SIP URI for



the IMS Public User Identity. Upon successful IMS registration using the IMSI-based SIP URI as the device's IMS Public User Identity, the device shall operate in a limited access SMS mode where the device only originates/terminates administrative SMS messages. An example of SMS messages supported in this limited access SMS mode are the administrative SMS messages for the OTADM application or the SIM OTA application. An example of SMS messages that are not supported in this mode would be application directed SMS messages for an end user application. When operating in this limited access SMS mode, the device shall be capable of receiving SMS messages addressed to the device's MDN or addressed to the device's IMSI.

#### 1.3.2.10.5.25 ~~UDP VS. TCP FOR SIP SIGNALING~~ VZ\_REQ\_LTEB13NAC\_35803

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#### 1.3.2.10.5.26 UDP vs. TCP for SIP Signaling VZ\_REQ\_LTEB13NAC\_35804

The device shall use UDP for all SIP requests where the request is less than the MTU size for the IMS PDN minus 200 bytes. If the SIP request is within 200 bytes of the MTU size for the IMS PDN, then the device shall use TCP for the SIP request. Refer to RFC 3261 and 3GPP TS 24.229: *Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3* for additional details.

**NOTE:** When creating a TCP socket, the device shall use port 5060 as the default P-CSCF IMS SIP port number, i.e. the destination port number that the device's IMS SIP User Agent Client uses to send SIP messages to the P-CSCF (and the listening port number of the P-CSCF). When opening a new TCP socket for SIP, the device shall randomly select a source port that is equal to or above 32768. When opening up a new TCP socket, the device shall not re-use a source port that has been used in any of the previous 32 TCP sockets.

#### 1.3.2.10.6 IMS REGISTRATION ERRORS VZ\_REQ\_LTEB13NAC\_23527

### 1.3.2.10.6.1 ~~IMS REGISTRATION/RE-REGISTRATION RETRY ALGORITHM~~

VZ\_REQ\_LTEB13NAC\_23528

### 1.3.2.10.6.2 IMS Registration/Re-Registration Retry Algorithm

VZ\_REQ\_LTEB13NAC\_6444

The device shall implement an IMS registration/re-registration retry algorithm based on the Failure Type as described in the table below.

| Failure Type   | Retry Behavior  |
|--|---|
| No response from network and the SIP timeout timer (i.e. SIP Timer F) expires  | Follow algorithm below.   |
| Network rejects the IMS registration/re-registration with the following SIP error codes:<br>400, 402, 421, 484   | Refer to the special requirement for these error codes.   |
| Network rejects the IMS registration/re-registration with the following SIP error codes:<br>403, 404   | Refer to the special requirement for this error code.   |
| Network rejects the IMS registration/re-registration with the following SIP error codes:<br>401<br>423   | Part of normal registration call flow, refer to 3GPP TS 24.229. The device shall use the same P-CSCF for all retries. |
| Network rejects the IMS registration/re-registration with the following SIP error codes:<br>480 (if Retry-After header is absent)<br>482<br>486 (if Retry-After header is absent)<br>491<br>494<br>500 (if Retry-After header is absent) | Follow algorithm below.   |

|  |  |
|--|--|
| 503 (if Retry-After header is absent)<br>504<br>600 (if Retry-After header is absent)  |  |
| Network rejects the IMS registration/re-registration with the following SIP error codes:<br>480 (if Retry-After header is present)<br>486 (if Retry-After header is present)<br>500 (if Retry-After header is present)<br>503 (if Retry-After header is present)<br>600 (if Retry-After header is present) | Follow the algorithm below with the following exception:<br><br>The throttling timer value shall be set to the duration specified in the Retry-After header. |
| Network rejects the IMS re-registration or de-registration with the following SIP error codes:<br>481<br>501 (de-registration only)  | Refer to the special requirements.   |

Definition of general IMS registration and re-registration algorithm is provided below (note that as defined in the above table, some scenarios with specific SIP error codes have special requirements and these are defined in the subsequent sections):

1. The first time an IMS registration or re-registration attempt fails, the IMS application shall increment a "throttling counter" to 1 and start a "throttling timer". The length of the timer shall be 30 seconds. The IMS application shall not make another registration or re-registration attempt while the throttling timer is running.
2. Upon the expiration of the throttling timer, the IMS application shall make another IMS registration or re-registration attempt. A re-registration attempt shall use the same P-CSCF while a registration attempt shall use the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt). If the IMS registration or re-registration is successful, the throttling counter shall be cleared. If the IMS registration or re-registration attempt fails, the IMS application shall increment the throttling counter to 2 and start the throttling timer. The length of the timer shall be 30 seconds. The IMS application shall not make another registration or re-registration attempt while the throttling timer is running.
3. Upon the expiration of the throttling timer, the IMS application shall make another IMS registration attempt using the next P-CSCF IP address provided by the network in

the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt). If the previous attempt was a re-registration attempt, the IMS application shall make a new IMS registration request in this step and all subsequent steps of the algorithm. If the IMS registration is successful, the throttling counter shall be cleared. If the IMS registration attempt fails, the IMS application shall increment the throttling counter to 3 and start the throttling timer. This time, the length of the timer shall be one minute plus a random value; the random value shall have an upper bound of 15 seconds. The IMS application shall not make another registration attempt while the throttling timer is running.

4. Upon the expiration of the throttling timer, the IMS application shall make another IMS registration attempt using the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt). If the IMS registration is successful, the throttling counter shall be cleared. If the IMS registration attempt fails, the IMS application shall increment the throttling counter to 4 and start the throttling timer. This time, the length of the timer shall be two minutes. The IMS application shall not make another registration attempt while the throttling timer is running.

5. Upon the expiration of the throttling timer, the IMS application shall make another IMS registration attempt using the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt). If the IMS registration is successful, the throttling counter shall be cleared. If the IMS registration attempt fails, the IMS application shall increment the throttling counter to 5 and start the throttling timer. This time, the length of the timer shall be eight minutes. The IMS application shall not make another registration attempt while the throttling timer is running.

6. Upon the expiration of the throttling timer, the IMS application shall make another IMS registration attempt using the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt). If the IMS registration is successful, the throttling counter shall be cleared. If the IMS registration attempt fails, the IMS application shall increment the throttling counter to 6 and start the throttling timer. This time, the length of the timer shall be fifteen minutes. The IMS

application shall not make another registration attempt while the throttling timer is running. All subsequent IMS registration failures on this system that occur while the throttling counter is set to a value of 6 or greater shall result in a fifteen minute throttling timer. i.e. from this point on, there shall not be more than one attempt at an IMS registration on this system per fifteen minutes. For each subsequent attempt, the IMS application shall use the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the IMS application used the last P-CSCF IP address provided by the network in the previous attempt, then the IMS application shall use the first P-CSCF IP address provided by the network for this attempt).

#### 1.3.2.10.6.3 ~~NETWORK REJECTS THE IMS REGISTRATION/RE-REGISTRATION WITH A 'SIP 400', 'SIP 402', 'SIP 421', OR 'SIP 484' MESSAGE~~

VZ\_REQ\_LTEB13NAC\_23529

#### 1.3.2.10.6.4 Network Rejects the IMS Registration/Re-registration with a 'SIP 400', 'SIP 402', 'SIP 421', or 'SIP 484' Message

VZ\_REQ\_LTEB13NAC\_6452

If the network rejects the IMS registration/re-registration attempt with either of the following cause codes:

- SIP 400
- SIP 402
- SIP 421
- SIP 484

the device shall follow the algorithm defined in section **IMS Registration/Re-Registration Retry Algorithm** of this document. If the device encounters another rejection of an IMS registration/re-registration attempt before the throttling counter is reset where the IMS registration/re-registration is rejected by the network with either of the following cause codes:

- SIP 400
- SIP 402
- SIP 421
- SIP 484

then the device shall not attempt to IMS register/re-register with the Verizon Wireless LTE network until the device is power cycled or the UICC containing the ISIM is removed/replaced.

### 1.3.2.10.6.5 ~~NETWORK REJECTS THE IMS REGISTRATION/RE-REGISTRATION WITH A 'SIP 403' OR 'SIP 404' MESSAGE~~ VZ\_REQ\_LTEB13NAC\_23530

### 1.3.2.10.6.6 Network Rejects the IMS Registration/Re-registration with a 'SIP 403' or 'SIP 404' Message VZ\_REQ\_LTEB13NAC\_6453

If the network rejects an IMS registration/re-registration attempt using the MSISDN-based SIP URI for the IMS Public User Identity with either of the following cause codes:

- SIP 403
- SIP 404

the device shall wait 30 seconds and then reattempt the registration using the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the previous attempt was a re-registration attempt, the device shall send a new IMS registration request in this and all subsequent retry attempts). Typically the network will provide the IP address values of three P-CSCF servers in the PCO field. If the device has attempted to IMS register/re-register using all of the P-CSCF IP addresses provided by the network and in all attempts the network has rejected the IMS registration/re-registration attempt (using the MSISDN-based SIP URI for the IMS Public User Identity) with either of the following cause codes:

- SIP 403
- SIP 404

then the device shall wait 30 seconds and then reattempt the registration using the IMSI-based SIP URI for the IMS Public User Identity. If an IMS registration using the IMSI-based SIP URI for the IMS Public User Identity is successful, the device shall operate in limited access SMS mode as described in this document.

If the network rejects an IMS registration/re-registration attempt using the IMSI-based SIP URI for the IMS Public User Identity with either of the following cause codes:

- SIP 403
- SIP 404

the device shall wait 30 seconds and then reattempt the registration using the next P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (if the previous attempt was a re-registration attempt, the device shall send a new IMS registration request in this and all subsequent retry attempts). Typically the network will provide the IP address values of three P-CSCF servers in the PCO field. If the device has attempted to IMS register/re-register using all of the P-CSCF IP addresses provided by the network and in all attempts the network has rejected the IMS registration/re-registration attempt (using the IMSI-based SIP URI for the IMS Public User Identity) with either of the following cause codes:

- SIP 403
- SIP 404

then the device shall not attempt to IMS register with an LTE network until the device is power cycled or airplane mode is toggled on then off on the device or the UICC containing the ISIM is removed/replaced.

### **1.3.2.10.6.7 ~~IMS REGISTRATION TIMER EXPIRES WHILE THROTTLING~~** VZ\_REQ\_LTEB13NAC\_23531

### **1.3.2.10.6.8 IMS Registration Timer Expires while Throttling** VZ\_REQ\_LTEB13NAC\_6454

If the device is attempting to re-register and the registration timer expires while the throttling timer is running, the device shall perform a new registration attempt at the next retry. The throttling counter shall not be reset.

### **1.3.2.10.6.9 ~~IMS REGISTRATION/RE-REGISTRATION THROTTLING ACROSS SYSTEM TRANSITIONS~~** VZ\_REQ\_LTEB13NAC\_23532

### 1.3.2.10.6.10 IMS Registration/Re-Registration Throttling Across System Transitions VZ\_REQ\_LTEB13NAC\_6455

The device shall maintain only one set of IMS registration/re-registration throttling parameters (e.g. timers and counters). This set of throttling parameters shall apply to all systems. The device shall not reset these throttling parameters as the result of a system transition unless one of the following events occurs:

1. The device receives a new IMS PDN bearer activation and the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message contains a new list of P-CSCF IP addresses which does NOT include the current serving P-CSCF.
2. The device receives a new IMS PDN bearer activation, and the IP address for the IMS PDN connection changes (i.e. IP address continuity is NOT maintained).

If one of the events above occurs, the device shall stop the IMS registration throttling timer, reset the IMS registration throttling counter, and initiate a new IMS registration using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN.

#### **Example A:**

- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is no re-activation of IMS PDN bearer during the system transition (i.e. the current IMS PDN bearer is maintained across the system transition).
- The IMS registration/re-registration throttling counter will still be 6 and the 15 minute throttling timer will still be running. The device does not retry IMS registration/re-registration until the throttling timer expires.

#### **Example B:**

- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is a new IMS PDN bearer activation during the system transition but the IP address for the IMS PDN is the same as the previous IMS PDN context and there is no change in the entire set or order of the P-CSCF IP addresses provided in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN.
- The IMS registration/re-registration throttling counter will still be 6 and the 15 minute throttling timer will still be running. The device does not retry IMS registration/re-registration until the throttling timer expires.

#### **Example C:**



- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is a new IMS PDN bearer activation during the system transition and the current serving P-CSCF is NOT included in the list of P-CSCF IP addresses provided in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN.
- The IMS registration/re-registration throttling timer will still be stopped and the throttling counter will be reset. The device initiates a new IMS registration using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN.

**Example D:**

- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is a new IMS PDN bearer activation during the system transition and the IP address for the IMS PDN is the same as the previous IMS PDN context and the order of the entries in the list of P-CSCF IP addresses provided in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN is different from the previous IMS PDN context (the entries in the list are the same).
- The IMS registration/re-registration throttling counter will still be 6 and the 15 minute throttling timer will still be running. The device does not retry IMS registration/re-registration until the throttling timer expires.

**Example E:**

- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is a new IMS PDN bearer activation during the system transition and the IP address for the IMS PDN is the same as the previous IMS PDN context and both the order and one or more of the entries in the list of P-CSCF IP addresses provided in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN is different from the previous IMS PDN context, but the current serving P-CSCF is included in the list.
- The IMS registration/re-registration throttling counter will still be 6 and the 15 minute throttling timer will still be running. The device does not retry IMS registration/re-registration until the throttling timer expires.

**Example F:**

- The current system is system "A" and the IMS registration/re-registration throttling counter is set to a value of 6 and a fifteen minute throttling timer is running.
- The device transitions to system "B". There is a new IMS PDN bearer activation during the system transition and the IP address for the IMS PDN is different from the previous IMS PDN context.
- The IMS registration/re-registration throttling timer will still be stopped and the throttling counter will be reset. The device initiates a new IMS registration using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER REQUEST message for the IMS PDN.

**1.3.2.10.6.11 ~~RESET OF THROTTLING COUNTERS AND TIMERS ON POWER CYCLE AND ON USIM/ISIM REPLACEMENT/REFRESH~~** VZ\_REQ\_LTEB13NAC\_23533

**1.3.2.10.6.12 Reset of Throttling Counters and Timers on Power Cycle and on USIM/ISIM Replacement/Refresh** VZ\_REQ\_LTEB13NAC\_6456

The device shall reset all IMS registration throttling counters and throttling timers on power cycle or USIM/ISIM replacement/refresh.

**1.3.2.10.6.13 ~~SIP 501 OR SIP 481 IN RESPONSE TO A DEREGISTRATION REQUEST~~** VZ\_REQ\_LTEB13NAC\_23534

**1.3.2.10.6.14 SIP 501 or SIP 481 in Response to a Deregistration Request** VZ\_REQ\_LTEB13NAC\_6457

If the device receives a SIP 501 or SIP 481 error code in response to a deregistration request, the device shall ignore the error and consider the deregistration request to have been accepted by the network.

**1.3.2.10.6.15 ~~IMS SIGNALING AND LOWER LAYER FAILURES~~** VZ\_REQ\_LTEB13NAC\_23535

**1.3.2.10.6.16 IMS Signaling and Lower Layer Failures**  
VZ\_REQ\_LTEB13NAC\_6480

An IMS registration procedure shall not be started if an IMS signaling connection cannot be established due to lower layer failure(s). An IMS registration procedure shall not be considered a failure if an IMS signaling connection/lower layer failure occurs before the procedure completes. The IMS registration retry throttling counter shall not be incremented and the IMS registration throttling shall not be started. An IMS signaling connection/lower layer failure includes any of the following:

- Any data retry event that prevents connection to the IMS PDN or the P-CSCF.
- Any RRC/radio connection failure

Refer to the Verizon Wireless LTE Data Retry Requirements for additional details.

If the device has successfully IMS registered, any IMS non-registration procedure shall be executed regardless of the IMS signaling connection/lower layer status of the device. For example, if a data retry event prevents connection to the LTE network a SIP SUBSCRIBE shall be allowed to time out.

**NOTE 1:** It is recommended to start TimerF when the REGISTER message is sent to the modem for transmission (and not prior).

**NOTE 2:** This requirement applies to all IMS registration procedures (i.e. IMS registration procedures for initial registration, re-registration, and de-registration).

**1.3.2.10.6.17 ~~SIP 503 WITH 'OUTAGE TEXT'~~** VZ\_REQ\_LTEB13NAC\_23536

**1.3.2.10.6.18 ~~SIP 503 with 'Outage Text'~~** VZ\_REQ\_LTEB13NAC\_6485

If the network rejects an IMS registration/re-registration attempt with SIP 503 and includes the following text in the Reason-Phrase (on the Status-Line):

- 503 Service Unavailable: IMS Core Outage

the device shall follow the IMS registration retry logic in section 3.2.10.5.1 of this document.

If the device is using IMS for SMS over IMS only and the network rejects any SUBSCRIBE or MESSAGE SIP request from the device with SIP 503 and includes the following text in the Reason-Phrase (on the Status-Line):

- 503 Service Unavailable: IMS Core Outage

the device shall locally terminate all active SIP dialogs and requests, enter IMS non-registered state, and attempt a new IMS registration. All IMS registration and registration retry requirements in this document shall apply.

**NOTE:** The device shall NOT treat the reason phrase in this scenario as case sensitive.

### 1.3.2.10.6.19 SIP 481 IN RESPONSE TO A RE-REGISTRATION REQUEST

VZ\_REQ\_LTEB13NAC\_36127

### 1.3.2.10.6.20 SIP 481 in Response to a Re-Registration Request

VZ\_REQ\_LTEB13NAC\_36128

If the network rejects an IMS re-registration request with a SIP 481 cause code, the device shall locally terminate the current IMS registration (including all active SIP dialogs and SIP requests), enter IMS non-registered state, and initiate a new IMS registration request.

## 1.3.2.10.7 IMS REGISTRATION ON SYSTEM TRANSITIONS

VZ\_REQ\_LTEB13NAC\_23537

### 1.3.2.10.7.1 IMS REGISTRATION ON SYSTEM TRANSITIONS

VZ\_REQ\_LTEB13NAC\_6458

If the device has successfully IMS registered and either a) transitions to another system and successfully performs a tracking area update or "handover" attach (i.e. the "Request Type" information element in the PDN CONNECTIVITY REQUEST message sent as part of the attach procedure is set to "**Handover**"), or b) transitions to "no service" and back to any system and successfully performs a tracking area update or "handover" attach (i.e. the "Request Type" information element in the PDN CONNECTIVITY REQUEST message sent as part of the attach procedure is set to "**Handover**"), the device shall maintain the IMS registration as follows.

The device shall retain the previous IMS registration context including the P-CSCF IP address until either 1) the registration timer for this context expires, or 2) the device sends a de-registration request for this context, or 3) the device successfully re-registers, or 4) the device successfully performs a new registration.

If the following criteria are all met, then the device shall not send a new registration as the result of a system transition (including a transition to another RAT within the same PLMN), i.e. the device shall use the previous established IMS registration context and route all IMS communications using the original P-CSCF:

- IP address continuity is maintained.
- The IMS registration timer has not expired.
- The original P-CSCF IP address is one of the P-CSCF IP addresses provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

If one or more of the criteria above is not met, then the device shall send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

If the device is using IMS for SMS over IMS only and all the criteria above are all met and the re-registration is not due, then the device shall not send a re-registration request as the result of a system transition, i.e. the device shall use the previous established IMS registration context and route all IMS communications using the original P-CSCF. If the device is using IMS for SMS over IMS only and all the criteria above are all met and the re-registration is due, then the device shall send a re-registration request to the using the original P-CSCF.

For all system transitions where the device successfully performs an "initial" attach (i.e. the "Request Type" information element in the PDN CONNECTIVITY REQUEST message (sent as part of the attach procedure) is set to "**Initial Request**"), the device shall send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**NOTE:** If the device is throttling IMS registration retry attempts when the system transition occurs, then requirement VZ\_REQ\_LTEB13NAC\_6455 applies and takes precedence.

### 1.3.2.10.7.2 IMS REGISTRATION ON SYSTEM TRANSITIONS - EXAMPLES 1-7 VZ\_REQ\_LTEB13NAC\_6459

#### Example 1:

- The UE is turned on.
- The UE successfully performs an "initial" attach to system A.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

#### Example 2:

- UE transitions from system A to system B, and successfully performs either a tracking area update with system B or a "handover" attach to system B.
- All the criteria below are met and the re-registration is not due. The UE does not perform a re-registration and uses the previous established IMS registration context and routes all IMS communications using the original P-CSCF.
  - IP address continuity is maintained.
  - The IMS registration timer has not expired.
  - The device is using IMS for SMS over IMS only.
  - The original P-CSCF IP address is one of the P-CSCF IP addresses provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

#### Example 2a:

- UE transitions from system A to system B, and successfully performs a "handover" attach to system B.
- The original P-CSCF IP address is one of the P-CSCF IP addresses provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation), but IP address continuity is NOT maintained.
- The UE performs a new registration using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER

CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 2b:**

- UE transitions from system A to system B, and successfully performs a "handover" attach to system B.
- The original P-CSCF IP address is NOT one of the P-CSCF IP addresses provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).
- The UE performs a new registration using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 3:**

- UE transitions from system A to system B, and successfully performs either a tracking area update with system B or a "handover" attach to system B.
- All the criteria below are met and the re-registration is due. The UE sends a re-registration request using the original P-CSCF.
  - IP address continuity is maintained.
  - The IMS registration timer has not expired.
  - The device is using IMS for SMS over IMS only.
  - The original P-CSCF IP address is one of the P-CSCF IP addresses provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 4:**

- UE transitions from system A to no service and back to system A.
- The UE successfully performs a tracking area update with system A.
- All the criteria below are met and the re-registration is not due. The UE does not perform a re-registration and uses the previous established IMS registration context and routes all IMS communications using the original P-CSCF.
  - IP address continuity is maintained.
  - The IMS registration timer has not expired.
  - The device is using IMS for SMS over IMS only.

**Example 5:**

- UE transitions from system A to system B, and a "handover" attach to system B is rejected with EMM #19 piggybacked with ESM #54 (in the PDN connection reject).
- The UE then successfully performs an "initial" attach to system B.

- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 5a:**

- UE transitions from system A to system B, and initiates a tracking area update that is rejected by system B with EMM 9.
- The UE then successfully performs an "initial" attach to system B.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 6:**

- Network detaches the UE from system A.
- The UE then successfully performs an "initial" attach to system A.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 7:**

- The UE initiates a detach from system A (per Verizon Wireless requirements, prior to sending the NAS DEATCH REQUEST message, the UE terminates the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message).
- The UE then successfully performs an "initial" attach to system A.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**1.3.2.10.8 IMS REGISTRATION DUE TO NEW IMS PDN BEARER ACTIVATION** VZ\_REQ\_LTEB13NAC\_23538

**1.3.2.10.8.1 IMS REGISTRATION DUE TO NEW IMS PDN BEARER ACTIVATION** VZ\_REQ\_LTEB13NAC\_6460



If while attached to the network the device is required to send a new PDN connection request to re-establish the IMS PDN connection (e.g. network initiates disconnect of the IMS PDN), upon successful re-establishment of the IMS PDN connection, the device shall send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 8:**

- Network disconnects the IMS PDN.
- The UE then successfully performs a PDN connection request to re-establish the IMS PDN connection.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

**Example 9:**

- The UE initiates a disconnection of the IMS PDN (per Verizon Wireless requirements, prior to sending the NAS PDN DISCONNECT REQUEST message, the UE terminates the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message).
- The UE then successfully performs a PDN connection request to re-establish the IMS PDN connection.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

### 1.3.2.10.9 IMS REGISTRATION AFTER UICC REFRESH OR UICC INSERTION VZ\_REQ\_LTEB13NAC\_23539

#### 1.3.2.10.9.1 IMS REGISTRATION AFTER UICC REFRESH OR UICC INSERTION VZ\_REQ\_LTEB13NAC\_6483

If the device detached from an LTE network and then successfully re-attached to an LTE network as the result of receiving a UICC REFRESH type 0 command, the device shall send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

If no UICC was present in the device or the device detached from an LTE network as the result of removal of the UICC, upon successful attach to an LTE network after insertion of a UICC the device shall send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

Example 10:

- The UICC issues a REFRESH type 0 command to the device triggering a detach from system A (per Verizon Wireless requirements, prior to sending the NAS DEATCH REQUEST message, the UE terminates the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message).
- The UE then successfully performs an "initial" attach to system A using all updated USIM parameters.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation) using all updated USIM/ISIM parameters.

Example 11:

- No UICC is present in the device on power up.
- UICC is inserted into the device.
- UE is power cycled.
- The UE then successfully performs an "initial" attach to system A.
- The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

Example 12:

- UICC is removed from the device triggering a detach from system A (per Verizon Wireless requirements, prior to sending the NAS DEATCH REQUEST message, the UE terminates the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message).
- UICC is inserted into the device.
- The UE then successfully performs an "initial" attach to system A.

The UE sends a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN (in the new IMS PDN bearer activation).

## 1.3.2.10.10P-CSCF RESTORATION PROCEDURES VZ\_REQ\_LTEB13NAC\_33801

### 1.3.2.10.10.1 P-CSCF Restoration Procedures VZ\_REQ\_LTEB13NAC\_33802

If the device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO of the MODIFY EPS BEARER CONTEXT REQUEST message contains a new list of P-CSCF IP addresses where either or both of the following is true:

- The new list contains one or more P-CSCF IP address entries that are different from the current list of P-CSCF IP addresses.
- The new list contains one or more of the P-CSCF IP address entries in the current list of P-CSCF IP addresses, but the order of the P-CSCF IP addresses has changed.

The device shall replace the current list of P-CSCF IP addresses with the new list of P-CSCF IP addresses. IMS registration retry procedures shall use the new list of P-CSCF IP addresses in the order provided by the network.

If the device is IMS registered and the current P-CSCF IP address is NOT an entry in the new P-CSCF IP address list, the device shall locally terminate the current IMS registration, enter IMS non-registered state, and immediately send a new IMS registration request using the first P-CSCF IP address provided by the network in the PCO field of the MODIFY EPS BEARER REQUEST message. If the IMS registration request fails, the device shall follow the IMS registration retry requirements in this document using the new P-CSCF IP address list.

If the device is IMS registered and the current P-CSCF IP address is an entry in the new P-CSCF IP address list, the device shall immediately send an IMS re-registration request to the current P-CSCF. If the re-registration request fails, the device shall follow the IMS registration retry requirements in this document using the new P-CSCF IP address list.

**NOTE 1:** If the device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO of the MODIFY EPS BEARER CONTEXT REQUEST message indicates the P-CSCF IPv6 address container is present but the container is either empty or contains an invalid IP address (e.g. all 0's), the device shall disregard the P-CSCF IPv6 address container entirely and maintain the current IMS registration and the current set of P-CSCF IPv6 addresses. The device shall make no change in IMS registration status.

**NOTE 2:** If the device transitions from one system to another system and receives a new ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS

PDN, then the requirements VZ\_REQ\_LTEB13NAC\_6455 and VZ\_REQ\_LTEB13NAC\_6458 shall take precedence.

**Example 13:**

- The device receives P-CSCF IP addresses A, B, and C (in this order) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.
- The device successfully IMS registers with P-CSCF A.
- The device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO contains P-CSCF IP addresses A, B, and C (in that order).
- The device immediately attempts an IMS re-registration with P-CSCF A.

**Example 14:**

- The device receives P-CSCF IP addresses A, C, and B (in this order) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.
- The device successfully IMS registers with P-CSCF A.
- The device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO contains P-CSCF IP addresses A, B, and C (in that order).
- The device immediately attempts an IMS re-registration with P-CSCF A.
- Both re-registration attempts to P-CSCF A fail.
- The device attempts a new initial IMS registration with P-CSCF B at the next registration retry attempt (i.e. the devices uses the new order for IMS registration retry).

