

Reqs-LTE-1xHybrid hVoLTE

Device Requirements

Issued: Oct-15

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### hVOLTE

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| **Revision History**   |  |  | | --- | --- | | **Description of Changes** | **Date** | | Version 1.0  Initial version | January 2014 | | Version 2.0  Updates to sections: 4.1.2.2.3 (VZ\_REQ\_HVOLTE\_34124), 4.1.3.2.1 (VZ\_REQ\_HVOLTE\_34133), 5.3.1.2 (VZ\_REQ\_HVOLTE\_34141), 5.3.1.3.1 (VZ\_REQ\_HVOLTE\_35609), 5.3.2.1 (VZ\_REQ\_HVOLTE\_34142), 5.3.3.1.1 (VZ\_REQ\_HVOLTE\_34143), 5.3.3.2.1 (VZ\_REQ\_HVOLTE\_34144), 5.3.3.11.1.1 (VZ\_REQ\_HVOLTE\_35614), 5.3.3.11.2.1 (VZ\_REQ\_HVOLTE\_35615), 5.3.3.12.1 (VZ\_REQ\_HVOLTE\_35616), 5.3.5.1 (VZ\_REQ\_HVOLTE\_34153), 5.4.1.1 (VZ\_REQ\_HVOLTE\_34155), 7.4.1 (VZ\_REQ\_HVOLTE\_35618) | May 2014 | | Version 3.0  Updates to sections: 4.1 (VZ\_REQ\_HVOLTE\_34073), 4.1.1 (VZ\_REQ\_HVOLTE\_34118), 4.1.2.1.1 (VZ\_REQ\_HVOLTE\_34120), 4.1.2.3.2.1 (VZ\_REQ\_HVOLTE\_34128), 4.1.2.3.3.1 (VZ\_REQ\_HVOLTE\_34129), 4.1.3.1.2 (VZ\_REQ\_HVOLTE\_34132), 4.1.3.2.1 (VZ\_REQ\_HVOLTE\_34133), 4.1.3.3.1.1 (VZ\_REQ\_HVOLTE\_34134), 4.3.1.3.2.1 (VZ\_REQ\_HVOLTE\_35052), 5.3.1.2 (VZ\_REQ\_HVOLTE\_34141), 5.3.3.1.1 (VZ\_REQ\_HVOLTE\_34143), 5.3.3.2.1 (VZ\_REQ\_HVOLTE\_34144), 5.3.3.11.2.1 (VZ\_REQ\_HVOLTE\_35615), 5.3.3.12.1 (VZ\_REQ\_HVOLTE\_35616), 5.4.2.1 (VZ\_REQ\_HVOLTE\_34156), 5.6.1 (VZ\_REQ\_HVOLTE\_36527), 7.4.1 (VZ\_REQ\_HVOLTE\_35618) | June 2014 | | Version 4.0  Updates to sections: VZ\_REQ\_HVOLTE\_34129, VZ\_REQ\_HVOLTE\_37260, VZ\_REQ\_HVOLTE\_34138, VZ\_REQ\_HVOLTE\_34144, VZ\_REQ\_HVOLTE\_34152, VZW\_REQ\_HVOLTE\_35612, VZ\_REQ\_HVOLTE\_37261, VZ\_REQ\_HVOLTE\_35616, VZ\_REQ\_HVOLTE\_37282, VZ\_REQ\_HVOLTE\_37283, VZ\_REQ\_HVOLTE\_37291, VZ\_REQ\_HVOLTE\_37297, VZ\_REQ\_HVOLTE\_37298, VZ\_REQ\_HVOLTE\_37300, VZ\_REQ\_HVOLTE\_34155 | October 2014 | | Version 5.0  Updates to sections: VZ\_REQ\_HVOLTE\_34121, VZ\_REQ\_HVOLTE\_34130, VZ\_REQ\_HVOLTE\_34133, VZ\_REQ\_HVOLTE\_35615, VZ\_REQ\_HVOLTE\_37282, VZ\_REQ\_HVOLTE\_38020 | February 2015 | | Version 6.0  Updates to sections: VZ\_REQ\_HVOLTE\_35614, VZ\_REQ\_HVOLTE\_35615, VZ\_REQ\_HVOLTE\_38020, VZ\_REQ\_HVOLTE\_38999, VZ\_REQ\_HVOLTE\_34157, VZ\_REQ\_HVOLTE\_34158, VZ\_REQ\_HVOLTE\_38505, VZ\_REQ\_HVOLTE\_37926  Removed: VZ\_REQ\_HVOLTE\_37282, VZ\_REQ\_HVOLTE\_37283, VZ\_REQ\_HVOLTE\_37291, VZ\_REQ\_HVOLTE\_37297, VZ\_REQ\_HVOLTE\_37298, VZ\_REQ\_HVOLTE\_37300 | June 2015 | | Version 7.0  Updates to sections: VZ\_REQ\_HVOLTE\_34073, VZ\_REQ\_HVOLTE\_34128, VZ\_REQ\_HVOLTE\_34151 | October 2015 | |

#### INTRODUCTION VZ\_REQ\_HVOLTE\_34066

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| Verizon Wireless is launching VoLTE voice service for enterprise and consumer customers. This document details VoLTE-to-1xRTT voice and SMS service fallback procedures for LTE-CDMA multi-mode devices that support LTE + 1xRTT hybrid Single Radio LTE operation.  These devices are referred to as hybrid VoLTE devices (a.k.a., hVoLTE).  In this document, the terms LTE (Long Term Evolution) and E-UTRA (Evolved Universal Terrestrial Radio Access) are considered equivalent. |

##### APPLICABILITY VZ\_REQ\_HVOLTE\_34067

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| These requirements apply to all Verizon Wireless type 1 and type 2 LTE devices that are VoLTE capable and support Hybrid VoLTE operation.  **NOTE:** Device type is per the Verizon Wireless LTE Data Devices Requirements.  **NOTE:** Refer to "Roaming Operation for hVoLTE Device" section regarding roaming operation of hVoLTE devices.  **NOTE:** All requirements apply for all VoLTE calls both normal voice calls and TTY calls.  **NOTE:** While active on a 1xRTT call, the device shall use 1xRTT to add any additional calls. While active on the 1xRTT call, all 1xRTT calling features (e.g., call-waiting, 3-way calling, etc.) shall be available. |

**Associated Requirements**

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| **HVOLTE: 34108** ROAMING OPERATIONS FOR HVOLTE DEVICES (Section)  **LTEDATA: 50** LTE Data Devices (Folder) |

##### ACRONYMS/GLOSSARY/DEFINITIONS VZ\_REQ\_HVOLTE\_34068

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| This section defines acronyms and terms used throughout the document. For an extended list of Acronyms and Glossary terms refer to the Verizon Wireless Glossary.     |  |  | | --- | --- | | **Acronym/Term** | **Definition** | | 1xRTT | 1x Radio Transmission Technology | | 3GPP | 3rd Generation Partnership Project, manages GSM, EDGE, UMTS, HSPA, and LTE standards | | APN | Access Point Name | | CS | Circuit Switched | | CSFB | Circuit Switched Fallback | | eHRPD | Evolved High Rate Packet Data | | E-UTRA | Evolved Universal Terrestrial Radio Access | | FFS | For Future Study | | IMS | IP Multimedia Subsystem | | IMSI | International Mobile Subscriber Identity | | LTE | Long Term Evolution | | MO | Mobile Originated | | MSISDN | Mobile Subscriber Integrated Services Digital Network | | MT | Mobile Terminated | | NAS | Non-Access Stratum | | PDN | Packet Data Network | | RRC | Radio Resource Control | | SIP | Session Initiation Protocol | | SMS | Short Message Service | | hVoLTE | Hybrid VoLTE | | SVLTE | Simultaneous Voice (1xRTT) and LTE (Data) | | TAU | Tracking Area Update | | UE | User Equipment | | UICC | Universal Integrated Circuit Card | | URI | Uniform Resource Identifier | | VZW | Verizon Wireless | |

##### HOW TO USE THIS DOCUMENT VZ\_REQ\_HVOLTE\_34069

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| Section 1 ‘ Introduction, definitions, and applicability.  Section 2 ‘ Marketing requirements that are translated to technical requirements defined in sections 4 ‘ 8.  Section 3 ‘ User interface definition where applicable.  Section 4, 5, 6, 7, 8 ‘ Technical requirements used in device compliance testing and acceptance.  Section 9 ‘ References. |

#### MARKETING REQUIREMENTS VZ\_REQ\_HVOLTE\_34070

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| N/A |

#### USER INTERFACE VZ\_REQ\_HVOLTE\_34071

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| N/A |

#### HARDWARE SPECIFICATIONS VZ\_REQ\_HVOLTE\_34072

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##### HYBRID SRLTE MODEM OPERATION VZ\_REQ\_HVOLTE\_34073

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| The illustration below depicts the high level operations while the device is **in** hVoLTE state.  It is meant for illustrating the concept of operating modes, events and triggers and should not be interpreted as prescription for UE implementation.  The shaded area indicates the two operating modes within the hVoLTE state and their transitions.  The transitions from hVoLTE state to roaming state could happen in either operating mode. |



###### HYBRID SRLTE MODEM OPERATION VZ\_REQ\_HVOLTE\_34118

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| The device shall support hybrid VoLTE device operations as follows:   1. hVoLTE: this shall apply when the device is connected to the Verizon Wireless LTE network or an LTE network that broadcasts the Verizon Wireless PLMN.    * LTE-Only Mode    * LTE+1xRTT SRLTE Mode 2. Roaming: this shall apply when the device is roaming    * When an hVoLTE device is LTE roaming, hVoLTE operation shall be disabled.    * Roaming operation of hVoLTE devices is the same as requirements defined in VZW Multi-Mode Operations requirement document.     Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

###### LTE-ONLY MODE VZ\_REQ\_HVOLTE\_34119

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* + - 1. Entering LTE-Only Mode VZ\_REQ\_HVOLTE\_34074

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* + - * 1. Two Conditions VZ\_REQ\_HVOLTE\_34120

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| An hVoLTE device shall enter LTE-Only mode in two conditions:   * The LTE-Only Mode shall be the initial state whenever an hVoLTE device's cellular radio is enabled on device power up. Upon initial device power up, the hVoLTE device shall operate in hVoLTE mode.      * + **NOTE**: If the device is LTE roaming, it does not operate in hVoLTE state.   + **NOTE**: Upon entering airplane mode, the device shall retain knowledge of the operational mode of the device when the device entered airplane mode. Upon exiting airplane mode, the device shall operate in the same operational mode as when the device entered airplane mode until the criteria for transition to a different operational mode are met.      * The device shall transition from LTE+1xRTT SRLTE mode to LTE-Only mode as defined in the "Existing LTE+1xRTT SRLTE Mode" section.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34083** Exiting LTE+1xRTT SRLTE Mode (Section) |

