3GPP2/3GPP Multi Mode Device and Interoperability Requirements

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Table of Contents

Table of Tables

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Introduction

1.1 Purpose

The purpose of this document is to define how a Multi Mode (MM) 3GPP2 (CDMA2000 for example) and 3GPP (LTE for example) enabled device functionality shall be implemented.

Included in this document are the recommended interoperability requirements such as system selection, mobility/handover and interworking.

For MM devices. All the requirements for the operation in single mode are to follow the specifications defined by the Standardization Organizations listed in the references.

1.2 Scope

The target audiences for this document are 3GPP2 operators and device vendors that are developing devices that support legacy 2G and 3G systems (with an emphasis on 3GPP2 standards), as well as 3GPP standards such as LTE air interfaces.

For the purpose of this document, the MM device defined herein may only be active on one system (3GPP or 3GPP2) at any time. This document defines how the air interfaces are managed on a MM device to determine which system is active, and the user impacts of the underlying air interface.

This document details the requirements specific to MM functionality. This includes implementation of system selection, manual and automatic, between 3GPP2 and 3GPP (GSM/WCDMA, and LTE) as well as the minimum requirements to support the interoperability. Functional requirements for specific CDMA and various service enablers (such as WAP) are detailed in other GHRC requirements documents and will not be addressed here.

As AMPS systems are expected to have been completely replaced by other technologies, there shall be no requirements in the device to support AMPS.

1.3 Reference Documents

Reference documents are referred to throughout this specification. Please use the following sites to find reference documents:

3GPP2 reference documents can be found at
http://www.3gpp2.org/Public_html/specs/index.cfm

3GPP reference documents can be found at http://www.3gpp.org/ftp/Specs/html-info/36-series.htm (March 2009 or later)

CDG reference documents can be found at http://www.cdg.org.

CCF reference documents can be found at http://www.globalccf.org.

Standards		
Ref#	***Document Name***	**Document Number**
1	*cdma2000 High Rate Packet Data Air Interface Specification*	3GPP2 C.S0024-B v3.0
2	*CDMA Device Requirements – CDMA2000 1xEV-DO Revision 0, A, and B*	CDG Document 148
3	*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA)Radio Resource Control (RRC);Protocol Specification*	3GPP TS 36.331
4	*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*	3GPP TS 36.306
5	*3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3*	3GPP TS 24.301
6	*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Procedures in Idle Mode*	3GPP TS 36.304
7	*Recommended System Selection Requirements for 1X and 1xEV-DO-Capable Terminals*	CDG Document 143
8	*E-UTRAN – cdma2000 1x Connectivity and Interworking Air Interface Specification*	3GPP2 C.S0097-0 v2.0
9	*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Radio Transmission and Reception*	3GPP TS 36.101
10	*cdma2000 Application on UICC for Spread Spectrum Systems*	C.S0065-B v1.0
11	*3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access Stratum (NAS) Functions Related to Mobile Station (MS) in Idle Mode*	3GPP TS 23.122
12	*Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Conformance Specification; Radio Transmission and Reception; Part 1: Conformance Testing*	TS 36.521-1
13	*Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Conformance Specification; Radio Transmission and Reception; Part 2: Implementation Conformance Statement (ICS)*	TS 36.521-2
14	*Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) Conformance Specification; Radio Transmission and Reception; Part 3: Radio Resource Management (RRM) Conformance Testing*	TS 36.521-3
15	*Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) Conformance Specification; Part 1: Protocol Conformance Specification*	TS 36.523-1

Standards		
Ref#	***Document Name***	**Document Number**
16	*Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) Conformance Specification; Part 2: ICS*	TS 36.523-2
17	*Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) Conformance Specification; Part 3: Test Suites*	TS 36.523-3
18	*Recommended Minimum Performance Standards for cdma2000 Simultaneous Voice and High Rate Packet Data Mobile Stations*	3GPP2 C.S0096 v1.0
19	*Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Terminal*	3GPP2 C.S0033-B
20	*Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations - Release B*	C.S0011-A v2.0
21	*Signaling Conformance Specification for High Rate Packet Data Air Interface*	C.S0038-B v1.0
22	*Signaling Conformance Test Specification for cdma2000 Spread Spectrum Systems*	C.S0043-0 v1.0
23	*Over-the-Air Service Provisioning of Mobile Stations in Spread Spectrum Standards*	C.S0016-D v1.0
27	*E-UTRAN – cdma2000 HRPD Connectivity and Inter-working Air Interface*	3GPP2 C.S0087-0
28	*E-UTRAN – eHRPD Connectivity and Interworking: Core Network Aspects*	3GPP2 X.S0057-0
29	*3rd Generation Partnership Project;* *Technical Specification Group Services and System Aspects;* *Architectural requirements*	TS 23.221
30	***3rd Generation Partnership Project;*** ***Technical Specification Group Services and System Aspects;*** ***Circuit Switched Fallback in Evolved Packet System;*** ***Stage 2***	3GPP TS 23.272
31	***Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems***	3GPP2 S.0005

1.4 Acronyms and Abbreviations

Table 1-1 Acronyms and Abbreviations

Acronym / Abbreviation	Description
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
AMPS	Advanced Mobile Phone System (Analogue Cellular)
AN	Access Network
APDU	Application Protocol Data Unit

Acronym / Abbreviation	Description
APN	Access Point Network
BREW	Binary Run-time Environment for Wireless
CAT	Card Application Tool
CCF	CDMA Certification Forum
CDG	CDMA Development Group
CDMA	Code Division Multiple Access
CRX	CDMA Roaming eXchange Service
CS	Circuit Switched
CSIM	CDMA Subscriber Identify Module
CTIA	Cellular Telephone Industries Association
DOR0	1x Evolution Data Optimized rev 0
DORA	1x Evolution Data Optimized Rev A
EDGE	Enhanced Data for GSM Evolution
eHRPD	Evolved HRPD
ETSI	European Telecommunications Standards Institute
EvDO (1x-EVDO)	1x Evolution Data Optimized, a.k.a. HRPD
GCF	Global Certification Forum
GHRC	Global Handset Requirement for CDMA
GPRS	General Packet Radio Service
GRX	GPRS Roaming Exchange
GSM	Global System for Mobile communications
GSMA	GSM Association
HD	Highly Desirable
HO	Hand Over (Also Hand Off)
HRPD	High Rate Packet Data, a.k.a. 1x EV-DO
IP	Internet Protocol
IRAT	Inter Radio Access Technology
Java	A computer SW platform
LTE	Long Term Evolution
M	Mandatory

Acronym / Abbreviation	Description
MCC	Mobile Country Code
MLPL	MMSS Location Priority List
MM	Multi Mode
MMS	Multi Media Services
MMSS	Multi Mode System Selection
MNC	Mobile Network Code
MS	Mobile Station
MSPL	MMSS System Priority List
O	Optional
OTT	Over-The-Top
PLMN	Public Land Mobile Network
PRI	Programmable Requirement Indicator
PRL	Preferred Roaming List
PS	Packet Switched
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RUIM	Removable User Identity Module
SAR	Specific Absorption Rate
SIM	Subscriber Identity Module
SMS	Short Message Services
SVDO	Simultanious Voice and Data Optimized
SVLTE	Simultaneous 1X Voice and LTE Data
TS	Technical Specification
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile for Telecommunications System
USIM	Universal Subscriber Identity Module
VoHSPA	Voice over Internet Protocol over High Speed Packet Access
VoLTE	Voice over Long Term Evolution
VoRA	Voice over Internet Protocol over Data Optimized Revision A

Acronym / Abbreviation	Description
WAP	Wireless Access Protocol
WCDMA	Wideband CDMA

1.5 Revision History

Revision	Date	Description
1.1	4 Aug 2010	Initial Release
1.2	25 Oct 2011	Updated per CRs approved in October 2011 GHRC Team meeting in San Diego.

1

Three categories of requirements are established:

(M) Mandatory	The device **shall** support that characteristic in order to achieve approval.
(HD) Highly Desirable	It is highly desirable and recommended that the device supports this characteristic. This feature may become Mandatory in subsequent versions of the document. Supporting this characteristic will be valued in the commercial promotion of the terminal.
(O) Optional	It is left up to the manufacturer whether or not the terminal supports this characteristic. The device **may** support this option.

2.1 Carrier Acceptance

If required by the CDMA 2000 operator, the documentation and equipment that shall be delivered to the Multimode Operator for technical evaluation are detailed below.

Table 2-1 Documentation and Equipment

Req. #	Requirement	Category	Remarks	References
2.1.1	The Multi Mode device shall pass the CDMA certification process defined in CCF testing.	M	Testing is only for CDMA	CCF Test Plan
2.1.2	The multimode device shall pass the GCF certification requirements.	M	Compliance report detailing GCF completion (LTE shall be included).	
2.1.3	MM device shall pass all the 3GPP2/3GPP interworking requirements as specified by CCF and GCF.	M		

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System Selection Requirements

3.1 Purpose

This chapter is intended to capture the MM system selection requirements of all operators.

3.2 Frequency Band/Modes

Table 3-1 Frequency Band/Modes

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.2.1.1	The device shall have an option to enable/disable frequency bands in the PRI.	M			Y
	Emergency calls shall be allowed on bands disabled in the PRI.	M			

For details of frequency bands supported by each system please refer to [28] and [9] - Section 5 - Frequency Bands and Channel Arrangement.

3.3 Definitions

Note: the term "network" is interchangeable with the term "system" throughout this document.