**Example 15:**

- The device receives P-CSCF IP addresses A, C, and B (in this order) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.
- The device successfully IMS registers with P-CSCF A.
- The device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO contains P-CSCF IP addresses E, F, and A (in that order).
- The device immediately attempts an IMS re-registration with P-CSCF A.
- Both re-registration attempts to P-CSCF A fail.
- The device attempts a new initial IMS registration with P-CSCF E at the next registration retry attempt (i.e. the devices uses the new list and order for IMS registration retry).

**Example 16:**

- The device receives P-CSCF IP addresses A, C, and B (in this order) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.
- The device successfully IMS registers with P-CSCF A.
- The device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO contains P-CSCF IP addresses D, E, and F (in that order).
- The device immediately attempts a new initial IMS registration with P-CSCF D (i.e. the devices uses the new list and order for IMS registration retry).

**Example 17:**

- The device receives P-CSCF IP addresses A, C, and B (in this order) in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the IMS PDN.
- The device successfully IMS registers with P-CSCF A.
- The device receives a MODIFY EPS BEARER CONTEXT REQUEST message for the IMS PDN default bearer and the PCO contains P-CSCF IP addresses D, E, and F (in that order).
- The device immediately attempts a new initial IMS registration with P-CSCF D and this registration attempt fails.
- The device attempts a new initial IMS registration with P-CSCF E at the next registration retry attempt (i.e. the devices uses the new list and order for IMS registration retry).

**1.3.2.10.11 SUBSCRIPTION TO THE REG EVENTS PACKAGE FAILURES** VZ\_REQ\_LTEB13NAC\_36123

**1.3.2.10.11.1 ~~RETRY ALGORITHM FOR THE SUBSCRIPTION TO THE REG EVENTS PACKAGE~~** VZ\_REQ\_LTEB13NAC\_36974

**1.3.2.10.11.2 Retry Algorithm for the Subscription to the Reg Events Package** VZ\_REQ\_LTEB13NAC\_36124

The device shall implement a retry algorithm for the subscription to the reg events package based on the Failure Type as described in the table below.

**NOTE:** This retry behavior ONLY applies to SUBSCRIBE requests for the reg events package.

| Failure Type  | Retry Behavior   |
|---|--|
| <p>No response from network to the SUBSCRIBE and the SIP timeout timer (i.e. SIP Timer F) expires</p> <p><b>NOTE:</b> This does NOT apply to the re-SUBSCRIBE case.</p>   | <p>Follow algorithm below.</p>   |
| <p>Network rejects the SUBSCRIBE request (for the reg events package) with the following SIP error codes:<br/>400, 403, 404, 420</p> <p><b>NOTE:</b> This does NOT apply to the re-SUBSCRIBE case.</p>                                    | <p>Refer to the special requirement for these error codes.</p>   |
| <p>Network rejects the SUBSCRIBE request (for the reg events package) with the following SIP error codes:<br/>482<br/>487<br/>500 (if Retry-After header is absent)</p> <p><b>NOTE:</b> This does NOT apply to the re-SUBSCRIBE case.</p> | <p>Follow algorithm below.</p>   |
| <p>Network rejects the SUBSCRIBE request (for the reg events package) with the following SIP error codes:<br/>500 (if Retry-After header is present)</p> <p><b>NOTE:</b> This does NOT apply to the re-SUBSCRIBE case.</p>                | <p>Follow the algorithm below with the following exception:<br/>The throttling timer value shall be set to the duration specified in the Retry-After header.</p> |
| <p>re-SUBSCRIBE failure</p>   | <p>Refer to the special requirement.</p>   |

Definition of the general retry algorithm for the subscription to the reg events package is provided below (note that as defined in the above table, some scenarios with specific SIP error codes have special requirements and these are defined in the subsequent sections):

1. The first time a SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment a "throttling counter" to 1 and start a "throttling timer". The length of the timer shall be 30 seconds. The IMS application shall not make another SUBSCRIBE attempt for the reg events package while the throttling timer is running. There is no impact to the IMS registration status.
2. Upon the expiration of the throttling timer, the IMS application shall make another SUBSCRIBE attempt for the reg events package. If the SUBSCRIBE attempt for the reg events package is successful, the throttling counter shall be cleared. If the SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment the throttling counter to 2 and start the throttling timer. The length of the timer shall be 30 seconds. The IMS application shall not make another SUBSCRIBE attempt for the reg events package while the throttling timer is running. There is no impact to the IMS registration status.
3. Upon the expiration of the throttling timer, the IMS application shall make another SUBSCRIBE attempt for the reg events package. If the SUBSCRIBE attempt for the reg events package is successful, the throttling counter shall be cleared. If the SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment the throttling counter to 3 and start the throttling timer. This time, the length of the timer shall be one minute plus a random value; the random value shall have an upper bound of 15 seconds. The IMS application shall not make another SUBSCRIBE attempt for the reg events package while the throttling timer is running. There is no impact to the IMS registration status.
4. Upon the expiration of the throttling timer, the IMS application shall make another SUBSCRIBE attempt for the reg events package. If the SUBSCRIBE attempt for the reg events package is successful, the throttling counter shall be cleared. If the SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment the throttling counter to 4 and start the throttling timer. This time, the length of the timer shall be two minutes. The IMS application shall not make another SUBSCRIBE attempt for the reg events package while the throttling timer is running. There is no impact to the IMS registration status.
5. Upon the expiration of the throttling timer, the IMS application shall make another SUBSCRIBE attempt for the reg events package. If the SUBSCRIBE attempt for the reg events package is successful, the throttling counter shall be cleared. If the SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment the throttling counter to 5 and start the throttling timer. This time, the length of the timer shall be eight minutes. The IMS application shall not make another

SUBSCRIBE attempt for the reg events package while the throttling timer is running. There is no impact to the IMS registration status.

6. Upon the expiration of the throttling timer, the IMS application shall make another SUBSCRIBE attempt for the reg events package. If the SUBSCRIBE attempt for the reg events package is successful, the throttling counter shall be cleared. If the SUBSCRIBE attempt for the reg events package fails, the IMS application shall increment the throttling counter to 6 and start the throttling timer. This time, the length of the timer shall be fifteen minutes. The IMS application shall not make another SUBSCRIBE attempt for the reg events package while the throttling timer is running. All subsequent SUBSCRIBE failures for the reg events package on this system that occur while the throttling counter is set to a value of 6 or greater shall result in a fifteen minute throttling timer. i.e. from this point on, there shall not be more than one attempt of a SUBSCRIBE for the reg events package on this system per fifteen minutes. There is no impact to the IMS registration status.

The device shall only reset the throttling counter and throttling timer for the algorithm above after one of the following events has occurred:

- The device has successfully subscribed to the reg events package.
- The device has established a new IMS registration (as opposed to an IMS re-registration).
- Power cycle.
- USIM/ISIM replacement/refresh.

The device shall maintain only one set of IMS subscription to the reg events package throttling parameters (e.g. timers and counters). This set of throttling parameters shall apply to all systems. The device shall not reset these throttling parameters as the result of a system transition.

For example: consider the case in which the current system is system "A" and the IMS subscription to the reg events package throttling counter is set to a value of 6 and a fifteen minute throttling timer is running. The device transitions to system "B". The IMS subscription to the reg events package throttling counter will still be 6 and the 15 minute throttling timer will still be running. The device does not retry the subscription to the reg events package until the throttling timer expires.

### **1.3.2.10.11.3 NETWORK REJECTS THE SUBSCRIBE REQUEST WITH A SIP 400, 403, 404, OR 420 CAUSE CODE**

VZ\_REQ\_LTEB13NAC\_36972



### 1.3.2.10.11.4 Network Rejects the SUBSCRIBE Request with a SIP 400, 403, 404, or 420 Cause Code VZ\_REQ\_LTEB13NAC\_36125

If the network rejects the SUBSCRIBE attempt for the reg events package with either of the following cause codes:

- SIP 400
- SIP 403
- SIP 404
- SIP 420

the device shall follow the algorithm defined in section **Retry Algorithm for the Subscription to the Reg Events Package** of this document. If the device encounters another rejection of a SUBSCRIBE attempt for the reg events package before the throttling counter is reset where the SUBSCRIBE attempt for the reg events package is rejected by the network with either of the following cause codes:

- SIP 400
- SIP 403
- SIP 404
- SIP 420

then the device shall not make any further SUBSCRIBE attempts for the reg events package until one of the following events has occurred:

- The device has established a new IMS registration (as opposed to an IMS re-registration).
- Power cycle.
- USIM/ISIM replacement/refresh.

### 1.3.2.10.11.5 NETWORK REJECTS A re-SUBSCRIBE REQUEST VZ\_REQ\_LTEB13NAC\_36973

### 1.3.2.10.11.6 Network Rejects a re-SUBSCRIBE Request VZ\_REQ\_LTEB13NAC\_36126

If the network rejects a re-SUBSCRIBE attempt for the reg events package with a SIP 481 cause code, the device shall locally terminate the current subscription to the reg events package and initiate a new subscription request for the reg events package.

If the network rejects a re-SUBSCRIBE attempt for the reg events package with any cause code other than SIP 481, the device shall maintain the current subscription to the reg events package until it expires (i.e. the device shall not send any further re-SUBSCRIBE attempts). Upon expiration of the current subscription to the reg events package, the device shall initiate a new subscription request for the reg events package.

If the network ignores a re-SUBSCRIBE attempt for the reg events package (and TimerF expires), the device shall wait 30 seconds and then send a second re-SUBSCRIBE attempt for the reg events package. If the second re-SUBSCRIBE attempt for the reg events package is ignored by the network (and TimerF expires), the device shall maintain the current subscription to the reg events package until it expires (i.e. the device shall not send any further re-SUBSCRIBE attempts). Upon expiration of the current subscription to the reg events package, the device shall initiate a new subscription request for the reg events package.

### 1.3.2.11 SYSTEM TIME AND LOCAL TIME VZ\_REQ\_LTEB13NAC\_23540

#### 1.3.2.11.1 SYSTEM TIME AND LOCAL TIME VZ\_REQ\_LTEB13NAC\_6339

For system time and local time, the device shall support:

- SIB16 per the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*, including all optional informational elements in SIB16.
- The EMM information procedure and all optional informational elements within the EMM INFORMATION message.

The device shall update the local time based on the contents of SIB16 if SIB16 is broadcast by the LTE network and SIB16 contains all the optional IE's needed to compute local time (i.e. **dayLightSavingIndicator** and **localTimeOffset**). If SIB16 is not broadcast by the network or optional SIB16 IE's needed to compute local time are not present, the device shall update local time based on the contents of the EMM INFORMATION message. Refer to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)* and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

### 1.3.2.12 CIPHERING AND INTEGRITY PROTECTION VZ\_REQ\_LTEB13NAC\_23541

#### 1.3.2.12.1 CIPHERING AND INTEGRITY PROTECTION VZ\_REQ\_LTEB13NAC\_6340

The device shall support ciphering of RRC signaling, NAS signaling, and user plane data. The device shall also support integrity protection of the RRC signaling and the NAS signaling messages. The device shall support both the SNOW 3G based algorithm and the AES based algorithm for ciphering and integrity protection. 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*, 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, and 3GPP TS 36.323: *Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification* for additional details.

#### 1.3.2.13 ~~OTADM~~ VZ\_REQ\_LTEB13NAC\_23542

~~The device shall support over-the-air device management (OTADM) as specified in the Verizon Wireless LTE OTADM Device Requirements. Compliance to LTE OTADM requirements shall be per the Verizon Wireless LTE OTADM Test Plan.~~

#### 1.3.2.14 ~~UE MODE OF OPERATION~~ VZ\_REQ\_LTEB13NAC\_23543

~~VOID~~

#### 1.3.2.14.1 ~~UE MODE OF OPERATION~~ VZ\_REQ\_LTEB13NAC\_6341

~~The device shall operate in PS mode 2 (as defined in section 4.3 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*) at all times when attached to the Verizon Wireless LTE network. The device shall not transition to any other mode of operation defined in section 4.3 of 3GPP TS 24.301:~~

~~Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 when attached to the Verizon Wireless LTE network.~~

### 1.3.2.15 PRIMARY AND SECONDARY SYNCHRONIZATION SIGNAL RECEPTION VZ\_REQ\_LTEB13NAC\_23544

#### 1.3.2.15.1 PRIMARY AND SECONDARY SYNCHRONIZATION SIGNAL RECEPTION VZ\_REQ\_LTEB13NAC\_6342

The device shall be capable of receiving and decoding the primary and secondary synchronization signals when transmitted by the eNB on antenna port 0, antenna port 1, or both antenna ports 0 and 1. Specifically, the device shall be capable of receiving and decoding the primary and secondary synchronization signals for all three of the eNB transmission scenarios described below:

- The eNB transmits the primary and secondary synchronization signals on antenna port 0 only.
- The eNB transmits the primary and secondary synchronization signals on antenna port 1 only.
- The eNB transmits the primary and secondary synchronization signals on both antenna port 0 and antenna port 1 with precoding.

Primary and secondary synchronization signals are per 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation.*

### 1.3.2.16 CMAS SUPPORT VZ\_REQ\_LTEB13NAC\_23545

#### 1.3.2.16.1 INDICATION OF CMAS NOTIFICATION VZ\_REQ\_LTEB13NAC\_23548

##### 1.3.2.16.1.1 INDICATION OF CMAS NOTIFICATION VZ\_REQ\_LTEB13NAC\_6343

The device shall be able to receive CMAS messages over LTE per the procedures defined in 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*. Devices in RRC\_IDLE and RRC\_CONNECTED state shall find out about the presence of one or more CMAS notifications from the *Paging* message (refer to the specification "Reception of the Paging message by the UE" in section 5.3.2.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*). If the device receives a *Paging* message including the *cmas-Indication*, the device shall start receiving the CMAS notifications according to the *schedulingInfoList* contained in the *SystemInformationBlockType1* (SIB1).

Device shall perform System Information Acquisition procedures as defined in section 5.2.2.4 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)* to acquire the *SystemInformationBlockType12* (SIB12), that contains CMAS notifications, when present.

### 1.3.2.16.2 WARNING MESSAGE PROCESSING VZ\_REQ\_LTEB13NAC\_23549

#### 1.3.2.16.2.1 WARNING MESSAGE PROCESSING VZ\_REQ\_LTEB13NAC\_6344

Following reception of the *SystemInformationBlockType12* (SIB12), the device shall perform the procedures per the specification "Actions upon reception of SystemInformationBlockType12" defined in section 5.2.2.19 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)* to process the Warning message information received and forward it to the upper layers. Segmentation can be applied for the delivery of a CMAS notification. The device shall assemble all the segments of the message before forwarding it to the upper layers. Segments of the same message shall contain the same *messageIdentifier*, *serialNumber* and *warningMessageSegmentNumber*.

The device shall discard warning message segments and the associated values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType12* (SIB12) if the complete warning message has not been assembled within a period of [3] hours.

### 1.3.2.16.3 SYSTEMINFORMATIONBLOCKTYPE12 INFORMATION ELEMENT VZ\_REQ\_LTEB13NAC\_23550

### 1.3.2.16.3.1 SYSTEMINFORMATIONBLOCKTYPE12 INFORMATION ELEMENT VZ\_REQ\_LTEB13NAC\_6345

The information element *SystemInformationBlockType12* (SIB12) contains a CMAS notification with following fields:

- *messageIdentifier* identifying source and type of CMAS notification (refer to the section 9.4.1.2.2 of 3GPP TS 23.041: *Technical realization of Cell Broadcast Service (CBS)*)
- *serialNumber* identifying variations of a CMAS notification (refer to the section 9.4.1.2.1 of 3GPP TS 23.041: *Technical realization of Cell Broadcast Service (CBS)*)
- *warningMessageSegmentType* indicating whether the current segment is the last segment or not
- *warningMessageSegmentNumber* indicating segment number of the CMAS message contained in the SIB12 (0-63, first segment will have segment number of zero, etc)
- *warningMessageSegment* that carries a segment of the *Warning Message Contents* information element defined in 3GPP TS 36.413: *Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)*
- *dataCodingScheme* identifying alphabet/encoding/language of a CMAS notification. Refer to the 3GPP TS 23.041: *Technical realization of Cell Broadcast Service (CBS)* for information element definition and 3GPP TS 23.038: *Alphabets and language-specific information* for encoding details.

In addition, the *Segment1* field shall be present in the first segment of SIB12 only. Refer to the section 6.3.1 ("System Information Blocks") of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)* for additional details.

### 1.3.2.16.4 DEVICE BEHAVIOR VZ\_REQ\_LTEB13NAC\_23554

#### 1.3.2.16.4.1 DEVICE BEHAVIOR VZ\_REQ\_LTEB13NAC\_6346

Refer to the ATIS-TIA-J-STD-100 Joint ATIS/TIA CMAS Mobile Device Behavior Specification for a common set of requirements for mobile device behavior when a CMAS alert message is received and processed.

### 1.3.2.17 SCHEDULING REQUESTS OVER PRACH VZ\_REQ\_LTEB13NAC\_23546

#### 1.3.2.17.1 SCHEDULING REQUESTS OVER PRACH VZ\_REQ\_LTEB13NAC\_6418

The device shall be capable of supporting scheduling requests over the PRACH as per 3GPP TS 36.321: *Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification*.

### 1.3.2.18 LTE FEMTOCELL SUPPORT VZ\_REQ\_LTEB13NAC\_23547

#### 1.3.2.18.1 LTE FEMTOCELL SUPPORT VZ\_REQ\_LTEB13NAC\_6472

The device shall be capable of supporting open, closed, and hybrid mode femtocells. Refer to 3GPP TS 22.220: *Service requirements for Home Node B (HNB) and Home eNode B (HeNB)*, 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2*, 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)*, and 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management* for additional details.

### 1.3.2.19 MAC PADDING VZ\_REQ\_LTEB13NAC\_36842

#### 1.3.2.19.1 MAC Padding VZ\_REQ\_LTEB13NAC\_36843

When applying MAC padding (as defined in 3GPP TS 36.321: *Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol*

*specification*), the device shall use pseudo-random data in the form of a PN31 sequence for the contents of the MAC padding bits.

### 1.3.2.20 LTE R10 eICIC and CRS IC w/o ABS (Enhanced Inter-Cell Interference Cancellation) VZ\_REQ\_LTEB13NAC\_36948

Applicable scenarios:

- Heterogeneous network that has both small/pico cells and macro cells deployed
  - R10 eICIC is used to enable network to perform necessary interference management by configuring ABS subframe dynamically.
- Macro homogeneous network & Heterogeneous network
  - CRS IC is used in macro network in non-ABS scenario
    - Improve PDCCH and PDSCH performance in non-colliding CRS case (user throughput)
    - Improve RSRP accuracy and channel estimation in colliding CRS case (improved CRS SINR and as a result better performance on PBCH and PSS/SSS)

Note: UE shall not advertise any of the CRS IC and/or eICIC capability until "service enablement" direction is received from Verizon Device Marketing. (e.g., FGI115, crs-InterfHandl-r11 ).

#### 1.3.2.20.1 LTE eICIC Support VZ\_REQ\_LTEB13NAC\_36949

##### 1.3.2.20.1.1 Time-Domain Resource Partitioning VZ\_REQ\_LTEB13NAC\_36955

##### 1.3.2.20.1.2 Req-1 VZ\_REQ\_LTEB13NAC\_36950

The device shall support all three kinds of measurement resource restriction patterns defined in R10 eICIC that may be configured for the UE as specified in section 16.1.5.1



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

#### 1.3.2.20.1.3 Req-2 VZ\_REQ\_LTEB13NAC\_36951

The device shall support RRC Feature Group Indicator (FGI) index 115 for eICIC per Annex C, Table C.1-1 of the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification.*

#### 1.3.2.20.1.4 Req-3 VZ\_REQ\_LTEB13NAC\_36952

The device shall support R10 eICIC and apply the measurement subframe pattern of the serving and neighbor cells for RRM (Radio Resource Management)/RLM (Radio Link Monitoring)/CSI (Channel State Indication) measurements when resource restriction in time domain is signaled for inter-cell interference cancellation per sections 5.3.5.6, 5.3.7.2, 5.3.10.0, 5.3.10.8, 5.3.11.3, 5.5.2.5, 5.5.3.1, 6.3.2, 6.3.5, 6.3.6 of the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification.*

#### 1.3.2.20.1.5 Req-4 VZ\_REQ\_LTEB13NAC\_36953

The device shall support the RLM (Radio Link Monitoring) procedure with restricted measurement per sections 4.2.1 of the release 10 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures.*

#### 1.3.2.20.1.6 Req-5 VZ\_REQ\_LTEB13NAC\_36954

The device shall support RSRQ measurement with restricted resource measurement per sections 5.1.3 of the release 10 version of 3GPP TS 36.214: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer; Measurements.*

### 1.3.2.20.2 LTE eICIC and CRS IC W/O ABS Support VZ\_REQ\_LTEB13NAC\_36956

### 1.3.2.20.2.1 **CRS Interference Management** VZ\_REQ\_LTEB13NAC\_36957

The device shall support (including reporting its capability in *crs-InterfHandl-r11* defined in section 4.3.4.15 of the release 11 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); UE Radio Access Capabilities*) and apply neighbor CRS assistance information for CRS interference cancellation per sections, 6.3.2, 6.3.6 of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.20.2.2 **Synchronization and Common Channel Interference Management** VZ\_REQ\_LTEB13NAC\_36958

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### 1.3.2.20.2.3 **Req-1** VZ\_REQ\_LTEB13NAC\_36959

The device shall support *SystemInformationBlockType1* (SIB1) acquisition in dedicated RRC signaling in range extended cells per section 5.2.2.7, 5.3.5.3 of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.20.2.4 **Req-2** VZ\_REQ\_LTEB13NAC\_36960

The device shall support (including reporting its capability) for synchronization and common channel interference cancellation per section 6.3.6 of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

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### 1.3.2.20.3 ICIC for Femto Cell (FFS) VZ\_REQ\_LTEB13NAC\_36961

FFS

## 1.3.2.21 FREQUENCY HOPPING VZ\_REQ\_LTEB13NAC\_37713

### 1.3.2.21.1 PUSCH Frequency Hopping VZ\_REQ\_LTEB13NAC\_37714

Per the 3GPP standard, the device shall support predefined, inter-TTI frequency hopping for PUSCH with  $N_{sb}=1$ . Refer to 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation* for additional details.

## 1.3.2.22 LTE CoMP (Coordinated Multi-Point) VZ\_REQ\_LTEB13NAC\_37806

**NOTE:** Although specifications of DL CoMP are introduced in 3GPP Release 11, Release 10 specifications of Transmission Mode 9 provide some fundamental building blocks for DL CoMP. Verizon requires devices shall support both Release 10 Transmission Mode 9 and Release 11 Transmission mode 10 per the functional requirements in this section, and meet the respective performance requirements in VZ\_REQ\_LTEB13NAC\_37816 and VZ\_REQ\_LTEB13NAC\_37817.

### 1.3.2.22.1 Transmission Mode 9 (TM9) VZ\_REQ\_LTEB13NAC\_37807

#### 1.3.2.22.1.1 PDSCH Decoding in Transmission Mode 9 (TM9) VZ\_REQ\_LTEB13NAC\_37808

The device shall support transmission mode 9 per the 3GPP Release 10 Specifications.

When configured in transmission mode 9, the device shall support UE-specific reference signals and associated PDSCH with up to 4 transmission layers, per sections

6.10.3, 6.3, 6.4 of the Release 10 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*.

When configured in transmission mode 9, the device shall support DCI format 2C, per section 5.3.3.1.5C of the Release 10 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*.

When configured in transmission mode 9, the device shall support PDSCH transmission in MBSFN subframes, per section 7.1 of the Release 10 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

### 1.3.2.22.1.2 CSI (Channel State Information) Reporting in TM9

VZ\_REQ\_LTEB13NAC\_37809

When configured in transmission mode 9, the device shall support CSI (Channel State Information) reference signals with up to 4 CSI-RS antenna ports, per section 6.10.5 of the Release 10 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*. The device shall support one non-zero-power CSI-RS configuration per serving cell.

When configured in transmission mode 9, the device shall support CSI-RS based CSI measurements and reporting, per section 7.2 of the Release 10 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

### 1.3.2.22.1.3 RRC Signaling for TM9

VZ\_REQ\_LTEB13NAC\_37810

The device shall support PDSCH transmission mode 9 with up to 4 CSI-RS antenna ports. The device shall set Feature Group Indicator (FGI) index 103 to 1 in field *featureGroupIndRel10* of *UECapabilityInformation* message, per Annex C, Table C.1-1, of the Release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

The device shall support

- setting of *tm9-v1020* for field *transmissionMode-r10* of *AntennaInfoDedicated-r10* information element,

- *CSI-RS-Config-r10* information element with *antennaPortsCount-r10* set in the range of {*an1*, *an2*, *an4*}, as included in *PhysicalConfigDedicated* and/or *PhysicalConfigDedicatedSCell-r10* information element, and support the physical channel configuration and reconfiguration procedures, per sections 6.3.2, 5.3.3.4, 5.3.5.3, 5.3.5.4, 5.3.5.6, 5.3.7.5, 5.3.10.3b, 5.3.10.6, 5.4.3.5 of the Release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.22.2 Transmission Mode 10 (TM10) VZ\_REQ\_LTEB13NAC\_37811

#### 1.3.2.22.2.1 PDSCH Decoding in Transmission Mode 10 (TM10)

VZ\_REQ\_LTEB13NAC\_37812

The device shall support transmission mode 10 per the 3GPP Release 11 Specifications.

When configured in transmission mode 10, the device shall support UE-specific reference signals and associated PDSCH with up to 4 transmission layers, per sections 6.10.3, 6.3, 6.4 of the Release 11 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*.

When configured in transmission mode 10, the device shall support DCI format 2D, per section 5.3.3.1.5D of the Release 11 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*.

When configured in transmission mode 10, the device shall support PDSCH transmission in MBSFN subframes, per section 7.1 of the Release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

When configured in transmission mode 10, the device shall support Type A and Type B quasi co-location types, per section 7.1.10 of the Release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

When configured in transmission mode 10, the device shall support 4 parameter sets per serving cell associated with 'PDSCH RE Mapping and Quasi-Co-Location indicator' field in DCI format 2D to determine PDSCH RE mapping and PDSCH antenna port

quasi co-location, per section 7.1.9 of the Release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

### 1.3.2.22.2 CSI Reporting in TM10 VZ\_REQ\_LTEB13NAC\_37813

When configured in transmission mode 10, the device shall support CSI reference signals with up to 4 CSI-RS antenna ports, per section 6.10.5 of the Release 11 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*. The device shall support 3 non-zero power CSI-RS configurations and 4 zero-power CSI-RS configurations per serving cell.

When configured in transmission mode 10 and configured with multiple CSI processes, the device shall support 2-bit CSI request field in UL grants, per section 5.3.3.1 of the Release 11 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*.

When configured in transmission mode 10, the device shall support 4 CSI processes per serving cell, and the measurements and reporting for each CSI process, per section 7.2 of the Release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*, and sections 5.2.2.6 and 5.2.3.3 of the Release 11 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*. The device shall support RI-reference CSI process.