* + - * 1. Attach to LTE Network VZ\_REQ\_HVOLTE\_34121

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| When entering the LTE-Only mode, the device shall immediately attach to the LTE network as a voice-centric device and perform IMS registration1 using procedures defined in VZW LTE 3GPP Band 13 Network Access Requirements, Verizon Wireless VoLTE Device Service requirements, and the Verizon Wireless IMS Requirements documents.  ------------------------- 1 NOTE: when VoLTE service is not provisioned (by network or by the user as defined in the Verizon Wireless VoLTE Device Service Requirements), refer to the Verizon Wireless VoLTE Device Service Requirements for additional details on IMS registration procedures.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **RCSVOLTE: 4250** Initial provisioning check on power up (Functional)  **RCSVOLTE: 4251** In the case the device receives a '403 Forbidden: Not authorized for Presence.' at any time the VoLTE (Functional)  **RCSVOLTE: 4272** If after VoLTE has been disabled per the above algorithm the device moves to eHRPD the device shall n (Functional)  **IMS: 35** IMS (Folder)  **LTEB13NAC: 46** LTE 3GPP Band 13 Network Access (Folder)  **RCSVOLTE: 91** VoLTE Device Service (Folder) |

* + - 1. Operations In LTE-Only Mode VZ\_REQ\_HVOLTE\_34075

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| The details of VoLTE operation in LTE-Only mode is addressed in the "Voice and SMS Operation on hVoLTE Device" section. |

**Associated Requirements**

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| **HVOLTE: 34089** VOICE AND SMS OPERATION ON HVOLTE DEVICES (Section) |

* + - * 1. Suspend 1XRTT Tune-aways VZ\_REQ\_HVOLTE\_34122

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| When operating in LTE-Only mode, the hVoLTE devices shall suspend 1xRTT tune-aways and operate in LTE only mode (i.e. CDMA modem is "cold").  Scope: [Branded, Open Development, Wholesale] |

* + - * 1. LTE Operation in All Verizon LTE Bands VZ\_REQ\_HVOLTE\_34123

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| The device shall support LTE operation in all Verizon Wireless LTE Bands (i.e. band 13, 4, and 2) when attached to the Verizon Wireless LTE network.  Scope: [Branded, Open Development, Wholesale] |

* + - * 1. All LTE Services VZ\_REQ\_HVOLTE\_34124

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| The device shall support ALL LTE services for smart phones in this mode (e.g., data, VoLTE, RCS, ePDG, Carrier aggregation and eMBMS). However, eMBMS functionality shall be disabled unless indicated otherwise by Verizon Wireless Device Marketing at device feature lockdown. The end user shall not be able to change this eMBMS functionality enable/disable state via the device user interface.  Scope: [Branded, Open Development, Wholesale] |

* + - 1. Exiting LTE-Only Mode VZ\_REQ\_HVOLTE\_34076

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| The device shall exit LTE-Only mode under the conditions defined in the following sections: |

* + - * 1. Silent Redial to 1xRTT VZ\_REQ\_HVOLTE\_34126

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Silent Redial to 1xRTT VZ\_REQ\_HVOLTE\_34077

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| * When a MO VoLTE call setup experiences failure, the device shall silent redial to 1xRTT as defined in the "UE Operations when VoLTE is not Available" section (Note: not ALL scenarios in that section causes silent redial to 1xRTT). * The silent redial scenarios will cause the device to transition to 1xRTT and eventually transition to LTE+1xRTT SRLTE mode of operation.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34092** UE Operations when VoLTE is not available (Section) |

* + - * 1. IRAT to CDMA VZ\_REQ\_HVOLTE\_34078

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IRAT to CDMA VZ\_REQ\_HVOLTE\_34128

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| The device shall perform IRAT procedures defined in VZW Multi-mode Operations Requirements document for transitioning to CDMA.  **NOTE**: Upon re-acquiring LTE, the device shall operate in SRLTE mode until the criteria for transition to LTE-only mode are met.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

* + - * 1. Transition to LTE+1xRTT SRLTE Mode VZ\_REQ\_HVOLTE\_34079

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Directly while not in a current VoLTE call VZ\_REQ\_HVOLTE\_34129

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| The device shall transition to LTE+1xRTT SRLTE mode directly while not in a current VoLTE call upon the following conditions:   * The device is not provisioned/de-provisioned for VoLTE service or VoLTE service has been disabled by the user through the device's user interface. Refer to sections of the Verizon Wireless VoLTE Device Service Requirements for additional details. * VoLTE is not Supported (UE enters a non-VoPS area)   + - Upon receipt of an ATTACH ACCEPT or TRACKING AREA UPDATE ACCEPT message that either a) does not contain the "EPS Network feature Support" IE or b) contains an "EPS Network feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode not supported",   The device shall transition to LTE+1xRTT SRLTE mode directly while not in a current VoLTE call upon the following IMS registration/re-registration failure conditions:   * IMS Registration/Re-registration1 Failure   + - The IMS registration throttling timer is started     - The IMS client is unable to initiate any further IMS registration requests until the device is power cycled or the UICC containing the ISIM is removed/replaced.     - SIP 503 reject with "IMS Outage" text in response to SIP REGISTER   The device shall transition to LTE+1xRTT SRLTE mode directly while not in a current VoLTE call as described below when an IMS PDN connection failure condition occurs:   * IMS PDN Connection Failure   + - If two consecutive standalone (i.e. not part of an attach procedure) IMS PDN connection requests fail, then the device shall transition to LTE+1xRTT SRLTE mode.     - If a standalone IMS PDN connection request is rejected with a transient ESM cause code and the throttling timer is greater than 0 (e.g. ESM #26 with a non-zero value for T3396), then the device shall transition to LTE+1xRTT SRLTE mode.     - If the IMS PDN is blocked until power cycle due to a data retry event, then the device shall transition to LTE+1xRTT SRLTE mode.     - *The IMS PDN connection has been deactivated by the network:* If the device was IMS registered and later the IMS PDN is deactivated by the network, the device shall enter IMS non-registered state. The device shall attempt to establish a new IMS PDN connection and a new IMS registration. If the standalone IMS PDN connection fails and any of the criteria above are met, the device shall transition to LTE+1xRTT SRLTE mode.     - If the IMS PDN connection request was part of an attach procedure and the attach procedure was rejected with ESM #19 and the device is required to switch to the class 3 APN for further attach attempts (per the Verizon Wireless LTE Data Retry Requirements), then the device shall stay in LTE-only mode and attempt to attach using the class 3 APN. If the attach using the class 3 APN is successful, the device shall make a standalone IMS PDN connection request (per the Verizon Wireless LTE Data Retry Requirements). If the standalone IMS PDN connection fails and any of the criteria above are met, the device shall transition to LTE+1xRTT SRLTE mode.     - If any attach procedure using the class 3 APN is successful, but a standalone IMS PDN connection request cannot be sent immediately after attach because either the IMS PDN throttling timer is running or the IMS PDN is blocked until power cycle, then the device shall transition to LTE+1xRTT SRLTE mode.   The device shall transition to LTE+1xRTT SRLTE mode directly while not in a current VoLTE call upon the following conditions:   * SIP 503 Reject with "IMS Outage" text in response:   + - Any non-INVITE SIP request when there is no active VoLTE call.   ------------------------- 1 An IMS re-registration failure is declared when per the IMS registration/re-registration throttling algorithm (in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements), the device exhausts all re-registration attempts on the current serving P-CSCF and is required to initiate a new IMS registration at the next registration attempt.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **RCSVOLTE: 4250** Initial provisioning check on power up (Functional)  **LTEB13NAC: 23528** IMS REGISTRATION/RE-REGISTRATION RETRY ALGORITHM (Section)  **RCSVOLTE: 4251** In the case the device receives a '403 Forbidden: Not authorized for Presence.' at any time the VoLTE (Functional)  **RCSVOLTE: 4272** If after VoLTE has been disabled per the above algorithm the device moves to eHRPD the device shall n (Functional) |

Directly after a VoLTE call ends VZ\_REQ\_HVOLTE\_34130

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| The device shall transition to LTE+1xRTT SRLTE mode directly after a VoLTE call ends/drops if the IMS PDN is deactivated by the network during an active VoLTE call.  The device shall enter IMS non-registered state. The device shall attempt to establish a new IMS PDN connection and a new IMS registration.  For additional cases where the device shall transition to LTE+1xRTT SRLTE mode directly after a VoLTE call ends/drops, refer to the "*UE Operations when VoLTE is not available*" section of this document.  Scope: [Branded, Open Development, Wholesale] |

###### LTE+1xRTT SRLTE Mode VZ\_REQ\_HVOLTE\_34080

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* + - 1. Entering LTE+1xRTT SRLTE Mode VZ\_REQ\_HVOLTE\_34081

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* + - * 1. Req-1 VZ\_REQ\_HVOLTE\_34131

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| The hVoLTE devices shall always enter LTE+1xRTT SRLTE mode when transitioning from CDMA to LTE for any reason (e.g., after silent redial or iRAT) per "IRAT Transition" section of this document.  The hVoLTE devices shall follow requirements defined in "Exiting LTE Only Mode" section of this document when entering LTE+1xRTT SRLTE mode from LTE-Only mode.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34107** IRAT Transition (Section)  **HVOLTE: 34076** Exiting LTE-Only Mode (Section) |