The following section provides a description of the network types, network modes, and system selection modes that are provided on a MM device. The definitions of these network types, network modes, and system selection modes will be referred to throughout the remainder of the document.

There are two network types a Multi Mode device may use.

Table 3-2 Definitions of Network Types

Network Types	Description
3GPP2	1x and HRPD and eHRPD
3GPP	WCDMA, EDGE, GPRS, GSM, and LTE

Additionally, there two network modes a MM device may use, that can utilize either network type.

Note: UI may use other terms than 3GPP and 3GPP2 to refer to these network types.

Table 3-3 Definitions of network modes

Network Modes	Description
Constrained	The device is constrained to operating in one network type, either 3GPP2, or 3GPP. This may occur when the home country operator or user disables the 3GPP, or 3GPP2 support
Global	The device is not constrained to one network type, and can operate on either 3GPP or 3GPP2.

If the network type the MM device is operating on is 3GPP2, the following selection modes are defined.

Table 3-4 Definitions of 3GPP2 selection modes

3GPP2 Selection Mode	Description
Automatic	The device selects the system based on the PRL, and always selects the most preferred system.
Home Only	The device only selects home 3GPP2 systems. Roaming systems are ignored.

If the selected network type the MM device is operating on is 3GPP the following selection modes are defined.

Table 3-5 Definitions of 3GPP selection modes

3GPP Selection Mode	Description
Automatic	The device selects a 3GPP system automatically. Refer to [11].
Manual	The user selects the 3GPP system from a list of the available 3GPP systems. Refer to [11].

When a device is in Global network mode, the device may be active on either the 3GPP2 or 3GPP network. Dual radio is an optional capability mode and not mandatory.

The following selection modes available to the user when 3GPP2 or 3GPare enabled in the PRI: Global Manual and Global Automatic. These modes are defined as:

Table 3-6 Definitions of Global selection modes

Global Selection Mode	Description
Global Automatic	The device selects the network type independent of user input. Requirements are defined in section 3.4.1.3.
Global Manual	The user selects the 3GPP network type through either a software shortcut or a dedicated hard key. Requirements are defined in section 3.4.1.4. Turning manual mode on will switch the MM device to 3GPP mode automatically in the device.

The table below shows the options that may be available to the user in the “main menu” -> “settings” -> “network” settings.

Table 3-7 Network settings

Global Selection Mode	Network Type	Network Selection Mode
Global Automatic	3GPP2	Automatic
		Home Only
	3GPP	Automatic
		Manual
Global Manual	3GPP2	Automatic
		Home Only
	3GPP	Automatic
		Manual

There are several different configuration options that will modify the options that may be available to the user under the “main menu” -> “settings” -> “network” menu. For example, the operator may choose to disable GSM/WCDMA and LTE support in the PRI. In this case, the user would be shown only the following options:

Table 3-8 Network settings 3GPP disabled in PRI

Network Type	Network Selection Mode
3GPP2	Automatic
	Home Only

Additionally, an operator may choose to disable 3GPP in the PRI.

Table 3-9 Network settings – 3GPP2 disabled

Network Type	Network Selection Mode
3GPP	Automatic
	Manual

If either the 3GPP2 or 3GPP system is disabled by the operator in the PRI, the user shall NOT be presented the options to change to the global mode. All menu structures available to the user specific to the global mode shall be hidden.

If Global Automatic selection mode is disabled in the PRI, and 3GPP, 3GPP2 support is enabled, the user shall be shown just the following options:

Table 3-10 Network settings - Global Automatic disabled

Global Selection Mode	Network Type	Network Selection Mode
Global Manual	3GPP2	Automatic
		Home Only
	3GPP	Automatic
		Manual

If Global Manual selection mode is disabled in the PRI, and both CDMA and 3GPP support are enabled, the user shall be shown just the following options:

Table 3-11 Network settings - Global Manual disabled

Global Selection Mode	Network Type	Network Selection Mode
Global Automatic	3GPP2	Automatic
		Home Only
	3GPP	Automatic
		Manual

3.4 High Level Requirements

3.4.1 User Experience

A primary objective of a MM device is to make the user experience of roaming into a different than current network (HRPD to LTE as an example) as transparent as possible. In other words, a MM device would provide a similar user experience (for services that are provided on both 3GPP2 as well as 3GPP) regardless of whether the device is roaming into a CDMA or 3GPP network.

For system selection, this premise implies that the user should not be burdened with the need to perform additional operations, such as manually selecting the device operating mode, upon switching from a 3GPP2 to a 3GPP network, or vise versa.

3.4.1.1 User Interface Requirements

The option to select the global selection mode, network type, and network selection mode shall be displayed to the user of the MM device. The options available to the user to select from are configurable through the PRI. UI navigations given in the table below are all examples.

Table 3-12 UI Requirements

Req. #	Requirement	Category	Remarks	References
3.4.1.1.1	The MM device shall display through the user interface a setting titled “Network”, found under “main menu” -> ”settings” structure.	M		

Req. #	Requirement	Category	Remarks	References
3.4.1.1.2	Under the “Network” setting, the user shall be able to select one of two settings under the label “Global Selection Mode”: “Global Automatic” or “Global Manual”, if both are enabled in the PRI.	M		
3.4.1.1.3	If either 3GPP or 3GPP2 system is disabled in the PRI, the device shall NOT show the user the option to select a Global Selection Mode, and all menu structures specific to “Global” mode, must be hidden or masked from the user.	M	For example, if there is a software shortcut to switch network types, this shortcut must be hidden from the user if either 3GPP or 3GPP2 is disabled.	
3.4.1.1.4	Under the “Network” setting, the user shall be able to select one of two settings under the label “Network Type”: “3GPP2” or “3GPP”, if both are enabled in the PRI.	M		
3.4.1.1.5	Under the network setting, if the selected “Network Type” is “3GPP”, the user shall be able to select one of two settings under the label “Network Selection Mode”: “Automatic” or “Manual”.	M	3GPP includes GSM, UMTS and LTE. The service provider may select to enable any or all of these modes. An example would be to select LTE only, i.e., for 3GPP only LTE may be selected.	
3.4.1.1.6	Under the network setting, if the selected “Network Type” is “3GPP2”, the user shall be able to select one of two settings under the label “Network Selection Mode”: “Automatic” or “Home Only”.	M		
3.4.1.1.7	The device display should indicate to the user which network type they are currently using, either 3GPP or 3GPP2 at the signal bar in the standby status.	HD	This requirement shall apply to the devices with displays or to devices intended for direct human interaction.	
3.4.1.1.8	The device should comply with the HMI of the user equipment 3GPP specification.	HD		3GPP TS22.030

3.4.1.2 Multi Mode

When both 3GPP2 and 3GPP are enabled in the PRI, the device is considered to be in Multimode.

When in Multimode, the user may switch between 3GPP2 and 3GPP network types. The following section defines the requirements for the “Multimode” network mode.

Table 3-13 Multi Mode

Req. #	Requirement	Category	Remarks	References
3.4.1.2.1	If neither “Global Automatic” nor “Global Manual” is enabled in the PRI, the user shall NOT be shown the “Global Selection Mode” settings.	M		
3.4.1.2.2	If no UICC is installed or no USIM exists on the installed UICC, and the user changes the Network Type from “3GPP2” to “3GPP”, the device shall display the message “Please insert properly provisioned card to use 3GPP network”.	M	The error message is just an example.	
3.4.1.2.3	If no UICC is installed or no CSIM exists on the installed UICC, and the user changes the Network Type from “3GPP” to “3GPP2”, the device shall display the message “Please insert properly provisioned card to use 3GPP2 network”.	M	Mandatory if the device supports requirement 4.2.1.2 The error message is just an example.	
3.4.1.2.4	When in Multimode, MM device should support switching network types selection through a hardware key.	HD	The hardware button will switch the user from 3GPP2 to 3GPP network type, and vice versa.	
3.4.1.2.5	When in Multimode, MM device shall support switching network types selection through a software shortcut key.	M	The software shortcut shall NOT be the same as the main menu -> settings -> network -> network type setting. If a hardware key is supported, this requirement is Highly Desirable.	
3.4.1.2.6	If the user attempts to switch network types through the hardware key, or the software shortcut, the user must be prompted with the following message “Would you like to search for <3GPP2/3GPP>?.” And given the option to confirm the selection”.	M		
3.4.1.2.7	If 3GPP2 or 3GPP is disabled in the PRI, attempts to switch network types through the hardware key must be ignored.	M		
3.4.1.2.8	While in an active call, attempts to switch network types through either the hardware key or software shortcut shall be ignored.	M	Attempts to switch network during an active call shall NOT be queued.	

Req. #	Requirement	Category	Remarks	References
3.4.1.2.9	When in global mode, the MM device shall NOT reset when the user changes the network type from 3GPP2 to 3GPP or vice versa.	M		

3.4.1.3 Global Automatic 3GPP2/3GPP System Selection

MM device shall support a Global Automatic 3GPP2/3GPP selection mode of operation. In this mode, the switch between 3GPP2 and 3GPP networks is performed automatically, without requiring any input from the user. When multiple networks are available, MM device shall be able to automatically select the most preferred network, regardless whether such network is based on 3GPP2 or 3GPP air interface.

Currently the Global Automatic system selection algorithm has not been explicitly defined in standards or GHRC documents. The necessary supporting parameters for MMSS have been standardized in both 3GPP2 (to be published as [16]) and 3GPP (sections 4.2.5, 4.2.53 and 4.2.54 of TS 31.102). Although not considered a normative reference, Annex E in [16] does provide a detailed recommendation on how the MMSS parameters should be used. The requirements in the following table captures the operations necessary for supporting the Global Automatic system selection based on standards recommendation.