### 1.3.2.22.2.3 RRC Signaling for TM10 VZ\_REQ\_LTEB13NAC\_37814

The device shall indicate *supportedCSI-Proc-r11* per band per band combination in *UE-EUTRA-Capability* information element, per section 4.3.5.5 of the Release 11 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, and sections 6.3.6, 5.6.3.3 of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

The device shall support

- setting of *tm10-v1130* for field *transmissionMode-r10* in *AntennaInfoDedicated-r10* information element,
- *PDSCH-ConfigDedicated-v1130* information element,
- *CSI-RS-ConfigNZP-r11* information element with *antennaPortsCount-r11* set in the range of {*an1*, *an2*, *an4*}, and *CSI-RS-ConfigZP-r11* information element,

- *CQI-ReportConfig-v1130* information element, as included in *PhysicalConfigDedicated* and/or *PhysicalConfigDedicatedSCell-r10* information element, and support the physical channel configuration and reconfiguration procedures, per sections 6.3.2, 5.3.3.4, 5.3.5.3, 5.3.5.4, 5.3.5.6, 5.3.7.5, 5.3.10.3b, 5.3.10.6, 5.4.3.5 of the Release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.23 ePDCCH VZ\_REQ\_LTEB13NAC\_38375

#### 1.3.2.23.1 Enhanced Physical Downlink Control Channel (ePDCCH)

VZ\_REQ\_LTEB13NAC\_38376

The device shall support receiving enhanced physical downlink control channel (EPDCCH) and associated demodulation reference signals, per sections 6.8A, 6.2.4A, 6.10.3A of the release 11 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*.

When configured with EPDCCH monitoring, the device shall monitor PDCCH and EPDCCH per the procedure in sections 9.1.1, 9.1.4 of the release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*. The device shall support number of EPDCCH-PRB-sets in the range of {1, 2}, with number of PRB-pairs in the range of {2, 4, 8} for each EPDCCH-PRB-set. The device shall support both localized and distributed transmission type, as independently configured for each EPDCCH-PRB-set. The device shall support ECCE aggregation level in the range of {1, 2, 4, 8, 16, 32}, and monitor the EPDCCH candidates as specified in aforementioned standard sections.

When configured with EPDCCH monitoring, the device shall derive the PDSCH starting position and EPDCCH starting position per sections 7.1.6.4, 9.1.4.1 of the release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

When configured in PDSCH transmission mode 10, and if configured to monitor EPDCCH, the device shall use the parameter set indicated by the higher layer parameter *re-MappingQCL-ConfigId-r11* to determine the EPDCCH RE mapping and EPDCCH antenna port quasi co-location for each EPDCCH-PRB-set, per sections 9.1.4.3, 9.1.4.2 of the release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

When configured in PDSCH transmission mode 9 or 10, and if configured to monitor EPDCCH, the device shall monitor EPDCCH in the MBSFN subframes except those indicated by higher layers to decode PMCH, per section 9.1.4 of the release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

The device shall support HARQ-ACK resource offset (ARO) field in DCI format 1/1A/1B/1D/2/2A/2B/2C/2D when the DCI is carried by EPDCCH, per section 5.3.3.1 of the release 11 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*. When a PDSCH transmission is assigned by EPDCCH, the device shall derive the PUCCH resource offset for HARQ-ACK per section 10.1.2 of the release 11 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

The device shall indicate the support of EPDCCH via *ePDCCH-r11* field in *UE-EUTRA-Capability* information element, per section 4.3.4.18 of the release 11 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, and section 6.3.6 of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

The device shall support *EPDCCH-Config-r11* information element, as included in *PhysicalConfigDedicated* and/or *PhysicalConfigDedicatedSCell-r10* information element, and support the physical channel configuration and reconfiguration procedures, per sections 6.3.2, 5.3.3.4, 5.3.5.3, 5.3.5.4, 5.3.5.6, 5.3.7.5, 5.3.10.3b of the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.24 SON SUPPORT VZ\_REQ\_LTEB13NAC\_23614

#### 1.3.2.24.1 RADIO LINK AND HANDOVER FAILURE REPORTING

VZ\_REQ\_LTEB13NAC\_23615

##### 1.3.2.24.1.1 RADIO LINK AND HANDOVER FAILURE REPORTING

VZ\_REQ\_LTEB13NAC\_6465



The device shall provide radio link and handover failure information to the network per the 3GPP release 10 specifications. The device shall store radio link and handover failure information in the *VarRLF-Report* per sections 5.3.5.6 and 5.3.11.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*. The device shall signal the availability of this failure information to the network by providing the *rlf-InfoAvailable* IE in the *RRCConnectionReestablishmentComplete*, *RRCConnectionSetupComplete*, and *RRCConnectionReconfigurationComplete* messages as specified in sections 5.3.7.5, 5.3.3.4, and 5.3.5.4, respectively, 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, Release 10. The device shall provide the *rlf-Report* in a *UEInformationResponse* message when requested by the network, per section 5.6.5.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, Release 10. The device may discard the stored failure information within 48 hours or upon power cycle or network detach as specified in section 5.3.11.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, Release 10.

### 1.3.2.24.2 RACH INFORMATION REPORTING VZ\_REQ\_LTEB13NAC\_23616

#### 1.3.2.24.2.1 RACH INFORMATION REPORTING VZ\_REQ\_LTEB13NAC\_6466

The device shall provide RACH information to the network per the 3GPP Release 10 specifications. The device shall store RACH information in a *rach-Report* which provides the number of preambles sent for the last successfully completed random access procedure and whether contention was detected for at least one of the transmitted preambles during the procedure. The device shall provide the *rach-Report* in a *UEInformationResponse* message when requested by the network, per section 5.6.5.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, Release 10.

### 1.3.2.24.3 MINIMIZATION OF DRIVE TEST VZ\_REQ\_LTEB13NAC\_38228

All requirements in this section apply to intra-LTE MDT.

### 1.3.2.24.3.1 Release 10 MDT Support VZ\_REQ\_LTEB13NAC\_38229

### 1.3.2.24.3.2 Overall Requirements VZ\_REQ\_LTEB13NAC\_38230

The device shall support ALL LTE MDT requirements (stage 2, mandatory and optional) that apply to device as defined in the release 10 version of 3GPP TS 37.320: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Test; Overall description; Stage 2.*

- The ability of the UE to include location information as part of UE radio measurement reporting in RRC connected state, including RACH report
- Configuration of a logging area
- The ability of the UE to log radio measurements during the UEs RRC idle state

### 1.3.2.24.3.3 MDT Capability VZ\_REQ\_LTEB13NAC\_38231

The device shall support UE capability for MDT as defined in section 4.3.13 in the release 10 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); UE Radio Access Capabilities*) and section 6.3.6 of the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification:*

- UE-BasedNetwPerfMeasParameters-r10
  - loggedMeasurementsIdle-r10
  - standaloneGNSS-Location-r10

### 1.3.2.24.3.4 LocationInfo for measurement report VZ\_REQ\_LTEB13NAC\_38232

The device shall set *LocationInfo* in measurement report (immediate reporting) if *includeLocationInfo* is configured in the corresponding *reportConfig* for the *measId* as stated in section 5.5.5, 6.2.2 in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification.*

When interpreting "*detailed location information that has not been reported is available*", the battery power usage for obtaining the most recent location information shall not exceed 10% of available battery power.

### 1.3.2.24.3.5 LocationInfo for failure reports VZ\_REQ\_LTEB13NAC\_38233

When storing failure information in *VarRLF-Report*, the device shall set *LocationInfo* as defined in sections 5.3.5.6 (HO failure), 5.3.11.3 (RLF), 5.6.8.2 (RRC idle MDT logging initiation) in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

When interpreting "*detailed location information is available*", the battery power usage for obtaining the most recent location information shall not exceed 10% of available battery power.

### 1.3.2.24.3.6 Logged Measurements Availability and Report VZ\_REQ\_LTEB13NAC\_38234

The device shall indicate availability (*logMeasAvailable*) and report of logged measurements collected in RRC Idle state for RPLMN (registered PLMN) as defined in sections 4.2.1 (architecture), 5.3.3.4 (*RRCCONNECTIONSETUPCOMPLETE*), 5.3.5.4, 5.4.2.3 (*RRCCONNECTIONRECONFIGURATIONCOMPLETE* for connection setup and HO), 5.3.7.5 (*RRCCONNECTIONREESTABLISHMENTCOMPLETE*), 5.6.5.3 (*UEINFORMATIONRESPONSE*, RACH report) and 6.2.1, 6.2.2 (message format) in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.24.3.7 Logged Measurements Configuration VZ\_REQ\_LTEB13NAC\_38235

The device shall support logged measurements configuration and maintenance/release of the logged measurements (*R10 VarLogMeasConfig-r10* and *VarLogMeasReport-r10*) as defined in section 5.6.6, 6.2.2 in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

When reporting logged measurement, the device shall use variables (as a result of logged measurement configuration) defined in section 7.1 and timers as defined in section 7.3 in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

The device shall support measurement logging in RRC idle state (per configuration defined in section 5.6.6 of TS 36.331) as defined in section 8 of the release 10 version of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Procedures in Idle Mode*.

The device shall support measurement logging in RRC idle state as defined in section 4.3 of the release 10 version of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for Support of Radio Resource Management*.

### 1.3.2.24.3.8 Limitation on Immediate MDT with LocationInfo

VZ\_REQ\_LTEB13NAC\_38236

The device shall apply R10 restriction on limiting *includeLocationInfo* in measurement report (immediate MDT) to event A2 and periodical report as defined in section 6.3.5 of release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.24.3.9 Location Area Configuration

VZ\_REQ\_LTEB13NAC\_38756

The device shall support location configuration parameters in *locationInf-r10* when reporting location in MDT measurements as defined in section 5.5.5, 6.3.4, 6.3.5 and 6.3.6 in the release 10 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*:

- *ellipsoid-Point-r10*
- *ellipsoidPointWithAltitude-r10*

### 1.3.2.24.3.10 Lower Layer Requirements for Logged MDT

VZ\_REQ\_LTEB13NAC\_38757

The device shall support measurement logging in RRC idle state (per configuration defined in section 5.6.6 of TS 36.331) as defined in section 8 of the release 10 version of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Procedures in Idle Mode*.

The device shall support measurement logging in RRC idle state as defined in section 4.3 of the release 10 version of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for Support of Radio Resource Management*.

### 1.3.2.24.3.11 Release 11 MDT Support VZ\_REQ\_LTEB13NAC\_38237

### 1.3.2.24.3.12 Overall requirement VZ\_REQ\_LTEB13NAC\_38238

The device shall support ALL LTE MDT requirements (stage 2) that apply to device as defined in the release 11 version of 3GPP TS 37.320: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Test; Overall description; Stage 2*, including the following:

- Details on requested location for UE standalone GNSS
- Details on using network-assisted and/or network-based location methods (A-GNSS, mobile-assisted GNSS, E-CID, OTDOA, CID, etc.) is TBD
- A list of PLMNs where MDT is allowed
- Additional configuration of a logging area
- Mandatory accessibility measurements
- Enhancement in location report (added uncertainty, additional shapes)

### 1.3.2.24.3.13 Connection Establishment Failure Handling

VZ\_REQ\_LTEB13NAC\_38239

The device shall support storing/maintaining, indication of Connection Establishment Failure availability status and reporting accessibility measurements as defined in section 5.3.3.4 (*RRCCONNECTIONSETUPCOMPLETE*), 5.3.3.6 (T300 expires, storing), 5.3.5.4, 5.4.2.3 (*RRCCONNECTIONRECONFIGURATIONCOMPLETE* connection setup or HO), 5.3.7.5 (*RRCCONNECTIONREESTABLISHMENTCOMPLETE*), 5.6.5.3 (*UEINFORMATIONRESPONSE, connEstFailReport*) and 6.2.1, 6.2.2 (message format) in the release 11 version of

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

- *connEstFailInfoAvailable-r11*
- Set proper fields in *ConnEstFailReport-r11* including:
  - *failedCellId* (5.3.3.6, T300 expire)
  - *maxTxPowerReached* (5.3.3.6, T300 expire)
  - *locationInfo*
  - *measResultFailedCell* (5.3.3.6, T300 expire)
  - *measResultNeighCells*
  - *numberOfPreamblesSent*
  - *contentionDetected*
  - *timeSinceFailure-r11*
  - *measResultListEUTRA*

#### 1.3.2.24.3.14 PLMN Configuration for MDT VZ\_REQ\_LTEB13NAC\_38240

The device shall support R11 *VarLogMeasConfig-r11* and *VarLogMeasReport-r11* including configuration of *plmn-IdentityList*, *areaConfiguration* and verification of RPLMN in *plmn-IdentityList*, of TAC in *areaConfiguration* for various MDT reports as defined in section 5.3.3.4, 5.3.3.6, 5.3.5.4, 5.3.5.6 (T304 expiry, HO failure), 5.3.7.5, 5.3.11.3, 5.4.2.3, 5.6.5.3, 5.6.6.3, 5.6.8.2, 6.2.1, 6.2.2, 6.3.4 (*PLMN-IdentityList3-r11*) in the release 11 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification:

- *plmn-IdentityList-r11*
- *areaConfiguration-v1130*

The device shall support update for *plmn-IdentityList* in section 8 of the release 11 version of 3GPP TS 36.304: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Procedures in Idle Mode.

#### 1.3.2.24.3.15 Enhanced Location Configuration VZ\_REQ\_LTEB13NAC\_38241

The device shall support additional location parameters in addition to *locationInfo-r10* (uncertainty and additional shape) when reporting location in MDT measurements as defined in section 5.5.5, 6.3.4, 6.3.5 (*includeLocationInfo-r11*) and 6.3.6 in the release 11 version of 3GPP TS 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification:

- *ellipsoidPointWithUncertaintyCircle-r11*
- *ellipsoidPointWithUncertaintyEllipse-r11*
- *ellipsoidPointWithAltitudeAndUncertaintyEllipsoid-r11*
- *ellipsoidArc-r11*
- *polygon-r11*

The device shall support enhanced location for various MDT reports (obtainLocationConfig and maintenance) as defined in section 5.3.7.2, 5.3.10.9 and 6.3.6 in the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.24.3.16 RLF Report Enhancement VZ\_REQ\_LTEB13NAC\_38242

The device shall support following addition fields in *UEInformationResponse* for RLF report as defined in section 5.3.3.6, 5.3.11.3, 5.6.5.3, 6.2.1 in the release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*:

- Set *rlf-Cause* to the trigger of RLF as defined by 3GPP (total of three reasons: T310 expiry, random access problem and max RLC retransmissions) as well as one other UE-proprietary declaration of RLF (use the spare values) in RLF report (*rlf-Cause-r11*) (5.3.11.3)
- Set *timeSinceFailure* (5.3.11.3)

### 1.3.2.24.3.17 Remove Location info. Restriction VZ\_REQ\_LTEB13NAC\_38243

The device shall remove R10 restriction on limiting includeLocationInfo in measurement report (immediate MDT) to event A2 and shall apply includeLocationInfo to all measurement report triggers as defined in section 6.3.5 in release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.24.3.18 E-CID positioning support for MDT (FFS)

VZ\_REQ\_LTEB13NAC\_38244

The device shall indicate its support of ue-Rx-TxTimeDiffMeasurements-r11 for using E-CID positioning for MDT as defined in section 6.3.6 in release 11 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.3.2.25 SMS OVER NAS FOR DATA-CENTRIC OR IMS-LESS DEVICES VZ\_REQ\_LTEB13NAC\_39730

#### 1.3.2.25.1 SMS over NAS (Data-Centric or IMS-Less Devices ONLY) VZ\_REQ\_LTEB13NAC\_39731

Data-centric or IMS-less devices that do NOT support IMS voice operation, and do NOT support SMS over IMS, shall support SMS using SMS over NAS per the "transport of NAS messages procedure" as defined in section 5.6.3 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

Refer to the LTE SMS Requirements for additional details.

**NOTE 1:** Data-centric or IMS-less devices that support SMS over NAS (and do NOT support SMS over IMS) are NOT required to support any IMS-related requirements in this document.

**NOTE 2:** *Data-centric or IMS-less device vendors should contact Verizon Wireless prior to implementing SMS over NAS on any devices.*

### 1.3.2.26 DL 256QAM VZ\_REQ\_LTEB13NAC\_39750

#### 1.3.2.26.1 DL 256QAM Support VZ\_REQ\_LTEB13NAC\_39749

All devices that are category 11 or higher, or DL category 11 or higher, per sections 4.1 and 4.1A of the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial*



Radio Access (E-UTRA); User Equipment (UE) radio access capabilities, shall support 256QAM on the downlink.

**NOTE:** The device shall be at least a category 11 or DL category 11 device, per sections 4.1 and 4.1A of the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, if it supports 256QAM.

The device shall indicate whether 256QAM is supported via *dl-256QAM-r12* field in *UE-EUTRA-Capability* information element, per section 4.3.5.7 of the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, and section 6.3.6 of the Release 12 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*. If the device supports 256QAM, it shall support 256QAM in all supported frequency bands.

If the device supports 256QAM, it shall support the *altCQI-Table-r12* field with the setting of {*allSubframes*, *csi-SubframeSet1*, *csi-SubframeSet2*}, in *CQI-ReportConfig-v1250* information element, as included in *PhysicalConfigDedicated* and/or *PhysicalConfigDedicatedSCell-r10* information element, and support the physical channel configuration and reconfiguration procedures, per sections 6.3.2, 5.3.3.4, 5.3.5.3, 5.3.5.4, 5.3.5.6, 5.3.7.5, 5.3.10.3b of the Release 12 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

If the device supports 256QAM, it shall support both *normal-r12* and *higherOrder-r12* value for *dataMCS-r12* field in *PMCH-InfoList* information element, per section 6.3.7 of the Release 12 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

If the higher layer parameter *altCQI-Table-r12* is configured, the device shall report CQI per section 7.2, with CQI indices and their interpretations defined in section 7.2.3, of the Release 12 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

If the higher layer parameter *altCQI-Table-r12* is configured, the device shall determine the modulation order and transport block size for PDSCH per section 7.1.7 of the Release 12 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

If a *higherOrder-r12* value is configured for *dataMCS-r12* field, the device shall determine the modulation order and transport block size for PMCH per section 11.1 of the Release 12 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

For 256QAM modulation of PDSCH and PMCH, the modulation mapping shall be per section 7.1.5 of the Release 12 version of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation*.

Rate matching for turbo coded transport channels shall be per section 5.1.4.1 of the Release 12 version of 3GPP TS 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*, if the device supports 256QAM. Downlink power allocation for PDSCH and PMCH with 256QAM modulation shall be assumed per section 5.2 of the Release 12 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

All devices that are downlink LTE category 16, 18, or higher, shall further support *alternative TBS-Index-r14*, per Sections 4.1A and 4.3.4.74 of the Release 14 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*. Also refer to TBS index 33B for specifications in Sections 7.1.7.1 and 7.1.7.2 of the Release 14 version of 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

### 1.3.2.27 DATA OVER CONTROL PLANE VZ\_REQ\_LTEB13NAC\_41334

VOID

#### ~~1.3.2.27.1 Data Over Control Plan for Low Data Rate M2M/IoT~~ VZ\_REQ\_LTEB13NAC\_41335

~~**NOTE 1:** This requirement only applies to M2M/IoT devices using a UICC with a 312770 IMSI. M2M/IoT devices using a UICC with a 312770 IMSI shall use SDS and operate as described below. Device vendors shall contact the Verizon Wireless M2M/IoT marketing team prior to implementing SDS on any devices.~~

~~-  
 Low data rate M2M/IoT devices that do not support IMS may use Verizon Wireless' proprietary short data service (SDS) data-over-control plane service.~~

~~-  
 Low data rate M2M/IoT devices that do not support IMS and use Verizon Wireless' proprietary SDS service shall comply with the following:~~

- ~~• The device shall only use SDS when a UICC is present with a 312770 IMSI and the device is attached to either a HPLMN or EHPLMN. The device shall NOT attempt to send an SDS message while attached to a roaming LTE network. When operating with a UICC~~

- ~~with a 312770 IMSI and attached to either a HPLMN or EHPLMN, the device shall use SDS and operate as described in this requirement.~~
- ~~• The device shall not send/receive any data over the IP user plane (i.e. the device shall NOT send any data over any PDN connection) if a UICC with a 312770 IMSI is present.~~
  - ~~• The device shall send/receive data using SDS messages where the SDS message is a variation of the DOWNLINK NAS TRANSPORT and UPLINK NAS TRANSPORT messages as defined below:
 
    - ~~• The device shall send/receive all data with the data being encapsulated in the CP-DATA message payload of a DOWNLINK NAS TRANSPORT message or an UPLINK NAS TRANSPORT message.~~
    - ~~• The SDS payload shall not exceed 252 bytes.~~
    - ~~• For an SDS message, the NAS protocol discriminator for the DOWNLINK NAS TRANSPORT message and UPLINK NAS TRANSPORT message shall be set to 1110 0100.~~~~
  - ~~• The device shall not send more than one SDS message every 5 minutes with the following exception: the device may send up to one uplink SDS message in response to any downlink SDS message. (There is no limit on the number of downlink SDS messages that may be sent to the device.)~~
  - ~~• The device shall support OTADM using SDS to deliver the OTADM updates.~~

~~The DOWNLINK NAS TRANSPORT message and UPLINK NAS TRANSPORT message are per 3GPP TS 24.301: Non-Access Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3. CP-DATA messages are per section 7.2 of 3GPP TS 24.011: Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface.~~

**NOTE 2:** All other requirements in this document shall apply.

### 1.3.2.28 **Blind Data Interference Cancellation/Supression** VZ\_REQ\_LTEB13NAC\_1238184

- When in RRC connected mode (regardless of QCI bearer type activated on the connection), the UE shall support interference cancellation/supression on PDSCH channel of the primary component carrier and secondary component carrier(s) of the serving eNB with two CRS antenna port (by cancelling interference from neighbor cells PDSCH) without any assistant signaling information from the network. This function is also referred to as Blind Data IC.
- The modem battery consumption of Data IC shall be kept within 10% of the total modem battery consumption

### 1.3.2.29 **UE-Assisted Adaptive DRX** VZ\_REQ\_LTEB13NAC\_1583448

### 1.3.2.29.1 UE-Assisted Adaptive DRX Support VZ\_REQ\_LTEB13NAC\_1583450

The device may support UE-assisted adaptive DRX which is an infrastructure vendor proprietary solution designed to reduce UE power consumption and network resource usage while in RRC\_CONNECTED state. If the device supports UE-assisted adaptive DRX, then the device shall ONLY initiate and advertise support for this feature if the network advertises support for this feature.

**NOTE: Device vendors shall contact Verizon Wireless prior to implementing UE-assisted adaptive DRX on any devices. Device vendors are required to contact Verizon Wireless for detailed description of the feature, protocol/signaling exchange between the UE and eNB, and required testing.**

## 1.3.2.30 CAT M1-SPECIFIC REQUIREMENTS VZ\_REQ\_LTEB13NAC\_4352172

### 1.3.2.30.1 SOFTWARE REQUIREMENTS APPLICABLE TO CAT M1 ONLY VZ\_REQ\_LTEB13NAC\_4352175

Cat-M1 Machine-to-Machine (M2M) and Internet of Things (IoT) devices that are data-centric or IMS-less and do NOT support IMS-based voice operation shall support requirements in this section. **NOTE:** The requirements in this section apply to Cat-M1 devices only, and are in addition to the other requirements in this document. The requirements in this section do apply to Cat-M1 devices that support over-the-top voice solutions.

- Cat-M1 data devices shall be IMS-less, and shall comply with all requirements in this document for data devices that do not support IMS. Cat-M1 data devices shall support SMS over NAS.
- Cat-M1 devices shall conform to the specifications in latest Release 13 versions of 3GPP TS 36.211: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation*, 36.212: *Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding*, 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*, 36.304: *Evolved*

*Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode, 36.306: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities, 36.321: Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification, 36.331: Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification, 36.101: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception, and 36.133: Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management, for **Bandwidth-reduced Low-complexity (BL) UE and UE of DL/UL Category M1. NOTE: Category M1 devices SHALL support operation when the eNB is transmitting on 1, 2, and 4 transmit ports.***

- Cat-M1 devices shall support the enhanced physical channels for BL UE (PBCH/PRACH/PDSCH/MPDCCH/PUSCH/PUCCH) and repetitions for coverage enhancement, as per 3GPP specifications (refer to Release 13 version of 3GPP TS 36.211, 36.212, 36.213). The Cat-M1 devices shall support both CE mode A and CE mode B.
- Cat-M1 devices shall support frequency hopping for SIB1-BR and other SI messages, PUCCH, PRACH, MPDCCH (Type 0/1/2 CSS and USS), PDSCH, and PUSCH, per Release 13 version of 3GPP TS 36.211, 36.212, and 36.213.
- Cat-M1 devices shall support either full duplex FDD (FD-FDD) operation or Type B half duplex FDD (HD-FDD) operation, per Section 6.2.5 of Release 13 version of 3GPP TS 36.211, and Sections 4.2.6 and 4.3.5.1 of Release 13 version of 3GPP TS 36.306.
- Cat-M1 devices shall support 23 dBm power class (Class 3), per Section 6.2.2E of Release 13 version of 3GPP TS 36.101.
- Cat-M1 devices shall support PDSCH TM1 and TM2 in both CE mode A and CE mode B; further, the Cat-M1 devices should support PDSCH TM6 and TM9 in CE mode A, and should support PDSCH TM9 in CE mode B, per Section 7.1 of Release 13 version of 3GPP TS 36.213.
- Cat-M1 devices shall support CSI reporting when in CE mode A, per Section 7.2 of Release 13 version of 3GPP TS 36.213.
- Cat-M1 devices shall support UL power control when in CE mode A, per Section 5.1 of Release 13 version of 3GPP TS 36.213.
- Cat-M1 devices shall support 8 HARQ processes in both DL and UL when in CE mode A, and shall support 2 HARQ processes in both DL and UL when in CE mode B, per Sections 7 and 8 of Release 13 version of 3GPP TS 36.213.
- Cat-M1 devices shall support connected mode DRX, per Section 5.7 of Release 13 version of 3GPP TS 36.321.

- Cat-M1 devices shall support LTE cell selection and cell reselection in both normal and enhanced coverage, per Sections 5.2.3.2 and 5.2.4.6a of Release 13 version of 3GPP TS 36.304.
- Cat-M1 devices shall support the bandwidth-reduced (BR) version of System Information Blocks (SIBs), including SIB1, SIB2, SIB3, SIB4, SIB5, SIB8, SIB14, and SIB16, and shall support system information acquisition and modification, per Release 13 version of 3GPP TS 36.331.
- Cat-M1 devices shall support LTE connected-mode mobility. Both intra-frequency and inter-frequency measurement and reporting shall be supported.
- Cat-M1 devices shall support extended timers for radio link failure (RLF)/handover failure (T300/T301/T304), per Release 13 version of 3GPP TS 36.331.
- Cat-M1 devices shall support the Radio Resource Management (RRM) requirements for idle mode mobility, connected mode mobility, and mobility control, per Sections 4.2, 5.5, 5.6, 6.2, 6.7 and 6.8 of Release 13 version of 3GPP TS 36.133.
- For Cat-M1 devices supporting location services, LTE positioning (ECID and OTDOA) shall be supported.
- Cat-M1 devices shall support Power Saving Mode (PSM) and extended DRX (eDRX) device requirements in this document.
- Cat-M1 devices shall support low priority/delay-tolerant access and Extended Access Barring (EAB) device requirements in this document.

## 1.4 SCENARIOS VZ\_REQ\_LTEB13NAC\_1883

### 1.4.1 NETWORK & DEVICE MESSAGE TRANSMISSION & RETRIEVAL VZ\_REQ\_LTEB13NAC\_1884

#### 1.4.1.1 LTE SYSTEM SELECTION VZ\_REQ\_LTEB13NAC\_23554

#### 1.4.1.1.1 LTE SYSTEM SELECTION VZ\_REQ\_LTEB13NAC\_6347

The device shall support system selection per 3GPP Release 9 Specifications. Refer to section **SYSTEM SELECTION/RESELECTION** for additional details.