* + - * 1. Req-2 VZ\_REQ\_HVOLTE\_34132

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| Upon entering LTE+1xRTT SRLTE mode, the device shall perform the following actions:   * If not already attached, immediately attach to the LTE network as a voice-centric device, * When transitioning from CDMA to SRLTE mode when the device was previously using eHRPD for data service, start Tdelay timer, wait for Tdelay time, after Tdelay time perform IMS registration using the procedures defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements and Verizon Wireless IMS Requirements documents. The device shall IMS register for both voice and SMS if all the criteria below are met, otherwise the device shall IMS register for SMS only.   + VoLTE service is provisioned on the device and VoLTE is enabled on the device.   + The LTE network has VoPS enabled.   + For the current serving cell, service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". * When transitioning from CDMA to SRLTE mode when the device was previously using HRPD/1xRTT for data service, perform IMS registration using the procedures defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements and Verizon Wireless IMS Requirements documents. The device shall IMS register for both voice and SMS if all the criteria below are met, otherwise the device shall IMS register for SMS only.   + VoLTE service is provisioned on the device and VoLTE is enabled on the device.   + The LTE network has VoPS enabled.   + For the current serving cell, service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". * When transitioning from 1xRTT to SRLTE mode, the device shall send a TRACKING AREA UPDATE REQUEST message to resume LTE data operation and attempt a new IMS registration for both voice and SMS using procedures defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements and Verizon Wireless IMS Requirements documents. **Note:** Tdelay does not apply in this case. * When transitioning from LTE-only mode to SRLTE mode, the device shall perform IMS registration either for both voice and SMS or for SMS-only depending on the cause of transition.  For example,   + If the network has VoPS disabled or VoLTE service is not provisioned or VoLTE is disabled on the device, the device shall perform IMS registration for SMS only.   + If the current serving cell has service specific access control active with an "ac-BarringFactor" set to "p00", the device shall perform IMS registration for SMS only.   + If the IMS registration failed previously, but the VoLTE service is provisioned and network still supports VoPS, the device shall perform IMS retry under the control of IMS retry throttling algorithm.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34107** IRAT Transition (Section)  **IMS: 22838** SOFTWARE SPECIFICATIONS (Section)  **LTEB13NAC: 46** LTE 3GPP Band 13 Network Access (Folder) |

* + - 1. Operating In LTE+1xRTT SRLTE Mode VZ\_REQ\_HVOLTE\_34082

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* + - * 1. OPERATING IN LTE+1XRTT SRLTE MODE VZ\_REQ\_HVOLTE\_34133

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| When operating in LTE+1xRTT SRLTE mode,   * In LTE+1xRTT SRLTE mode, the devices shall operate in dual registration mode at all times. That is, the device shall be simultaneously registered on the 1xRTT network for voice services and attached to the LTE network for data services. * The device shall tune away from LTE to monitor the 1xRTT paging slot when attached to the Verizon Wireless LTE network. The device shall support one of the following tune away mechanisms:   + 1. Tune both receiver chains from LTE to 1xRTT (i.e. no LTE receiver chains shall stay active on LTE during the 1xRTT tune away).     2. In good 1xRTT RF conditions, tune one receiver chain from LTE to 1xRTT while the other receiver chain stays on LTE, i.e. single receiver SRLTE (SLTE). During the tune away, the device shall report a rank indicator of 1 to the LTE network. In poor 1xRTT RF conditions, tune both receiver chains from LTE to 1xRTT (i.e. no LTE receiver chains shall stay active on LTE during the 1xRTT tune away). The device shall switch from single receiver chain tune away to dual receiver chain tune away when either the 1xRTT RSSI drops below or equal to -95 dBm or the 1xRTT Ec/Io drops below or equal to -10 dB. The device shall switch from dual receiver chain tune away to single receiver chain tune away when both the 1xRTT RSSI rises above or equal to -85 dBm and the 1xRTT Ec/Io rises above or equal to -8 dB. * The device shall perform 1xRTT maintenance activities (including CDMA registration) during a normally scheduled 1xRTT tune away. * In the case of a collision between an LTE wake up slot and a 1xRTT wake up slot (when the device is tuning both receivers from LTE to 1xRTT during 1xRTT wake up slots), the device shall give the 1xRTT wake up slot priority and tune away to 1xRTT. * The device shall support LTE+1xRTT hybrid operation for LTE in all Verizon Wireless LTE Bands (i.e. bands 13, 4, and 2) when attached to the Verizon Wireless LTE network. * When on LTE during LTE + 1xRTT SRLTE operation, the devices LTE modem shall always operate in dual receiver operation, i.e. downlink 2x2 transmit diversity, downlink 4x2 transmit diversity, downlink 2x2 spatial multiplexing, or downlink 4x2 spatial multiplexing as directed by the network.  At no time shall the devices LTE modem autonomously cease dual receiver operation for any purpose (except during the 1xRTT tune away). * The device shall support ALL LTE DATA services for smart phones in this mode (e.g., data, ePDG, carrier aggregation) except eMBMS.  eMBMS shall be disabled in the SRLTE mode. * If the user initiates a voice call, the device shall use 1xRTT to originate the voice call. Upon initiating a voice call on 1xRTT or answering a 1xRTT voice page, the device shall send an EXTENDED SERVICE REQUEST message prior to starting 1xRTT call set up. * The device shall support SMS over IMS in this state and follow the SMS retry requirements in the "Verizon Wireless IMS requirements" in case of SMS delivery failure.  **NOTE:**   The EXTENDED SERVICE REQUEST message is not sent in the case of a MO SMS retry in 1xRTT or a MT SMS in 1xRTT.  The device is also required NOT to perform a TAU after a MO SMS on 1xRTT.   Scope: [Branded, Open Development, Wholesale] |

* + - 1. Exiting LTE+1xRTT SRLTE Mode VZ\_REQ\_HVOLTE\_34083

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* + - * 1. Transition to LTE-Only Mode VZ\_REQ\_HVOLTE\_35050

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Req-1 VZ\_REQ\_HVOLTE\_34134

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| When in LTE+1xRTT SRLTE mode, upon all of the following conditions (i.e., UE recovers from conditions defined in section "Transition to LTE+1xRTT SRLTE Mode"):   * The device has successfully attached/connected to an LTE network that supports VoLTE, and has IMS registered for both VoLTE and SMS services using the MSISDN-based SIP URI. An LTE network shall be considered to support VoLTE if the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message contain an "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode supported". * VoLTE service is provisioned by the user.  Refer to Verizon Wireless VoLTE Device Service Requirements for additional details. * The criteria in the section "Conditional VoLTE calling" Verizon Wireless IMS Requirements have been met.   The devices shall suspend tune-away to 1xRTT and transition to LTE only mode (i.e. CDMA modem is "cold").  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **IMS: 22923** CONDITIONAL VOLTE CALLING (Functional)  **HVOLTE: 34079** Transition to LTE+1xRTT SRLTE Mode (Section)  **RCSVOLTE: 91** VoLTE Device Service (Folder) |

Req-2 VZ\_REQ\_HVOLTE\_34135

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| The devices shall suspend tune-away to 1xRTT and transition to LTE only mode (i.e. CDMA modem is "cold").  Scope: [Branded, Open Development, Wholesale] |

* + - * 1. IRAT to CDMA VZ\_REQ\_HVOLTE\_35051

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Req-1 VZ\_REQ\_HVOLTE\_35052

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| The device shall perform IRAT procedures defined in VZW Multi-mode Operations Requirements document for transitioning to CDMA.    **NOTE**: Upon leaving LTE, the device shall retain knowledge of the operational mode of the device when the device leaves LTE. Upon re-acquiring LTE, the device shall operate in the same operational mode as when the device left LTE until the criteria for transition to a different operational mode are met.    Scope: [Branded, Open Development, Wholesale] |

#### SOFTWARE SPECIFICATIONS VZ\_REQ\_HVOLTE\_34084

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##### IMS SIGNALING AND LOWER LAYER FAILURES VZ\_REQ\_HVOLTE\_34085

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| Refer to the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements (SIP registration) and the Verizon Wireless LTE Data Devices Requirements (non-registration procedures/requests). |

**Associated Requirements**

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| **LTEB13NAC: 46** LTE 3GPP Band 13 Network Access (Folder)  **LTEDATA: 50** LTE Data Devices (Folder) |

##### TIMER\_VZW AND SILENT REDIAL TO 1XRTT VZ\_REQ\_HVOLTE\_34086

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###### Timer\_VZW Definition VZ\_REQ\_HVOLTE\_34087

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* + - 1. Timer\_VZW Definition VZ\_REQ\_HVOLTE\_34136

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| * The device shall start Timer\_VZW when the IMS client generates a SIP INVITE for a VoLTE call.   + The device shall only send a SIP INVITE from the IMS client to the modem for transmission if an IMS signaling connection exists. (**NOTE:** If the SIP INVITE is for an E911 call, the IMS client shall indicate to the modem that it requires an IMS signaling connection to establish a VoLTE E911 call so that the LTE modem can take all appropriate action based on 3GPP standards and the Verizon Wireless E911 for LTE Only or LTE Multi-mode VoLTE Capable Devices Requirements).   + If the user hits "END" before Timer\_VZW expires, the device shall treat this as a normal call termination.   + If the device receives a SIP 100 Trying before Timer\_VZW expires, then any further failure of the VoLTE call setup shall be considered a normal call failure (i.e. an ineffective attempt).   + The device shall only apply Timer\_VZW when there is no active VoLTE call, i.e. Timer\_VZW shall not be applied to the SIP INVITE for a second VoLTE call during an already active VoLTE call.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **e911: 30193** e911 For LTE Only or LTE Multi-Mode VoLTE Capable Devices (Folder) |

###### Silent Redial to 1xRTT VZ\_REQ\_HVOLTE\_34088

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| Silent redial triggers are defined in the following sections:   * Data Retry or RRC/Radio Connection Failure or Lower Layer Signaling Failure * IMS re-registration failure per section * UE moved out of LTE coverage per section * UE receives SIP 503 (IMS service not available) error code with "Outage text" as per section   **NOTE:** if a device dials directly to 1xRTT without sending SIP INVITE 1st on LTE, it is not considered "silent redial" from terminology perspective.  The sections address those scenarios are:   * Not ready for VoLTE services per section * UE initiates a WPS call as per section |

**Associated Requirements**

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| **HVOLTE: 34094** Data Retry or RRC/Radio Connection or Lower Layer Signaling Failure (Section)  **HVOLTE: 34095** IMS Re-Registration Failure (Section)  **HVOLTE: 34097** UE Moved out of LTE Coverage (Section)  **HVOLTE: 34098** SIP 503 with 'IMS Outage' Text (Section)  **HVOLTE: 34099** WPS Calls (Section) |

* + - 1. Req-1 VZ\_REQ\_HVOLTE\_34137

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| While in LTE-Only mode, if SILENT\_REDIAL\_ENABLE is set to "1", the device shall perform a silent redial to 1xRTT if:   * Timer\_VZW expires and the device has not received a SIP 100 Trying in response to the SIP INVITE * The SIP INVITE is rejected with SIP 503 with "Outage text" and there is no active VoLTE call.   Scope: [Branded, Open Development, Wholesale] |