Table 3-14 Global Automatic 3GPP2/3GPP System Selection

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.3.1	The MM device shall only support “Global Automatic” selection mode when both 3GPP2 and 3GPP are enabled in the PRI.	M			Y
3.4.1.3.2	If the PRI setting for “Global Automatic” is disabled, the user shall not be presented the option to select “Global Automatic” as a “Global Selection Mode” in the Network settings.	M			N
3.4.1.3.3	If the MM device supports 3GPP2 MMSS, the “Global Automatic” selection mode shall be based on parameters for the MLPL and the MSPL.	M	MLPL is used to select the correct MSPL record based on location specific information and MSPL contains parameters for prioritizing network types.		N

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.3.4	For MM device supporting 3GPP2 MMSS, the selection of the MLPL record shall be based on the MCC, MNC and/or SYS_LOC_TAG parameters.	M	MCC, MNC and SYS_LOC_TAG are currently the only parameters defined for MLPL. MLPL can be based on any combination of the three location specific parameters.		N
3.4.1.3.5	For MM device supporting 3GPP2 MMSS, if more than one MLPL record can be selected based on MCC, MNC and/or SYS_LOC_TAG parameters, the MLPL record based also on SYS_LOC_TAG shall be chosen.	HD	To provide better granularity, multiple MLPL records may be defined in a country (MCC). SYS_LOC_TAG provides better granularity. Thus, MLPL record based on SYS_LOC_TAG and MCC has preference over MLPL records based only on MCC. It is possible for the MM device to match with multiple MLPL and this needs to be resolved to determine the MSPL to use.		N
3.4.1.3.6	For MM device supporting 3GPP2 MMSS, the selection of the MSPL record shall be based on the selected MLPL record.	M			N
3.4.1.3.7	For MM device supporting 3GPP2 MMSS, there shall only be one MSPL record specified by an MLPL record.	M	However there can be multiple MLPL records that reference the same MSPL record.		N
3.4.1.3.8	For MM device supporting 3GPP2 MMSS, if no suitable MLPL record is found, the default MSPL record shall be used for network type selection.	M	The default MSPL may also be used when the MM device is first powered up and MLPL is not readily available.		N
3.4.1.3.9	For MM device supporting 3GPP2 MMSS, the network/RAT type selection shall be based on the priorities indicated by the MSPL parameters.	M	The MSPL parameters include SYS_TYPE, PRI_CLASS, SYS_PRI, HIGHER_PRI_SRCH_TIME and NETWORK_CAP.		N
3.4.1.3.10	For MM device supporting 3GPP2 MMSS, the SYS_TYPE within the MSPL record shall be listed in order of decreasing priority.	M	More than one MSPL entries can have the same priority.		N

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.3.11	For MM device supporting 3GPP2 MMSS, the matching MSPL entry for the currently found system is determined using both the SYS_TYPE and PRI_CLASS and if there multiple entries matching, use the one which has higher priority.	M	For example, acquiring a CDMA network belonging to a non-preferred roaming partner is not better than acquiring a GSM network belonging to a preferred roaming partner. CDMA is only preferred over GSM if the preferred roaming partner is acquired.		N
3.4.1.3.12	For MM device supporting 3GPP2 MMSS, the SYS_TYPE associated with a matching NETWORK_CAP should have priority over a higher priority SYS_TYPE without a matching NETWORK_CAP.	HD	Currently the NETWORK_CAP indicates whether the network supports both voice and data.		N
3.4.1.3.13	For MM device supporting 3GPP2 MMSS, the MM device shall be provisioned with a prioritized list of RATs, Technology Order Table (ToT). This may be used to determine the order in which systems are scanned when the UE has not yet identified the MSPL to be used in its current location.	HD			N
3.4.1.3.14	For MM device supporting 3GPP2 MMSS, the MM device shall be provisioned with an acquisition table for 3GPP scanning.	HD			N

3.4.1.4 Global Manual 3GPP2/3GPP System Selection

MM device shall support Global Manual selection mode of operation. This mode can be enabled or disabled by the operator through the PRI.

In Global Manual selection mode the user controls switching between 3GPP2 and 3GPP network types. The user can switch between 3GPP2 and 3GPP network types through either a software shortcut, or a hardware key. In constrained mode, the hardware key and software shortcut are disabled, and the user must go into Main Menu -> Settings -> Network setting to change between network types in constrained mode or switch to Global mode and, these options are only available if enabled by the operator through the PRI. This way, an operator has the option to launch a MM device as a 3GPP2 only device, 3GPP only device, or Multi Model (MM) device, without the user being aware the device can operate in other network modes.

Table 3-15 Global Manual 3GPP2/3GPP System Selection

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.4.1	MM device shall support “Global Manual” selection mode when in “Global” network mode	M			Y
3.4.1.4.2	If the PRI setting for “Global Manual” is disabled (req. 3.4.1.4.1) , the user shall not be presented the option to select “Global Manual” as a “Global Selection Mode” in the Network settings	M			N

3.4.1.5 Constrained Mode of Operation

MM device shall support limiting the air interface capabilities to 3GPP or 3GPP2 only mode of operation. In other words, the MM device shall be able to be placed in a mode where it operates as a 3GPP2 only device or 3GPP only device. In constrained mode, the hardware key and software shortcut are disabled, and the software shortcut shall be hidden from the user.

Table 3-16 Constrained Mode of Operation

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.5.1	The MM device shall support operating on “3GPP2”	M			Y
3.4.1.5.2	If the PRI setting for “3GPP2” is disabled (req. 3.4.1.5.1) , the user shall not be presented the option to select “3GPP2” as a network type in the Network settings.	M			N
3.4.1.5.3	The MM device shall support operating on “3GPP”.	M			Y
3.4.1.5.4	If the PRI setting for “3GPP” is disabled (req. 3.4.1.5.3) , the user shall not be presented the option to select “3GPP Only” as a network type in the Network settings.	M			N

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.5.5	If no UICC is installed or no USIM exists on the installed UICC and support for “3GPP2” is disabled, the MM device shall display an error message “Please insert properly provisioned card to use 3GPP”.	M	The error message is just an example.		N
	If no UICC is installed or no CSIM exists on the installed UICC and support for “3GPP” is disabled, the MM device shall display an error message “Please insert properly provisioned card to use 3GPP2”.	M	Mandatory if the device supports requirement 4.2.1.2 The error message is just an example.		N
3.4.1.5.6	If only an R-UIM is inserted into the device, the MMS device shall operate in 3GPP2 constrained mode. It will only use the PRL for system selection.	HD			
3.4.1.5.7	If only a SIM is inserted into the device, the MM device shall operate in 3GPP constrained mode. It will only use the EHPLMN/HPLMN, OPLMN and UPLMN ef files for system selection.	HD	eHRPD credentials are stored in the SIM card and the MM device may be able to associate with the eHRPD network for operation. The MM device with only the SIM card will not have the 1X/HRPD credentials that are retained in the CSIM card.		

3.4.1.6 3GPP2 Mode

When operating on a 3GPP2 network, MM device shall fully comply with all 3GPP2 system selection requirements.

3GPP2 system selection requirements are specified in [7].

The following section defines the requirements for 3GPP2 only mode.

Table 3-17 3GPP2 Mode

Req. #	Requirement	Category	Remarks	References
3.4.1.6.1	The MM device shall comply with [7[, Recommended System Selection Requirements for 1x and 1xEV-DO-Capable Terminals.	M		[7]

3.4.1.7 3GPP Operation

When operating on a 3GPP network, MM device shall fully comply with all 3GPP system selection requirements.

3GPP system selection requirements are specified in the 3GPP recommendations.

Table 3-18 3GPP Operation

Req. #	Requirement	Category	Remarks	References
3.4.1.7.1	The MM device shall comply with [11]: "Non-Access-Stratum functions related to Mobile Station (MS) in idle mode"	M		[11]
3.4.1.7.2	The MM device shall comply with 3GPP TS 43.022: "Functions related to Mobile Station (MS) in idle mode and group receive mode."	M		TS 43.022

3.4.1.8 Power up Requirements

Table 3-19 Power up Requirements

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.8.1	Upon power up, the MM device shall start in the default “Global Selection Mode”, set by the operator in the PRI setting. The default “Global Selection Mode” must be enabled in the PRI.	M			Y
3.4.1.8.2	If the PRI setting for MM device “Global Selection Mode” (req. 3.4.1.8.1) is set to NULL, upon power up the MM device shall start in the same “Global Selection Mode” used at power down.	M			N
3.4.1.8.3	Upon power up, the MM device shall start in the default “network type”, set by the operator in the PRI setting.	M			Y

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.8.4	If the PRI setting for MM device default “network type” (req. 3.4.1.8.1) is set to NULL, upon power up, the MM device shall start searching in the same network type used at power down.	M			N
3.4.1.8.5	Upon power up, if the MM device is in Global Mode, and no UICC card is present and the 3GPP2 credentials are in the device, the device shall search only for 3GPP2 networks regardless of the default “network type”.	M			N
3.4.1.8.6	Upon power up, if there is no (U)SIM card present, and the device is “Constrained” to “3GPP”, the MM device shall display an error message “Please insert (U)SIM card to use 3GPP”.	M			N

3.4.1.9 Emergency Call Requirements

Emergency calls shall be permitted at all times regardless of “network”, “network type”, or “selection mode”.