#### 1.4.1.2 LTE NETWORK ATTACHMENT VZ\_REQ\_LTEB13NAC\_23555

##### 1.4.1.2.1 LTE NETWORK ATTACHMENT VZ\_REQ\_LTEB13NAC\_6348

The device shall attach to the LTE network using the Attach Procedure described in 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

##### 1.4.1.2.2 PDN CONNECTION FOR NETWORK ATTACHMENT VZ\_REQ\_LTEB13NAC\_23556

###### 1.4.1.2.2.1 NORMAL OPERATION VZ\_REQ\_LTEB13NAC\_23557

###### 1.4.1.2.2.2 PDN CONNECTION FOR NETWORK ATTACHMENT - NORMAL OPERATION VZ\_REQ\_LTEB13NAC\_6349

In normal operation for IMS capable devices, the device shall attach to the LTE network by connecting to the IMS PDN. In normal operation for IMS capable devices, the device shall not attach to the LTE network by connecting to any PDN other than the IMS PDN.

**NOTE:** In normal operation for IMS capable devices, the device shall attach to the LTE network by connecting to the IMS PDN regardless of the setting of the SMS\_Over\_IP\_Networks\_Indication parameter setting. Refer to the LTE SMS Device Requirements for additional details.

In normal operation for devices that do NOT support IMS, the device shall NOT specify an APN when attaching to the LTE network (i.e. the device shall allow the network to choose the attach APN). The network will typically use the Internet PDN (or PDN identified by the class 3 APN) as the attach PDN for devices that do not support IMS. The device may consider the attach Internet PDN (or PDN identified by the class 3 APN) as an "always on" connection as opposed to an "on-demand" PDN connection. If the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table, devices that do not support IMS shall treat this attach APN the same as the class 3 APN and route all internet traffic to this PDN. Devices that do not support IMS shall NOT make a PDN connection request using the class 3 APN in the APN table when the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table.

IMS-Less devices that are Category M1 and below and support "NIDD" shall also support the following:

- NIDD, i.e. a request for a Non IP connection via the PDN type IE during PDN connection setup. Refer to section 6.5.1 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* and sections 4.3.17.8 and 5.10 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* for additional details.

IMS-Less devices that are Category M1 and below and support "rate control" shall also support the following:

- PLMN rate control from MME as defined in section 4.7.7.2 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* by limiting the Uplink NAS data PDU rate with user data. The rate is defined in serving PLMN rate control IE during PDN connection setup. Refer to sections 6.3.8, 6.4.1, and 9.9.4.28 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.
- APN rate control from SCEF/PDN GW as defined in 4.7.7.3 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* by limiting the Uplink data PDU rate with user data. The rate is defined via the PCO IE's during PDN connection setup. Refer to sections 6.3.9, 6.4.1, and 9.9.4.11 of 3GPP TS



24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

### 1.4.1.2.2.3 IMS TEST MODE OPERATION VZ\_REQ\_LTEB13NAC\_23558

### 1.4.1.2.2.4 PDN CONNECTION FOR NETWORK ATTACHMENT - IMS TEST MODE OPERATION VZ\_REQ\_LTEB13NAC\_6350

IMS capable devices shall support an IMS test mode in which the IMS client is disabled. The device shall initiate a soft reset when it is toggled between the IMS test mode and normal operating mode. When operating in this test mode, an IMS capable device shall attach to the LTE network by connecting to the Internet PDN immediately upon detection of the LTE network. This test mode will be used to support RF and signaling conformance testing.

Per the table below, the IMS test mode shall operate independently of the setting of the *SMS\_Over\_IP\_Networks\_Indication* parameter defined in the *SMS over IMS Control* section of the LTE SMS Device Requirements.

| IMS Test Mode Control Parameter | SMS_Over_IP_Networks_Indication Parameter Setting | Device Operation Mode  |
|---------------------------------|---|--|
| Disable                         | Enable  | Normal operation, Device attaches via the IMS PDN, Normal SMS over IMS operation   |
| Disable                         | Disable   | Normal operation, Device attaches via the IMS PDN and performs IMS registration, SMS origination over IMS shall be disabled, but device shall be |

|        |         |  |
|--------|---------|--|
|        |         | capable of receiving MT SMS messages over IMS  |
| Enable | Enable  | IMS test mode operation, Device attaches via the Internet PDN, SMS over IMS is disabled (device shall not perform IMS registration), |
| Enable | Disable | IMS test mode operation, Device attaches via the Internet PDN, SMS over IMS is disabled (device shall not perform IMS registration)  |

### 1.4.1.2.3 IMS PDN DEDICATED BEARER SETUP VZ\_REQ\_LTEB13NAC\_23559

#### 1.4.1.2.3.1 IMS PDN DEDICATED BEARER SETUP VZ\_REQ\_LTEB13NAC\_6351

On network attach (in normal operation) for IMS capable devices, the network may initiate the setup of a dedicated bearer to the IMS PDN.

Should the dedicated bearer setup fail or should the dedicated bearer be released for any reason, the network will attempt to reestablish the dedicated bearer. The device shall not request a dedicated bearer to the IMS PDN at any time.

#### 1.4.1.2.4 IP ADDRESS ASSIGNMENT VZ\_REQ\_LTEB13NAC\_23560

#### 1.4.1.2.4.1 NORMAL OPERATION VZ\_REQ\_LTEB13NAC\_23561

#### 1.4.1.2.4.2 IP ADDRESS ASSIGNMENT - NORMAL OPERATION

VZ\_REQ\_LTEB13NAC\_6352

On network attach to the IMS PDN (i.e. normal operation) for IMS capable devices, the device shall associate an IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address with the default bearer to the IMS PDN as directed by the network in the "PDN Address" information element of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The device shall be capable of supporting a dual IP bearer to the IMS PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the bearers to the IMS PDN. The device shall be capable of supporting an IPv6 address and an IPv4 address for the IMS PDN connection that are unique to any IP addresses assigned to on-demand PDN connections. Verizon Wireless currently plans to use IPv6 addressing for the IMS PDN. *IPv4 addressing for the IMS PDN is reserved for future use.*

On network attach to the Internet PDN (or PDN identified by the class 3 APN) for devices that do NOT support IMS (i.e. normal operation), the device shall associate an IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address with the default bearer to the attach Internet PDN as directed by the network in the "PDN Address" information element of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The device shall be capable of supporting a dual IP bearer to the attach Internet PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the bearers to the attach Internet PDN. The device shall be capable of supporting an IPv6 address and an IPv4 address for the attach Internet PDN connection that are unique to any IP addresses assigned to on-demand PDN connections. If the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table, devices that do not support IMS shall treat this attach APN the same as the class 3 APN and route all internet traffic to this PDN. Devices that do not support IMS shall NOT make a PDN connection request using the class 3 APN in the APN table when the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table.

Refer to the *IPv6 Address Assignment* section of this document for additional details on IPv6 address assignment.

#### 1.4.1.2.4.3 IMS TEST MODE OPERATION VZ\_REQ\_LTEB13NAC\_23562

#### 1.4.1.2.4.4 IP ADDRESS ASSIGNMENT - IMS TEST MODE OPERATION

VZ\_REQ\_LTEB13NAC\_6353

On network attach to the Internet PDN during IMS test mode operation, IMS capable devices shall associate an IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address with the default bearer to the Internet PDN as directed by the network in the "PDN Address" information element of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The device shall be capable of supporting a dual IP bearer to the Internet PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the bearers to the Internet PDN connection. The device shall be capable of supporting an IPv6 address and an IPv4 address for the Internet PDN connection that are unique to any IP addresses assigned to other PDN connections.

Refer to the *IPv6 Address Assignment* section of this document for additional details on IPv6 address assignment.

#### 1.4.1.2.5 NAS MESSAGING DURING LTE NETWORK ATTACHMENT

VZ\_REQ\_LTEB13NAC\_23563

##### 1.4.1.2.5.1 NAS MESSAGING DURING LTE NETWORK ATTACHMENT

VZ\_REQ\_LTEB13NAC\_6354

Refer to the 3GPP TS 24.301: *Non-Access Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* and the sections below for additional details on the NAS messaging during LTE network attachment.

##### 1.4.1.2.5.2 ATTACH REQUEST MESSAGE

VZ\_REQ\_LTEB13NAC\_23564

### 1.4.1.2.5.3 NAS MESSAGING DURING LTE NETWORK ATTACHMENT - ATTACH REQUEST Message VZ\_REQ\_LTEB13NAC\_6355

During the attach procedure, IMS-capable devices shall set the following information elements in the ATTACH REQUEST message as described below:

The device should set the "EPS Attach Type" to *EPS Attach*. The device may use *Combined EPS/IMSI Attach*. However, if the device uses *Combined EPS/IMSI Attach*, the Verizon Wireless network will send an ATTACH ACCEPT message with an EMM cause value of 18 (CS domain not available) to indicate that non-EPS services are not available on the Verizon Wireless LTE network. The device shall comply with all Verizon Wireless LTE data retry requirements as per the Verizon Wireless LTE Data Retry Requirements regardless of the "EPS Attach Type".

### 1.4.1.2.5.4 ATTACH REQUEST Message - Data-Centric or IMS-Less Devices that Support SMS over NAS VZ\_REQ\_LTEB13NAC\_39732

In addition to the requirements in VZ\_REQ\_LTEB13NAC\_6355, data-centric or IMS-less devices that do NOT support IMS voice operation but do support SMS over NAS shall set the following information elements in the ATTACH REQUEST message as described below:

- The device shall set the "EPS Attach Type" to *Combined EPS/IMSI Attach*.
- The device shall include the "Additional update type" information element set to "1 SMS Only".

IMS-Less devices that are Category M1 and below and support "attach without PDN" shall also support the following:

- The device shall read the Clot-optimization/attachWithoutPDN from SystemInformationBlockType2 for LTE or SystemInformationBlockType1-NB for NB-IoT to define network support for attach without PDN. Refer to section 5.2.2 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.
- The device shall advertise its support with attachWithoutPDN in the attach request. Refer to section 5.5.1 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, section 5.3.2.1 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access*, and section 5.3.3 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* for additional details.

#### 1.4.1.2.5.5 PDN CONNECTIVITY REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23565

#### 1.4.1.2.5.6 NAS MESSAGING DURING LTE NETWORK ATTACHMENT - PDN CONNECTIVITY REQUEST Message VZ\_REQ\_LTEB13NAC\_6356

During the attach procedure, IMS-capable devices shall set the following information elements in the PDN CONNECTIVITY REQUEST message as described below:

- The device shall set the "Request Type" to *Initial Request*.
- The device shall set the "PDN Type" to the value in the "APN IP Type" field of the APN table in section 5.4.1 of this document (Currently, this value is *IPv4v6* for all PDN's).
- The device shall set the "ESM Information Transfer Flag" to indicate that ciphering of ESM information is requested.
- The device shall not include the APN (per section 6.5.1.2 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*).
- If the IMS PDN is used for network attach (i.e. normal operation), the device shall include the "Protocol Configuration Options", including requests for the IPv6 DNS IP addresses, IPv4 DNS IP addresses, IPv4 MTU size, and the IPv6 P-CSCF IP addresses. In addition, the device shall include the PCO container "P-CSCF Re-Selection Support" to indicate support for Verizon Wireless P-CSCF restoration procedure requirements (i.e. requirement VZ\_REQ\_LTEB13NAC\_33802).
- If the internet PDN (or PDN identified by the class 3 APN) is used for network attach (i.e. IMS test mode operation or data retry scenario for IMS capable devices), the device shall include the "Protocol Configuration Options", including requests for the IPv6 DNS IP addresses, the IPv4 DNS IP addresses, and the IPv4 MTU size. The device SHALL NOT request a P-CSCF IP address or include the PCO container "P-CSCF Re-Selection Support" in the PCO field of a PDN CONNECTIVITY REQUEST message for the internet PDN (or PDN identified by the class 3 APN).
- The device shall also request the operator reserved PCO container FF00H. The device shall always set the MCC to "311" and the MNC to "480" for the operator reserved PCO container FF00H.
- The device shall also request the MSISDN (i.e. PCO item 000EH) in the "Protocol Configuration Options" for the attach PDN. The device shall NOT request the MSISDN (i.e. PCO item 000EH) in the "Protocol Configuration Options" for any post-attach/on demand PDN connection requests.

During the attach procedure, devices that do NOT support IMS shall set the following information elements in the PDN CONNECTIVITY REQUEST message as described below:

- The device shall set the "Request Type" to *Initial Request*.
- The device shall set the "PDN Type" to the value in the "APN IP Type" field for the class 3 APN in the APN table in section 5.4.1 of this document (Currently, this value is *IPv4v6* for all PDN's).
- The device shall NOT set the "ESM Information Transfer Flag" to indicate that ciphering of ESM information is requested. The device shall NOT request a specific APN at any point in attach procedure.
- The device shall include the "Protocol Configuration Options", including requests for the IPv6 DNS IP addresses, the IPv4 DNS IP addresses, and the IPv4 MTU size. The device SHALL NOT request a P-CSCF IP address or include the PCO container "P-CSCF Re-Selection Support" in the PCO field of a PDN CONNECTIVITY REQUEST message.
- The device shall also request the operator reserved PCO container FF00H. The device shall always set the MCC to "311" and the MNC to "480" for the operator reserved PCO container FF00H.
- The device shall also request the MSISDN (i.e. PCO item 000EH) in the "Protocol Configuration Options" for the attach PDN. The device shall NOT request the MSISDN (i.e. PCO item 000EH) in the "Protocol Configuration Options" for any post-attach/on demand PDN connection requests.

#### 1.4.1.2.5.7 ESM INFORMATION RESPONSE MESSAGE VZ\_REQ\_LTEB13NAC\_23566

#### 1.4.1.2.5.8 NAS MESSAGING DURING LTE NETWORK ATTACHMENT - ESM INFORMATION RESPONSE Message VZ\_REQ\_LTEB13NAC\_6357

The device shall include the APN in the ESM INFORMATION RESPONSE message in the network attach procedure.

#### 1.4.1.2.5.9 ATTACH ACCEPT MESSAGE VZ\_REQ\_LTEB13NAC\_23567

#### 1.4.1.2.5.10 NAS MESSAGING DURING LTE NETWORK ATTACHMENT - ATTACH ACCEPT Message VZ\_REQ\_LTEB13NAC\_6358

The device shall be capable of receiving the following optional information elements in the ATTACH ACCEPT message during the network attach procedure:

- "GUTI"
- "EMM Cause". **NOTE:** By network policy, for an IMS-capable device, the network will include an EMM cause value of 18 (CS domain not available) in the ATTACH ACCEPT message in response to an ATTACH REQUEST with the "EPS Attach Type" set to *Combined EPS/IMSI Attach*.

#### 1.4.1.2.5.11 ATTACH ACCEPT Message - Data-Centric or IMS-Less Devices that Supports SMS over NAS VZ\_REQ\_LTEB13NAC\_39733

In addition to the requirements in VZ\_REQ\_LTEB13NAC\_6358, data-centric or IMS-less devices that do NOT support IMS voice operation but do support SMS over NAS shall be capable of receiving the following optional information elements in the ATTACH ACCEPT message during the network attach procedure:

- "Additional update result". A combined EPS/IMSI attach request for SMS only shall be considered successful if the network omits this information element in the ATTACH ACCEPT message or if the network sets the "Additional update result" information element to either "0 0 No additional information" or "1 0 SMS only".

IMS-Less devices that are Category M1 and below and support "attach without PDN" shall also be capable of receiving the following during a network attach procedure:

- attach without PDN in the Supported Network Behavior with an *ESM DUMMY MESSAGE* if the network supports attach without PDN. Refer to section 4.3.5.10 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and section 5.5.1.2.4 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.
- An attach reject if the network does not support attach without PDN;

#### 1.4.1.2.5.12 ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23568



### 1.4.1.2.5.13 **NAS MESSAGING DURING LTE NETWORK ATTACHMENT - ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST Message** VZ\_REQ\_LTEB13NAC\_6359

The device shall be capable of receiving the following optional information elements in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message during network attach:

- "APN-AMBR"
- "Protocol Configuration Options", will include DNS IP addresses, P-CSCF IP addresses (if the IMS PDN is used for network attach), and the IPv4 MTU size (if the network does not provide the MTU size, the device shall set the MTU size to 1428). If the network provides the operator reserved PCO container FF00H, the device shall make the contents of the FF00H container available to higher layers. If the network does not provide the operator reserved PCO container FF00H, the device shall not consider this to be an error and shall report to higher layers that the operator reserved PCO container FF00H is not available. If the network provides the PCO container 000EH (i.e. MSISDN), the device shall provide the contents of the PCO container to the UICC as described in VZ\_REQ\_LTEB13NAC\_6299. If the network does not provide the PCO container 000EH (i.e. MSISDN), the device shall not consider this to be an error.

**NOTE:** For devices that do NOT support IMS, if the APN in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the attach PDN does not match any APN entries in the device's APN table, devices that do not support IMS shall treat this attach APN the same as the class 3 APN and route all internet traffic to this PDN. Devices that do not support IMS shall NOT make a PDN connection request using the class 3 APN in the APN table when the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table.

In addition, if an IMS-Less device of Category M1 and below supports "attach without PDN" and the network also supports "attach without PDN", then these devices shall:

- send an attach complete with an ESM DUMMY MESSAGE contained in the ESM message.
- not establish a PDN connectivity.

Refer to sections 4.3.5.10 and 5.3.2.1 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and section 5.5.1 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

### 1.4.1.2.5.14 **PIGGYBACKING SUPPORT** VZ\_REQ\_LTEB13NAC\_23569

VOID

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### 1.4.1.3 ON -DEMAND PDN CONNECTION ESTABLISHMENT

VZ\_REQ\_LTEB13NAC\_23570

#### 1.4.1.3.1 ON -DEMAND PDN CONNECTION ESTABLISHMENT - NORMAL OPERATION

VZ\_REQ\_LTEB13NAC\_6360

After initial network attachment to the IMS PDN (i.e. normal operation) for IMS capable devices, the device shall establish a default bearer to the Internet PDN, the Administrative PDN, or the VZW Application PDN if an application(s) running on the device or a tethered laptop requires a bearer to any of these PDNs. Refer to the *LTE IPv6/IPv4 and Bearer Support* section of this document for additional details.

**NOTE 1:** In a data retry scenario where the device attaches to the LTE network using the internet PDN (or PDN identified by the class 3 APN), the device shall consider the internet PDN (or PDN identified by the class 3 APN) as an "always on" connection as opposed to an "on-demand" PDN connection. In such a data retry scenario, the PDN CONNECTIVITY RQEUEST message for the internet PDN (or PDN identified by the class 3 APN) shall comply with section 4.1.2.4 of this document. If the device successfully attaches to the LTE network using the internet PDN (or PDN identified by the class 3 APN), the device shall consider the IMS PDN to be an "on-demand" PDN for the duration of the attach, and the PDN CONNECTIVITY REQUEST for the IMS PDN shall comply with section 4.1.3.3 of this document.

After initial network attachment for devices that do NOT support IMS (i.e. normal operation), the device shall establish a default bearer to the Administrative PDN or the VZW Application PDN if an application(s) running on the device or a tethered laptop requires a bearer to any of these PDNs. Refer to the *LTE IPv6/IPv4 and Bearer Support* section of this document for additional details. If the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table, devices that do not support IMS shall treat this attach APN the same as the class 3 APN and route all internet traffic to this PDN. Devices that do not support IMS shall NOT make a PDN connection request using the class 3 APN in the APN table when the APN for the attach PDN chosen by the network does not match any APN entries in the device's APN table.

**NOTE 2:** Devices that do NOT support IMS shall NOT request a connection to the IMS PDN at any time.

### 1.4.1.3.2 ON -DEMAND PDN CONNECTION ESTABLISHMENT - IMS TEST MODE OPERATION VZ\_REQ\_LTEB13NAC\_6361

After initial network attachment to the Internet PDN during IMS test mode operation for IMS capable devices, the device shall establish a default bearer to the Administrative PDN or the VZW Application PDN if an application(s) running on the device or a tethered laptop requires a bearer to any of these PDNs. Refer to the *LTE IPv6/IPv4 and Bearer Support* and *LTE Network Attachment* sections of this document for additional details.

### 1.4.1.3.3 DEFAULT BEARERS AND IP ADDRESSES FOR ON- DEMAND PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_23571

#### 1.4.1.3.3.1 DEFAULT BEARERS AND IP ADDRESSES FOR ON- DEMAND PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_6362

For the default bearers to on-demand PDNs, the device shall associate at least one IPv6 address, an IPv4 address, or both an IPv6 and IPv4 address as directed by the network in the "PDN Address" information element of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The device shall be capable of supporting a dual IP bearer to any on-demand PDN connection, i.e. the device shall be capable of simultaneously associating both an IPv6 and an IPv4 address with the default bearer to any on-demand PDN connection. The device shall be capable of supporting a unique IPv6 address and a unique IPv4 address for each PDN connection.

Refer to the *IPv6 Address Assignment* section of this document for additional details on IPv6 address assignment.

### 1.4.1.3.4 DEDICATED BEARERS FOR ON-DEMAND PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_23572

#### 1.4.1.3.4.1 DEDICATED BEARERS FOR ON-DEMAND PDN CONNECTIONS VZ\_REQ\_LTEB13NAC\_6363

The device shall not request a dedicated bearer to any on-demand PDN.

#### 1.4.1.3.5 NAS MESSAGING DURING ON DEMAND PDN CONNECTION ESTABLISHMENT VZ\_REQ\_LTEB13NAC\_23573

##### 1.4.1.3.5.1 NAS MESSAGING DURING ON DEMAND PDN CONNECTION ESTABLISHMENT VZ\_REQ\_LTEB13NAC\_6364

Refer to the 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* and the sections below for additional details on the NAS messaging during on demand PDN connection establishment.

##### 1.4.1.3.5.2 PDN CONNECTIVITY REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23574

##### 1.4.1.3.5.3 NAS MESSAGING DURING ON DEMAND PDN CONNECTION ESTABLISHMENT - PDN CONNECTIVITY REQUEST Message VZ\_REQ\_LTEB13NAC\_6365

The device shall set the following information elements in the PDN CONNECTIVITY REQUEST message as described below:

- The device shall set the "Request Type" to *Initial Request*.
- The device shall set the "PDN Type" to the value in the "APN IP Type" field of the APN table in section 5.4.1 of this document (Currently, this value is *IPv4v6* for all PDN's).
- The device shall omit the "ESM Information Transfer Flag".
- The device shall include the APN.

- The device shall include the "Protocol Configuration Options", including requests for the IPv6 DNS IP addresses, the IPv4 DNS IP addresses, and the IPv4 MTU size.
- If the PDN CONNECTIVITY REQUEST is for the IMS PDN (e.g. IMS test mode operation or data retry scenario), the device shall include requests for the IPv6 P-CSCF IP addresses in the "Protocol Configuration Options". In addition, the device shall include the PCO container "P-CSCF Re-Selection Support" to indicate support for Verizon Wireless P-CSCF restoration procedure requirements (i.e. requirement VZ\_REQ\_LTEB13NAC\_33802). The device SHALL NOT request a P-CSCF IP address or include the PCO container "P-CSCF Re-Selection Support" in the PCO field of a PDN CONNECTIVITY REQUEST for any PDN other than the IMS PDN.
- The device shall also request the operator reserved PCO container FF00H. The device shall always set the MCC to "311" and the MNC to "480" for the operator reserved PCO container FF00H.

#### 1.4.1.3.5.4 ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23575

#### 1.4.1.3.5.5 NAS MESSAGING DURING ON DEMAND PDN CONNECTION ESTABLISHMENT - ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST Message VZ\_REQ\_LTEB13NAC\_6366

The device shall be capable of receiving the following optional information elements in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message:

- "APN-AMBR"
- "Protocol Configuration Options", will include DNS IP addresses and the IPv4 MTU size (if the network does not provide the MTU size, the device shall set the MTU size to 1428). If the network provides the operator reserved PCO container FF00H, the device shall make the contents of the FF00H container available to higher layers. If the network does not provide the operator reserved PCO container FF00H, the device shall not consider this to be an error and shall report to higher layers that the operator reserved PCO container FF00H is not available.

#### 1.4.1.4 PDN DISCONNECTION VZ\_REQ\_LTEB13NAC\_23576

## 1.4.1.4.1 NETWORK INITIATED PDN DISCONNECTION

VZ\_REQ\_LTEB13NAC\_23577

### 1.4.1.4.1.1 NETWORK INITIATED PDN DISCONNECTION

VZ\_REQ\_LTEB13NAC\_6367

The network will initiate disconnection of a PDN connection if the network inactivity timer for that PDN connection has expired, usually by sending a DEACTIVATE EPS BEARER CONTEXT REQUEST message if the device is connected to two or more PDN's or by sending a DETACH REQUEST if the device is connected to only one PDN.

If the network disconnects the connection to the IMS PDN and the IMS capable device is still attached to the LTE network (through a different PDN connection), the IMS capable device shall attempt to re-establish the IMS PDN connection by sending a PDN CONNECTIVITY REQUEST message. If that PDN CONNECTIVITY REQUEST message is rejected by the network using a PDN CONNECTIVITY REJECT message or the network does not respond to the PDN CONNECTIVITY REQUEST message, the device shall follow Verizon Wireless data retry procedures for PDN connection requests as defined in the Verizon Wireless LTE Data Retry Requirements.

If the network disconnects the connection to the IMS PDN using a network initiated DETACH REQUEST message and the network indicates that a re-attach is required per the "Detach Type" information element in the DETACH REQUEST message, an IMS capable device shall acknowledge the detach procedure and then attempt to re-attach to the LTE network and the IMS PDN by sending an ATTACH REQUEST message. Device behavior shall be per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the Verizon Wireless LTE Data Retry Requirements, and this document.

If the network disconnects the connection to the IMS PDN using a network initiated DETACH REQUEST message and the network indicates that a re-attach is not required per the "Detach Type" information element in the DETACH REQUEST message, an IMS capable device shall acknowledge the detach procedure and take appropriate action based on the EMM cause code in the DETACH REQUEST message. Device behavior shall be per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the Verizon Wireless LTE Data Retry Requirements, and this document.

If attach without PDN connection is supported, the network may at any time release all the PDN connections and IMS-Less devices that are Category M1 and below shall

remain EPS attached, meaning EMM-REGISTERED state with SMS only. Refer to section 4.3.5.10 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and section 5.5.2 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

#### 1.4.1.4.2 UE INITIATED PDN DISCONNECTION VZ\_REQ\_LTEB13NAC\_23578

##### ~~1.4.1.4.2.1 UE INITIATED PDN DISCONNECTION - APN INACTIVITY TIMERS FOR PDN CONNECTIONS~~ VZ\_REQ\_LTEB13NAC\_23579

VOID

##### ~~1.4.1.4.2.2 UE INITIATED PDN DISCONNECTION UPDATE TO APN RELATED PARAMETERS~~ VZ\_REQ\_LTEB13NAC\_23580

#### 1.4.1.4.2.3 UE Initiated PDN Disconnection Update to APN Related Parameters VZ\_REQ\_LTEB13NAC\_6368

If an APN network identifier or APN-related parameter (refer to the *Factory Programming* section of this document for additional details) is updated after a PDN connection using the APN has been established, the device shall release the PDN connection and then immediately re-establish the PDN connection using the updated APN parameter(s).

The device shall release the PDN connection by:

- sending a PDN DISCONNECT REQUEST message if the device is connected to two or more PDNs.
- sending a DETACH REQUEST if the device is connected to only one PDN connection.