* + - 1. Req-2 VZ\_REQ\_HVOLTE\_34138

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| When performing silent redial to 1xRTT, the device shall meet the following requirements:   * The device shall leave LTE after Timer\_VZW expires (if Timer\_VZW is active) if there is no SIP 100 Trying response from the network, and redial the same call over 1xRTT network (sections *Data Retry or RRC/Radio Connection or Lower Layer Signaling Failure* , *IMS Re-Registration Failure*, *UE Moved out of LTE Coverage*). * The device shall leave LTE upon receipt of a SIP 503 with "Outage text" in response to a SIP INVITE when there is no active VoLTE call, and redial the same call over the 1xRTT network (section *SIP 503 with "IMS Outage" Text*). * The UE shall terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and fall back to 1xRTT (including attach to 1xRTT network, perform an implicit 1xRTT registration and voice call setup). * Any MO SMS over IMS over LTE procedures in progress when Timer\_VZW expires shall be terminated. * Upon silent redial when LTE connection is still available, the UE shall send an EXTENDED SERVICE REQUEST message to provide a "notification" to the core network whenever possible so that the UE is going to another technology so that LTE network suspends data transmission on LTE. * After leaving LTE to redial the voice call in 1xRTT:      1. If the UE cannot find an available 1xRTT system to perform silent redial and attaches to an eHRPD network for data service, the UE shall:    1. IMS re-register for SMS only (refer to the Verizon Wireless IMS Requirements for additional details).    2. Send indication to user that the call attempt has failed.      1. If the UE attaches to eHRPD (1xRTT available or not), the UE shall always perform IMS re-register for SMS only (refer to the Verizon Wireless IMS Requirements for additional details).      1. If the UE attaches to an HRPD or 1xRTT network for data service and was previously IMS registered for VoLTE on LTE or the UE falls back to 1xRTT to redial any call, the UE shall send the Domain Change Notification (DCN) SMS over the 1xRTT network to notify the network that the device is not available to receive incoming VoLTE calls until a new IMS registration (with VoLTE tags) is established. Refer to the the Verizon Wireless IMS Requirements for additional details on the DCN SMS.      1. Regardless which network is used for data service (eHRPD, HRPD or 1xRTT), if 1xRTT system is available and UE successfully registered on the 1xRTT system, the UE shall use 1xRTT for voice.      1. While active on the 1xRTT call, the device shall use 1xRTT to add any additional calls. While active on the 1xRTT call, all 1xRTT calling features (e.g., call-waiting, 3-way calling, etc.) shall be available.      1. If the UE finds no CDMA system, it shall enter the system loss state and restart system selection process as defined in Verizon Wireless Multi-Mode Operations requirement document      * In all the scenarios above where CDMA system is available,   + SMS shall be supported as follows:     - The UE shall use IMS for SMS if the UE is attached to an eHRPD network and there is no active 1xRTT voice call.     - The UE shall use 1xRTT for SMS if the UE is attached to an eHRPD network and there is an active 1xRTT voice call.     - The UE shall use 1xRTT for SMS if the UE is attached to an HRPD or 1xRTT network.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34094** Data Retry or RRC/Radio Connection or Lower Layer Signaling Failure (Section)  **HVOLTE: 34095** IMS Re-Registration Failure (Section)  **HVOLTE: 34097** UE Moved out of LTE Coverage (Section)  **HVOLTE: 34098** SIP 503 with 'IMS Outage' Text (Section)  **IMS: 35** IMS (Folder)  **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

* + - 1. Req-3 VZ\_REQ\_HVOLTE\_34139

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| If Timer\_VZW expires and the device has not received a SIP 100 Trying from the network, SILENT\_REDIAL\_ENABLE is set to "0" (i.e. disable):  The device shall treat this as a normal call failure (i.e. an ineffective attempt).  Scope: [Branded, Open Development, Wholesale] |

* + - 1. SIB8 Broadcast of CDMA Co-located Channel VZ\_REQ\_HVOLTE\_37260

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| When performing silent redial on 1xRTT, the device shall use the following logic to speed up collocated CDMA channel acquisition with descending priority:   1. MRU ) SIB 8 (intersection) 2. Remaining SIB 8 1xRTT channels 3. Per legacy/existing scan sequence (which covers GEO, MRU, PRL etc.)   SIB8 broadcast of co-located CDMA channel information contains the following elements in the *parameters1XRTT* IE within cellReselectionParameters1XRTT:  Under neighCellList, for each co-located CDMA band class:  ***bandClass***,  Under neighCellsPerFreqList  ***arfcn***  physCellIdList  When *parameter1xRTT* IE is not present in SIB8, the device shall use the MRU and PRL for CDMA channel acquisition as usual.  **NOTE:** Other than the two highlighted parameters (band class and arfcn of the collocated CDMA cells) all the other fields of the *parameter1xRTT* IE including phyCellIdList shall be ignored by the device for the purpose of CDMA channel acquisition during silent redial on 1xRTT.  The value of the "bandClass" and "arfcn" will be part of the co-located CDMA sectors channel list.  **NOTE:** CSFB-RegistrationParam1xRTT IE will not be populated by the network.  **NOTE:** GEO refers to the system table that contains SID/NIDs for 1xRTT systems grouped into geographical areas.    Scope: [Branded, Open Development, Wholesale] |

##### VOICE AND SMS OPERATION ON HVOLTE DEVICES VZ\_REQ\_HVOLTE\_34089

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###### Voice Service VZ\_REQ\_HVOLTE\_34090

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* + - 1. Req-1 VZ\_REQ\_HVOLTE\_34140

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| The device shall use 1xRTT for voice if the device is attached to an eHRPD, HRPD, or 1xRTT network for data.  Scope: [Branded, Open Development, Wholesale] |

* + - 1. Req-2 VZ\_REQ\_HVOLTE\_34141

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| The device shall only use IMS over LTE for both voice and SMS when in LTE-Only Mode under the following conditions:   * The device has successfully attached/connected to an LTE network that supports VoLTE, and has IMS registered for both VoLTE and SMS services using the MSISDN-based SIP URI. An LTE network shall be considered to support VoLTE if the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message contain an "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode supported". * The criteria in section "Conditional VoLTE Calling" of the Verizon Wireless IMS Requirements have been met. * The device is provisioned for VoLTE service and VoLTE service has been enabled by the user through the device's user interface. Refer to the Verizon Wireless VoLTE Device Service Requirements and the "VoLTE Service Discovery" section of this document for additional details. * For the current serving cell, service specific access control is either not active or active with an "ac-BarringFactor" other than "p00".   Otherwise, the device shall use 1xRTT for voice when in LTE+1xRTT SRLTE mode (attached to the Verizon Wireless LTE network).  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **IMS: 22923** CONDITIONAL VOLTE CALLING (Functional)  **RCSVOLTE: 4250** Initial provisioning check on power up (Functional)  **RCSVOLTE: 4251** In the case the device receives a '403 Forbidden: Not authorized for Presence.' at any time the VoLTE (Functional)  **RCSVOLTE: 4272** If after VoLTE has been disabled per the above algorithm the device moves to eHRPD the device shall n (Functional) |

* + - 1. VOLTE SERVICE DISCOVERY VZW\_REQ\_HVOLTE\_35608

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* + - * 1. VOLTE SERVICE DISCOVERY VZ\_REQ\_HVOLTE\_35609

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| Before enabling VoLTE service, the device shall determine if the user is provisioned for VoLTE service as follows:     1. The device shall read the SDM parameters associated with VoLTE, video calling, and EAB as defined in the Verizon Wireless VoLTE Device Service Requirements and the Verizon Wireless LTE Multi-Mode OTADM Requirements. 2. The device shall determine if the user is provisioned for VoLTE service based on the SDM parameter settings as defined in the Verizon Wireless VoLTE Device Service Requirements and the Verizon Wireless LTE Multi-Mode OTADM Requirements. 3. If the user is provisioned for VoLTE service based on the SDM parameter settings and VoLTE is enabled by the user through the device's user interface, the device shall then enable VoLTE service and proceed with IMS registration for both VoLTE and SMS. In this scenario, if a SIP PUBLISH request is rejected with a SIP 403 error code, the device shall not disable VoLTE service. 4. If the user is NOT provisioned for VoLTE service based on the SDM parameter settings or if VoLTE is disabled by the user through the device's user interface, then the device shall disable VoLTE service and IMS register for SMS only. 5. If the SDM parameters associated with VoLTE are not present on the device, the device shall use the presence-based algorithm for determining whether the user is provisioned for VoLTE service as defined in the Verizon Wireless VoLTE Device Service Requirements.     Scope: [Branded, Open Development, Wholesale] |

###### SMS Service VZ\_REQ\_HVOLTE\_34091

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* + - 1. SMS SERVICE VZ\_REQ\_HVOLTE\_34142

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| In normal operation, the device shall only use IMS for SMS when one the following criteria has been met. If neither of the criteria below has been met, the device shall use 1xRTT for SMS. If the device is IMS registered using the IMSI-based SIP URI, only administrative SMS shall be supported in regards to SMS over IMS (as per the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements).   * The device has successfully attached/connected to an eHRPD network, and is IMS registered for SMS services using the MSISDN-based SIP URI or the IMSI-based SIP URI. * The device has successfully attached/connected to an LTE network, and is IMS registered for SMS services using the MSISDN-based SIP URI or the IMSI-based SIP URI in both LTE-only and LTE+1xRTT SRLTE modes).   **NOTE:**  While in administrative SMS mode for SMS over IMS, the device shall support normal SMS text messaging using 1xRTT if the device is in SRLTE mode and successfully registers with the 1xRTT network.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEB13NAC: 46** LTE 3GPP Band 13 Network Access (Folder) |

###### UE Operations when VoLTE is not available VZ\_REQ\_HVOLTE\_34092

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| Terminologies used in this section:   * VoLTE Call Setup in Progress: User has pressed the "SEND" button * VoLTE Call in progress: there is an active VoLTE call |

* + - 1. LTE Network does not Support VoLTE VZ\_REQ\_HVOLTE\_34093

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* + - * 1. LTE NETWORK DOES NOT SUPPORT VOLTE VZ\_REQ\_HVOLTE\_34143