Table 3-20 Emergency Call Requirements

Req. #	Requirement	Category	Remarks	References
3.4.1.9.1	The MM device shall allow emergency calls on any available “network”, regardless of “network type”, and “selection mode” settings.	M		
3.4.1.9.2	The MM device shall allow emergency calls on any available 3GPP system, even when no UICC card is present on the device.	M		
3.4.1.9.3	The MM device shall allow emergency calls on any available 3GPP2 system, even when no UICC card with CSIM application is present on the device.	M		

3.4.1.10 Idle Mode Requirements

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.4.1.10.1	If a MM device supporting 3GPP2 MMSS is operating in Global Automatic mode, and is not camped on the most preferred system according to the rules in provisioned databases, it shall periodically scan for more preferred systems.	M	This is similar to the BSR procedure in [7].		Y
3.4.1.10.2	The MM device should allow for a mechanism to arbitrate across the better system reselection procedure based on provisioning in the MMSS databases and cell reselection procedure based on the information broadcast by the individual cells in determining the procedure to follow when they are in conflict with each other.	HD	In Idle mode the MM device can move between two systems in two ways. The first way is based on a periodic scan for higher-priority systems as defined in the MMSS databases. The second is based on reselection (idle-HO) using the thresholds and priorities specified in the overhead messages. Since the MMSS database is configured by the home operator and the reselection priorities are specified by the visited operator, they could be in conflict.		N

1

Integration of 3GPP2 and 3GPP Services

4.1 Purpose

The purpose of this section is to define requirements for integrating services between 3GPP2 and 3GPP.

4.2 High Level Requirements

4.2.1 UICC

This section defines the requirements for the hardware slot on the device.

Table 4-1 Hardware Slot Requirements

Req. #	Requirement	Category	Remarks	References	PRI Configurable
4.2.1.1	The UICC card slot in the MM device shall support a UICC with at a minimum a USIM application.	M		TS 31.101	N
4.2.1.2	The UICC card slot in the MM device should support a UICC with at least one CSIM and one USIM application active simultaneously.	HD	R-UIM is not recommended for multimode devices as a UICC supporting both R-UIM an USIM will have unacceptably long switching times between R-UIM and USIM. A less preferred approach is to have non 3GPP credentials provisioned in nonvolatile (NV) memory on the device and 3GPP provisioned in the USIM on the UICC.	[10] 3GPP TS.31.101, TS.31.102	N
4.2.1.3	The MM device shall support handset subsidy locking mechanism to a particular UICC or set of UICCs.	M	If this feature is disabled in the PRI, all UICCs shall be accepted as valid.	TS 22.022	Y

Req. #	Requirement	Category	Remarks	References	PRI Configurable
3.2.1.4	The MM device shall comply with UICC physical and electrical characteristics specified in TS 31.101.	M		TS 31.101	N
4.2.1.4	The MM device should support (U)SIM Application Toolkit.	HD		TS 31.111	N
4.2.1.5	The MM device should support Smart Card; Card Application Toolkit Transport Protocol (CAT/TP).	HD		ETSI TS 102 127	N
4.2.1.6	The MM device should support Smart cards; Card Application Toolkit (CAT).	HD		ETSI TS 102 223	N
4.2.1.7	The MM device shall support secured packet structure for UICC based applications.	M		ETSI TS 102 225	N
4.2.1.8	The MM device shall support Remote APDU structure for UICC based applications.	M		ETSI TS 102 226	N
4.2.1.9	The MM device shall support the secure package structure for universal subscriber identity module USIM tool kit applications	M		3GPP TS 31.115	N
4.2.1.10	The MM device shall support remote APDU structure for USIM tool kit applications	M		3GPP TS 31.116	N

4.2.2 Phonebook Integration

Table 4-2 Phonebook Integration

Req. #	Requirement	Category	Remarks	References
4.2.2.1	When viewing the internal memory phonebook, the MM device shall provide an option to switch to the phonebook stored on the UICC.	M		3GPP TS 31.102
4.2.2.2	Under any “network type” the UICC phonebook will be available for viewing, editing and copying.	M		3GPP TS 31.102

Req. #	Requirement	Category	Remarks	References
4.2.2.3	Under any “network type”, the MM device shall allow the user to make calls from the UICC card phone book	M		3GPP TS 31.102
4.2.2.4	+ code dialing shall be available in both network types. In 3GPP2 mode, the device must comply with + code dialing requirements specified in CDG ref #90. In 3GPP mode, the device must send a “+” code.	M	Device shall support +code dialing in both 3GPP and 3GPP2 networks even when a network-based solution is not implemented.	CDG ref #90
4.2.2.5	When viewing the UCC phonebook, the MM device shall provide the option to “copy entry”, or “copy all” to the internal phonebook.	M		

4.2.3 Call Records

Table 4-3 Call Records

Req. #	Requirement	Category	Remarks	References
4.2.3.1	When viewing all call records, the phone may display which network was used for each call.	O		

4.2.4 SMS Integration

Table 4-4 SMS Integration

Req. #	Requirement	Category	Remarks	References	PRI Configurable
4.2.4.1	The MM device shall save all incoming and outgoing SMS messages to the internal memory of the MM device.	M			N
4.2.4.2	For all SMS messages stored in the internal memory, the device may display the network the message was received on.	O			N
4.2.4.3	The MM device shall support the option to save 3GPP SMS messages to the UICC in addition to the internal memory.	M	If this option is disabled in the PRI, the user can not choose to save 3GPP messages to the UICC.		Y
4.2.4.4	The MM device shall support the option to save 3GPP2 SMS messages to the UICC in addition to the internal memory.	M	If this option is disabled in the PRI, the user can not choose to save 3GPP messages to the UICC. Mandatory if the device supports requirement 4.2.1.2.		N

Req. #	Requirement	Category	Remarks	References	PRI Configurable
4.2.4.5	The MM device shall support the Short Message Service (SMS) Point-to-point (PP).	M		TS 23.040 TS 23.048	N
4.2.4.6	If there are previously saved SMS messages on the UICC, the MM device shall allow the user the option to view those messages.	M			N
4.2.4.7	In any “network type”, the MM device shall allow the user to make calls, and reply to messages from the UICC SMS message storage.	M			N
4.2.4.8	SMS addressing functionality shall include “+” code dialing support on both 3GPP2 and 3GPP network types. For 3GPP2 requirements are specified in CDG ref. #90. For 3GPP, a “+” shall be sent.	M	Device shall support +code dialing in both 3GPP and 3GPP2 networks even when a network-based solution is not implemented”.	CDG ref. #90	N
4.2.4.9	The MM device shall allow for provisioning to allow or disallow SMS over IMS domain.	M	When SMS support over IMS is allowed, a successful IMS registration implies SMS support over the IMS domain.		
4.2.4.10	The MM device may be able to send and receive SMS messages in both 3GPP and 3GPP2 formats over the IMS domain.	O			
4.2.4.11	The MM device shall allow for provisioning the format of MO SMS messages sent over the IMS domain.	M			
4.2.4.12	The MM device shall be able to send and receive SMS messages over all circuit-switched radio technologies similar to a single mode device when operating over the circuit-switched domain.	M			

Req. #	Requirement	Category	Remarks	References	PRI Configurable
4.2.4.13	The MM device shall allow the operator to provision SMS transport mechanism (CS or IMS etc.) for each of the radio access technologies supported in the MM device.	O	When operating over LTE, the MM device can support SMS messaging over the S102 interface or over the packet domain as IMS. When operating over UMTS or 1X+HRPD hybrid mode, the SMS can be supported over the circuit-switched or packet-switched domain.		
4.2.4.14	The device shall allow for provisioning the preferred order of domains over which the SMS is supported over.	M			
4.2.4.15	The device shall allow for provisioning if SMS is a mandated service.	M			
4.2.4.16	The device shall allow supporting SMS over the domain based on the currently associated technology(ies) as specified by the preference order.	M			
4.2.4.17	If SMS is a mandated service and if the current domain of association does not support SMS service, the MM device shall attempt to find an alternative available system/technology to support this service over.	M			

4.2.5 APN Support

The MM device shall support several different APNs to support different carrier services and features. The APNs should be stored in the PRI, and the operator can enable/disable the user from editing the default APNs. It is also assumed the operator has an agreement with a GRX/CRX provider to support international data roaming. The requirements below list the different APNs that the device must support, as well as the formatting of the APN.

Table 4-5 APN Support

Req. #	Requirement	Category	Remarks	References	PRI Configurable
4.2.5.1	All APNs must be formatted as follows <Network ID>.<MNC>.<MCC>.GPRS	M	In CDMA, operators are not given MNC/MCC, the GRX/CRX will provide the CDMA operator values for these fields.		N
4.2.5.2	For devices supporting WAP, the device shall support APN for WAP	M	The PRI setting determines if this APN can be modified by the user. This APN will be used for MMS clients and WAP browsing.		Y
4.2.5.3	APN for dial-up networking	O	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.4	APN for Internet (email, browsing, streaming, etc.)	M	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.5	For the MM devices supporting Java, the device shall support APN for Java	M	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.6	For the MM device supporting BREW, the device shall support APN for BREW	M	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.7	For the MM device supporting IMS, the device shall support APN for IMS	M	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.8	For the MM device supporting VPN connections to private networks, the device shall support APN for VPN.	M	The PRI setting determines if this APN can be modified by the user.		Y
4.2.5.9	Associated with each APN, the MM device shall allow for provisioning IPv4 and IPv6 support, Default APN identification, always on type services, and PCO related parameters like the DNS address request, CSCF address request.	M	The parameters associated with each APN are retained as part of application profiles in the MM device.		Y

4.2.6 Service/Feature Integration

The services and features below should work seamlessly across either a 3GPP2 or 3GPP network. If a feature is highly desirable, the device tier will determine whether or not it is included on the device. For each feature, please refer to appropriate CDG documents for feature specific requirements.