If the device disconnects the connection to the IMS PDN and the IMS capable device is still attached to the LTE network (through a different PDN connection), the IMS capable device shall attempt to re-establish the IMS PDN connection by sending a PDN CONNECTIVITY REQUEST message. If that PDN CONNECTIVITY REQUEST message is rejected by the network using a PDN CONNECTIVITY REJECT message or the network does not respond to the PDN CONNECTIVITY REQUEST message, the device shall follow Verizon Wireless data retry procedures for PDN connection requests as defined in the Verizon Wireless LTE Data Retry Requirements.

If the device disconnects an on-demand PDN connection and the device is still attached to the LTE network (through a different PDN connection), the device shall attempt to re-establish the PDN connection by sending a PDN CONNECTIVITY REQUEST message and using the updated APN parameter(s). Device behavior shall be per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the Verizon Wireless LTE Data Retry Requirements, and this document.

If the device disconnects the connection using a UE-initiated DETACH REQUEST message, the device shall complete the detach procedure and then attempt to re-attach to the LTE network by sending an ATTACH REQUEST message. All updated APN parameter(s) shall be used in the attach procedure and any subsequent PDN connection establishment procedures. Device behavior shall be per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the Verizon Wireless LTE Data Retry Requirements, and this document. **NOTE:** Devices that do NOT support IMS shall not request a specific APN during the attach procedure.

#### ~~1.4.1.4.2.4 UE INITIATED PDN DISCONNECTION ALL OTHER CASES~~

~~VZ\_REQ\_LTEB13NAC\_23581~~

#### 1.4.1.4.2.5 UE Initiated PDN Disconnection All Other Cases

VZ\_REQ\_LTEB13NAC\_6369

If the device is required to initiate a PDN disconnection for any reason other than in response to the expiration of an APN inactivity timer or in response to an update to an APN-related parameter, the device shall follow the requirements below.

Per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the device shall release the PDN connection by:

- sending a PDN DISCONNECT REQUEST message if the device is connected to two or more PDNs.



- sending a DETACH REQUEST if the device is connected to only one PDN connection.

Device behavior shall be per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, the Verizon Wireless LTE Data Retry Requirements, and this document.

If attach without PDN connection is supported by an IMS-less device, then the device shall at any time release all the PDN connections and remain EPS attached, meaning EMM-REGISTERED state with SMS only. Refer to section 4.3.5.10 of 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and section 5.5.2 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details. These devices shall ONLY request PDN Connectivity on demand.

#### 1.4.1.4.3 IMS DE-REGISTRATION DURING UE INITIATED IMS PDN DISCONNECTION VZ\_REQ\_LTEB13NAC\_23582

##### 1.4.1.4.3.1 IMS DE-REGISTRATION DURING UE INITIATED IMS PDN DISCONNECTION VZ\_REQ\_LTEB13NAC\_6370

If the device has a valid IMS registration, the device shall terminate the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message. This shall be done before sending a NAS PDN DISCONNECT REQUEST or DETACH REQUEST message. Upon the IMS client generating the initial SIP REGISTER message with expires=0, the device shall start an implementation specific timer with a value of 4 seconds. While this implementation specific timer is running, the device shall respond to all SIP messaging from the network, e.g. if the network challenges the de-registration request with a 401 Unauthorized. Upon expiration of this implementation specific timer, the device shall take no further action with respect to SIP messages from the network and execute the NAS detach procedure or NAS PDN disconnect procedure. The device shall stop the implementation specific timer and immediately execute the NAS detach procedure or NAS PDN disconnect procedure if a SIP 200 OK or a SIP 481 or a SIP 501 is received in response to the SIP REGISTER (with expires=0) before the implementation specific timer expires.

**NOTE:** The implementation specific timer is started when the IMS client generates the initial SIP REGISTER message with expires=0. The implementation specific timer shall run even if the IMS client cannot send the SIP REGISTER message to the modem for transmission because an IMS signaling connection could not be established.

## 1.4.1.5 TRACKING AREA UPDATES VZ\_REQ\_LTEB13NAC\_23583

### 1.4.1.5.1 TRACKING AREA UPDATES VZ\_REQ\_LTEB13NAC\_6371

Tracking area update procedures are per 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

### 1.4.1.5.2 NAS MESSAGING DURING TRACKING AREA UPDATES VZ\_REQ\_LTEB13NAC\_23584

#### 1.4.1.5.2.1 NAS MESSAGING DURING TRACKING AREA UPDATES VZ\_REQ\_LTEB13NAC\_6372

Refer to the 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* and the sections below for additional details on the NAS messaging during tracking area updates.

#### 1.4.1.5.2.2 TRACKING AREA UPDATE REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_40648

#### 1.4.1.5.2.3 NAS MESSAGING DURING TRACKING AREA UPDATES - TRACKING AREA UPDATE REQUEST Message VZ\_REQ\_LTEB13NAC\_40649

In addition to the requirements in VZ\_REQ\_LTEB13NAC\_6372, the device shall set the following information elements in the TRACKING AREA UPDATE REQUEST message as described below when a combined tracking area update is required per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*:

- The device shall support the extended periodic timer and advertise support to the network in the "MS Network Capability" information element\*

\* Support for the extended periodic timer is **mandatory** for machine-to-machine (M2M) and internet of things (IoT devices); and optional for all other devices.

In addition to the requirements above and in VZ\_REQ\_LTEB13NAC\_6372, data-centric or IMS-less devices that do NOT support IMS voice operation but do support SMS over NAS shall set the following information elements in the TRACKING AREA UPDATE REQUEST message as described below when a combined tracking area update is required per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*:

- The device shall set the "EPS Update Type" to *Combined TA/LA Updating* (i.e. combined tracking area update request).
- The device shall include the "Additional update type" information element set to "1 SMS Only".

#### 1.4.1.5.2.4 TRACKING AREA UPDATE ACCEPT MESSAGE

VZ\_REQ\_LTEB13NAC\_23585

#### 1.4.1.5.2.5 NAS MESSAGING DURING TRACKING AREA UPDATES - TRACKING AREA UPDATE ACCEPT Message

VZ\_REQ\_LTEB13NAC\_6373

The device shall be capable of receiving the following optional information elements in the TRACKING AREA UPDATE ACCEPT message:

- "T3412 Value", included if the MME configuration changes
- "T3412 Extended Value", if included by the MME\*
- "GUTI", mandatory if the MME changes
- "TAI List", included in all cases

\* Support for the extended periodic timer is **mandatory** for machine-to-machine (M2M) and internet of things (IoT devices); and optional for all other devices.

In addition to the requirements above and in VZ\_REQ\_LTEB13NAC\_6372, data-centric or IMS-less devices that do NOT support IMS voice operation but do support SMS over NAS shall be capable of receiving the following information elements in the TRACKING AREA UPDATE ACCEPT message as described below when a combined tracking area update is required per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*:

- "Additional update result". A combined tracking area update request for SMS only shall be considered successful if the network omits this information element in the TRACKING AREA UPDATE ACCEPT message or if the network sets the "Additional update result" information element to either "0 0 No additional information" or "1 0 SMS only".

#### 1.4.1.6 LTE NETWORK DETACHMENT VZ\_REQ\_LTEB13NAC\_23586

##### 1.4.1.6.1 LTE NETWORK DETACHMENT VZ\_REQ\_LTEB13NAC\_6374

Upon device power down, device soft reset, power down of the LTE radio/modem (e.g. when entering airplane mode), or user initiated disconnect of the wireless connection, the device shall initiate the Detach Procedure. Refer to 3GPP TS 23.401: *General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access* and to 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

##### 1.4.1.6.2 IMS DE-REGISTRATION DURING UE INITIATED NETWORK DETACH VZ\_REQ\_LTEB13NAC\_23587

### 1.4.1.6.2.1 IMS DE-REGISTRATION DURING UE INITIATED NETWORK DETACH

VZ\_REQ\_LTEB13NAC\_6375

If the device has a valid IMS registration, the device shall terminate the subscription to the registration events package by sending a Subscribe message with expires= 0, followed by an IMS de-registration request message. This shall be done before sending a NAS DETACH REQUEST message. Upon the IMS client generating the initial SIP REGISTER message with expires=0, the device shall start an implementation specific timer with a value of 4 seconds. While this implementation specific timer is running, the device shall respond to all SIP messaging from the network, e.g. if the network challenges the de-registration request with a 401 Unauthorized. Upon expiration of this implementation specific timer, the device shall take no further action with respect to SIP messages from the network and execute the NAS detach procedure. The device shall stop the implementation specific timer and immediately execute the NAS detach procedure if a SIP 200 OK or a SIP 481 or a SIP 501 is received in response to the SIP REGISTER (with expires=0) before the implementation specific timer expires.

**NOTE:** The implementation specific timer is started when the IMS client generates the initial SIP REGISTER message with expires=0. The implementation specific timer shall run even if the IMS client cannot send the SIP REGISTER message to the modem for transmission because an IMS signaling connection could not be established.

### 1.4.1.7 SYSTEM LOSS

VZ\_REQ\_LTEB13NAC\_23588

#### 1.4.1.7.1 SYSTEM LOSS

VZ\_REQ\_LTEB13NAC\_6376

If radio link failure occurs (specifically an out-of-sync detection as defined in 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures*), the device shall follow all procedures defined in the 3GPP Release 9 Specifications. Refer to 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* and 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

#### 1.4.1.7.2 TRACKING AREA UPDATE REQUEST Message after RLF

VZ\_REQ\_LTEB13NAC\_35805

If the device needs to send a TRACKING AREA UPDATE REQUEST message after LTE connection re-establishment following LTE radio-link failure (RLF)/system loss and the device has uplink data pending, the device shall set bit 4 of the "EPS Update Type" information element in the TRACKING AREA UPDATE REQUEST message to "1 Bearer establishment requested". Refer to 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* for additional details.

## 1.4.1.8 IPv6 ADDRESS ASSIGNMENT VZ\_REQ\_LTEB13NAC\_23589

### 1.4.1.8.1 LINK-LOCAL ADDRESS AND GLOBALLY ROUTABLE IPv6 ADDRESS FORMATION VZ\_REQ\_LTEB13NAC\_23590

#### 1.4.1.8.1.1 LINK-LOCAL ADDRESS AND GLOBALLY ROUTABLE IPv6 ADDRESS FORMATION VZ\_REQ\_LTEB13NAC\_6377

For IPv6 address assignment, the device shall use IPv6 Stateless Address Autoconfiguration. The device shall not initiate DHCP signaling for the purposes of securing an IPv6 address. The device shall use the Interface ID value received from the network in the "PDN Address" information element of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for its Interface ID when forming its link-local address; the device shall not alter the value for the Interface ID or use a different value when forming its link-local address.

The device shall use the values MAX\_RTR\_SOLICITATION\_DELAY (1 second), MAX\_RTR\_SOLICITATIONS (3), and RTR\_SOLICITATION\_INTERVAL (4 seconds) from RFC 4861 as the default values for governing the sending of *Router Solicitation* messages. The device shall form its globally routable IPv6 address by combining the prefix received in the *Router Advertisement* message with the device's Interface ID. When forming a globally routable IPv6 address, the device shall either use the Interface ID provided by the network in the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message or choose an Interface ID in accordance with 3GPP TS 29.061: *Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)*. The device shall only form one globally routable IPv6 address when connected to the IMS PDN, and the device shall use that IPv6 address for the duration of the IMS PDN connection. The device should only form

one globally routable IPv6 address per PDN connection when connecting to PDNs other than the IMS PDN.

#### 1.4.1.8.1.2 IPV6 ADDRESS LIFETIME VZ\_REQ\_LTEB13NAC\_6378

The device shall use either the "Valid Lifetime" value or the "Router Lifetime" value received in the *Router Advertisement* message (refer to RFC 4861, section 4.6.2), whichever is shortest, to determine the valid lifetime of its IPv6 address per RFC 4862. The device shall use the "Preferred Lifetime" to determine when the IPv6 address is preferred or deprecated per RFC 4862. If the network sends an unsolicited *Router Advertisement* message, the device shall refresh its valid lifetime by using the values of "Valid Lifetime", and "Router Lifetime" from the new message and its preferred lifetime by using the "Preferred Lifetime". The device may refresh its IPv6 address by soliciting a new *Router Advertisement* message from the network. If the device needs to solicit a new *Router Advertisement* message, it shall use one of following two methods to determine the appropriate timing. Method 1: the device shall wait until at least 75% of the minimum of "Preferred Lifetime", "Valid Lifetime", or "Router Lifetime" has expired and then send a *Router Solicitation* message per RFC 4861 and RFC 4862. Method #2: the device shall wait until either "Preferred Lifetime" has expired or 75% of the valid lifetime (determined by taking the minimum of the "Valid Lifetime" and the "Router Lifetime") has expired before sending the *Router Solicitation* message.

#### 1.4.1.8.1.3 IPV6 ADDRESS ASSIGNMENT FOR LAN-SIDE DEVICES

VZ\_REQ\_LTEB13NAC\_23591

#### 1.4.1.8.1.4 IPv6 Address Assignment for LAN-Side Devices

VZ\_REQ\_LTEB13NAC\_6429

If the device supports a LAN and serves as a gateway for the LAN-side devices, the device shall assign globally routable IPv6 addresses to the LAN-side devices as follows:

- All traffic from the LAN-side devices shall be routed on the internet PDN (i.e. Class 3 APN).
- The device shall use the IPv6 prefix provided in the *Router Advertisement* for the Internet PDN for all LAN-side devices.
- To complete the globally routable IPv6 address for a given LAN-side device, the gateway device shall combine the IPv6 prefix provided in the *Router Advertisement* for the Internet PDN with a unique Interface ID created in

accordance with 3GPP TS 29.061: *Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)*. The gateway device's WAN-side IPv6 address and all LAN-side IPv6 address shall be unique, i.e. the device shall not use any Interface ID more than once.

- The gateway device shall only assign one globally routable IPv6 address to each LAN-side device.

Refer to RFC 6434 and RFC 6204bis for additional details.

### ~~1.4.1.8.2 ROUTER ADVERTISEMENT FAILURES~~ VZ\_REQ\_LTEB13NAC\_23592

#### ~~1.4.1.8.2.1 ROUTER ADVERTISEMENT FAILURE DURING INITIAL IPV6 ADDRESS FORMATION~~ VZ\_REQ\_LTEB13NAC\_23594

~~Refer to the Verizon Wireless Data Retry Requirements.~~

#### ~~1.4.1.8.2.2 ROUTER ADVERTISEMENT FAILURE DURING IPV6 ADDRESS REFRESH~~ VZ\_REQ\_LTEB13NAC\_23595

~~Refer to the Verizon Wireless Data Retry Requirements.~~

### ~~1.4.1.8.3 NEIGHBOR SOLICITATION MESSAGES~~ VZ\_REQ\_LTEB13NAC\_23593

#### ~~1.4.1.8.3.1 NEIGHBOR SOLICITATION MESSAGES~~ VZ\_REQ\_LTEB13NAC\_6379

The device shall not send a *Neighbor Solicitation* message for any reason.



## 1.4.1.9 DHCP IP ADDRESS ASSIGNMENT/MODIFICATION

VZ\_REQ\_LTEB13NAC\_23602

### 1.4.1.9.1 DHCP IP ADDRESS ASSIGNMENT/MODIFICATION

VZ\_REQ\_LTEB13NAC\_6380

The device shall not use DHCP for assignment or modification of IP addresses.

## 1.4.1.10 DNS ADDRESS REQUESTS

VZ\_REQ\_LTEB13NAC\_23603

### 1.4.1.10.1 DNS SERVER IP ADDRESS ASSIGNMENT

VZ\_REQ\_LTEB13NAC\_6381

The device shall request DNS server addresses for a PDN connection using the "Protocol Configuration Options" information element in the PDN CONNECTIVITY REQUEST message. For any PDN connection request, the device shall always request an IPv6 DNS server address and an IPv4 DNS server address from the network. The device shall be capable of accepting 2 IPv6 DNS server addresses, 2 IPv4 DNS server addresses, or both 2 IPv6 DNS server addresses and 2 IPv4 DNS server addresses for each PDN connection as directed by the network. The device shall be capable of supporting unique DNS server addresses for each PDN connection.

### 1.4.1.10.2 DNS SERVER PER PDN

VZ\_REQ\_LTEB13NAC\_6382

When performing DNS resolution on behalf of an application that connects via a specific PDN connection, the device shall utilize the DNS server that was assigned when the device set up the connection to that PDN. For example, if the device has connections to PDN A (with DNS servers A1 and A2) and PDN B (with DNS servers B1 and B2) and an application that connects through PDN B needs a DNS resolution, the device shall request the resolution from B1 or B2, not from A1 or A2.

### 1.4.1.10.3 DNS QUERY ORDER

VZ\_REQ\_LTEB13NAC\_6462

When performing a DNS resolution on behalf of an application that connects via a specific PDN connection, the device shall issue DNS queries in the following order:

1. Query to the first IPv6 DNS server address provided in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN.
2. Query to the first IPv4 DNS server address provided in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN.
3. Query to the second IPv6 DNS server address provided in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN (if a second IPv6 DNS server address is provided by the network).
4. Query to the second IPv4 DNS server address provided in the PCO of the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN (if a second IPv4 DNS server address is provided by the network).

If the first DNS server in the list above does not respond to a query or returns a DNS server error, the device shall issue the request to the next server in the list and so on.

The device shall wait a minimum of 2 seconds before determining a DNS query has timed out.

After a first pass through the DNS server list without a response, the device should apply an incremental backoff to the timeout value for subsequent retries.

#### **1.4.1.11 IMS TRAFFIC** VZ\_REQ\_LTEB13NAC\_23604

##### **1.4.1.11.1 IMS TRAFFIC** VZ\_REQ\_LTEB13NAC\_6419

The device shall use the IMS PDN for all IMS traffic destined for the Verizon Wireless IMS network. The device SHALL NOT route any IMS traffic destined for the Verizon Wireless IMS network over any on-demand PDN.

#### **1.4.1.12 NETWORK INITIATED BEARER MODIFICATION AND DEACTIVATION PROCEDURES** VZ\_REQ\_LTEB13NAC\_23605

### 1.4.1.12.1 NETWORK INITIATED BEARER MODIFICATION AND DEACTIVATION PROCEDURES VZ\_REQ\_LTEB13NAC\_6425

The device shall support network initiated bearer modification and deactivation procedures as defined in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

### 1.4.1.12.2 NAS MESSAGING FOR NETWORK INITIATED BEARER ACTIVATION, NETWORK INITIATED BEARER MODIFICATION, AND BEARER DEACTIVATION PROCEDURES VZ\_REQ\_LTEB13NAC\_23606

#### 1.4.1.12.2.1 MODIFY EPS BEARER CONTEXT REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23607

#### 1.4.1.12.2.2 NAS MESSAGING FOR NETWORK INITIATED BEARER MODIFICATION - MODIFY EPS BEARER CONTEXT REQUEST Message VZ\_REQ\_LTEB13NAC\_6426

The device shall be capable of receiving the following optional information elements in the MODIFY EPS BEARER CONTEXT REQUEST message:

- "New EPS QoS"
- "TFT". The device shall be capable of receiving and applying a TFT for a default bearer or a dedicated bearer.
- "APN-AMBR"
- "Protocol Configuration Options". If the network provides the operator reserved PCO container FF00H, the device shall make the contents of the FF00H container available to higher layers.

#### 1.4.1.12.2.3 DEACTIVATE EPS BEARER CONTEXT REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23608

#### 1.4.1.12.2.4 NAS MESSAGING FOR NETWORK INITIATED BEARER DEACTIVATION PROCEDURES - DEACTIVATE EPS BEARER CONTEXT REQUEST Message VZ\_REQ\_LTEB13NAC\_6427

The device shall be capable of receiving the following optional information elements in the DEACTIVATE EPS BEARER CONTEXT REQUEST message:

- "Protocol Configuration Options". If the network provides the operator reserved PCO container FF00H, the device shall make the contents of the FF00H container available to higher layers.

#### 1.4.1.12.2.5 ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST MESSAGE VZ\_REQ\_LTEB13NAC\_23609

#### 1.4.1.12.2.6 NAS MESSAGING FOR NETWORK INITIATED BEARER ACTIVATION - ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST Message VZ\_REQ\_LTEB13NAC\_6463

The network may activate a dedicated bearer for any PDN. If the network activates a dedicated bearer for a given PDN, the device shall be capable of receiving and processing the ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST message per 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*.

#### 1.4.1.13 NAS MESSAGE PIGGYBACKING SUPPORT VZ\_REQ\_LTEB13NAC\_23610

#### 1.4.1.13.1 PDN BEARER ACTIVATION DURING ATTACH VZ\_REQ\_LTEB13NAC\_23611

#### 1.4.1.13.1.1 NAS MESSAGE PIGGYBACKING SUPPORT - PDN BEARER ACTIVATION DURING ATTACH VZ\_REQ\_LTEB13NAC\_6430

The device shall be capable of receiving the ATTACH ACCEPT message, the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the attach PDN, and up to two ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST messages for the attach PDN within the same *RRConnectionReconfiguration* message.

#### 1.4.1.13.2 PDN BEARER ACTIVATION AFTER ATTACH VZ\_REQ\_LTEB13NAC\_23612

#### 1.4.1.13.2.1 NAS MESSAGE PIGGYBACKING SUPPORT - PDN BEARER ACTIVATION AFTER ATTACH VZ\_REQ\_LTEB13NAC\_6431

Upon sending a PDN CONNECTIVITY REQUEST message to the network for a given PDN (after attach), the device shall be capable of receiving the ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message for the given PDN and up to two ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST messages for the given PDN within the same *RRConnectionReconfiguration* message.

#### 1.4.1.14 GUTI REALLOCATION COMMAND VZ\_REQ\_LTEB13NAC\_23613

#### 1.4.1.14.1 GUTI REALLOCATION COMMAND VZ\_REQ\_LTEB13NAC\_6464

The device shall support the GUTI reallocation procedure per section 5.4.1 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. The device shall be capable of receiving the following optional information elements in the GUTI REALLOCATION COMMAND:

- "TAI List"

### 1.4.1.15 SON SUPPORT VZ\_REQ\_LTEB13NAC\_39045

VOID

### 1.4.1.16 NON-CONTENTION BASED RANDOM ACCESS VZ\_REQ\_LTEB13NAC\_23617

#### 1.4.1.16.1 NON-CONTENTION BASED RANDOM ACCESS

VZ\_REQ\_LTEB13NAC\_6467

When receiving an *RRCConnectionReconfiguration* message with the handover command, the device shall support the *RACH-ConfigDedicated* field in the *MobilityControlInfo* IE if present.

The device shall support the *ttbundling* field in the *radioResourceConfigDedicated* IE under *MAC-MainConfig*.

Note: if *ttbundling* is enabled by the source eNB and contention-free RACH is used at the target eNB, the 3rd message (i.e., *RRCConnectionConfigurationComplete* message) during RACH shall use *ttbundling*.

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

### 1.4.1.17 ACCESS BARRING AND ACCESS CLASSES VZ\_REQ\_LTEB13NAC\_23618

#### 1.4.1.17.1 ACCESS BARRING AND ACCESS CLASSES VZ\_REQ\_LTEB13NAC\_6468

The device shall support SIB2 and access barring per 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, including all optional IE's in SIB2.

Devices that support Release 12 or later of the 3GPP standard shall support AC-BarringPerPLMN, and the SIB2 *AC-BarringPerPLMN-List-r12* and *AC-BarringPerPLMN-r12* IE's and all of their mandatory and optional component IE's.

#### 1.4.1.17.2 ACCESS CLASSES AND HIGH PRIORITY ACCESS

VZ\_REQ\_LTEB13NAC\_6469

Per 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, if the access class in the USIM of the device is in the range of 11-15, the device shall specify "highPriorityAccess" as the *establishmentCause* in all *RRCConnectionRequest* messages.

#### 1.4.1.18 LTE FEMTOCELL INTERACTIONS

VZ\_REQ\_LTEB13NAC\_23619

##### 1.4.1.18.1 LTE FEMTOCELL CELL SELECTION/RE-SELECTION

VZ\_REQ\_LTEB13NAC\_23620

##### 1.4.1.18.1.1 LTE FEMTOCELL CELL SELECTION/RE-SELECTION

VZ\_REQ\_LTEB13NAC\_6473

The device shall support cell selection and re-selection with CSG cells per sections 5.2.4.1, 5.2.4.4, 5.2.4.6, 5.2.4.8, and 5.3.1 of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode*.

The device shall support manual CSG selection as specified in section 5.5.1 of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode* and section 5.5.4 of 3GPP TS 22.220: *Service requirements for Home Node B (HNB) and Home eNode B (HeNB)*. The device shall be capable of displaying available CSG cells to the end user through the device user interface or the remote access user interface (for devices operating in a tethered mode).

When a CSG ID which is not included in the device's Allowed CSG List is manually selected by the user, a NAS tracking area update procedure via the selected CSG cell

shall be triggered immediately by the device to enable the network to perform CSG access control.

The device shall support section 5.2.4.9 of the Release 10 version of 3GPP TS 36.304: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode*.

### 1.4.1.18.2 CSG LIST SUPPORT VZ\_REQ\_LTEB13NAC\_23621

#### 1.4.1.18.2.1 CSG LIST SUPPORT VZ\_REQ\_LTEB13NAC\_6474

The device shall support CSG lists as specified in section 5.3.2 of 3GPP TS 22.220: *Service requirements for Home Node B (HNB) and Home eNode B (HeNB)*. This support shall include, but not be limited to, the following:

- The device shall store CSG lists on the USIM as specified in 3GPP TS 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application*.
- The device shall maintain two CSG lists:
  - Allowed CSG List
  - Operator CSG List
- The device shall allow the end user to add new CSG's to the Allowed CSG List through the manual CSG selection process.

### 1.4.1.18.3 MOBILITY BETWEEN CSG AND HYBRID CELLS

VZ\_REQ\_LTEB13NAC\_23622

#### 1.4.1.18.3.1 MOBILITY BETWEEN CSG AND HYBRID CELLS

VZ\_REQ\_LTEB13NAC\_6475

The device shall support mobility to and from CSG and hybrid cells as specified in section 10.5 of 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2*.



## 1.4.1.18.4 RRC AND RRM SUPPORT FOR FEMTOCELLS AND CSG CELLS

VZ\_REQ\_LTEB13NAC\_23623

### 1.4.1.18.4.1 ~~SIB1 AND SIB9 SUPPORT~~

VZ\_REQ\_LTEB13NAC\_23624

### 1.4.1.18.4.2 RRC AND RRM SUPPORT FOR FEMTOCELLS AND CSG CELLS - SIB1 and SIB9 Support

VZ\_REQ\_LTEB13NAC\_6476

The device shall supporting and processing the following information elements in SystemInformationBlockType1 (SIB1) per 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*:

- "cellIdentity", i.e. E-CGI.
- "csg-Indication"
- "csg-Identity"

The device shall supporting and processing the following information elements in SystemInformationBlockType9 (SIB9) per 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*:

- "hnb-Name", i.e. the home eNB name.