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| **NOTE:**  The device shall determine whether an LTE network supports or doesn't support VoLTE based on the "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) setting in the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message.  If the device powers up or moves into an LTE network that does not support VoLTE while in LTE-Only mode:   * *No VoLTE call in progress, no VoLTE call setup in progress*: The device shall:   + Enable LTE+1xRTT SRLTE mode of operation.   + IMS register/re-register for SMS only.   + Use 1xRTT for voice and IMS for SMS. * *VoLTE call in progress when the device moves into an LTE network that does not support VoLTE*: The device shall allow the VoLTE call to continue until it ends or drops. Upon the VoLTE call ending/dropping, the device shall:   + Enable LTE + 1xRTT SRLTE mode of operation.   + IMS re-register for SMS only.   + Use 1xRTT for voice and IMS for SMS. * *VoLTE call setup in progress when the device moves into an LTE network that does not support VoLTE*: The device shall allow the VoLTE call set up to continue. After the call ends/drops (i.e. if the call set up is successful) or after the call set up fails (i.e. the call set up is not successful):   + Enable LTE + 1xRTT SRLTE mode of operation.   + IMS re-register for SMS only.   + Use 1xRTT for voice and IMS for SMS.   After IMS re-registering for SMS only as the result of encountering a tracking area which doesn't support VoLTE, the device shall start a hysteresis timer TVoLTE\_hys when the device moves to a cell in a tracking area which supports VoLTE (via the NAS VoPS indicator) and where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". The device shall IMS re-register for VoLTE upon the expiry of TVoLTE\_hys if the device is still in a cell in a tracking area which supports VoLTE (via the NAS VoPS indicator) and where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". While TVoLTE\_hys is running, if the device moves into a cell which is either in a tracking area that does not support VoLTE (via the NAS VoPS indicator) or where service specific access control is active with an "ac-BarringFactor" set to "p00", the device shall stop and reset TVoLTE\_hys and maintain the current IMS registration for SMS only. Refer to the *Service Specific Access Control* section of this document for additional details on service specific access control behavior.  Scope: [Branded, Open Development, Wholesale] |

* + - 1. Data Retry or RRC/Radio Connection or Lower Layer Signaling Failure VZ\_REQ\_HVOLTE\_34094

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* + - * 1. DATA RETRY OR RRC/RADIO CONNECTION OR LOWER LAYER SIGNALING FAILURE VZ\_REQ\_HVOLTE\_34144

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| **NOTE:**  For access barring/access control related RRC failures (including RRC connection reject), the requirements in the "Access Barring" section of this document shall take precedence.     * *VoLTE Call in Progress:* If the device encounters a data retry or RRC/radio connection failure and loses IMS signaling connectivity during an active VoLTE call, the device shall maintain the VoLTE call until the call ends or drops. * *VoLTE Call Setup in Progress:*   + If Timer\_VZW expires and the device has not received a SIP 100 Trying from the network nor any reject from the network, SILENT\_REDIAL\_ENABLE is set to "1" (i.e. enable):  The device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and initiate silent redial on 1xRTT.     - The 1xRTT call set up shall start within TBD seconds of the expiration of Timer\_VZW.     - Any MO SMS over IMS over LTE procedures in progress when Timer\_VZW expires shall be terminated.   + If the device has to transition from RRC\_IDLE to RRC\_CONNECTED to send the SIP INVITE and during this process the network indicates that the device no longer has a valid IMS PDN connection, then if SILENT\_REDIAL\_ENABLE is set to "1" (i.e. enable):  The device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and immediately initiate silent redial on 1xRTT. Examples scenarios include:     - The service request is rejected with EMM cause code 9 or 10, forcing the device to re-attach to the LTE network.     - The service request succeeds but during bearer re-synchronization the network indicates that the IMS PDN has been deactivated.   + If Timer\_VZW expires and the device has not received a SIP 100 Trying from the network, SILENT\_REDIAL\_ENABLE is set to "0" (i.e. disable):  The device shall treat this as a normal call failure (i.e. an ineffective attempt).     Scope: [Branded, Open Development, Wholesale] |

* + - 1. IMS Re-Registration Failure VZ\_REQ\_HVOLTE\_34095

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* + - * 1. IMS Re-Registration Failure VZ\_REQ\_HVOLTE\_34145

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| If an IMS re-registration fails while the device is in LTE-Only mode:   * *Device IMS registered for VoLTE, no VoLTE call in progress, no VoLTE call set up in progress*: the device shall:   + Enable LTE + 1xRTT SRLTE mode of operation.   + Use 1xRTT for voice and SMS until either the re-registration (for both voice and SMS) succeeds or a new IMS registration for VoLTE and SMS services is established (VZW IMS registration retry requirements per the VZW LTE 3GPP Band 13 Network Access Requirements apply). * *VoLTE call in progress*: the device shall:   + Maintain the VoLTE call until the call ends or drops. After the device exhausts all re-registration retries on the current P-CSCF (per the IMS registration throttling procedures defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements), the device shall suspend IMS registration retry procedures until the VoLTE call ends or drops. Upon the VoLTE call ending/dropping, the device shall:     - Enable LTE + 1xRTT SRLTE mode of operation.     - Resume IMS registration retry procedures as defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.     - Use 1xRTT for voice and SMS until either the re-registration succeeds or a new IMS registration is established (VZW IMS registration retry requirements per the VZW LTE 3GPP Band 13 Network Access Requirements apply).   + While the current IMS registration is still valid, additional IMS services shall be supported (e.g., upgrade to video call, RCS chat, presence update, SMS) unless the re-registration/registration attempt was rejected with SIP 503 with "Outage Text".   + If a re-registration/registration attempt is rejected with SIP 503 with "Outage Text", the device shall not allow any non-REGISTER SIP requests until either the re-registration succeeds or a new IMS registration is established. * *VoLTE call set up in progress*:   + Registration has not expired: The device shall allow the VoLTE call setup to continue. If the VoLTE call setup succeeds, the device shall allow the VoLTE call to continue until either the call drops or the call ends. After the device exhausts all re-registration retries on the current P-CSCF (per the IMS registration throttling procedures defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements), the device shall suspend IMS registration retry procedures until either the VoLTE call set up fails or the VoLTE call ends or drops.     - Upon either the VoLTE call set up failing or the VoLTE call ending/dropping, the device shall:       * Enable LTE + 1xRTT SRLTE mode of operation.       * Resume IMS registration retry procedures (for both voice and SMS) as defined in the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.       * Use 1xRTT for voice and SMS until either the re-registration succeeds or a new IMS registration for VoLTE and SMS services is established (VZW IMS registration retry requirements per the VZW LTE 3GPP Band 13 Network Access Requirements apply).     - If a re-registration/registration attempt is rejected with SIP 503 with "Outage Text", the device shall not allow any non-REGISTER SIP requests until either the re-registration succeeds or a new IMS registration for VoLTE and SMS services is established.   + Registration expires during call set up: This scenario should not occur.  If any race condition happens to make this scenario a reality, the device shall:     - Locally terminate all active SIP dialogs and SIP requests, and attempt a new IMS registration.     - Enable LTE + 1xRTT SRLTE mode of operation.     - Use 1xRTT for voice and SMS until either the re-registration succeeds or a new IMS registration for VoLTE and SMS services is established (VZW IMS registration retry requirements per the VZW LTE 3GPP Band 13 Network Access Requirements apply). * If the IMS registration expires while the device is active on a 1xRTT voice call, then the device shall attempt a new IMS registration for VoLET and SMS services after the 1xRTT voice call ends.  The device shall use 1xRTT for voice and SMS until either the re-registration succeeds or a new IMS registration for VoLTE and SMS services is established (VZW IMS registration retry requirements per the VZW LTE 3GPP Band 13 Network Access Requirements apply).   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEB13NAC: 23528** IMS REGISTRATION/RE-REGISTRATION RETRY ALGORITHM (Section)  **LTEB13NAC: 23531** IMS REGISTRATION TIMER EXPIRES WHILE THROTTLING (Section) |

* + - 1. VoLTE is not ready VZ\_REQ\_HVOLTE\_34096

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* + - * 1. VoLTE is not ready VZ\_REQ\_HVOLTE\_34146

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| *User initiates a voice call:*   * If the device does not have an IMS PDN connection (for any reason) and/or not IMS registered already (i.e., the criteria defined in section "Voice Service" for using IMS for voice and SMS is not met), the device shall perform the following actions immediately1: * The device shall originate the voice call on the 1xRTT network. No SIP INVITE shall be sent by the IMS client.The call manager on the device needs to decide if the VoLTE activation criteria have been met before it tells the IMS client to initiate the call over VoLTE. In this case the activation criteria have not been met.   ------------------------- 1 Note, this scenario refers to initial power up case where IMS PDN is still being established.  If MO call is initiated and IMS PDN is torn down later, Timer\_VzW should expire and trigger silent redial.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **HVOLTE: 34090** Voice Service (Section) |

* + - 1. UE Moved out of LTE Coverage VZ\_REQ\_HVOLTE\_34097

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* + - * 1. UE Moved out of LTE Coverage VZ\_REQ\_HVOLTE\_34147

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| Upon losing LTE coverage (e.g., radio link failure in RRC connected state or failure to find a suitable LTE system in RRC Idle state)1,   * *VoLTE Call Setup in Progress:*   + If Timer\_VZW expires and the device has not received a SIP 100 Trying from the network, SILENT\_REDIAL\_ENABLE is set to "1" (i.e. enable):  The device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and initiate silent redial on 1xRTT.     - The 1xRTT call set up shall start within TBD seconds of the expiration of Timer\_VZW.     - Any MO SMS over IMS over LTE procedures in progress when Timer\_VZW expires shall be terminated.   + If Timer\_VZW expires and the device has not received a SIP 100 Trying from the network, SILENT\_REDIAL\_ENABLE is set to "0" (i.e. disable):  The device shall treat this as a normal call failure (i.e. an ineffective attempt).   + If the SIP 100 Trying is received before Timer\_VZW expires, i.e. the LTE connection is re-established before Timer\_VZW expires, the device shall proceed with the VoLTE call set up as usual.   + If the SIP 100 Trying is received before Timer\_VZW expires and LTE coverage is lost resulting in VoLTE call set up failure, the device shall treat this as a normal call failure (i.e. ineffective attempt).      * After leaving LTE coverage in the case where there is no silent redial, the device shall attempt to attach to the next most preferred, available system indicated by system selection:  1. If the device attaches to an eHRPD network for data service, the UE shall:    1. *VoLTE Call Setup was in Progress:* Send a SIP CANCEL message to terminate the SIP INVITE process if a SIP 100 Trying message has been received (refer to the Verizon Wireless IMS Requirements for additional details), and send indication to user that the call attempt has failed    2. IMS re-register for SMS only (refer to the Verizon Wireless IMS Requirements for additional details).      1. If the UE attaches to eHRPD (1xRTT available or not), the UE shall always perform IMS re-register for SMS only (refer to the Verizon Wireless IMS Requirements for additional details).      1. If the UE attaches to an HRPD or 1xRTT network for data service and was previously IMS registered for VoLTE on LTE, the UE shall send the Domain Change Notification SMS over the 1xRTT network to "de-register IMS" per the Verizon Wireless IMS Requirements.      1. Regardless which network is used for data service (eHRPD, HRPD or 1xRTT), if 1xRTT system is available and UE successfully registered on the 1xRTT system, the UE shall use 1xRTT for voice.      1. While active on the 1xRTT call, the device shall use 1xRTT to add any additional calls. While active on the 1xRTT call, all 1xRTT calling features (e.g., call-waiting, 3-way calling, etc.) shall be available.      1. If the UE finds no CDMA system, it shall enter the system loss state and restart system selection process as defined in Verizon Wireless Multi-Mode Operation requirement document      * In all the scenarios above where CDMA system is available,   + SMS shall be supported as follows:     - The UE shall use IMS for SMS if the UE is attached to an eHRPD network and there is no active 1xRTT voice call.     - The UE shall use 1xRTT for SMS if the UE is attached to an eHRPD network and there is an active 1xRTT voice call.     - The UE shall use 1xRTT for SMS if the UE is attached to an HRPD or 1xRTT network.   ------------------------- 1 Note, in this case, there is no active connection in LTE anymore.  Therefore, no Extended Service Request (ESR) can be sent.  But in other cases where LTE connection is still available, ESR is required.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **IMS: 35** IMS (Folder)  **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