Table 4-6 Service/Feature Integration

Req. #	Requirement	Category	Remarks	References
4.2.6.1	All services/features that are enabled in 3GPP2 “network type” should also be enabled and work in a similar fashion on 3GPP “network type”	HD		
4.2.6.2	The MM device shall include an SMS client	M		
4.2.6.3	The MM device should include an MMS client	HD		CDG ref. #92
4.2.6.4	The MM device should support a browser	HD		

4.2.7 Clock

Table 4-7 Clock

Req. #	Requirement	Category	Remarks	References
4.2.7.1	When a 3GPP2 system is selected the clock shall be synchronized with the CDMA system time.	M		CDG ref #90
4.2.7.2	The handset shall maintain an internal clock that is not dependant on CDMA system time (i.e., clock works even when system, either 3GPP or 3GPP2, is unavailable).	M		

4.2.8 Identifiers

Table 4-8 Identifiers

Req. #	Requirement	Category	Remarks	References
4.2.8.1	The MM device shall use a decimal based MEID as its single device equipment identifier.	M	A decimal MEID can be used both as an IMEI (for operation in 3GPP systems) and MEID (for operation in 3GPP2 systems).	3GPP2 SC.R4001 § 6.5

4.2.9 Calling Party Number

When the MM device is on a 3GPP system, and there is an incoming voice call from 3GPP2 system, the MM device should inform the user by displaying the calling party number so that the user can determine whether to accept it (then the device will switch to 3GPP2 system); or to ignore it (then the device will stay on the current 3GPP serving system).

Table 4-9 Calling Party Number

Req. #	Requirement	Category	Remarks	References
4.2.9.1	The MM device should display the calling party number if such call is coming from another network system.	O	One example is LTE to 1xRTT CSFB. The multiple mode mobile device users should have the right to either accept or deny this incoming call from 1xRTT network system.	3GPP TS 23.272

4.2.10 Voice Mail and Text Message Indication

Table 4-10 Voice Mail and Text Message Indication

Req. #	Requirement	Category	Remarks	References
4.2.10.1	The MM device should support the voice message notification icon to display voice messages that are sent from a different network system.	HD	If the 3GPP systems is used as data service only system, Voice Mail should be supported while the device is idle or on active data session on the serving 3GPP system.	
4.2.10.2	The MM device should support the Message Waiting Indication icon to display to the user that there is a messages waiting from a different network system.	O	This is an existing function in 3GPP2 1xRTT standard and is well used by 3GPP2 device. To support this, the device should support feature notification acknowledgement.	

4.2.11 Multi-Mode Authentication

Table 4-11 Multi-Mode Authentication

Req. #	Requirement	Category	Remarks	References
4.2.11.1	The MM device should share the same authentication keys between 3GPP and 3GPP2 network systems so that the same authentication vector can be maintained by the common authentication center.	M	This is mandatory if authentication is required by the multi-mode network operators.	

Mobility/Interworking Requirements for Multi Mode Devices

5.1 Purpose

The purpose of this section is to define the minimum requirement for a MM device when it moves from its current system to a different system.

5.2 Definition of Handover Triggers

The table below provides the definitions for handover triggers.

Table 5-1 Definition of Handover Triggers

Handover Trigger	Definition
Handover Message	Handover Message sent by source AN to mobile with System Information of target RAT/AN.
Reselection/Idle HO	Neighbor List sent to mobile includes target RAT cells. Mobile makes independent decision based on current RAT strength.
Better System Selection	Target RAT is specified as a more preferred system according to the MMSS provisioning in the mobile. Mobile searches for target-RAT while idle/dormant on source-RAT.
Redirection Message	Message used by source AN to direct mobile to another RAT. Specifies System Type of target RAT and frequency information of target RAT.
Out-of-service Scans	Mobile goes out of coverage of source RAT. Out-of-service scans are started based on System Selection Algorithm.
Active State	Active is a state where mobile has an open connection with RAN.
Idle State	When mobile station has acquired the system but the connection is closed and there is no assigned IP address, the mobile station is in idle state.
Dormant State	When mobile station is in idle state and has assigned IP address, the mobile station is in dormant state.
Context	The information on the current state of a routing-related service required to re-establish the routing-related service on a new subnet without having to perform the entire protocol exchange with the mobile station from scratch.
Context Transfer	The movement of context from one router or other network entity to another as a means of re-establishing routing-related services on a new subnet or collection of subnets.
Seamless Handover	A handover in which there is no change in service capability, security, or quality. In practice, some degradation in service is to be expected. The definition of a seamless handover in practical case should be that other protocols, applications, or end users do not detect any change in service capability, security or quality, which would have a bearing on their (normal) operation. It is also called optimized handover.

Handover Trigger	Definition
Optimized Handover	A handover from one technology with the radio and IP session context created on the target RAT while still operating over the source RAT prior to transitioning to the target RAT.
Non-Optimized Handover	A handover from one technology where the radio and IP context is not created over the target RAT while operating on the source RAT prior to transitioning to the target RAT.
CS Fallback	Mobile receives a page in a PS only source RAT for a CS voice call to be received on target RAT.
PS Fallback	Mobile receives a PS page in source RAT for a MT PS data call in target RAT

5.3 Mobility Transition Type and Trigger Mechanism

The mobility transition type and the triggering mechanism are specified using the Notation "State in Source RAT -> State in Target RAT". The table below shows all the possible scenarios.

Table 5-2 Mobility Transition Type and Trigger Mechanism Scenarios

Terminology	Mobility Transition Type	Trigger Mechanism	State in Source RAN & Network	State in Target RAN & Network	Service-Level Impact
Inter-technology Handoff or Seamless/Optimized IRAT Handover	Active -> Active	Handover Message	Traffic channel assigned to mobile in RAN IP/QoS Context exists in Network	Traffic channel assigned to Mobile in target-RAN *prior to handover.* IP/QoS Context created in target-Network *prior to handover.*	Minimum Service discontinuity for real-time services (interruption < 200ms). IP address unchanged after handover.
Inter-technology Redirection or Non-optimized IRAT Handover (with context transfer)	Active -> Dormant	Redirection Message	Traffic channel assigned to mobile in RAN. IP/QoS Context exists in Network.	No traffic channel assigned to mobile in target RAN prior to handover. Identical IP/QoS Context transferred to target-Network *after or prior to handover.*	Data Session Continuity is maintained with significant interruption. Not suitable for real-time applications IP address unchanged after handover.

Terminology	Mobility Transition Type	Trigger Mechanism	State in Source RAN & Network	State in Target RAN & Network	Service-Level Impact
Inter-technology redirection or Non-optimized IRAT Handover (without context transfer)	Active->Idle	Redirection Message	Traffic channel assigned to mobile in RAN IP/QoS Context exists in Network	No traffic channel assigned to mobile in target RAN prior to handover New IP/QoS Context created in target Network after handover	There is no data session continuity IP address cannot be maintained
CS Fallback or Cross Paging	Dormant -> Active	CS Page	No Traffic channel assigned to mobile in RAN. IP/QoS Context exists in Network.	Mobile attaches to CS network and responds to page.	Increases call setup delay due to fallback procedure. IP address cannot be maintained unless PS network remains the same.
Dormant Handoff (with context transfer)	Dormant -> Dormant	Reselection/ Idle HO Redirection Better System Selection Out-of-service scans.	No RAN resources assigned to mobile. IP/QoS Context exists in Network.	No traffic channel assigned to mobile in target RAN prior to handover. Identical IP/QoS Context created in target-Network either prior to or after handover.	IP address unchanged after handover and attachment.
Idle Handoff or Cell Reselection (without context transfer)	Dormant ->Idle	Reselection/ Idle HO Redirection Better System Selection Out-of-service scans.	No RAN resources assigned to mobile. IP/QoS Context exists in Network.	No traffic channel assigned to mobile in target RAN prior to handover. New IP/QoS Context created in network after handover.	IP address changes after handover.

Terminology	Mobility Transition Type	Trigger Mechanism	State in Source RAN & Network	State in Target RAN & Network	Service-Level Impact
Idle Handoff or Cell Reselection (without context transfer)	Idle -> Idle	Reselection/ Idle HO Redirection Better System Selection Out-of-service scans.	No RAN resources assigned to mobile. No IP/QoS Context exists in Network.	No traffic channel assigned to mobile in target RAN prior to handover No IP/QoS Context created in target Network after handover.	

5.3.1 LTE ←→ eHRPD Cell-Reselection

Table 5-3 LTE to eHRPD Redirection Requirements

Req. #	Requirement	Category	Remarks	References
5.3.1.1	The MM device shall be able to receive and process the LTE neighbor information sent over the HRPD air-interface. The MM device shall transition to the LTE system when cell reselection criteria is met based on information received over HRPD.	HD		
5.3.1.2	The MM device shall be able to receive and process the LTE neighbor information sent over the 1x air-interface. The MM device shall transition to the LTE system when cell reselection criteria is met based on information received over 1xRTT.	HD		
5.3.1.3	The MM device shall be able to receive and process different LTE neighbor information sent over the 1xRTT and HRPD air-interfaces. The MM device shall transition to the LTE system when cell reselection criteria is met based on information received over 1xRTT or HRPD.	HD	When cell reselection from 1X/(e)HRPD to LTE is enabled, it is recommended that the MMSS databases to be provisioned to treat these LTE, (e)HRPD, and 1xRTT systems to have equal priority.	