### 1.4.1.18.4.3 PROXIMITY INDICATION

VZ\_REQ\_LTEB13NAC\_23625

### 1.4.1.18.4.4 RRC AND RRM SUPPORT FOR CSG CELLS - Proximity Indication

VZ\_REQ\_LTEB13NAC\_6477

The device shall send a ProximityIndication message to the network whenever it detects or leaves the presence of CSG or hybrid cells if configured by the network to do so per section 5.3.14 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* and section 10.5.1.2 of

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

**1.4.1.18.4.5 AUTONOMOUS GAPS** VZ\_REQ\_LTEB13NAC\_23626

**1.4.1.18.4.6 RRC AND RRM SUPPORT FOR FEMTOCELLS AND CSG CELLS - Autonomous Gaps** VZ\_REQ\_LTEB13NAC\_6478

When directed to do so by the network, the device shall acquire system information and measurement information of targeted cells using autonomous gaps per section 5.5.3.1 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification* and per 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management.*

**1.4.1.18.4.7 MEASUREMENT REPORTING** VZ\_REQ\_LTEB13NAC\_23627

**1.4.1.18.4.8 RRC AND RRM SUPPORT FOR FEMTOCELLS AND CSG CELLS - Measurement Reporting** VZ\_REQ\_LTEB13NAC\_6479

When directed by the network to do so during handover procedures, the device shall provide the following information in a measurement report for a target HeNB per section 10.5.1.2 of 3GPP TS 36.300: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2* and section 5.5.5 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification:*

- *cellGlobalID* (e-CGI)
- *trackingAreaCode*
- *csgIdentity*
- *csgMemberStatus*

## 1.4.1.18.5 FEMTOCELL CONNECTIVITY INDICATOR VZ\_REQ\_LTEB13NAC\_23629

### 1.4.1.18.5.1 FEMTOCELL CONNECTIVITY INDICATOR

VZ\_REQ\_LTEB13NAC\_6484

When a device is attached to the Verizon Wireless LTE network via an eNB whose ID (20 most significant bits of ECI) is within the range 1,024,000 to 1,048,575, the device shall provide an indicator (visual or audible) that the device is currently accessing the Verizon Wireless LTE network via a femtocell.

## 1.4.1.19 MEASUREMENT REPORTING VZ\_REQ\_LTEB13NAC\_35801

### 1.4.1.19.1 Measurement Reporting VZ\_REQ\_LTEB13NAC\_35802

When reporting measurement results (as per 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*), the device shall include the following optional fields in the *MeasResults* information element:

- plmn-IdentityList

When scanning and reporting based on the measurement report trigger configured by EUTRAN (per definition in section 5.5.4, 5.5.5 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*), the UE shall use the following scanning and reporting order of frequencies/bands: measObjectID associated with the smallest measID will be scanned earlier (measIDs are listed in the MeasIdToAddModList presented in measConfigIE). The order configured by the EUTRAN shall be reflected in UE's stored measurement configuration in VarMeasConfig.

## 1.4.1.20 RRC CONNECTION STATE MISMATCH BETWEEN THE UE

**AND NETWORK** VZ\_REQ\_LTEB13NAC\_36237**1.4.1.20.1 RRC CONNECTION STATE MISMATCH BETWEEN THE UE AND NETWORK** VZ\_REQ\_LTEB13NAC\_36238

If the device is in RRC\_CONNECTED state and receives a paging message from the network, the device shall assume an RRC connection state mismatch has occurred between the device and the network, and the device shall take the following corrective action:

- After RRC connection is established, the device shall wait a configurable delay. During that delay, any paging message towards the UE shall be ignored. After the delay expires, UE shall start to process paging message towards the UE. If paged, the UE shall transition to RRC\_IDLE state and initiate a new RRC connection request to respond to the page from the network.
- This delay shall be configurable from 0 to 10 seconds in 1 second increments on the device via a non-volatile memory setting. The default setting for the delay shall be 5 seconds. The vendor shall provide a lab application to modify this delay setting during device acceptance testing. The device vendor shall not allow the user to modify this delay setting through the device user interface or the remote access user interface for tethered devices.

**1.4.1.21 LOW PRIORITY ACCESS & DELAY TOLERANT UE FEATURE SUPPORT** VZ\_REQ\_LTEB13NAC\_36994**1.4.1.21.1 Low Priority Access & Delay Tolerant UE Feature Support**  
VZ\_REQ\_LTEB13NAC\_36995

**NOTE:** This requirement only applies to certain data-centric M2M devices and internet-of-things devices.

The device shall support the handling of NAS signalling low priority indication as per Section 4.2A of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. The device shall only use low priority indication if indicated to do so based on the contents of the NAS configuration management object,

EFNASCONFIG , in the UICC as specified in 3GPP TS 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application* and 3GPP TS 24.368: *Non-Access Stratum (NAS) configuration Management Object (MO)*.

If the device is configured for low priority access as described above, the device shall support the use of the RRC connection *establishmentCause* delayTolerantAccess as specified in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3* and 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*. If the device is configured for low priority access as described above, the device shall support the handling of the *extendedWaitTime* parameter in the *RRCConnectionReject* and *RRCConnectionRelease* messages as defined in 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*. The device shall only use low priority indication if indicated to do so based on the contents of the NAS configuration management object, EFNASCONFIG , in the UICC as specified in 3GPP TS 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application* and 3GPP TS 24.368: *Non-Access Stratum (NAS) configuration Management Object (MO)*.

If the device is configured for low priority access as described above, the device shall support SIB14 and Extended Access Barring as defined in 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*. The device shall only use Extended Access Barring if indicated to do so based on the contents of the NAS configuration management object, EFNASCONFIG, in the UICC as specified in 3GPP TS 31.102: *Characteristics of the Universal Subscriber Identity Module (USIM) application* and 3GPP TS 24.368: *Non-Access Stratum (NAS) configuration Management Object (MO)*.

The device may support dual priority as specified in 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*. The device shall only use dual priority if it is configured for low access priority and Extended Access Barring and is also configured for override of low access priority and Extended Access Barring, based on the contents of the NAS configuration management object, EFNASCONFIG, in the USIM as specified in 3GPP TS 24.368: *Non-Access Stratum (NAS) configuration Management Object (MO)*. For devices supporting dual priority, only certain non-delay-tolerant applications may be permitted for overriding low access priority and Extended Access Barring restrictions, and the usage of overriding low access priority and Extended Access Barring, such as the amount of PDN connection activations and RRC connection requests and the duration of PDN connections and RRC connections with low access priority and Extended Access Barring overridden, shall be agreed upon with Verizon Wireless. Device vendors must contact Verizon Wireless prior to implementing dual priority on any devices.

### 1.4.1.21.2 Power Saving Mode (PSM) VZ\_REQ\_LTEB13NAC\_40930

**NOTE:** This requirement only applies to certain data-centric M2M devices and internet-of-things devices.

Machine-to-Machine (M2M) and Internet of Things (IoT) devices that are data-centric and do NOT support voice operation may request the use of Power Saving Mode (PSM).

If the device supports PSM and wants to use PSM, it shall request PSM in every ATTACH REQUEST and TRACKING AREA UPDATE REQUEST message by including the Active Time (T3324) value IE. It is recommended that the device also include the Periodic TAU Timer (T3412) extended value IE. The requested Active Time value and Periodic TAU Timer value shall be set based on device application needs. When the T3412 extended value IE is included, it shall be set to a value no lower than 186 minutes, to avoid excessive periodic TAU exchanges. If the device application cannot tolerate mobile termination (MT) delay of 186 minutes or higher, it shall not request PSM, and may use extended idle-mode DRX (eDRX) for power saving purpose. Refer to VZ\_REQ\_LTEB13NAC\_4355562 for details on eDRX.

The device shall use the Active Time value provided by the network in the last ATTACH ACCEPT or TRACKING AREA UPDATE ACCEPT message. The device shall NOT use PSM if the network does not include a value for Active Time in the last ATTACH ACCEPT or TRACKING AREA UPDATE ACCEPT message.

Refer to sections 5.1.3.2.4.7, 5.3.11, 5.5.1.2.2, 5.5.1.2.4, 5.5.3.2.2, 5.5.3.2.4 of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, and section 4.7.2.8 of 3GPP TS 24.008: *Mobile radio interface Layer 3 specification; Core network protocols; Stage 3* for additional details of PSM operation.

The device modem shall provide an interface to the application layer such that applications can request the use of PSM and/or request to stop using PSM, set or change the requested Active Time value and Periodic TAU Timer value, query the Active Time value and Periodic TAU Timer value requested by device, and query the Active Time value and Periodic TAU Timer value provided by network and in use by device for PSM activation/deactivation.

The device shall support AT commands for PSM per sections 7.38, 10.1.22 of the Release 12 version of 3GPP TS 27.007: *AT command set for User Equipment (UE)*.

The device vendor shall provide a test application (for use during device acceptance testing) to request the use of PSM and/or request to stop using PSM, to set or change the requested Active Time value and Periodic TAU Timer value, to query the Active

Time value and Periodic TAU Timer value requested by device, and to query the Active Time value and Periodic TAU Timer value provided by network and in use by the device.

### 1.4.1.21.3 EXTENDED IDLE-MODE DRX VZ\_REQ\_LTEB13NAC\_4355562

**NOTE:** This requirement only applies to certain M2M devices and internet-of-things (IoT) devices.

Machine-to-Machine (M2M) and Internet of Things (IoT) devices may request the use of extended idle-mode DRX (idle mode eDRX), to reduce power consumption.

If the device supports idle mode eDRX and wants to use idle mode eDRX, it shall request idle mode eDRX in every ATTACH REQUEST and TRACKING AREA UPDATE REQUEST message by including the Extended DRX parameters IE. The requested eDRX value shall be set based on device application needs, for example by considering the delay tolerance of the mobile terminating services on the device. The device shall request eDRX values that are within the ranges defined in 3GPP TS 24.008 section-10.5.5.32

The device shall use the Extended DRX parameter values provided by the network in the last ATTACH ACCEPT or TRACKING AREA UPDATE ACCEPT message. The device shall NOT use idle mode eDRX if the network does not include the Extended DRX parameters IE in the last ATTACH ACCEPT or TRACKING AREA UPDATE ACCEPT message.

Refer to Sections 5.3.12, 5.5.1.2.2, 5.5.1.2.4, 5.5.3.2.2, 5.5.3.2.4 and 5.6.2.2.1.1 of the Release 13 version of 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*, and Section 10.5.5.32 of the Release 13 version of 3GPP TS 24.008: *Mobile radio interface Layer 3 specification; Core network protocols; Stage 3*.

When configured by NAS layer to use idle mode eDRX, the device shall only use idle mode eDRX if idle mode eDRX is allowed in the cell that the UE camps on, as indicated in SIB1 or SIB1-BR, per Release 13 version of 3GPP TS 36.331. The device shall stop using idle mode eDRX if idle mode eDRX is not allowed in the cell.

When the device is in idle mode eDRX, the device shall monitor paging per Section 7.3 of the Release 13 version of 3GPP TS 36.304, shall perform system information modification per Sections 5.2.1.3, 5.2.2.4 and 5.3.2.3 of the Release 13 version of 3GPP TS 36.331, and shall perform cell reselection per the Radio Resource Management requirements in Section 4.2.2 of the Release 13 version of 3GPP TS 36.133.

The device modem shall provide an interface to the application layer such that applications can request the use of idle mode eDRX and/or request to stop using idle mode eDRX, set or change the requested Extended DRX parameter values, query the Extended DRX parameter values requested by device, and query the Extended DRX parameter values provided by the network and in use by device.

The device shall support the AT commands for idle mode eDRX, per Sections 7.40 and 7.41 of the Release 13 version of 3GPP TS 27.007: *AT command set for User Equipment (UE)*.

The device vendor shall provide a means (for example a test application) to test idle mode eDRX in device acceptance testing. It shall provide capabilities to request the use of idle mode eDRX and/or request to stop using idle mode eDRX, to set or change the requested Extended DRX parameter values, to query the Extended DRX parameter values requested by device, and to query the Extended DRX parameter values provided by network and in use by the device.

#### 1.4.1.22 LTE DOWNLINK MONITORING VZ\_REQ\_LTEB13NAC\_38506

##### 1.4.1.22.1 Downlink Supervision Failures VZ\_REQ\_LTEB13NAC\_38507

For all downlink supervision failures that are NOT defined in 3GPP (section 5.3.11 of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*) during RRC-CONNECTED mode (before or after HO, including MIB/SIB read failure), the device shall consider the cell (the EARFCN/PCI where the device failed downlink supervision) for connectivity/selection/reselection purpose no later than a configurable delay after the failure (for example, continue RRC connection without any interruption fulfills this requirement). This delay shall be configurable from 0 to 10 seconds in 1 second increments on the device via a non-volatile memory setting. The default setting for the delay shall be 5 seconds. The vendor shall provide a lab application to modify this delay setting during device acceptance testing. The device vendor shall not allow the user to modify this delay setting through the device user interface or the remote access user interface for tethered devices.

##### 1.4.1.22.2 Non-Essential SIB Information VZ\_REQ\_LTEB13NAC\_38508



In RRC-CONNECTED mode, any non-essential system information detection failure (non-essential system information are any system information other than *MasterInformationBlock*, *SystemInformationBlockType1*, and *SystemInformationBlockType2*) shall NOT trigger downlink supervision failure and shall not cause any interruption of an existing RRC connection.

## 1.4.2 UICC ERROR CONDITIONS VZ\_REQ\_LTEB13NAC\_40796

### 1.4.2.1 NO UICC PRESENT or UICC REMOVED VZ\_REQ\_LTEB13NAC\_40797

If no UICC is present or if the device cannot detect a UICC that is present, then the device shall not attempt to access any LTE network.

The device shall detect the removal of the UICC from the device within 30 seconds of removal.

If the device detects that the UICC has been removed while the device is connected to a LTE network, then the device shall immediately cease operation on the LTE network except for the exception noted below. The device shall detach from any LTE network that it was attached to at the time of UICC removal. All normal LTE detach procedures per this document shall apply (refer to VZ\_REQ\_LTEB13NAC\_6374 and VZ\_REQ\_LTEB13NAC\_6375 for additional details). The device shall not attempt to access any LTE network until a UICC is inserted except for the exception noted below.

**EXCEPTION:** The device shall allow emergency calling regardless of whether a UICC is inserted or not.

## 1.5 PROVISIONING VZ\_REQ\_LTEB13NAC\_1885

### 1.5.1 LTE CREDENTIAL STORAGE VZ\_REQ\_LTEB13NAC\_1886

### 1.5.1.1 ~~LTE CREDENTIAL STORAGE~~ VZ\_REQ\_LTEB13NAC\_6383

~~LTE credentials to enable network access shall be stored on the UICC. The device shall retrieve the LTE credentials that are stored in the USIM as defined in 3GPP 31.102: Characteristics of the Universal Subscriber Identity Module (USIM) application.~~

### 1.5.2 PROVISIONING SEQUENCE VZ\_REQ\_LTEB13NAC\_1887

#### 1.5.2.1 PROVISIONING SEQUENCE VZ\_REQ\_LTEB13NAC\_6384

The device shall support provisioning/updates to the UICC/USIM using the Envelope SMS-PP Data Download as per 3GPP TS 31.111: *Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)* and the Bearer Independent Protocol-related class E commands as specified in ETSI TS 102 223: *Smart cards; Card Application Toolkit (CAT), Release 8*.

**NOTE:** The device shall implement the BIP connection establishment and processing exclusively on the baseband processor of the modem (as opposed to on an application processor in the device).

### 1.5.3 ~~SPECIFIC LTE PROGRAMMING PARAMETERS~~ VZ\_REQ\_LTEB13NAC\_1888

~~Verizon Wireless implementation details are in development. Additional details will be included in a future release.~~

### 1.5.4 FACTORY LTE PROGRAMMING VZ\_REQ\_LTEB13NAC\_1889

#### 1.5.4.1 ~~APN'S~~ VZ\_REQ\_LTEB13NAC\_23652

### 1.5.4.1.1 FACTORY LTE PROGRAMMING - APN'S VZ\_REQ\_LTEB13NAC\_6385

When the device is operated with a Verizon Wireless UICC, the device shall comply with the requirements in this section. APNs for the IMS PDN, the Administrative PDN, the Internet PDN, and the VZW Application PDN shall be stored on the device in non-volatile memory and factory provisioned with the

- APN Class
- APN Network Identifier
- APN IP Type
- APN Bearer
- APN Enable/Disable
- APN MAXCONN, MAXCONN\_T, WAIT\_TIME

detailed in the table below:

| APN Class       | APN NI      | APN IP Type ** | APN Bearer | APN Enable/Disable | APN   | APN WAIT_TIME <sup>+</sup> | Description                         |
|-----------------|-------------|----------------|------------|--------------------|---|----------------------------|-------------------------------------|
|                 |             |                |            |                    | MAX_CONN <sup>+</sup> and MAX_CONN_T <sup>+</sup> |                            |                                     |
| 1 <sup>++</sup> | IMS         | IPv4v6         | LTE        | Enabled            | MAX_CONN: 20<br>MAX_CONN_T: 300                   | 0                          | Verizon Wireless IMS PDN            |
| 2               | VZWADMIN    | IPv4v6         | LTE        | Enabled            | MAX_CONN: 20<br>MAX_CONN_T: 300                   | 0                          | Verizon Wireless Administrative PDN |
| 3               | VZWINTERNET | IPv4v6         | LTE        | Enabled            | MAX_CONN: 20<br>MAX_CONN_T: 300                   | 0                          | Verizon Wireless Internet PDN       |
| 4               | VZWAPP      | IPv4v6         | LTE        | Enabled*           | MAX_CONN: 20<br>MAX_CONN_T: 300                   | 0                          | Verizon Wireless Application PDN    |

\* Per the *UE PDN Support* section of this document, the Verizon Wireless Application PDN applies to handset form factor devices only (i.e. devices that support operation against the head). All other devices (i.e. devices that do not support operation against

the head) shall set the APN Enable/Disable for the Verizon Wireless Application PDN to "Disable".

\*\* Per the *Scenarios* section of this document, the device shall set the "PDN Type" to *IPv4v6* for all PDN CONNECTIVITY REQUEST messages regardless of the Type listed in the table above. For the IMS PDN, the network will most likely only provide an IPv6 address.

+ MAX\_CONN, MAX\_CONN\_T, and WAIT\_TIME are per the Verizon Wireless LTE Data Retry Requirements. **NOTE:** These parameters are not configurable via OTADM.

++ Applies to IMS capable devices ONLY. Devices that do NOT support IMS shall NOT populate this row in the APN table.

The device shall provide the capability of updating all APN parameters in the table above through OTADM except MAX\_CONN, MAX\_CONN\_T, and WAIT\_TIME (i.e. MAX\_CONN, MAX\_CONN\_T, and WAIT\_TIME are NOT OTADM configurable). Refer to the *OTADM* section of this document for additional details. The device shall not allow the user to update the following APN related parameters through the device user interface or the remote access user interface for tethered devices:

- APN Class
- APN IP Type
- APN Bearer
- APN Enable/Disable
- APN MAXCONN, MAXCONN\_T, WAIT\_TIME

If any APN parameter in the table above is updated after a PDN connection using the APN has been established, the device shall release the PDN connection and then immediately re-establish the PDN connection using the updated APN parameter(s). If any APN parameter in the table above is updated for an APN for which the device has no current PDN connection, the device shall use the updated APN parameter(s) in all future PDN connections using the APN. Refer to the *Scenarios* section of this document for additional details.

The device shall maintain the contents of the APN table during a device software update, i.e. the contents of the APN table after the software update shall be the same as before the software update.

### 1.5.4.2 SMS FORMAT PARAMETER VZ\_REQ\_LTEB13NAC\_23653

### 1.5.4.2.1 FACTORY LTE PROGRAMMING - SMS FORMAT PARAMETER VZ\_REQ\_LTEB13NAC\_6386

IMS capable devices shall store the smsformat parameter described in the table below in non-volatile memory. This parameter shall be factory provisioned with the parameter set to "3gpp2". Refer to the Verizon Wireless LTE SMS Requirements for additional details.

| Parameter | Value | Description   |
|-----------|-------|---|
| smsformat | 3gpp2 | The device shall use 3GPP2 SMS format per 3GPP2 C.S0015-A v1.0 "Short Message Service (SMS) for Wideband Spread Spectrum Systems" for SMS over IMS (i.e. SMS messages sent from the device using SMS over IMS)                        |
|           | 3gpp  | The device shall use 3GPP SMS format per 3GPP TS 23.204: Support of Short Message Service (SMS) over generic 3GPP Internet Protocol (IP) access; Stage 2 for SMS over IMS (i.e. SMS messages sent from the device using SMS over IMS) |

**NOTE:** For SMS over NAS, this requirement does NOT apply. SMS over NAS always uses 3GPP format.

## 1.5.5 USER LTE PROGRAMMING VZ\_REQ\_LTEB13NAC\_1890

### 1.5.5.1 SMSWRITEUICC PARAMETER VZ\_REQ\_LTEB13NAC\_23654

VOID

### 1.5.5.1.1 USER LTE PROGRAMMING - SMSWRITEUICC PARAMETER VZ\_REQ\_LTEB13NAC\_6387

The device shall store the user configurable parameter `smswriteuicc` as described in the table below in non-volatile memory. Refer to the Verizon Wireless LTE SMS Requirements for additional details.

| Parameter    | Value | Description   |
|--------------|-------|---|
| smswriteuicc | On    | The device shall store 3GPP formatted SMS text messages on the UICC. Refer to the Verizon Wireless LTE SMS Requirements for additional details.   |
|              | Off   | The device shall store 3GPP formatted SMS text messages on the device. Refer to the Verizon Wireless LTE SMS Requirements for additional details. |

## 1.6 PERFORMANCE - Cat 1 and Higher Devices VZ\_REQ\_LTEB13NAC\_1891

### 1.6.1 LTE UE MINIMUM PERFORMANCE REQUIREMENTS

VZ\_REQ\_LTEB13NAC\_1892

- Test environments for 3GPP standard RF and signaling conformance shall be 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.*

#### 1.6.1.1 LTE RF AND RRM CONFORMANCE REQUIREMENTS VZ\_REQ\_LTEB13NAC\_23655

##### 1.6.1.1.1 LTE RF AND RRM CONFORMANCE REQUIREMENTS

VZ\_REQ\_LTEB13NAC\_6388

The device shall meet all RF and RRM conformance requirements for 3GPP Release 9, including all RF and RRM requirements and conformance test cases defined in:

- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*
- 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management*
- 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*
- 3GPP TS 36.521-3: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management conformance testing*

with the following exceptions:

- The value used in RF conformance testing (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*) for REFSSENS for a 10 MHz channel in 3GPP Band 13 shall be -97 dBm with an uplink RB allocation of 15 RB starting at RB 0. Refer to the *Receiver Sensitivity QPSK Modulation* section of this document for additional details.
- The tolerance for the UE power class 3 in Table 6.2.2-1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* for 3GPP Band 13 shall be +2/-1 dB. Refer to the *Maximum Conducted Output Power* section of this document for additional details.
- For 3GPP Band 13 operation, Table 6.2.5-1 in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* shall be replaced with the table in the *Configured Output Power* section of this document.

**NOTE 1:** 3GPP Band 13 is not included under Note 2 in Table 6.2.2-1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*. As a result, the 1.5 dB relaxation in the transmitter requirements below for uplink allocations within 4 MHz of a band edge are not applicable to LTE 3GPP Band 13 devices:

- UE maximum output power (section 6.2.2 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*)
- Configured transmitted power (section 6.2.5 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*)
- Power control (section 6.3.5 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*)

**NOTE 2:** All transmitter signal quality and transmitter emissions requirements defined by 3GPP in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*) that are **relative measurements** (e.g. carrier leakage, in-band emissions, adjacent channel leakage ratio, etc.) shall be met both conducted (at the UE antenna ports) **and radiated**.

### 1.6.1.2 ~~LTE SIGNALING CONFORMANCE~~ VZ\_REQ\_LTEB13NAC\_23656

#### 1.6.1.2.1 LTE SIGNALING CONFORMANCE VZ\_REQ\_LTEB13NAC\_6389

The device shall meet all signaling requirements for 3GPP Release 9, including all signaling requirements and conformance test cases defined in:

- 3GPP TS 36.523-1: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification*
- The Verizon Wireless LTE Supplementary Signaling Conformance Test Plan

### 1.6.1.3 ~~GCF CERTIFICATION~~ VZ\_REQ\_LTEB13NAC\_23657

#### 1.6.1.3.1 GCF CERTIFICATION VZ\_REQ\_LTEB13NAC\_6390

The device shall be GCF certified for LTE operation in Band 13. Refer to the Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process for additional details.

## 1.6.2 VERIZON WIRELESS-SPECIFIC LTE 3GPP BAND 13 RF PERFORMANCE REQUIREMENTS VZ\_REQ\_LTEB13NAC\_1893

Verizon Wireless-specific RF performance requirements for 3GPP Band 13 build on the RF minimum performance requirements in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and*



reception. Compliance to all Verizon Wireless-specific LTE 3GPP Band 13 RF performance requirements shall be per the Verizon Wireless LTE 3GPP Band 13 Supplementary RF Conformance Test Plan unless indicated otherwise.

## 1.6.2.1 MAXIMUM TRANSMITTER OUTPUT POWER AND CONFIGURED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_23658

### 1.6.2.1.1 ~~MAXIMUM CONDUCTED OUTPUT POWER~~ VZ\_REQ\_LTEB13NAC\_23659

#### 1.6.2.1.1.1 MAXIMUM CONDUCTED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_6391

The device shall be a UE Power Class 3 device with the following exception: the device conducted output power shall be +22 dBm minimum for all resource block (RB) allocations in a 10 MHz channel where the allowable Maximum Power Reduction (MPR) and Additional Maximum Power Reduction (A-MPR) are both 0 dB (for cases where MPR and A-MPR is applicable, the output power may be reduced by the corresponding values of MPR and A-MPR).

Maximum Power Reduction (MPR) may be applied based on RB allocation size and modulation type per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

### 1.6.2.1.2 ~~MAXIMUM RADIATED OUTPUT POWER~~ VZ\_REQ\_LTEB13NAC\_23660

#### 1.6.2.1.2.1 MAXIMUM RADIATED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_6392

The Total Radiated Power (TRP) shall meet the requirements in the table below for all RB allocations in a 10 MHz channel where the allowable MPR and A-MPR are both 0 dB (for cases where MPR and A-MPR is applicable, the values in the table may be reduced by the corresponding values of MPR and A-MPR).

These requirements apply for all valid mechanical use modes of the device, all antenna types, and for both the antenna extended or retracted in the case of devices with retractable antennas. Valid mechanical modes comprise all the mechanical use modes for the device that an end user would be expected to encounter in the course of normal operation of the device. Radiated output power testing shall be per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan.

For any mode in which the device supports voice operation against the head, the device shall meet the requirements in the table below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Head with right hand phantom, i.e. beside head and hand right side (BHHR)
- Head with left hand phantom, i.e. beside head and hand left side (BHHL)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

**NOTE:** If the device supports voice operation against the head in a given mechanical mode and is wider than 72mm, then the device shall be tested using the CTIA wide grip hand phantom, and the BHHR/BHHL and HR/HL requirements below shall apply.

In the case of devices that support operation against the head in at least one mode, for any mode in which the device does not support voice operation against the head but does support data operation, the device shall meet the requirements in the table below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

For data-centric devices that do not support voice operation against the head, the device shall meet the requirements in the table below for all valid mechanical modes of the device for the following:

- Free space (FS)

The conducted output power of devices submitted for Verizon Wireless over-the-air performance testing shall not exceed the conducted output power of devices submitted for FCC SAR testing. If the conducted output power of devices submitted for Verizon Wireless over-the-air performance testing exceed the conducted output power of devices submitted for FCC SAR testing, Verizon Wireless will adjust the TRP results downward accordingly to determine compliance to Verizon Wireless TRP requirements.

| Device Held Up to Head (Yes/No) | Antenna Type        | Device Mode | 3GPP Band 13 (dBm, Minimum) |                  |           |       |
|---------------------------------|---------------------|-------------|-----------------------------|------------------|-----------|-------|
|                                 |                     |             | FS                          | BH (BHL and BHR) | BHHR/BHHL | HR/HL |
|                                 |                     |             | Yes <sup>(1)</sup>          | Embedded         | LTE       | +18   |
|                                 | Stub Or Retractable | LTE         | +19                         | +16              | +11       | +16   |
| No <sup>(2)</sup>               | All                 | LTE         | +18                         | N/A              | N/A       | N/A   |

(1) "Yes" applies if the device supports a mode of operation against the head.