* + - 1. SIP 503 with 'IMS Outage' Text VZ\_REQ\_HVOLTE\_34098

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* + - * 1. SIP 503 with 'IMS Outage' Text VZ\_REQ\_HVOLTE\_34148

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| If the device sends any other non-REGISTER SIP request, and receives SIP 503 Service Unavailable error, with "IMS Outage" text:   * *Device IMS registered for VoLTE, no VoLTE call in progress, no VoLTE call set up in progress, non-INVITE/non-REGISTER SIP request rejected via SIP 503, with "IMS Outage" text*: The device shall:   + Locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and initiate a new IMS registration for both voice and SMS.   + Enable LTE + 1xRTT SRLTE mode of operation.   + Use 1xRTT for voice and SMS (until a new IMS registration is established). * *No VoLTE call in progress, SIP INVITE for a VoLTE call is rejected via SIP 503, with "IMS Outage" text*: The device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and initiate silent redial on 1xRTT. * *VoLTE call in progress, SIP INVITE for a second VoLTE call is rejected via SIP 503, with "IMS Outage" text*: The device shall allow the first VoLTE call to continue until it ends or drops, and report to the user that the second VoLTE call failed. The device shall not allow any additional SIP requests until a new IMS registration is established. Upon the first VoLTE call ending/dropping, the device shall:   + Enter IMS non-registered state and initiate a new IMS registration for both voice and SMS.   + Enable LTE + 1xRTT SRLTE mode of operation.   + Use 1xRTT for voice and SMS (until a new IMS registration is established). * *VoLTE call in progress, non-INVITE/non-REGISTER SIP request rejected via SIP 503, with "IMS Outage" text*: The device shall allow the VoLTE call to continue until it ends or drops. The device shall not allow any additional SIP requests until a new IMS registration is established. Upon the  VoLTE call ending/dropping, the device shall:   + Enter IMS non-registered state and initiate a new IMS registration for both voice and SMS.   + Enable LTE + 1xRTT SRLTE mode of operation.   + Use 1xRTT for voice and SMS (until a new IMS registration is established).   Scope: [Branded, Open Development, Wholesale] |

* + - 1. WPS Calls VZ\_REQ\_HVOLTE\_34099

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* + - * 1. WPS Calls VZ\_REQ\_HVOLTE\_34149

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| If the user initiates a MO WPS call (\*272+MDN):   * *No VoLTE call in progress*: The device shall initiate the WPS call using the 1xRTT modem.  The device shall use 1xRTT for voice and SMS services. * *VoLTE call setup  in progress*: The device shall initiate the WPS call using the 1xRTT modem.  The device shall use 1xRTT for voice and SMS services. * *VoLTE call in progress:* the device shall provide the user the option to either   1) Terminate the ongoing VoLTE call(s) and proceed with the WPS call  OR  2) Cancel the WPS call.  If the user selects 1), the UE shall terminate the VoLTE call and silent redial the WPS call using the 1xRTT modem.  The device shall use 1xRTT for voice and SMS services.   * + The device shall locally terminate all active SIP dialogs and SIP requests and enter IMS non-registered state.   Scope: [Branded, Open Development, Wholesale] |

* + - 1. Incoming Voice Page VZ\_REQ\_HVOLTE\_34100

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* + - * 1. Incoming Voice Page VZ\_REQ\_HVOLTE\_34150

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| In the LTE+1xRTT SRLTE mode, if the user accepts an incoming 1xRTT voice page (while the device is either IMS registered for SMS only or in the process of IMS registering for VoLTE), the device shall initiate the call setup on 1xRTT. The device shall use 1xRTT for voice and SMS services.  Scope: [Branded, Open Development, Wholesale] |

* + - 1. SMS Failure VZ\_REQ\_HVOLTE\_34101

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* + - * 1. SMS Failure VZ\_REQ\_HVOLTE\_34151

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| When MO SMS over IMS over LTE delivery fails:   * *Device IMS registered for VoLTE, no VoLTE call in progress, no VoLTE call set up in progress*: The device shall follow the SMS retry logic in the Verizon Wireless LTE SMS Requirements and the Verizon Wireless IMS Requirements with the following exception: no retry on 1xRTT. * *VoLTE call in progress*: The device shall follow the SMS retry logic in the Verizon Wireless LTE SMS Requirements and the Verizon Wireless IMS Requirements with the following exception: no retry on 1xRTT. * *Device is not IMS registered for VoLTE*: The device shall follow the SMS retry logic in the Verizon Wireless LTE SMS Requirements and the Verizon Wireless IMS Requirements including retry on 1xRTT. * *VoLTE call set up in progress that fails and triggers silent redial of the voice call on 1xRTT:* The device shall follow the SMS retry logic in the Verizon Wireless LTE SMS Requirements and the Verizon Wireless IMS Requirements. The device should include retry on 1xRTT.   Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTESMS: 30305** RETRY REQUIREMENTS FOR MO SMS USING SMS OVER IMS (Section)  **IMS: 35** IMS (Folder) |

* + - 1. DCN Handling VZ\_REQ\_HVOLTE\_34102

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* + - * 1. DCN Handling VZ\_REQ\_HVOLTE\_34152

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| The device shall only send a Domain Change Notification SMS in the following cases:   * The device was IMS registered for VoLTE on LTE and moves out of LTE coverage and into either HRPD or 1xRTT coverage. * The device initiates a MO silent redial to 1xRTT and successfully established a 1xRTT call (this includes the case where the SIP INVITE for a VoLTE call cannot be sent due to access barring and the device silently redials on 1xRTT). The device shall send the domain change notification SMS while on 1xRTT traffic channel after it has successfully established a 1xRTT traffic channel for the 1xRTT call.  A hysteresis timer between the value of 10 second and 15 seconds may be applied for the UE to wait for 1XRTT connection to be stabilized before sending DCN.   Scope: [Branded, Open Development, Wholesale] |

* + - 1. ACCESS BARRING VZW\_REQ\_HVOLTE\_35610

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* + - * 1. Access Barring for MO Data and RRC Connection Reject VZW\_REQ\_HVOLTE\_35612

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Access Barring for MO Data VZ\_REQ\_HVOLTE\_35614

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| If the device is IMS registered for VoLTE and in RRC\_IDLE mode and the user initiates a voice call and the modem reports that an RRC connection cannot be established due to access barring for MO data, then the device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and immediately dial the call on 1xRTT.  **NOTE 1:** This requirement only applies if the current eNB is in a tracking area which supports VoLTE, i.e. the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message contain an "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode supported". If the "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) indicates that the "IMS voice over PS session in S1 mode NOT supported", then the requirements in "LTE Network Does Not Support VoLTE" section of this document shall take precedence.  **NOTE 2:** If the eNB is broadcasting the "ac-BarringSkipForMMTELVoice-r12" set to *TRUE*, then when attempting to send a SIP INVITE for a VoLTE call, the device shall consider access barring for MO data as NOT active in the cell regardless of the setting of the "ac-BarringForMO-Data" IE.    Scope: [Branded, Open Development, Wholesale] |

RRC Connection Reject VZ\_REQ\_HVOLTE\_37261

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| If the device is IMS registered for VoLTE and in RRC\_IDLE mode and the user initiates a voice call and the modem reports that an IMS signaling connection could not be established because the RRC connection request was rejected by the network with an *RRCConnectionReject* message, then the device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and immediately dial the call on 1xRTT.  **NOTE:** This requirement only applies if the current eNB is in a tracking area which supports VoLTE, i.e. the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message contain an "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode supported". If the "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) indicates that the "IMS voice over PS session in S1 mode NOT supported", then the requirements in "LTE Network Does Not Support VoLTE" section of this document shall take precedence.  Scope: [Branded, Open Development, Wholesale] |

* + - * 1. Service Specific Access Control VZW\_REQ\_HVOLTE\_35613

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Service Specific Access Control VZ\_REQ\_HVOLTE\_35615