5.3.2 LTE to eHRPD Redirection

Table 5-4 LTE to eHRPD Redirection Requirements

Req. #	Requirement	Category	Remarks	References
5.3.2.1	ConnectionRequest shall be sent by the UE when it transitions to eHRPD from LTE.	M		
5.3.2.2	Inter-RAT Mobility Indication (IRMI) message may be supported by the UE	O		
5.3.2.3	The UE shall be able to perform serving cell measurements in RRC_CONNECTED.	M		
5.3.2.4	The UE shall be able to support reporting events for LTE Intra RAT A1, A2, A3, A4, A5, B1 and B2 as specified in [3].	M		
5.3.2.5	The software stack in the UE can determine whether the redirection message is received as part of CSFB procedure.	M	Used to put the packet session over LTE in a suspended state, to be reactivated when the UE returns to LTE after completing the 1xCSFB call.	
5.3.2.6	The UE shall support unicast 3GPP Redirection procedure from LTE to (e)HRPD.	M	This applies only when the UE is HRPD capable. Note that the redirection procedure can be executed with and without measurements of the HRPD pilots.	
5.3.2.7	The UE shall support redirection from LTE to 1xRTT.	M	Given that the packet session is not maintained across LTE and 1X transitions, the UE can wait to go out of service on LTE to acquire the 1X network.	

Req. #	Requirement	Category	Remarks	References
5.3.2.8	Upon receiving a redirection from the LTE to the (e)HRPD network, the UE attaches to the appropriate personality based on the eHRPD or HRPD network to which it is redirected to. When 1X+Hybrid mode is enabled, then the UE after acquiring the (e)HRPD network attempts to find available 1X network. If a 1X network is found, the UE enters hybrid mode with the HRPD system associated with the acquired 1X network.	M	Procedures for camping on associated HRPD system will be similar to the procedure of redirection from one HRPD subnet to another as specified by [7].	

5.4 Handover Scenarios

The section below describes all the possible handover scenarios. In the tables below, superscript represents trigger that results in the RAT transition. The following definitions apply.

[T1] Handover message
[T2] Reselection

[T3] Better System Selection
[T4] Redirection message

[T5] Out-of-service Scans

[T6] CS Fallback
[T7] Based on Layer-2 Tunneling

5.4.1 Handovers from 1x to Other Systems

Table 5-5 Handovers from 1x to Other Systems

Source RAT	Terminology	Mobility Type	Target RAT					
			1X	HRPD	eHRPD	LTE	Other 3GPP	Comment
1x	Seamless IRAT HO	Active-->Active	**M**[T1]	NA	NA	NA	NA	The handoff direction message is defined C.S0005-D
	Non-Optimized IRAT HO (with context transfer)	Active->Dormant	**M**[T4]	NA	NA	NA	NA	The Service redirection message is defined C.S0005-D
	Non-Optimized IRAT HO (without context transfer)	Active->Idle	**M**[T4]	NA	NA	NA	NA	Same as above. Active-->Idle will happen if simple IP is used in 1x network and MS crosses PDSN boundary.
	Dormant Handoff with IP context transfer	Dormant->Dormant	**M** [T3, T5]	**M**[T3, T5]	NA	NA	NA	MS may perform Better System Selection or Out of Service Scans
	Idle Handoff	Dormant->Idle or Idle -> Idle	**M**[T2, T3, T5]	**M**[T2,T3,T5]	**M**[T2,T3,T5]	**M**[T3, T5] **O**[T2]	**M**[T3, T5]	MS may perform Better System Selection based on provisioned PRL, 3GPP2 MMSS DB etc.

5.4.2 Handovers from HRPD to Other Systems

Table 5-6 Handovers from HRPD to Other Systems

Source RAT	Terminology	Mobility Type	Target RAT					
			1X	HRPD	eHRPD	LTE	Other 3GPP	Comment
HRPD	Seamless IRAT HO	Active-->Active	NA	**M**[T1]	NA	NA	NA	Route Update Protocol messages defined in [1]
	Non-Optimized IRAT HO (with context transfer)	Active->Dormant	**M**[T4]	**M**[T4]	NA	NA	NA	Redirect Message defined in [1] causes transition from active to dormant (idle) on target. IP continuity can be maintained if Mobile IP is used or PDSN does not change.
	Non-Optimized IRAT HO (without context transfer)	Active->Idle	**M**[T4]	**M**[T4]	**M**[T4]	NA	NA	Redirect Message defined in [1] causes transition from active to idle on target RAT. IP continuity cannot be maintained if target RAT is eHRPD or if Simple IP is used and PDSN changes.
	Dormant Handoff with IP context transfer	Dormant->Dormant	**M**[T2,T3,T5]	**M**[T2,T3,T5]	N/A	N/A	N/A	Reselection using Neighbor List message specified in [1].
	Idle Handoff	Dormant->Idle or Idle -> Idle	**M**[T2,T3,T5]	**M**[T2,T3,T5]	**M**[T2,T3,T5]	**M** [T3, T5] **O**[T2]	**M** [T3, T5]	MS may perform Better System Selection based on provisioned PRL, 3GPP2 MMSS DB etc. In addition, HRPD-->eHRPD might occur due to reselection if a network is partially upgraded to eHRPD. Since IP continuity cannot be maintained MS goes from Dormant to Idle on eHRPD.
	CS Fallback	Dormant->Active	0 [T6]	NA	NA	NA	NA	CSNA makes Dormant--> Active possible. But CSNA is not widely implemented.

5.4.3 Handovers from eHRPD to Other Systems

Table 5-7 Handovers from eHRPD to Other Systems

Source RAT	Terminology	Mobility Type	Target RAT					
			1X	HRPD	eHRPD	LTE	Other 3GPP	Comment
eHRPD	Seamless IRAT HO	Active-->Active	NA	NA	**M**^{T1}	NA	NA	Route Update Protocol messages defined in [27]
	Non-Optimized IRAT HO (with context transfer)	Active->Dormant	NA	NA	**M**^{T4}	NA	NA	Uses Redirect Message defined in [1] causes transition from active to dormant (idle) on target.
	Non-Optimized IRAT HO (without context transfer)	Active->Idle	**M**^{T4}	**M**^{T4}	**M**^{T4}	NA	NA	If network wants to redirect an AT active on eHRPD to a HRPD/1x frequency, it has to use the Redirect Message defined in [1]. Since IP continuity cannot be maintained, it causes transition from active to idle on target RAT. A redirection to another eHRPD network might also lead to loss of IP continuity under certain conditions (VSNCP handoff attach fails).
	Dormant Handoff with IP context transfer	Dormant->Dormant	NA	NA	**M**^{T2,T3,T5}	**M**$^{T3,\ T5}$ **O**^{T2}	N/A	
	Idle Handoff	Dormant->Idle or Idle -> Idle	**M**^{T2,T3,T5}	**M**^{T2,T3,T5}	**M**^{T2,T3,T5}	**M**$^{T3,\ T5}$ **O**^{T2}	**M**$^{T5,\ T3}$	MS may perform Better System Selection based on provisioned PRL, 3GPP2 MMSS DB etc. In addition, if 1x/HRPD neighbors are specified in the NeighborLIst message, eHRPD-->HRPD/1x reselection might occur but since IP continuity cannot be maintained MS goes from Dormant to Idle on HRPD/1x
	CS Fallback	Dormant->Active	**O**^{T6}	NA	NA	N/A	NA	CSNA

5.4.4 Handovers from LTE to Other Systems

Table 5-8 Handovers from LTE to Other Systems

Source RAT	Terminology	Mobility Type	Target RAT					
			1X	HRPD	eHRPD	LTE	Other 3GPP	Comment
LTE	Seamless IRAT HO	Active-->Active	NA	NA	**HD**[T1,T7]	**Refer to 3GPP Specifications**		LTE-->eHRPD Active handover is defined in X.P0057 and is based on S101 tunnel.
	Non-Optimized IRAT HO (with context transfer)	Active->Dormant	NA	NA	**M**[T4]			Based on RRC Connection Release message defined in 36.331.
	Non-Optimized IRAT HO (without context transfer)	Active->Idle	**M**[T4]	**M**[T4]	**M**[T4]			Same as above
	Dormant Handoff with IP context transfer	Dormant->Dormant	NA	NA	**M**[T2,T3,T5]			Based on transmission of eHRPD/LTE/legacy-3GPP neighbors in SIBs (eHRPD neighbors are in SIB-8). Refer [6].
	Idle Handoff	Dormant->Idle or Idle -> Idle	**M**[T2,T3,T5]	**M**[T2,T3,T5]	**M**[T2,T3,T5]			MS may perform Better System Selection based on provisioned PRL, 3GPP2 MMSS DB, etc. If 1x/HRPD neighbors are present in SIB-8, reselection can occur and will result In transition from dormant --> idle due to loss of IP continuity. Refer [6].
	CS Fallback	Dormant->Active	**HD**[T6]	NA	NA			CS fallback as defined in 3GPP TS 23.272

5.4.5 Handovers from Other than LTE 3GPP to Other Systems

Table 5-9 Handovers from Other than LTE 3GPP to Other Systems

Source RAT	Terminology	Mobility Type	Target RAT					
			1X	HRPD	eHRPD	LTE	Other 3GPP	Comments
Other 3GPP	Seamless IRAT HO	Active-->Active	NA	NA	NA	**Refer to 3GPP Specifications**		
	Non-Optimized IRAT HO (with context transfer)	Active->Dormant	NA	NA	NA			
	Non-Optimized IRAT HO (without context transfer)	Active->Idle	NA	NA	NA			
	Dormant Handoff with IP context transfer	Dormant->Dormant	NA	NA	NA			
	Idle Handoff	Dormant->Idle or Idle -> Idle	**M**[T3, T5]	**M**[T3, T5]	**M**[T3, T5]			MS may perform Better System Selection based on provisioned PRL, 3GPP2 MMSS DB etc
	CS Fallback	Dormant->Active	NA	NA	NA			

Voice over LTE multimode device

Figure 6-1 provides the different voice choices that can potentially be available over a LTE multimode device. It covers the voice support over the circuit-switched domains including 1xRTT, GSM, and UMTS, the voice choices while camping on LTE including the CSFB to a 3GPP2 and 3GPP domains and MMTel VoIP on LTE (VoLTE), VoIP over DoRA (VoRA), VoIP over HSPA (VoHSPA) and the requirements to address emergency and priority calling. It also lists the over-the-top (OTT) VoIP solutions. The voice choices required needs to be determined by the operators and device / network vendors allowing for effective in-home and global roaming scenarios.