(2) "No" would be applicable to data centric devices that are not held up to the head, e.g. data cards, USB dongles, embedded laptop modules, etc.

### 1.6.2.1.2.2 ~~RADIATED OUTPUT POWER REDUCTION FOR TABLETS~~

VZ\_REQ\_LTEB13NAC\_23664

### 1.6.2.1.2.3 Radiated Output Power Reduction for Tablets

VZ\_REQ\_LTEB13NAC\_6481

Tablet devices may reduce radiated output power to meet FCC SAR requirements. If radiated output reduction is implemented in a tablet device, the tablet device shall meet the following requirements:

- The tablet device shall implement a proximity sensor such that radiated output power reduction is only applied when the tablet device is in close proximity to a human body. The tablet device shall not apply radiated output power reduction when the tablet device is not in close proximity to a human body (e.g. lying on a table).
- The tablet device shall be designed such that the radiated output power reduction needed to meet FCC SAR requirements for LTE operation in 3GPP Band 13 shall not exceed 7 dB.
- The device vendor shall provide a lab application to apply the radiated output power reduction setting during device acceptance testing. The device vendor shall not allow the user to modify the radiated output power setting through the device user interface or the remote access user interface for tethered devices.
- TRP shall be measured and reported with and without the radiated output power reduction applied.

### 1.6.2.1.3 CONFIGURED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_23662

#### 1.6.2.1.3.1 CONFIGURED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_6393

The device shall meet the requirements in section 6.2.5 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* with the following exception. For 3GPP Band 13 operation, Table 6.2.5-1 in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* shall be replaced with the table below:

| PCMAX (dBm)       | Tolerance T(PCMAX) (dB) |
|-------------------|-------------------------|
| 21 <= PCMAX <= 23 | +2.0/-1.0               |
| 0 <= PCMAX < 21   | +/- 2.0                 |
| -40 <= PCMAX < 0  | +/- 7.0                 |

## 1.6.2.2 TRANSMITTER EMISSIONS AND TRANSMIT SIGNAL QUALITY

VZ\_REQ\_LTEB13NAC\_23663

### 1.6.2.2.1 NS\_06 EMISSIONS

VZ\_REQ\_LTEB13NAC\_23664

#### 1.6.2.2.1.1 NS\_06 EMISSIONS

VZ\_REQ\_LTEB13NAC\_6394

When attached to the Verizon Wireless LTE network using 3GPP Band 13, the device shall at all times meet the additional spectrum emissions requirements associated with a network signaled value of "NS\_06" per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*. The NS\_06 emissions mask insures compliance with FCC Part 27 requirements.

### 1.6.2.2.2 NS\_07 EMISSIONS

VZ\_REQ\_LTEB13NAC\_23665

#### 1.6.2.2.2.1 NS\_07 EMISSIONS

VZ\_REQ\_LTEB13NAC\_6395

When signaled by the network, the device shall meet the additional spectrum and spurious emissions requirements associated with a network signaled value of "NS\_07" per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

Additional Maximum Power Reduction (A-MPR) may be applied to meet the additional spurious emissions requirement per section 6.2.4 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* with the following exception: For 3GPP Band 13 operation of devices that support voice operation and are LTE category 2 or higher, Table 6.2.4-2 in 3GPP TS

36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* shall be replaced with the table below:

| Parameters               | Region A | Region B |       | Region C |
|--------------------------|----------|----------|-------|----------|
| RB_start <sup>1</sup>    | 0 - 12   | 13-18    | 19-42 | 43-49    |
| L_CRB <sup>2</sup> [RBs] | >= 16    | >= 25    | <= 30 | <= 7     |
| A-MPR [dB]               | <= 4     | <= 3     | 0     | 0        |

Note

1. RB\_start indicates the lowest RB index of transmitted resource blocks
2. L\_CRB is the length of a contiguous resource block allocation
3. For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.
4. For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe.

**NOTE:** Devices that do NOT support voice operation against the head may apply A-MPR as defined in Table 6.2.4-2 per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*. Category 1 devices that support voice operation against the head may apply A-MPR as defined in Table 6.2.4-2 per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

If NS\_07 is deployed in a cell, Verizon Wireless will also allow the network option to implement PUCCH (Physical Uplink Control Channel) over-provisioning in that cell. As a result, the device shall support PUCCH over-provisioning. In the NS\_07 with PUCCH over-dimensioning scenario, the RBs used for transmitting the PUCCH would be within Region B (refer to the NS\_07 A-MPR table in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* for a description of the regions). Unused or "blanked" PUCCH RBs in Regions A and C would be re-allocated for PUSCH (Physical Uplink Shared Channel) transmission. *Verizon Wireless deployment details are in development. Additional details will be included in a future release.*

**1.6.2.2.3 SPURIOUS EMISSIONS FOR UE CO-EXISTENCE WITH OTHER 3GPP FREQUENCY BANDS** VZ\_REQ\_LTEB13NAC\_23666

**1.6.2.2.3.1 SPURIOUS EMISSIONS FOR UE CO-EXISTENCE WITH OTHER 3GPP FREQUENCY BANDS** VZ\_REQ\_LTEB13NAC\_6396

The device shall meet the requirements in the table below for emissions into other 3GPP frequency bands. These emission requirements shall apply to UE transmitter emissions into the downlink bands of 3GPP Bands 2, 4, 5, 10, 12, 14, and 17 (3GPP band definition is per 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*).

| Uplink RB Allocation Size | UE Transmit Power          | Emission Requirement |
|---------------------------|----------------------------|----------------------|
| <= 15 RB                  | <= Maximum UE output power | <= -60 dBm/MHz       |
| > 15 RB and <= 50 RB      | <= +10 dBm                 | <= -60 dBm/MHz       |
| > 15 RB and <= 50 RB      | > +10 dBm                  | <= -50 dBm/MHz       |

**1.6.2.2.4 UE TRANSMITTER LO AND IMAGE SUPPRESSION** VZ\_REQ\_LTEB13NAC\_23667

**1.6.2.2.4.1 UE TRANSMITTER LO AND IMAGE SUPPRESSION** VZ\_REQ\_LTEB13NAC\_6397

The device shall meet the requirements in the table below for transmitter LO and image suppression.

| UE Transmitter Output Power | Limit |       |
|-----------------------------|-------|-------|
|                             | LO    | Image |
|                             |       |       |

|                                   |         |        |
|-----------------------------------|---------|--------|
| Output power > 0 dBm              | -28 dBc | -30 dB |
| -30 dBm <= Output power <= 0 dBm  | -20 dBc | -25 dB |
| -40 dBm <= Output power < -30 dBm | -10 dBc | -25 dB |

### 1.6.2.2.5 ~~SPURIOUS EMISSIONS FOR UE CO-EXISTENCE WITH GPS~~ VZ\_REQ\_LTEB13NAC\_23668

#### 1.6.2.2.5.1 SPURIOUS EMISSIONS FOR UE CO-EXISTENCE WITH GPS VZ\_REQ\_LTEB13NAC\_6398

The device shall meet the requirements in the table below for transmitter emissions into the GPS frequency band for all uplink RB allocations and output power levels.

| Frequency                | Emission Requirement |
|--------------------------|----------------------|
| 1559.00 MHz -1574.42 MHz | <= -60 dBm/MHz       |
| 1574.42 MHz -1576.42 MHz | <= -80 dBm/MHz       |
| 1576.42 MHz -1610.00 MHz | <= -60 dBm/MHz       |

### 1.6.2.3 RECEIVER SENSITIVITY QPSK MODULATION VZ\_REQ\_LTEB13NAC\_23669

#### 1.6.2.3.1 ~~CONDUCTED SENSITIVITY~~ VZ\_REQ\_LTEB13NAC\_23670

##### 1.6.2.3.1.1 CONDUCTED SENSITIVITY VZ\_REQ\_LTEB13NAC\_6399



The device conducted reference sensitivity (with QPSK modulation) shall meet the requirements in the table below for a 10 MHz channel bandwidth:

| Maximum Sensitivity                                | Uplink RB Allocation Size | Minimum UE Transmit Power |
|--|---------------------------|---------------------------|
| -97 dBm, Dual Receiver<br>-94 dBm, Single Receiver | <= 12 RB                  | +22 dBm (QPSK)            |
| -97 dBm, Dual Receiver<br>-94 dBm, Single Receiver | > 12 RB and <= 15 RB      | +21 dBm (QPSK)            |
| -97 dBm, Dual Receiver<br>-94 dBm, Single Receiver | > 15 RB and <= 50 RB      | +0 dBm (QPSK)             |

Single receiver testing is per the Verizon Wireless LTE 3GPP Band 13 Supplementary RF Conformance Test Plan.

### 1.6.2.3.2 ~~RADIATED SENSITIVITY~~ VZ\_REQ\_LTEB13NAC\_23674

#### 1.6.2.3.2.1 RADIATED SENSITIVITY VZ\_REQ\_LTEB13NAC\_6400

*For devices that enter device certification after version 3.8 of the CTIA Test Plan for Wireless Device Over the Air Performance is in force, this requirement shall apply (and requirements VZ\_REQ\_LTEB13NAC\_6401 and VZ\_REQ\_LTEB13NAC\_6402 do NOT apply). For devices that enter device certification before version 3.8 of the CTIA Test Plan for Wireless Device Over the Air Performance is in force, this requirement does not apply (but requirements VZ\_REQ\_LTEB13NAC\_6401 and VZ\_REQ\_LTEB13NAC\_6402 still apply).*

When operating in LTE Band 13, the radiated sensitivity with QPSK modulation and with all receivers enabled on the device in a manner that is consistent with the normal operation of the device shall meet the Combined Total Isotropic Sensitivity (C-TIS) requirements in the table below.

These requirements apply for all valid mechanical use modes of the device, all antenna types, and for both the antenna extended or retracted in the case of devices with retractable antennas. Valid mechanical modes comprise all the mechanical use modes for the device that an end user would be expected to encounter in the course of normal operation of the device. Radiated sensitivity testing shall be per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan.

For any mode in which the device supports voice operation against the head, the device shall meet the requirements in the table below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Head with right hand phantom, i.e. beside head and hand right side (BHHR)
- Head with left hand phantom, i.e. beside head and hand left side (BHHL)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

**NOTE:** If the device supports voice operation against the head in a given mechanical mode and is wider than 72mm, then the device shall be tested using the CTIA wide grip hand phantom, and the BHHR/BHHL and HR/HL requirements below shall apply.

In the case of devices that support operation against the head in at least one mode, for any mode in which the device does not support voice operation against the head but does support data operation, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

For data-centric devices that do not support voice operation against the head, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)

| Device Held | Antenna | 3GPP Band 13 C-TIS, 10 MHz Channel Bandwidth (3) |
|-------------|---------|--|
|-------------|---------|--|

| Up to Head (Yes/No) | Type                | dBm (Maximum) |         |           |       |
|---------------------|---------------------|---------------|---------|-----------|-------|
|                     |                     | FS            | BHR/BHL | BHHR/BHHL | HR/HL |
| Yes (1)             | Embedded            | -93.5         | -88.5   | -82.5     | -88.5 |
|                     | Stub or Retractable | -93.5         | -90.5   | -84.5     | -90.5 |
| No (2)              | All                 | -93.5         | N/A     |           |       |

(1) "Yes" applies if the device supports a mode of operation against the head.

(2) "No" would be applicable to data centric devices that are not held up to the head, e.g. data cards, USB dongles, embedded laptop modules, etc.

(3) For 5 MHz channel bandwidth, reduce the values above by 3 dB.

### 1.6.2.3.2 PRIMARY RECEIVER VZ\_REQ\_LTEB13NAC\_23672

### 1.6.2.3.2.3 RADIATED SENSITIVITY - Primary Receiver VZ\_REQ\_LTEB13NAC\_6401

The radiated sensitivity of the primary receiver (with QPSK modulation) shall meet the Total Isotropic Sensitivity (TIS) requirements in the table below for a 10 MHz channel bandwidth (and the uplink RB allocations and associated transmit powers defined in section **Conductor Sensitivity**). TIS measurements are to be based on a single receiver. As a result:

- The device shall support single receiver testing.
- The device shall be tested with the secondary MIMO receiver disabled.

These requirements apply for all valid mechanical use modes of the device, all antenna types, and for both the antenna extended or retracted in the case of devices with retractable antennas. Valid mechanical modes comprise all the mechanical use modes for the device that an end user would be expected to encounter in the course of normal operation of the device. Radiated sensitivity testing shall be per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan.

For any mode in which the device supports voice operation against the head, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Head with right hand phantom, i.e. beside head and hand right side (BHHR)
- Head with left hand phantom, i.e. beside head and hand left side (BHHL)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

**NOTE:** If the device supports voice operation against the head in a given mechanical mode and is wider than 72mm, then the device shall be tested using the CTIA wide grip hand phantom, and the BHHR/BHHL and HR/HL requirements below shall apply.

In the case of devices that support operation against the head in at least one mode, for any mode in which the device does not support voice operation against the head but does support data operation, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

For data-centric devices that do not support voice operation against the head, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)

**Primary receiver TIS requirement for 10 MHz channel bandwidth.**

| Device Held Up to Head (Yes/No) | Antenna Type | Device Mode | 3GPP Band 13 (dBm, Maximum) |                  |           |       |
|---------------------------------|--------------|-------------|-----------------------------|------------------|-----------|-------|
|                                 |              |             | FS                          | BH (BHL and BHR) | BHHR/BHHL | HR/HL |
|                                 |              |             | Yes <sup>(1)</sup>          | Embedded         | LTE       | -91   |

|                   |                           |     |     |     |     |     |
|-------------------|---------------------------|-----|-----|-----|-----|-----|
|                   | Stub<br>Or<br>Retractable | LTE | -91 | -88 | -82 | -88 |
| No <sup>(2)</sup> | All                       | LTE | -91 | N/A | N/A | N/A |

(1) "Yes" applies if the device supports a mode of operation against the head.

(2) "No" would be applicable to data centric devices that are not held up to the head, e.g. data cards, USB dongles, embedded laptop modules, etc.

#### 1.6.2.3.2.4 SECONDARY MIMO RECEIVER VZ\_REQ\_LTEB13NAC\_23673

#### 1.6.2.3.2.5 RADIATED SENSITIVITY - Secondary MIMO Receiver VZ\_REQ\_LTEB13NAC\_6402

The radiated sensitivity of the secondary MIMO receiver (with QPSK modulation) shall meet the Total Isotropic Sensitivity (TIS) requirements in the tables below for a 10 MHz channel bandwidth (and the uplink RB allocations and associated transmit powers defined in section *Conducted Sensitivity*). TIS measurements are to be based on a single receiver. As a result:

- The device shall support single receiver testing.
- The device shall be tested with the primary receiver disabled.

These requirements apply for all valid mechanical use modes of the device, all antenna types, and for both the antenna extended or retracted in the case of devices with retractable antennas. Valid mechanical modes comprise all the mechanical use modes for the device that an end user would be expected to encounter in the course of normal operation of the device. Radiated sensitivity testing shall be per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan.

For any mode in which the device supports voice operation against the head, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Head with right hand phantom, i.e. beside head and hand right side (BHHR)
- Head with left hand phantom, i.e. beside head and hand left side (BHHL)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

**NOTE 1:** If the device supports voice operation against the head in a given mechanical mode and is wider than 72mm, then the device shall be tested using the CTIA wide grip hand phantom, and the BHHR/BHHL and HR/HL requirements below shall apply.

In the case of devices that support operation against the head in at least one mode, for any mode in which the device does not support voice operation against the head but does support data operation, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)
- Right hand only phantom, i.e. hand right (HR)
- Left hand only phantom, i.e. hand left (HL)

For data-centric devices that do not support voice operation against the head, the device shall meet the requirements in the tables below for all valid mechanical modes of the device for the following:

- Free space (FS)

**Secondary/MIMO receiver TIS requirement for 10 MHz channel bandwidth.**

| Device Held Up to Head (Yes/No) | Antenna Type        | Device Mode | 3GPP Band 13 (dBm, Maximum) |                  |           |       |
|---------------------------------|---------------------|-------------|-----------------------------|------------------|-----------|-------|
|                                 |                     |             | FS                          | BH (BHL and BHR) | BHHR/BHHL | HR/HL |
| Yes(1)                          | Embedded            | LTE         | -88                         | -83              | -77       | -83   |
|                                 | Stub Or Retractable | LTE         | -88                         | -85              | -79       | -85   |
| No(2)                           | All                 | LTE         | -                           | N/A              | N/A       | N/A   |

|  |  |  |    |  |  |
|--|--|--|----|--|--|
|  |  |  | 88 |  |  |
|--|--|--|----|--|--|

**NOTE 2:** There is no requirement for antenna imbalance.

**1.6.2.3.2.6 MIMO ANTENNA ENVELOPE CORRELATION COEFFICIENT**  
VZ\_REQ\_LTEB13NAC\_23674

**1.6.2.3.2.7 MIMO Antenna Envelope Correlation Coefficient**  
VZ\_REQ\_LTEB13NAC\_6403

The device shall meet the following performance requirements when tested in free space (FS) in the MIMO OTA (TM3) environment defined in the latest "in force" version of the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance:

- The device shall meet 70% of the theoretical maximum throughput in all 12 azimuthal orientations.
- The device shall meet 90% of the theoretical maximum throughput in at least 10 of the 12 azimuthal orientations.
- The device shall meet 95% of the theoretical maximum throughput in at least 10 of the 12 azimuthal orientations.
- The MARSS spatially averaged value for DL SIR for the 70% outage point shall not exceed 23.5 dB. The MARSS spatially averaged value for DL SIR for the 90% and 95% outage points shall not exceed 26 dB.

**NOTE:** If the device supports 4 receiver operation on Band 13, then MIMO OTA testing for Band 13 shall be performed with all 4 receivers enabled.

**1.6.2.4 RECEIVER OUT-OF-BAND INTERFERERS** VZ\_REQ\_LTEB13NAC\_23675

**1.6.2.4.1 BLOCKING** VZ\_REQ\_LTEB13NAC\_23676

### 1.6.2.4.1.1 BLOCKING VZ\_REQ\_LTEB13NAC\_6404

The device receiver shall be capable of rejecting the inband and out-of-band signals in the table below:

| Signal Type | Center Frequency | Channel BW | Signal Level |
|-------------|------------------|------------|--------------|
| ATSC        | 689 MHz          | 6 MHz      | -15 dBm      |
| ATSC        | 695 MHz          | 6 MHz      | -15 dBm      |
| LTE         | 719 MHz          | 5 MHz      | -44 dBm      |
| LTE         | 723 MHz          | 10 MHz     | -44 dBm      |
| LTE         | 731.5 MHz        | 5 MHz      | -44 dBm      |
| LTE         | 735 MHz          | 10 MHz     | -44 dBm      |
| LTE         | 741 MHz          | 10 MHz     | -44 dBm      |
| LTE         | 743.5 MHz        | 5 MHz      | -44 dBm      |
| LTE         | 760.5 MHz        | 5 MHz      | -44 dBm      |
| LTE         | 763 MHz          | 10 MHz     | -44 dBm      |
| CW tone     | 769-775 MHz      | N/A        | -30 dBm      |

For additional details on ATSC signals, refer to A/53: *ATSC Digital Television Standard, Parts 1-6, 2007*.

### 1.6.2.4.2 INTERMODULATION VZ\_REQ\_LTEB13NAC\_23677

#### 1.6.2.4.2.1 INTERMODULATION VZ\_REQ\_LTEB13NAC\_6405

The device receiver shall be capable of rejecting intermodulation distortion from the following pairs of out-of-band signals:



| Pair # | Interferer #1 (type, center frequency, channel BW, level) | Interferer #2 (type, center frequency, channel BW, level) |
|--------|---|---|
| 1      | ATSC, 689 MHz, 6 MHz, -15 dBm                             | LTE, 719.5 MHz, 5 MHz, -44 dBm                            |
| 2      | ATSC, 695 MHz, 6 MHz, -15 dBm                             | LTE, 723 MHz, 10 MHz, -44 dBm                             |
| 3      | LTE, 738.5 MHz, 5 MHz, -44 dBm                            | LTE, 743.5 MHz, 5 MHz, -44 dBm                            |
| 4      | LTE, 719.5 MHz, 5 MHz, -44 dBm                            | LTE, 735 MHz, 10 MHz, -44 dBm                             |
| 5      | LTE, 719.5 MHz, 5 MHz, -44 dBm                            | LTE, 739 MHz, 10 MHz, -44 dBm                             |
| 6      | LTE, 723 MHz, 10 MHz, -44 dBm                             | LTE, 735 MHz, 10 MHz, -44 dBm                             |
| 7      | LTE, 723 MHz, 10 MHz, -44 dBm                             | LTE, 739 MHz, 10 MHz, -44 dBm                             |
| 8      | LTE, 731.5 MHz, 5 MHz, -44 dBm                            | LTE, 741 MHz, 10 MHz, -44 dBm                             |
| 9      | LTE, 735 MHz, 10 MHz, -44 dBm                             | LTE, 743.5 MHz, 5 MHz, -44 dBm                            |
| 10     | LTE, 760.5 MHz, 5 MHz, -44 dBm                            | LTE, 765.5 MHz, 5 MHz, -44 dBm                            |
| 11     | LTE, 763 MHz, 10 MHz, -44 dBm                             | CW tone, 775 MHz, -30 dBm                                 |
| 12     | LTE, 760.5 MHz, 5 MHz, -44 dBm                            | CW tone, 770 MHz, -30 dBm                                 |
| 13     | LTE, 765.5 MHz, 5 MHz, -44 dBm                            | CW tone, 775 MHz, -30 dBm                                 |
| 14     | LTE, 701.5 MHz, 5 MHz, -25 dBm                            | LTE, 723 MHz, 10 MHz, -44 dBm                             |
| 15     | LTE, 712.5 MHz, 5 MHz, -25 dBm                            | LTE, 734 MHz, 10 MHz, -44 dBm                             |

For additional details on ATSC signals, refer to A/53: *ATSC Digital Television Standard, Parts 1-6, 2007*.

## 1.6.2.5 RF PERFORMANCE OVER TEMPERATURE AND VOLTAGE

VZ\_REQ\_LTEB13NAC\_23678

### 1.6.2.5.1 AMBIENT TEMPERATURE

VZ\_REQ\_LTEB13NAC\_23679

#### 1.6.2.5.1.1 AMBIENT OPERATING TEMPERATURE RANGE

VZ\_REQ\_LTEB13NAC\_6406

Verizon Wireless-specific RF performance requirements for 3GPP Band 13 apply across the temperature ranges for both the normal and extreme conditions defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*.

### 1.6.2.5.1.2 EXTENDED AMBIENT OPERATING TEMPERATURE RANGE

VZ\_REQ\_LTEB13NAC\_6407

The device vendor may design the device to operate over an extreme temperature range that extends from  $-30^{\circ}$  to  $+60^{\circ}$  C. For devices designed to operate over an extreme temperature range of  $-30^{\circ}$  to  $+60^{\circ}$  C, 3GPP UE minimum performance requirements per the *LTE UE Minimum Performance Requirements* section of this document and Verizon Wireless-specific RF performance requirements for 3GPP Band 13 apply across the temperature ranges for both the normal and extreme conditions defined in 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception* with the following exceptions:

- The extreme temperature range (refer to section E.2.1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*) shall be  $-30^{\circ}$  to  $+60^{\circ}$  C.
- At ambient temperatures greater than  $+55^{\circ}$  C, the following RF requirements may be relaxed:
  - The conducted output power in the *Maximum Conducted Output Power* section of this document may be relaxed by 2 dB, i.e. the device may apply an additional A-MPR of 2 dB for all uplink RB allocations.
  - The maximum radiated output power (i.e. TRP) in the *Maximum Radiated Output Power* section of this document may be relaxed by 2 dB.
  - The dual receiver and single receiver sensitivity requirements in the *Conducted Sensitivity* section of this document may be relaxed by 2 dB.
  - The radiated sensitivity requirement (i.e. TIS) for the primary receiver in the *Radiated Sensitivity* section of this document may be relaxed by 2 dB.

### 1.6.2.5.2 POWER SUPPLY/BATTERY VOLTAGE VZ\_REQ\_LTEB13NAC\_23680

#### 1.6.2.5.2.1 POWER SUPPLY/BATTERY VOLTAGE VZ\_REQ\_LTEB13NAC\_6408

The device manufacturer shall provide the range of operating power supply/battery voltages for the device. The device shall comply with the voltage requirements 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*. Verizon Wireless-specific RF performance requirements for 3GPP Band 13 apply across the operating voltage of the device.

### 1.6.3 LTE DATA CALL PERFORMANCE VZ\_REQ\_LTEB13NAC\_1894

The requirements in this section assume an optimal network environment, i.e.:

- One UE per cell
- eNodeB, Serving Gateway, and PDN Gateway are co-located

#### 1.6.3.1 NETWORK ATTACHMENT TIME VZ\_REQ\_LTEB13NAC\_23684

##### 1.6.3.1.1 NETWORK ATTACHMENT TIME VZ\_REQ\_LTEB13NAC\_6409

The average LTE network attachment time shall be less than 120 ms where the network attach time is defined as the control plane latency from the *RRConnectionSetupComplete* message from the UE with the "ATTACH REQUEST" NAS message until both the "ATTACH COMPLETE" and the "ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT" NAS messages are received by the MME. Compliance to this requirement shall be per the Verizon Wireless LTE 3GPP Band 13 Data Throughput Test Plan.

#### 1.6.3.2 TRANSITION FROM RRC\_IDLE TO RRC\_CONNECTED VZ\_REQ\_LTEB13NAC\_23682

##### 1.6.3.2.1 TRANSITION FROM RRC\_IDLE TO RRC\_CONNECTED VZ\_REQ\_LTEB13NAC\_6410

The average control plane latency for the transition from the RRC\_IDLE state (i.e. EMM-REGISTERED and EMM-IDLE) to the RRC\_CONNECTED state (i.e. EMM-REGISTERED and EMM-CONNECTED) shall be less than 100ms for a UE that is registered on the LTE network. The control plane latency is defined as the time from the *RRCConnectionSetupComplete* message from the UE with the "SERVICE REQUEST" NAS message until the MME receives the "INITIAL CONTEXT SETUP RESPONSE" NAS message. Compliance to this requirement shall be per the Verizon Wireless LTE 3GPP Band 13 Data Throughput Test Plan.

### 1.6.3.3 ROUND TRIP DELAY VZ\_REQ\_LTEB13NAC\_23683

#### 1.6.3.3.1 ROUND TRIP DELAY VZ\_REQ\_LTEB13NAC\_6411

The average user plane round trip delay as measured using 32 byte pings shall be less than 25 ms when the device is in the RRC\_CONNECTED state and pings a server connected directly to the PDN Gateway. Compliance to this requirement shall be per the Verizon Wireless LTE 3GPP Band 13 Data Throughput Test Plan.

### 1.6.3.4 DATA THROUGHPUT PERFORMANCE VZ\_REQ\_LTEB13NAC\_23684

Compliance to the LTE data throughput performance requirements shall be per the Verizon Wireless LTE 3GPP Band 13 Data Throughput Test Plan.

#### 1.6.3.4.1 DOWNLINK DATA THROUGHPUT VZ\_REQ\_LTEB13NAC\_23685

##### 1.6.3.4.1.1 DOWNLINK DATA THROUGHPUT VZ\_REQ\_LTEB13NAC\_6412

The device shall be capable of meeting the downlink data throughput requirements in the table below:

| UE Category*** | Peak Physical Layer Throughput* (Mbps) | Average Throughput Range at the TCP/UDP Layer** |
|----------------|--|---|
|----------------|--|---|

|            |    | (Mbps)           |
|------------|----|------------------|
| 1          | 10 | 0.050 to >= 8.2  |
| 2          | 50 | 0.050 to >= 41.0 |
| 3, 4, 6, 9 | 73 | 0.050 to >= 51.6 |
| >= 11      | 97 | 0.050 to >= 72.3 |

\* In a channel without impairments and with sufficient SNR, the device shall be capable of supporting the peak downlink data throughput rate at the physical layer for its given UE Category operating in a 10 MHz channel with the maximum possible transport block size and two layer spatial multiplexing per 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities* and 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

\*\* The device shall be capable of operating across this entire range of throughput values for a 10 MHz channel, and dependent on channel conditions (i.e. modulation and coding, signal strength, AWGN, multipath, fading).