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| If the eNB indicates via the "ssac-BarringForMMTEL-Voice-r9" IE in SIB2 that service specific access control is active in the current cell, then if the device is IMS registered for VoLTE and in RRC\_IDLE mode and the user initiates a voice call and the modem reports that an RRC connection cannot be established due to service specific access control barring for VoLTE, then the device shall locally terminate all active SIP dialogs and SIP requests, enter IMS non-registered state, and immediately dial the call on 1xRTT.  If the eNB indicates via the "ssac-BarringForMMTEL-Voice-r9" IE in SIB2 that service specific access control is active in the current cell with an "ac-BarringFactor" set to "p00" and the device is IMS registered for VoLTE, then the device shall behave as follows:   * *Device IMS registered for VoLTE, no VoLTE call in progress, no VoLTE call set up in progress*: the device shall:   + Enable LTE + 1xRTT SRLTE mode of operation.   + IMS re-register for SMS only. Use 1xRTT for voice in the current cell.   + Upon entering a cell where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00", the device shall IMS re-register for both voice and SMS after the expiry of TVoLTE\_hys (please see below). Upon successful IMS registration for voice and SMS, the device shall exit SRLTE mode to LTE-only mode. * *VoLTE call in progress*: the device shall:   + Maintain the VoLTE call until the call ends or drops. During the VoLTE call, additional IMS services shall be supported (e.g., upgrade to video call, RCS chat, presence update, SMS). Upon the VoLTE call ending/dropping, the device shall:     - Enable LTE + 1xRTT SRLTE mode of operation.     - IMS re-register for SMS only. Use 1xRTT for voice in the current cell.     - Upon entering a cell where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00", the device shall IMS re-register for both voice and SMS after the expiry of TVoLTE\_hys (please see below). Upon successful IMS registration for voice and SMS, the device shall exit SRLTE mode to LTE-only mode. * *VoLTE call set up in progress*: If the SIP INVITE for a VoLTE call has already been generated by the IMS client, then the device shall:   + Allow the VoLTE call setup to continue. If the VoLTE call setup succeeds, the device shall allow the VoLTE call to continue until either the call drops or the call ends. During the VoLTE call, additional IMS services shall be supported (e.g., upgrade to video call, RCS chat, presence update, SMS). Upon either the VoLTE call set up failing or the VoLTE call ending/dropping, the device shall:     - Enable LTE + 1xRTT SRLTE mode of operation.     - IMS re-register for SMS only. Use 1xRTT for voice in the current cell.     - Upon entering a cell where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00", the device shall IMS re-register for both voice and SMS after the expiry of TVoLTE\_hys (please see below). Upon successful IMS registration for voice and SMS, the device shall exit SRLTE mode to LTE-only mode.   After IMS re-registering for SMS only as the result of encountering VoLTE service specific access control with the "ac-BarringFactor" set to "p00", the device shall start a hysteresis timer TVoLTE\_hys when the device moves to a cell in a tracking area which supports VoLTE (via the NAS VoPS indicator) and where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". The device shall IMS re-register for VoLTE upon the expiry of TVoLTE\_hys if the device is still in a cell in a tracking area which supports VoLTE (via the NAS VoPS indicator) and where service specific access control is either not active or active with an "ac-BarringFactor" other than "p00". While TVoLTE\_hys is running, if the device moves into a cell which is either in a tracking area that does not support VoLTE (via the NAS VoPS indicator) or where service specific access control is active with an "ac-BarringFactor" set to "p00", the device shall stop and reset TVoLTE\_hys and maintain the current IMS registration for SMS only.  **NOTE:** This requirement only applies if the current eNB is in a tracking area which supports VoLTE, i.e. the ATTACH ACCEPT message and/or the latest TRACKING AREA UPDATE ACCEPT message contain an "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) set to indicate that the "IMS voice over PS session in S1 mode supported". If the "EPS Network Feature Support" IE with the "IMS voice over PS session indicator (IMS VoPS)" field (bits) indicates that the "IMS voice over PS session in S1 mode NOT supported", then the requirements in the "LTE Network Does Not Support VoLTE" section of this document shall take precedence.    Scope: [Branded, Open Development, Wholesale] |

* + - 1. VOLTE SERVICE NOT PROVISIONED OR VOLTE SERVICE DISABLED BY THE USER VZW\_REQ\_HVOLTE\_35611

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* + - * 1. VOLTE SERVICE NOT PROVISIONED OR VOLTE SERVICE DISABLED BY THE USER VZ\_REQ\_HVOLTE\_35616

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| If the user is not provisioned for VoLTE service\* or if  the user disables VoLTE service through the device user interface, the device shall operate in a sub-state of LTE+1xRTT SRLTE mode known as basic SRLTE (bSRLTE). When operating in basic SRLTE, the device shall comply with all LTE+1xRTT SRLTE requirements in this document with the following exceptions:   * The device shall only IMS register for SMS when operating on LTE and eHRPD. * The device shall not IMS re-register on iRAT transitions between LTE and eHRPD unless a re-registartion or new registration is required per the *IMS Registration on System Transitions* section of the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements. * Timer Tdelay is not implemented on iRAT transitions from eHRPD to LTE. * If the device is configured as a bSRLTE-only device, the *Voice domain preference for E-UTRAN* bits shall be set to "0 0 CS Voice only". * If the device is configured as an hVoLTE device and the user disables VoLTE service through the device user interface, the device shall continue to set the the *Voice domain preference for E-UTRAN* bits to "1 1  IMS PS voice preferred, CS Voice as secondary".   \* **NOTE:** VoLTE service discovery to determine whether or not the user is provisioned for VoLTE service is per SDM setting or presence-based mechanism as described in the Verizon Wireless VoLTE Device Service Requirements and the "VoLTE Service Discovery" section of this document.    Scope: [Branded, Open Development, Wholesale] |

* + - 1. VoLTE CALL FAILURE DUE TO IMS REGISTRATION STATE MISMATCH VZ\_REQ\_HVOLTE\_38019

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* + - * 1. VoLTE Call Rejected with SIP 403 Forbidden - Originating user not registered VZ\_REQ\_HVOLTE\_38020

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| If the device receives a SIP 403 with the reason-phrase "403 Forbidden - Originating user not registered" in response to a SIP INVITE for a VoLTE call that was originated by the device, the device shall immediately 1) terminate VoLTE call setup, 2) declare call failure to the user, 3) enter IMS non-registered state and transition to LTE+1xRTT SRLTE mode, and 4) initiate a new IMS registration. All IMS registration-related requirements in this document and the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements shall apply. **NOTE:** The device shall NOT treat the reason-phrase in this scenario as case sensitive.  Scope: [Branded, Open Development, Wholesale] |

###### EXTENDED SERVICE REQUEST Message VZ\_REQ\_HVOLTE\_34103

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* + - 1. Req-1 VZ\_REQ\_HVOLTE\_34153

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| Prior to initiating 1xRTT voice call set up (i.e. silent redial or otherwise, both MO and MT), the device shall attempt to send an EXTENDED SERVICE REQUEST message to suspend the given LTE session with service type set to 1xCS fallback. The device shall wait for up to 500 ms for a response for the network. Upon completion of the extended service request procedure or if after 500 ms the device either cannot send the EXTENDED SERVICE REQUEST message or the network fails to respond to the EXTENDED SERVICE REQUEST message, the device shall immediately initiate 1xRTT call setup. Upon termination of all active 1xRTT voice calls, if system selection indicates that the given LTE network is still the most preferred, available system for data service, the device shall immediately re-acquire the given LTE network and send a TRACKING AREA UPDATE REQUEST message to resume LTE data operation. Otherwise, upon termination of all active 1xRTT voice calls, the device shall immediately acquire the most preferred, available system for data service as indicated by system selection.  If the network rejects the EXTENDED SERVICE REQUEST message for any reason, the device shall immediately leave LTE and initiate 1xRTT call set up.  **NOTE 1:** The extended service request procedure shall be considered complete when the network sends an *RRCConnectionRelease* message.  **NOTE 2:**  The device shall NOT send an EXTENDED SERVICE REQUEST message when sending a MO SMS message over 1xRTT or receiving a MT SMS message over 1xRTT.    Scope: [Branded, Open Development, Wholesale] |

###### CMAS Support VZ\_REQ\_HVOLTE\_34104

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* + - 1. CMAS SUPPORT VZ\_REQ\_HVOLTE\_34154

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| The device shall be capable of receiving CMAS messages over both LTE and 1xRTT.  Scope: [Branded, Open Development, Wholesale] |

##### REACQUIRING LTE VZ\_REQ\_HVOLTE\_34105

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###### After 1xRTT call VZ\_REQ\_HVOLTE\_34106

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* + - 1. AFTER 1XRTT CALL VZ\_REQ\_HVOLTE\_34155

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| After a 1xRTT call (due to silent redial from LTE-Only mode or voice call in SRLTE mode) ends, the device shall attempt to re-acquire the LTE network and send a TRACKING AREA UPDATE REQUEST message to resume LTE data operation. If the device is no longer in LTE coverage, the device shall acquire the most preferred, available system indicated by system selection.   * The device shall continue to use 1xRTT for SMS until one of the following criteria is satisfied:   + The device has successfully attached/connected to an eHRPD network, and is IMS registered for SMS services using the MSISDN-based SIP URI or the IMSI-based SIP URI (If the device is IMS registered using the IMSI-based SIP URI, only administrative SMS shall be supported in regards to SMS over IMS as per the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.).   + The device has successfully attached/connected to an LTE network, and is IMS registered for SMS services using the MSISDN-based SIP URI or the IMSI-based SIP URI (If the device is IMS registered using the IMSI-based SIP URI, only administrative SMS shall be supported in regards to SMS over IMS as per the Verizon Wireless LTE 3GPP Band 13 Network Access Requirements.).   **NOTE:** While in administrative SMS mode for SMS over IMS, the device shall support normal SMS text messaging using 1xRTT if the device is in SRLTE mode and successfully registers with the 1xRTT network.     * The device shall continue to use 1xRTT for voice until all of the following criteria are met:   + The device has successfully attached/connected to an LTE network that supports VoLTE, and is IMS registered for both VoLTE and SMS services using the MSISDN-based SIP URI.   + The criteria in section "Conditional VoLTE Calling" of the Verizon Wireless IMS Requirements have been met.   + The device is provisioned for VoLTE service and VoLTE service has been enabled by the user through the device's user interface. Refer to sections of the Verizon Wireless VoLTE Device Service Requirements for additional details1.   **NOTE:** For all cases where the device initiated silent redial on 1xRTT (from LTE-Only mode), the device shall attempt a new IMS registration (since the device is in IMS non-registered state as soon as 1xRTT silent redial is triggered) when the device re-acquires the LTE network after the 1xRTT call ends/drops (or eHRPD if the LTE network is not available). This includes the case where the 1xRTT silent redial call setup fails or the user terminates the call (by pressing the END button) before the 1xRTT silent redial call setup completes.  ------------------------- 1 Note, the interactions of the device IMS registration and VoLTE provisioning are best addressed as compliance to VZW VoLTE Device Service requirement document.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **RCSVOLTE: 4250** Initial provisioning check on power up (Functional)  **IMS: 22923** CONDITIONAL VOLTE CALLING (Functional)  **RCSVOLTE: 4251** In the case the device receives a '403 Forbidden: Not authorized for Presence.' at any time the VoLTE (Functional)  **RCSVOLTE: 4272** If after VoLTE has been disabled per the above algorithm the device moves to eHRPD the device shall n (Functional)  **LTEB13NAC: 46** LTE 3GPP Band 13 Network Access (Folder) |

###### IRAT Transition VZ\_REQ\_HVOLTE\_34107

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* + - 1. IRAT TRANSITION VZ\_REQ\_HVOLTE\_34156

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| On an iRAT transition from eHRPD/HRPD/1xRTT to LTE (for data service), the device shall:   * Enable LTE + 1xRTT SRLTE mode of operation. * When transitioning from eHRPD to LTE, delay the IMS re-registration (to indicate VoLTE support) by timer Tdelay. Tdelay shall be started upon receipt of the NAS ATTACH ACCEPT message for the LTE network. Tdelay shall not apply in the opposite direction, i.e. from LTE to eHRPD (for data service). Tdelay shall not apply to iRAT transitions between HRPD/1xRTT and LTE (for data service). * When transitioning from HRPD/1xRTT to LTE, IMS register for both VoLTE and SMS. * Upon successful IMS registration for VoLTE, the device shall disable LTE + 1xRTT hybrid mode operation.   Scope: [Branded, Open Development, Wholesale] |