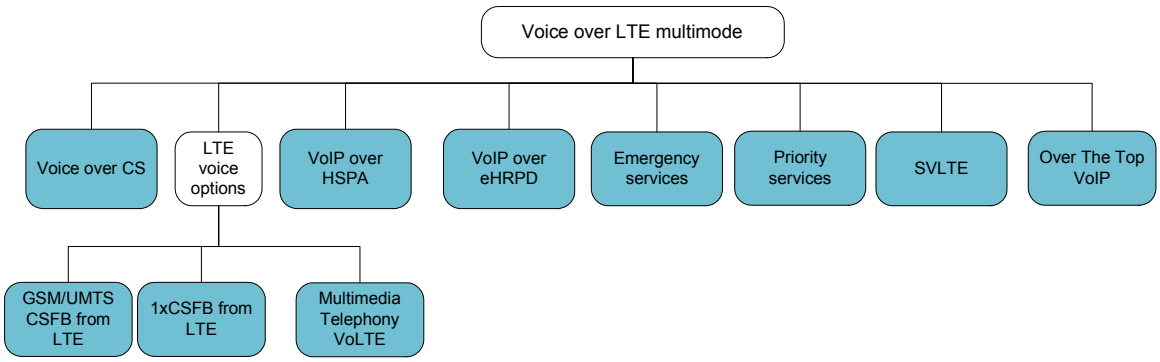

Figure 6-1 Voice choices for a LTE multimode device.

This section currently addresses the SVLTE and 1xCSFB choices that are currently predominantly deployed on the market.

Note the requires for VoLTE itself is addressed by 3GPP GSMA IR.92 and should be used as reference for implementation.

The different inter-RAT mobility support will be addressed in a future revision of this document. This includes VoLTE to VoRA/VoHSPA transitions and SR-VCC procedures.

6.1 SVLTE and SVDO

The following two subsections cover requirements for devices that support Simultaneous 1X Voice and LTE Data (SVLTE) and Simultaneous 1X Voice and DO Data (SVDO). The last subsection covers the modifications of MMSS to support dual transceiver devices.

6.1.1 SVLTE

The class of devices that support simultaneous receive and transmit in both LTE and 1xRTT is called SVLTE. These devices interact with 1xRTT and LTE networks like two devices and there is no protocol level coordination. From 1xRTT network perspective, SVLTE device is like any other 1xRTT device. Similarly, SVLTE device is like any other LTE device from the perspective of LTE network.

Table 6-1 SVLTE Requirements

Req. #	Requirement	Category	Remarks	References
6.1.1.1	The SVLTE device shall support two independently tunable transceivers. One transceiver is used for transmit and receive of 1xRTT signal and the other transceiver is used for transmit and receive of LTE signal.	M		
6.1.1.2	The LTE transceiver shall support two receivers and one transmitter.	M		
6.1.1.3	The 1X transceiver shall support one receiver and one transmitter.	M		
6.1.1.4	The SVLTE device shall support a mechanism for controlling LTE maximum transmit power as a function of 1X transmit power.	M	This requirement is needed for meeting SAR requirement when both transmitters are on.	
6.1.1.5	If SVLTE UE receives UECapabilityEnquiry message with ue-CapabilityRequest includes 'eutra', the SVLTE UE shall exclude cdma2000-1xRTT parameters in UE-EUTRA-Capability information element. This configuration implies that this device does not support LTE ←→1XRTT interworking.	M	Since SVLTE devices look like two different devices to network, interworking is not required. For example, the following functionalities: cell-reselection, 1xCSFB, and re-direction are not required.	[3], [4]
6.1.1.6	If SVLTE UE that supports EVDO receives UECapabilityEnquiry message with ue-CapabilityRequest includes 'eutra', the SVLTE UE shall include cdma2000-HRPD parameters in UE-EUTRA-Capability information element. This configuration implies that this device supports LTE ←→ eHRPD interworking.	M	This requirement is needed for IP mobility between LTE and eHRPD.	[3], [4]

Req. #	Requirement	Category	Remarks	References
6.1.1.7	If the SVLTE device supports EVDO, the UE shall populate tx-ConfigHRPD and rx-ConfigHRPD fields in UE-EUTRA-Capability information element as follows: ■ tx-ConfigHRPD = “Single” ■ rx-ConfigHRPD = “Single”	M	This means that the device supports LTE or EVDO but not both at the same time.	[3], [4]
6.1.1.8	If the SVLTE device loses the LTE system while dormant over the LTE and the 1X system is still acquired, the AT shall delay data service transfer from the LTE to 1X by the minimum of a configurable attribute (1XDataServiceTransferTimer) or the time it takes to acquire EV-DO or LTE system. This delay is required to give enough time for system determination to acquire an alternative EV-DO or LTE system when LTE service is lost before moving data service to 1X.	M	Once the data service is transferred, there has to be another data call attempt or retry to establish data call over 1X.	
6.1.1.9	If the SVLTE device loses the LTE system while on an active LTE call (LTE call goes dormant) and the 1X system is still acquired, the AT shall delay the data service transfer from LTE to 1X by the minimum of a configurable attribute (1XDataServiceTransferTimer) or the time it takes to acquire EV-DO or LTE system. This delay is required to give enough time for system determination to acquire an alternative EV-DO or LTE system when LTE service is lost.	M		
6.1.1.10	If the SVLTE device is on the active 1X data call and it acquires a full LTE service on its other receiver, the UE shall trigger hand up from 1X to LTE by tearing down of 1X data call and attaching to the LTE system.	M	Full LTE service means successful attach to LTE network.	[5]
6.1.1.11	If the SVLTE device is dormant on the 1X system and it acquires a full LTE service on its other receiver, the AT shall trigger hand up from the 1X to the LTE by forcing tearing down of 1X data call and attaching to the LTE system.	M	Full LTE service means successful attach to LTE network.	[5]

Req. #	Requirement	Category	Remarks	References
6.1.1.12	The SVLTE UE shall allow provisioning of a timer attribute for delaying transfer of data service to 1X so that the UE has enough time to search for acquisition of an EV-DO or LTE system. This timer starts when LTE system loss is declared and stops if an EV-DO or LTE system is acquired. If this timer expires and there is no LTE or EV-DO service, the AT shall select 1X system for data services.	M	The default value of this parameter is 15 sec.	
6.1.1.13	The SVLTE UE shall meet Specific Absorption Rate (SAR) limit while transmitting simultaneously.	M	The US limit is 1.6 mW/g. This requirement is region specific.	
6.1.1.14	The AT shall make an emergency call on 1X system.	M		[7]
6.1.1.15	The SVLTE UE shall suspend LTE and the EV-DO modem during an emergency call and emergency callback state. The AT shall enable LTE and EV-DO operation once it exits the emergency callback state.	M		
6.1.1.16	The SVLTE device shall comply with [11], [12], [13], [14], [15], [16], and [17] during an LTE only call.			[11], [12], [13], [14], [15], [16], and [17].
6.1.1.17	The SVLTE device shall comply with [9] when operating in an LTE-only call.			[9]
6.1.1.18	The SVLTE device shall comply with requirements in [20] when operating in 1X-only mode.			[20]
6.1.1.19	The SVLTE device shall maintain 1xRTT performance during simultaneous operation at expense of reducing LTE maximum transmit power level.		Depending on band and channel combinations, there may be IM products that impact 1x or LTE sensitivity during simultaneous transmit. This may require LTE transmit power backoff to minimize the impact to 1X sensitivity.	
6.1.1.20	The SVLTE device shall support SMS over 1X.	M		
6.1.1.21	The SVLTE device should support SMS over IMS when it has full LTE service.	HD	This requires IMS network support.	

6.1.2 SVDO

This section covers the requirements for devices that support Simultaneous 1x Voice and DO Data (SVDO).