\*\*\* If the device includes *ue-CategoryDL* field in *UE-EUTRA-Capability* information element, the UE Category in the above table shall take the value set by field *ue-CategoryDL*. Otherwise, it shall take the maximum value set by the field *ue-Category* in the *UE-EUTRA-Capability* information element. Refer to the Release 12 version of 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*, and the Release 12 version of 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol Specification*.

### 1.6.3.4.2 UPLINK DATA THROUGHPUT VZ\_REQ\_LTEB13NAC\_23686

#### 1.6.3.4.2.1 UPLINK DATA THROUGHPUT VZ\_REQ\_LTEB13NAC\_6413

The device shall be capable of meeting the uplink data throughput requirements in the table below:

| UE Category | Peak Physical Layer Throughput* (Mbps) | Average Throughput Range at the TCP/UDP Layer** (Mbps) |
|-------------|--|--|
| 1           | 5                                      | 0.050 to >= 3.8  |
| 2           | 25                                     | 0.050 to >= 19.0                                       |

|      |    |                  |
|------|----|------------------|
| >= 3 | 28 | 0.050 to >= 19.0 |
|------|----|------------------|

\* In a channel without impairments and with sufficient SNR, the device shall be capable of supporting the peak uplink data throughput rate at the physical layer for its given UE Category operating in a 10 MHz channel with the maximum possible transport block size as per 3GPP TS 36.306: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities* and 3GPP TS 36.213: *Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures*.

\*\* The device shall be capable of operating across this entire range of throughput values for a 10 MHz channel, and dependent on channel conditions (i.e. modulation and coding, signal strength, AWGN, multipath, fading).

### 1.6.3.5 LTE-TO-LTE HANDOVER PERFORMANCE VZ\_REQ\_LTEB13NAC\_23687

#### 1.6.3.5.1 LTE-TO-LTE HANDOVER PERFORMANCE VZ\_REQ\_LTEB13NAC\_6414

~~LTE-to-LTE handover performance shall be per 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management* and 3GPP TS 36.521-3: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management conformance testing*.~~

### 1.6.4 VERIZON WIRELESS-SPECIFIC LTE 3GPP BAND 13 RRM PERFORMANCE REQUIREMENTS VZ\_REQ\_LTEB13NAC\_1895

Verizon Wireless-specific RRM performance requirements for 3GPP Band 13 build on the RRM minimum performance requirements in 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management*. Compliance to all Verizon Wireless-specific LTE 3GPP Band 13 RRM performance requirements shall be per the Verizon Wireless LTE 3GPP Band 13 Supplementary RRM Conformance Test Plan unless indicated otherwise.

#### 1.6.4.1 RSRP ACCURACY VZ\_REQ\_LTEB13NAC\_23688

### 1.6.4.1.1 RSRP ABSOLUTE ACCURACY VZ\_REQ\_LTEB13NAC\_23690

#### 1.6.4.1.1.1 RSRP ABSOLUTE ACCURACY VZ\_REQ\_LTEB13NAC\_6420

The device shall meet the requirements in the table below for the absolute accuracy of RSRP measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo                                 |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±4            | ±6                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±4            | ±6                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

The device shall meet the accuracy requirements in the table below for the mean of the absolute RSRP values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo                                 |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±4            | ±6                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±4            | ±6                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

The device shall meet the accuracy requirements in the table below for the standard deviation of the absolute RSRP values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup> |
|-----------|------|---------------|--------------------------------|-------------------------|
|           |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo           |

|  |     |           |           |   |
|--|-----|-----------|-----------|---|
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB              | dBm | $\pm$ FFS | $\pm$ FFS | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -6 dB              | dBm | $\pm$ FFS | $\pm$ FFS | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Note 1. $l_o$ is assumed to have constant EPRE across the bandwidth. |     |           |           |   |

### 1.6.4.1.1.2 RSRP ABSOLUTE ACCURACY FOR FEICIC VZ\_REQ\_LTEB13NAC\_37647

With feICIC, the device shall meet the requirements in the table below for the absolute accuracy of RSRP measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>$l_o$                              |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -9.46 dB           | dBm  | $\pm$ 4       | $\pm$ 6                        | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| -  | -    | -             | -                              | -   |
| Note 1. $l_o$ is assumed to have constant EPRE across the bandwidth. |      |               |                                |   |

### 1.6.4.1.2 RSRP RELATIVE ACCURACY VZ\_REQ\_LTEB13NAC\_23691

#### 1.6.4.1.2.1 RSRP RELATIVE ACCURACY VZ\_REQ\_LTEB13NAC\_6421

The device shall meet the requirements in the table below for the relative accuracy of RSRP measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup> |
|-----------|------|---------------|--------------------------------|-------------------------|
|           |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>$l_o$        |



|   |     |         |         |   |
|---|-----|---------|---------|---|
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm | $\pm 2$ | $\pm 3$ | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm | $\pm 4$ | $\pm 6$ | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |

Note 1.  $l_o$  is assumed to have constant EPRE across the bandwidth.  
 Note 2. The parameter  $\hat{E}_s/\text{lot}$  is the minimum  $\hat{E}_s/\text{lot}$  of the pair of cells.to which the requirement applies.

The device shall meet the accuracy requirements in the table below for the mean of the relative RSRP values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter   | Unit | Accuracy [dB] |               | Conditions <sup>1</sup>                       |
|---|------|---------------|---------------|---|
|   |      | 0° to +40°C   | -10° to +55°C | Band 13                                       |
|   |      |               | -30° to +60°C | $l_o$   |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | $\pm 2$       | $\pm 3$       | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | $\pm 4$       | $\pm 6$       | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |

Note 1.  $l_o$  is assumed to have constant EPRE across the bandwidth.  
 Note 2. The parameter  $\hat{E}_s/\text{lot}$  is the minimum  $\hat{E}_s/\text{lot}$  of the pair of cells.to which the requirement applies.

The device shall meet the accuracy requirements in the table below for the standard deviation of the relative RSRP values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter   | Unit | Accuracy [dB]    |                  | Conditions <sup>1</sup>                       |
|---|------|------------------|------------------|---|
|   |      | 0° to +40°C      | -10° to +55°C    | Band 13                                       |
|   |      |                  | -30° to +60°C    | $l_o$   |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | $\pm \text{FFS}$ | $\pm \text{FFS}$ | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |
| Inter-Frequency RSRP for $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | $\pm \text{FFS}$ | $\pm \text{FFS}$ | -121dBm/15kHz & -50dBm/ $BW_{\text{Channel}}$ |

Note 1.  $l_o$  is assumed to have constant EPRE across the bandwidth.  
 Note 2. The parameter  $\hat{E}_s/\text{lot}$  is the minimum  $\hat{E}_s/\text{lot}$  of the pair of cells.to which the requirement applies.

### 1.6.4.1.2.2 RSRP RELATIVE ACCURACY FOR FEICIC VZ\_REQ\_LTEB13NAC\_37648

~~With feICIC, the device shall meet the requirements in the table below for the relative accuracy of RSRP measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.~~

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band-13<br><br>I <sub>o</sub>                 |
| Intra-Frequency RSRP for $\hat{E}_s/\text{lot}^3$ -9.46 dB | dBm  | ±2            | ±3                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| -  | -    | -             | -                              | -   |

Note 1. I<sub>o</sub> is assumed to have constant EPRE across the bandwidth.

## 1.6.4.2 RSRQ ACCURACY VZ\_REQ\_LTEB13NAC\_23689

### 1.6.4.2.1 RSRQ ABSOLUTE ACCURACY VZ\_REQ\_LTEB13NAC\_23692

#### 1.6.4.2.1.1 RSRQ ABSOLUTE ACCURACY VZ\_REQ\_LTEB13NAC\_6422

The device shall meet the requirements in the table below for the absolute accuracy of RSRQ measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br><br>I <sub>o</sub>                 |
| Intra-Frequency RSRQ when $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±2.5          | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRQ when $\hat{E}_s/\text{lot}^3$ -6 dB | dBm  | ±2.5          | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. I<sub>o</sub> is assumed to have constant EPRE across the bandwidth.

The device shall meet the accuracy requirements in the table below for the mean of the absolute RSRQ values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13                                       |
|  |      |               |                                | lo  |
| Intra-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 - 6$ dB | dBm  | ±2.5          | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 - 6$ dB | dBm  | ±2.5          | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

The device shall meet the accuracy requirements in the table below for the standard deviation of the absolute RSRQ values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13                                       |
|  |      |               |                                | lo  |
| Intra-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 - 6$ dB | dBm  | ±FFS          | ±FFS                           | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 - 6$ dB | dBm  | ±FFS          | ±FFS                           | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

### 1.6.4.2.1.2 RSRQ ABSOLUTE ACCURACY FOR FEICIC VZ\_REQ\_LTEB13NAC\_37649

With feICIC, the device shall meet the requirements in the table below for the absolute accuracy of RSRQ measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13                                       |
|   |      |               |                                | lo  |
| Intra-Frequency RSRQ for $\hat{E}_s/\text{lot}^3 - 9.46$ dB | dBm  | ±2.5          | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| -   | -    | -             | -                              | -   |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

## 1.6.4.2.2 RSRQ RELATIVE ACCURACY VZ\_REQ\_LTEB13NAC\_23693

### 1.6.4.2.2.1 RSRQ RELATIVE ACCURACY VZ\_REQ\_LTEB13NAC\_6423

The device shall meet the requirements in the table below for the relative accuracy of RSRQ measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo                                 |
| Intra-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | ±3            | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | ±3            | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

Note 2. The parameter  $\hat{E}_s/\text{lot}$  is the minimum  $\hat{E}_s/\text{lot}$  of the pair of cells to which the requirement applies.

The device shall meet the accuracy requirements in the table below for the mean of the relative RSRQ values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo                                 |
| Intra-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | ±3            | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Inter-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | ±3            | ±4                             | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

Note 1. lo is assumed to have constant EPRE across the bandwidth.

Note 2. The parameter  $\hat{E}_s/\text{lot}$  is the minimum  $\hat{E}_s/\text{lot}$  of the pair of cells to which the requirement applies.

The device shall meet the accuracy requirements in the table below for the standard deviation of the relative RSRQ values in RRC\_IDLE mode with a default idle mode DRX setting of 1.28 seconds.

| Parameter   | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|---|------|---------------|--------------------------------|---|
|   |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>lo                                 |
| Intra-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB | dBm  | ±FFS          | ±FFS                           | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |

|   |     |           |           |   |
|---|-----|-----------|-----------|---|
| Inter-Frequency RSRQ when RSRP $\hat{E}_s/\text{lot}^3 -6$ dB   | dBm | $\pm$ FFS | $\pm$ FFS | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| Note 1. $l_0$ is assumed to have constant EPRE across the bandwidth.<br>Note 2. The parameter $\hat{E}_s/\text{lot}$ is the minimum $\hat{E}_s/\text{lot}$ of the pair of cells to which the requirement applies. |     |           |           |   |

### 1.6.4.2.2.2 RSRQ RELATIVE ACCURACY FOR FEICIC VZ\_REQ\_LTEB13NAC\_37650

With feICIC, the device shall meet the requirements in the table below for the relative accuracy of RSRQ measurements in RRC\_CONNECTED mode (with and without connected mode DRX) and with L3 filtering enabled.

| Parameter  | Unit | Accuracy [dB] |                                | Conditions <sup>1</sup>                       |
|--|------|---------------|--------------------------------|---|
|  |      | 0° to +40°C   | -10° to +55°C<br>-30° to +60°C | Band 13<br>$l_0$                              |
| Intra-Frequency RSRQ for $\hat{E}_s/\text{lot}^3 -9.46$ dB           | dBm  | $\pm 3$       | $\pm 4$                        | -121dBm/15kHz & -50dBm/ BW <sub>Channel</sub> |
| -  | -    | -             | -                              | -   |
| Note 1. $l_0$ is assumed to have constant EPRE across the bandwidth. |      |               |                                |   |

### 1.6.5 eICIC Performance and CRS IC without ABS VZ\_REQ\_LTEB13NAC\_36962

#### 1.6.5.1 Req-1 VZ\_REQ\_LTEB13NAC\_36963

The device shall support and meet the E-UTRAN FDD UE intra-frequency measurements requirements (including cell detection/identification criteria) as specified in section 8.1.2.8.1, 8.1.2.8.3, Annex A.8.1.7, A.8.1.8, B.2.8, B.2.9 of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management.*

**1.6.5.2Req-2** VZ\_REQ\_LTEB13NAC\_36964

The device shall support and meet the E-UTRAN FDD UE Rx-Tx Time Difference Measurements requirements (including cell detection criteria) as specified in section 8.1.2.9.1, 8.1.2.9.3, 9.1.9.3, 9.1.9.4, A.9.7.3, A.9.7.5 of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management.*

**1.6.5.3Req-3** VZ\_REQ\_LTEB13NAC\_36965

The device shall support and meet RLM (Radio Link Monitoring) for MBSFN ABS and non-MBSFN ABS requirements as specified in section 7.6.1, 7.6.2, Annex A.7.3.9, A.7.3.11, A.7.3.13, A.7.3.15, A.7.3.17, A.7.3.19, A.7.3.21 of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management.*

**1.6.5.4Req-4** VZ\_REQ\_LTEB13NAC\_36966

The device shall support and meet **the more stringent requirement** between either the RSRP and RSRQ measurement accuracy requirements in this document or the RSRP and RSRQ measurement accuracy requirements as specified in section 9.1.2.3, 9.1.2.4, 9.1.2.5, 9.1.2.6, 9.1.5.2, 9.1.5.3, Annex A.9.1.8, A.9.1.10, A.9.1.14, A.9.2.7, A.9.2.9, A.9.2.13, A.9.2.15, B.3.9, B.3.10, B.3.11, B.3.12 of 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management* as follows:

- RSRP and RSRQ accuracy values shall use values defined in section 6.4 of this document
- $\hat{\epsilon}_s$ /lot threshold shall use values specified in section 9.1.2.3, 9.1.2.4, 9.1.2.5, 9.1.2.6, 9.1.5.3, Annex A.9.1.14, A.9.2.15, B.3.11, B.3.12 of 3GPP TS 36.133

**1.6.5.5Req-5** VZ\_REQ\_LTEB13NAC\_36967

The device shall support and meet PDSCH, PDCCH/PCFICH and PHICH demodulation requirements for transmit diversity, open-loop spatial multiplexing, close-loop spatial multiplexing, as specified in section "8.2.1.2.3, 8.2.1.2.3.A", "8.2.1.3.3, 8.2.1.3.4", 8.2.1.4.1C, "8.4.1.2.3, 8.4.1.2.4", "8.5.1.2.3, 8.5.1.2.4", A.3.1.1, A.3.5, C3.3

of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA) and User Equipment(UE) Radio Transmission and Reception.*

### 1.6.5.6Req-6 VZ\_REQ\_LTEB13NAC\_36968

~~The device shall support and meet the PBCH demodulation requirements for transmit diversity, open-loop spatial multiplexing, close-loop spatial multiplexing, as specified in section 8.6.1.2.3 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA) and User Equipment(UE) Radio Transmission and Reception.*~~

### 1.6.5.7Req-7 VZ\_REQ\_LTEB13NAC\_36969

The device shall support and meet the CSI, CQI and RI reporting requirements, as specified in section 9.2.1.3, 9.2.1.5, 9.3.1.1.3, 9.5.3.1, 9.5.4.1 of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA) and User Equipment(UE) Radio Transmission and Reception.*

### 1.6.5.8CRS IC WITHOUT ABS VZ\_REQ\_LTEB13NAC\_37651

The device shall support CRS IC capability when there is zero ABS subframe configured to achieve the following benefits in a macro-macro cell configuration:

- With colliding CRS
  - Channel estimation improvement (energy, phase)
    - Improves PDSCH decoding as well (UE throughput)
  - Better RSRP accuracy (benefit from averaging channel estimation over energy) than **the more stringent requirement** between either the RSRP and RSRQ measurement accuracy requirements in this document or the RSRP and RSRQ measurement accuracy requirements as specified in section 9.1.2.5, 9.1.2.6, 9.1.5.3, Annex A.9.1.14, A.9.2.15, B.3.11, B.3.12 of 3GPP TS 36.133
- With non-colliding CRS
  - Improved PDCCH and PDSCH decoding results (removing CRS tones from noise estimate for better UE throughput)

### 1.6.5.9FEATURE INTERACTION VZ\_REQ\_LTEB13NAC\_37652

The following feature interactions of feICIC with other existing features will need to be verified in E2E testing NOT using network emulators (i.e., live or lab eNBs in IODT or IOT activities). Note that these feature interactions apply to a system that uses ABS subframes. For the use case of non-ABS subframe, there is no feature interactions.

1. Legacy UE

The impact of eNB parameters for feICIC on legacy UE that does NOT support eICIC and feICIC

2. VoLTE

feICIC should improve voice call quality on small/pico. However, the ABS patterns on macro cell will impact VoLTE KPI/capacity (delay, jitter, voice quality etc.).

3. TTI-Bundling

In order to keep ABS subframes as "blank" as possible, eNB scheduler may provide additional restrictions on TTIB activation due to PHICH transmission for UL TTIB HARQ transmissions.

4. eDRX

eNB scheduler may provide additional care to handle interactions between eDRX (on/off durations) and ABS subframes.

On the UE side, accurate CQI report (set 1 and set 2 if configured) shall continue to be supported especially when the UE returns to eDRX on duration starting with the 1<sup>st</sup> subframe.

5. eMBMS

In addition to standard defined MBSFN (ABS SF colliding with eMBMS MBSFN) /non-MBSFN ABS verification which verifies feICIC performance, eMBMS quality should be examined as well.

6. Carrier Aggregation

As per 3GPP, the feICIC can only be used on the primary carrier. So even if the UE is in CA, feICIC (ABS patterns) could only be enabled on primary carrier.

In case the small has SCell and it has interference from other cells on the same frequency, then the SCell will suffer from interference on all its channels. There is no interference cancellation scheme on SCell(s).

It will be network deployment dependent (carrier and cell deployment).

For the primary component carrier, thrupt expectation in PCell of macro (interferer) will definitely change due to ABS patterns.

7. ePDCCH

FFS.

## 1.6.6 LTE CoMP (Coordinated Multi-Point) RF and RRM Performance

VZ\_REQ\_LTEB13NAC\_37815



### 1.6.6.1 RF and RRM Performance for LTE TM9 DL CoMP VZ\_REQ\_LTEB13NAC\_37816

The device shall support and meet PDSCH demodulation performance requirements with UE-specific reference signals for single-layer and dual-layer spatial multiplexing, as specified in sections 8.3.1.1, 8.3.1.1A, 8.3.1.1B, 8.3.1.2 of the Release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall support and meet CSI (CQI, PMI, and RI) reporting performance requirements, as specified in sections 9.2.3.1, 9.3.1.2.1, 9.3.2.2.1, 9.3.5.2.1, 9.4.1.3.1, 9.4.2.3.1, 9.5.2.1 of the Release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

### 1.6.6.2 RF and RRM Performance for LTE TM10 DL CoMP VZ\_REQ\_LTEB13NAC\_37817

The device shall support and meet PDSCH demodulation performance requirements with UE-specific reference signals for DCI format 2D and non Quasi Co-located Antenna Ports, as specified in sections 8.3.1.3 of the Release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall support and meet CSI (CQI and RI) reporting performance requirements, as specified in sections 9.2.4.1, 9.3.6.1, 9.5.5.1 of the Release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

### 1.6.7 ePDCCH Performance VZ\_REQ\_LTEB13NAC\_38377

#### 1.6.7.1 EPDCCH RF Performance VZ\_REQ\_LTEB13NAC\_38378

The device shall support and meet EPDCCH demodulation performance requirements for both distributed and localized transmission type, as specified in sections 8.8.1.1,

8.8.2.1, 8.8.3.1 of the release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall meet sustained downlink data rate performance requirements with EPDCCH scheduling, as specified in section 8.7.3 of the release 11 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

## 1.6.8 256QAM Performance VZ\_REQ\_LTEB13NAC\_39751

### 1.6.8.1256QAM RF Performance VZ\_REQ\_LTEB13NAC\_39752

The device shall support and meet receiver maximum input level performance requirements for 256QAM, as specified in sections 7.4.1, 7.4.1A of the Release 12 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall support and meet PDSCH demodulation performance requirements for 256QAM, as specified in sections 8.2.1.4.2, 8.3.1.1 of the Release 12 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall support and meet sustained downlink data rate performance requirements for 256QAM, as specified in section 8.7.1 of the Release 12 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

The device shall support and meet CQI reporting performance requirements for 256QAM, as specified in sections 9.2.1.7, 9.3.1.2.3 of the Release 12 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

## 1.6.9 SU-MIMO IC RF Performance VZ\_REQ\_LTEB13NAC\_39981

### 1.6.9.1 SU-MIMO IC RF Performance VZ\_REQ\_LTEB13NAC\_39982

The device shall support and meet receiver maximum input level performance requirements for SU-MIMO IC (Enhanced Performance Requirements Type C), for all transmission modes that are supported on Verizon's network as specified in sections 8.2.1.3.1.B (FDD, TM3), 8.2.1.4.2.A (FDD, TM4), 8.3.1.2.A (TM9/TM10) of the Release 12 version of 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment(UE) Radio Transmission and Reception*.

### 1.6.10 Blind Data IC VZ\_REQ\_LTEB13NAC\_1238214

While operating in Blind Data IC mode, the UE shall meet enhanced receiver Type B performance requirements defined in TS 36.101 (Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception) requirements on the following channel operations:

- PDSCH demodulation minimum performance using
  - CRS
    - 8.2.1.2.5 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model
    - 8.2.1.4.1D Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model
- PUCCH report of the channel quality (CQI) based on the receiver of the enhanced Type B using updated the updated fixed reference channel and interference models for enhanced performance requirements for Type-B receiver
  - 9.3.8 Additional requirements for enhanced receiver Type B
    - 9.3.8.1.1 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols) FDD

Testing of these performance requirements will use GCF-based test cases w/o network-assisted configuration.

## 2 GCF/3GPP RAN5 Coverage

For Blind data IC feature (UE-only), the test strategy is to follow GCF test case except the following in test setup:

- UE capability report of NAICS (UE-EUTRA-Capability)
- Pcell and Scell NAICS configuration in RadioResourceConfigDedicated
- Neighbor cell NAICS configuration (add, release, transmission parameters)

The equivalent to the following RAN5 test case will be executed with the above assumption:

- 36.521-1 (R13)
  - 8.2.1.2.5 FDD PDSCH Transmit Diversity 2x2 with TM2 Interference Model Enhanced Performance Requirement Type B
  - 8.2.1.4.4 FDD PDSCH Closed Loop Single Layer Spatial Multiplexing 2x2 with TM4 Interference Model Enhanced Performance Requirement Type B
  - 9.3.8.1.1 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols) for FDD

There are no additional thruput tests added for blind data IC. All existing data throughput (single cell) should be tested with Blind Data IC enabled and all existing test results shall pass.

### 2.1 PERFORMANCE - Cat M1 VZ\_REQ\_LTEB13NAC\_4297448

#### 2.1.1 LTE CAT M1 MINIMUM PERFORMANCE REQUIREMENTS

VZ\_REQ\_LTEB13NAC\_4297528

##### 2.1.1.1 LTE CAT M1 3GPP/GCF CONFORMANCE VZ\_REQ\_LTEB13NAC\_4297605

LTE category M1 devices shall be output power class 3.

LTE category M1 devices shall meet all 3GPP RF and RRM conformance requirements for LTE category M1, including all RF and RRM requirements and conformance test cases for LTE category M1 defined in:

- 3GPP TS 36.101: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*
- 3GPP TS 36.133: *Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management*
- 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*
- 3GPP TS 36.521-3: *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management conformance testing*
- 

LTE category M1 devices shall meet all 3GPP signaling requirements for LTE category M1, including all signaling requirements and conformance test cases for LTE category M1 defined in:

- 3GPP TS 36.523-1: *Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification*

LTE category M1 devices shall be GCF certified for LTE category M1 operation in Band 13.

## 2.1.2 LTE CAT M1 RADIATED PERFORMANCE VZ\_REQ\_LTEB13NAC\_4297533

### 2.1.2.1 LTE CAT M1 MAXIMUM RADIATED OUTPUT POWER VZ\_REQ\_LTEB13NAC\_4297578

All non-wearable Cat-M1 devices shall meet the free space (FS) requirements for Total Radiated Power (TRP) in the table below for all RB allocations in a Cat-M1 channel.

Wrist worn Cat-M1 wearable devices should meet the forearm requirements for Total Radiated Power (TRP) in the table below for all RB allocations in a Cat-M1 channel. Wrist worn wearable devices shall be tested per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan using the CTIA forearm phantom.

| Use Case        | TRP (dBm, Minimum) |
|-----------------|--------------------|
|                 | Band 13            |
| FS              | +18                |
| Forearm (WR/WL) | +8                 |

### 2.1.2.2 LTE CAT M1 SPURIOUS EMISSIONS FOR UE CO-EXISTENCE WITH GPS VZ\_REQ\_LTEB13NAC\_4299281

LTE category M1 devices shall meet the requirements in the table below for transmitter emissions into the GPS frequency band for all uplink RB allocations and output power levels.

| Frequency                | Emission Requirement |
|--------------------------|----------------------|
| 1559.00 MHz -1574.42 MHz | <= -50 dBm/MHz       |
| 1574.42 MHz -1576.42 MHz | <= -65 dBm/MHz       |
| 1576.42 MHz -1610.00 MHz | <= -50 dBm/MHz       |

### 2.1.2.3 LTE CAT M1 RADIATED SENSITIVITY VZ\_REQ\_LTEB13NAC\_4297600

All non-wearable Cat-M1 devices shall meet the free space (FS) requirements for Total Isotropic Sensitivity (TIS) in the table below for all uplink RB allocations and transmitter output levels.

Wrist worn Cat-M1 wearable devices should meet the forearm requirements for Total Isotropic Sensitivity (TIS) in the table below for all uplink RB allocations and transmitter output levels. Wrist worn wearable devices shall be tested per the Verizon Wireless LTE Over the Air Radiated Performance Test Plan using the CTIA forearm phantom.

| Use Case        | TIS (dBm, Maximum) |
|-----------------|--------------------|
|                 | Band 13            |
| FS              | -97                |
| Forearm (WR/WL) | -86                |

## 2.2 ~~REQUIRED VERIZON WIRELESS DEVICE COMPLIANCE TEST PLANS~~

VZ\_REQ\_LTEB13NAC\_1896

~~Refer to the Verizon Wireless LTE 3GPP Band 13 Device Conformance Test Process.~~

## 2.3 REFERENCES

VZ\_REQ\_LTEB13NAC\_1897

### <Industry Standards References>

Change requests may cause modification to the specifications listed below. Please refer to [www.3gpp.org](http://www.3gpp.org) for the latest version of the 3GPP specifications. Verizon Wireless LTE 3GPP Band 13 specifications are available at [opennetwork.verizonwireless.com](http://opennetwork.verizonwireless.com).

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20. 3GPP TS 29.274: *3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3, Release 9*
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<Other Applicable References>

1. N/A