##### ROAMING OPERATIONS FOR HVOLTE DEVICES VZ\_REQ\_HVOLTE\_34108

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###### hVOLTE OPERATION ON EHPLMNS VZ\_REQ\_HVOLTE\_38998

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* + - 1. EHPLMN hVOLTE BEHAVIOR VZ\_REQ\_HVOLTE\_38999

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| For hVoLTE/bSRLTE devices, if the roaming LTE network PLMN is in either the HPLMN or EHPLMN list on the UICC, then the device shall behave the same as it would on the Verizon Wireless LTE network and comply with all requirements in this document.  Scope: [Branded, Open Development, Wholesale] |

###### LTE Roaming for hVoLTE Devices that do NOT Support IMS Roaming VZ\_REQ\_HVOLTE\_34109

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* + - 1. Req-1 VZ\_REQ\_HVOLTE\_34157

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| When a voice-centric hVoLTE device that does NOT support IMS roaming roams in a LTE network that has underlying 3GPP legacy network, the device shall follow the requirements defined in Verizon Multi-Mode Operations Requirements document; silent redial shall be disabled regardless of the setting of "Silent\_Redial\_Enable" switch.  Circuit Switch Fall Back shall be used to support Voice features.  ALL global devices are required to support CSFB to 3GPP legacy network.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

* + - 1. Req-2 VZ\_REQ\_HVOLTE\_34158

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| When a voice-centric hVoLTE device that does NOT support IMS roaming roams on a LTE network that has NO underlying 3GPP legacy network, but has an underlying 3GPP2 network, the device shall behave as a 3G-only device; silent redial shall be disabled regardless of the setting of "Silent\_Redial\_Enable" switch.  Note, it is possible that the device may temporarily be in SRLTE mode after a call ends on 1x in a roaming partners LTE network before exiting SRLTE mode to the normal LTE roaming procedures.  Scope: [Branded, Open Development, Wholesale] |

###### LTE Roaming for hVoLTE Devices that Support IMS Roaming VZ\_REQ\_HVOLTE\_38504

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* + - 1. LTE Roaming for hVoLTE Devices that Support IMS Roaming VZ\_REQ\_HVOLTE\_38505

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| When a voice-centric hVoLTE device that supports IMS roaming roams onto a roaming LTE network PLMN that is NOT in the HPLMN or EHPLMN lists on the UICC, the device shall behave per the *IMS Roaming for Voice-Centric CDMA-Less and hVoLTE Devices* section of the Verizon Wireless LTE Data Devices Requirements.  Type 1 and 2 devices that support LTE + 1xRTT hybrid operation shall disable LTE + 1xRTT hybrid operation when attached to a (non-Verizon Wireless) roaming LTE network PLMN that is NOT in the HPLMN or EHPLMN lists on the UICC. Note, it is possible that the device may temporarily be in SRLTE mode after a call ends on 1x in a roaming partner's LTE network before exiting SRLTE mode to the normal LTE roaming procedures.    Scope: [Branded, Open Development, Wholesale] |

###### CDMA Roaming VZ\_REQ\_HVOLTE\_34110

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* + - 1. CDMA ROAMING VZ\_REQ\_HVOLTE\_34159

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| When a hVoLTE device falls back to 1xRTT due to silent redial and any CDMA roaming occurs while the device is registered in 3G, all device behavior shall follow the requirements in Verizon Multi-Mode Operations document.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **LTEMMO: 59** LTE Multi Mode Operations (Folder) |

##### TESTABILITY VZ\_REQ\_HVOLTE\_36526

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###### hVoLTE Test Mode Support VZ\_REQ\_HVOLTE\_36527

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| For lab conformance testing purposes, the device shall support the test modes in the table below.  The vendor shall provide a lab application to enable any of the test modes in the table below during device acceptance testing. The device vendor shall not allow the end user to enable any test mode in the table below through the device user interface or the remote access user interface for tethered devices.     |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Test Mode #** | **UE Configuration**  **(bSRLTE, hVoLTE)** | **UE Mode**  **(LTE Only, Global)** | **UE Usage Setting**  **(Data Centric, Voice Centric)** | **Voice Preference**  **(CS Only, PS Preferred)** | | 1 | bSRLTE | LTE Only | Voice Centric | CS Only | | 2 | bSRLTE | LTE Only | Data Centric | CS Only | | 3 | bSRLTE | Global | Voice Centric | CS Only | | 4 | bSRLTE | Global | Data Centric | CS Only | | 5 | hVoLTE | LTE Only | Voice Centric | PS Preferred | | 6 | hVoLTE | LTE Only | Data Centric | PS Preferred | | 7 | hVoLTE | Global | Voice Centric | PS Preferred | | 8 | hVoLTE | Global | Data Centric | PS Preferred |     Scope: [Branded, Open Development, Wholesale] |

##### CDMA DISABLED VZ\_REQ\_HVOLTE\_37281

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| VOID |

#### SCENARIOS VZ\_REQ\_HVOLTE\_34111

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| ***FFS ‘ To be included in a later release of the document.*** |

#### PROVISIONING VZ\_REQ\_HVOLTE\_34112

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##### TIMER\_VZW VZ\_REQ\_HVOLTE\_34113

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###### Req-1 VZ\_REQ\_HVOLTE\_34160

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| The device shall support Timer\_VZW for SIP INVITE requests when the device is using IMS over LTE. Timer\_VZW shall be stored in non-volatile memory and shall be configurable via OTADM. Refer to the Verizon Wireless LTE Multi-Mode Device OTADM Requirements for additional details. Timer\_VZW shall be configurable with allowed integer values between 0-30 seconds and a default value of 6 seconds.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **MMOTADM: 73** LTE Multi Mode OTADM (Folder) |

###### Req-2 VZ\_REQ\_HVOLTE\_34161

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| The vendor shall provide a lab application to modify the default value of Timer\_VZW during device acceptance testing. The device vendor shall not allow the end user to modify the value of Timer\_VZW through the device user interface or the remote access user interface for tethered devices.  Scope: [Branded, Open Development, Wholesale] |

##### TDELAY VZ\_REQ\_HVOLTE\_34114

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###### TDELAY VZ\_REQ\_HVOLTE\_34162

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| Tdelay shall be stored in non-volatile memory and shall be configurable via OTADM. Refer to the Verizon Wireless LTE Multi-Mode Device OTADM Requirements for additional details. The vendor shall provide a lab application to modify Tdelay during device acceptance testing. The device vendor shall not allow the user to modify Tdelay through the device user interface or the remote access user interface for tethered devices. Tdelay shall be configurable with allowed integer values between 0-600 seconds. The default setting for Tdelay shall be 5 seconds.  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **MMOTADM: 73** LTE Multi Mode OTADM (Folder) |

##### SILENT\_REDIAL\_ENABLE VZ\_REQ\_HVOLTE\_34115

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###### SILENT\_REDIAL\_ENABLE VZ\_REQ\_HVOLTE\_34163

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| The Boolean parameter SILENT\_REDIAL\_ENABLE shall be stored in non-volatile memory and shall be configurable via OTADM. Refer to the Verizon Wireless LTE Multi-Mode Device OTADM Requirements for additional details. The vendor shall provide a lab application to modify SILENT\_REDIAL\_ENABLE during device acceptance testing. The device vendor shall not allow the user to modify SILENT\_REDIAL\_ENABLE through the device user interface or the remote access user interface for tethered devices. The default setting for SILENT\_REDIAL\_ENABLE shall be "1" (i.e. enabled).  Scope: [Branded, Open Development, Wholesale] |

**Associated Requirements**

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| **MMOTADM: 73** LTE Multi Mode OTADM (Folder) |

##### TVOLTE\_HYS VZW\_REQ\_HVOLTE\_35617

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###### TVoLTE\_HYS VZ\_REQ\_HVOLTE\_35618

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| TVoLTE\_hys shall be stored in non-volatile memory and shall be configurable via OTADM. Refer to the Verizon Wireless LTE Multi-Mode Device OTADM Requirements for additional details. The vendor shall provide a lab application to modify TVoLTE\_hys during device acceptance testing. The device vendor shall not allow the user to modify TVoLTE\_hys through the device user interface or the remote access user interface for tethered devices. TVoLTE\_hys shall be configurable with allowed integer values between 0-512 seconds. The default setting for TVoLTE\_hys shall be 60 seconds.    Scope: [Branded, Open Development, Wholesale] |

##### CDMA\_ENABLED PARAMETER VZ\_REQ\_HVOLTE\_37299

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| VOID |

#### PERFORMANCE VZ\_REQ\_HVOLTE\_34116

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##### hVoLTE and feICIC Interaction VZ\_REQ\_HVOLTE\_37926

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| hVoLTE and feICIC    feICIC is a feature that uses interference cancellation on UE to reduce neighbor eNB's interference to serving.  It may apply to both macro/macro and macro/pico configurations.  There is no special performance impact due to feICIC in hVoLTE LTE-only mode that is different from what has been defined by 3GPP in R10 and R11. In SRLTE mode, UE may miss ABS subframes when tuning away to 1xRTT.  So the benefits of feICIC (eICIC part on ABS) regarding   * Dirty/clean CSI measurements and * Opportunity for the UE in the small cell to take advantage of the less interference in ABS subframes   will be less resulting in lower data thruput or potential higher radio link failure |

#### REFERENCES VZ\_REQ\_HVOLTE\_34117

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| **<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 open access specifications are available at [opennetwork.verizonwireless.com](http://opennetwork.verizonwireless.com/).     1. 3GPP TS 24.301: *Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*), Release 9 2. 3GPP TS 36.331: *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*, Release 9   **<Verizon Specific Documentation References>**     1. "Verizon Wireless LTE Data Devices Requirements" 2. "Verizon Wireless LTE Smartphone Requirements" 3. "Verizon Wireless IMS Requirements" 4. "Verizon Wireless 1xEV-DO/1xRTT Device Requirements" 5. "Verizon Wireless A002 Device Feature Definitions/Requirements" 6. "Verizon Wireless Data Requirements" 7. "Verizon Wireless LTE Multi-Mode Operations Requirements" 8. "Verizon Wireless LTE Multi-Mode Device Over the Air Device Management (OTADM) Requirements" 9. "Verizon Wireless E911 for LTE Only or LTE Multi-mode VoLTE Capable Devices Requirements" 10. "Verizon Wireless VoLTE-to-1xRTT Fallback Test Plan" 11. "Verizon Wireless Multi-Mode Operations Requirements"   **<Verizon Specific Documentation References Open Access Documents>**     1. "Verizon Wireless LTE 3GPP Band 13 Network Access Requirements" 2. "Verizon Wireless LTE Data Retry Requirements"   **<Other Applicable References>** |