Table 6-2: SVDO Requirements

Req. #	Requirement	Category	Remarks	References
6.1.2.1	The SVDO device shall support two independently tunable transceivers. One transceiver is used for transmit and receive of 1xRTT signal and the other transceiver is used for transmit and receive of EVDO signal.	M		
6.1.2.2	The EVDO transceiver shall support two receivers and one transmitter.	M		[2]
6.1.2.3	The 1X transceiver shall support one receiver and one transmitter.	M		
6.1.2.4	The SVDO device shall support a mechanism for controlling EVDO maximum transmit power as a function of 1X transmit power.	M	This requirement is needed for meeting SAR requirement when both transmitters are on.	
6.1.2.5	When the UE is on a 1X traffic channel and there is contention for mobile Tx power (PA headroom), the 1X traffic channel shall have higher priority than both DO access channel and traffic channel; i.e., the DO access channel and traffic channel shall use the excess power (PA headroom). If this contention results in DO traffic channel drop due to ForwardTrafficValid monitoring supervision and DO power is backed off due to above priority, the UE shall log ConnectionFailureReason = 0x1 (connection failure due to tune-away to cdma2000® 1X air-interface). This failure shall be reported in a ConnectionFailureReport message if ConnectionFailureReportingEnabled is set to 0x1.	M		[1]
6.1.2.6	The UE shall set the SimultaneousCommonChannelTransmit attribute of Multimode Capability Discovery Protocol to 0x0B. The UE supports multiple independently tunable transmitters that can be used simultaneously on the cdma2000 high rate packet data and the cdma2000 1X common channels. The transmitters can be tuned to separate channel numbers in the band classes supported by the device .	M		[1]

Req. #	Requirement	Category	Remarks	References
6.1.2.7	The UE shall set the SimultaneousDedicatedChannelTransmit attribute of Multimode Capability Discovery Protocol to 0x0B. The UE supports multiple independently tunable transmitters that can be used simultaneously on the cdma2000 high rate packet data and the cdma2000 1X dedicated channels. The transmitters can be tuned to separate CDMA channels.	M		[1]
6.1.2.8	The UE shall set the SimultaneousCommonChannelReceive attribute of Multimode Capability Discovery Protocol to 0x1. The UE supports multiple independently tunable receivers that can be used to simultaneously receive the cdma2000 high rate packet data Control Channel and one or more common channels defined by the cdma2000 1X air interface. The UE is defined to have independently tunable receivers if each receiver can be tuned to a separate CDMA channel.	M		[1]
6.1.2.9	The UE shall set the SimultaneousDedicatedChannelReceive attribute of Multimode Capability Discovery Protocol to 0x1. The AT supports multiple independently tunable receivers that can be used to simultaneously receive the cdma2000 high rate packet data Traffic Channel and one or more dedicated channels defined by the cdma2000 1X air interface. The UE is defined to have independently tunable receivers if each receiver can be tuned to a separate CDMA channel.	M		[1]
6.1.2.10	The AT shall set the ReceiverDiversity attribute of Multimode Capability Discovery Protocol to 0x1 if it supports EV-DO mobile Rx diversity.	M		[1]

Req. #	Requirement	Category	Remarks	References
6.1.2.11	If the SVDO device loses the EVDO system while dormant over the EVDO system and the 1X system is still acquired, the UE shall delay data service transfer from the EVDO to 1X by a minimum of configurable attribute (1XDataServiceTransferTimer) or the time it takes to acquire EV-DO or LTE system. This delay is required to give enough time for system determination to acquire an alternative EV-DO or LTE system when EVDO service is lost before moving data service to 1X.	M	Once the data service is transferred, there has to be another data call attempt or retry to establish data call over 1X. This requirement assumes that SVDO device also supports SVLTE.	
6.1.2.12	If the SVDO device loses the EVDO system while on an active EVDO call (EVDO call goes dormant) and the 1X system is still acquired, the UE shall delay the data service transfer from EVDO to 1X by a minimum of configurable attribute (1XDataServiceTransferTimer) or the time it takes to acquire EV-DO or LTE system. This delay is required to give enough time for system determination to acquire an alternative EV-DO or LTE system when EVDO service is lost.	M	This requirements assumes that SVDO device also supports SVLTE.	
6.1.2.13	If the SVDO device is on an active 1X data call and it acquires an EV-DO system on its other receiver, the UE shall start a configurable timer (1XtoEVDOHandupDelayTimer). If the EV-DO system is lost prior to expiration of the timer, the AT shall cancel the timer. If the 1XtoEVDOHandupDelayTimer expires, the AT shall trigger hand-up from 1X to EV-DO by tearing down the 1X data call and attaching to the EV-DO system	M	The EVDO acquisition means acquiring pilot and successfully updating overhead information.	
6.1.2.14	If the SVDO device is dormant on a 1X system and it acquires an EV-DO system on its other receiver, the UE shall start a configurable time (1XtoEVDOHandupDelayTimer). If the EVDO system is lost prior to expiration of the timer, the UE shall cancel the timer. If the 1XtoEVDOHandupDelayTimer expires, the UE shall trigger hand-up from 1X to EV-DO by attaching to the EV-DO system..	M	The EVDO acquisition means acquiring pilot and successfully updating overhead information	

Req. #	Requirement	Category	Remarks	References
6.1.2.15	The SVDO UE shall allow provisioning of an attribute (1XtoEVDOHandupDelayTimer) to allow for stable acquisition of an EV-DO system prior to initiating hand-up from 1X to EV-DO by forcing the 1X call to dormancy and initiating an EV-DO attach procedure.	M	The default value of this parameter is 15 sec	
6.1.2.16	The UE shall allow provisioning of an attribute (1XDataServiceTransferTimer) to allow for acquisition of an LTE or EV-DO system. This timer starts when EV-DO system loss is declared and stops if LTE or EV-DO system is acquired. If this timer expires and there is no LTE or EV-DO service, the AT shall select the 1X system for data services.		The default value of this parameter is 15 sec	
6.1.2.17	The SVDO UE shall meet Specific Absorption Rate (SAR) limit while transmitting simultaneously.	M	The US limit is 1.6 mW/g. This requirement is region specific.	
6.1.2.18	The UE shall make an emergency call on 1X system.	M		[7]
6.1.2.19	The UE shall suspend LTE and the EV-DO modem during an emergency call and emergency callback state. The UE shall enable LTE and EV-DO operation once it exits the emergency callback state.	M		
6.1.2.20	The SVDO-capable device shall comply with SVDO performance requirements in [18].	M		[18]
6.1.2.21	The SVDO-capable device shall comply with 1X performance requirements in [20] and [22] while operating in 1X only mode of operation.	M		[20], [22]
6.1.2.22	The SV-DO-capable device shall comply with EV-DO performance requirements in [19] and [21] while operating in EVDO only mode of operation.	M		[19], [21]
6.1.2.23	The SVDO device shall maintain 1xRTT performance during simultaneous operation at expense of reducing EVDO maximum transmit power level.		Depending on band and channel combinations, there may be IM products that impact 1x or EVDO sensitivity during simultaneous transmit. This may require EVDO transmit power backoff to minimize the impact to 1X sensitivity.	

Req. #	Requirement	Category	Remarks	References
6.1.2.24	The SVDO device shall support SMS over 1X.	M		
6.1.2.25	The SVDO device should support SMS over IMS when it has full eHRPD service.	HD	This requires IMS network support.	

6.1.3 SVLTE/SVDO MMSS Requirements

This section covers MMSS modification required for SVLTE/SVDO capable devices. These changes are required to allow for dual radio operation.

Req. #	Requirement	Category	Remarks	References
6.1.4	The SVLTE device shall use 1X/GSM/UMTS records in MMSS provisioning tables and respective priorities for acquiring 1X/GSM/UMTS service on one transceiver (voice transceiver) and use LTE and EV-DO records in MMSS provisioning tables plus their respective priorities to acquire LTE or EV-DO systems on the second transceiver (data transceiver).	M	The notion of voice transceiver and data transceiver is used for short reference. It does not mean that voice transceiver does not support PS service.	
6.1.5	The AT shall comply with system selection requirements for LTE per [11], [5], and [6].	M		
6.1.6	When operating in SV-DO mode, the AT shall maintain association between the acquired 1X system on one transceiver and the acquired EV-DO system on the other transceiver per collocation association in PRL as defined in [7].	M		
6.1.7	The device shall camp on {1X only, GSM only, UMTS only, HRPD only, LTE only, LTE+1X, HRPD+1X} systems based on the system availability and priorities required by the MMSS tables. 1. Relative priority is needed between: a. 1xRTT and LTE systems b. 1xRTT and GSM/UMTS systems c. LTE and HRPD systems 2. The voice transceiver provides the found 1X system to the data transceiver a. The transceiver uses this information to determine if LTE and HRPD systems are	M		

Req. #	Requirement	Category	Remarks	References
	available in the region based on the MMSS tables. b. If the voice transceiver reports a found 1X system, then the data transceiver allows for LTE camping only when the relative priority of the LTE system is equal-to or greater-than the 1X priority. c. If the voice transceiver reports a found 1X system, the UE shall attach only to HRPD systems associated with the found 1X system except the cases listed in CDG Document 143. 3. If the voice transceiver found GSM/UMTS full service, i.e., CS service attached: a. The data transceiver shall shut down. 4. When no 1X system is found: a. When the voice transceiver is OoS and the LTE/HRPD is acquired, the data transceiver shall throttle the GSM/UMTS scans in order to not preempt LTE/HRPD operation too often. i. GSM/UMTS should be scanned only once every $T_{GSMUMTSScansWithCVMOOS}$ minutes (default value is set to 6 mins) if LTE or HRPD is in Idle state. ii. If LTE or HRPD is on traffic, GSM/UMTS scan shall be stopped until LTE or HRPD connection closes. b. Each time the voice transceiver hands over control to data transceiver, it shall allow the data transceiver to run one full scan of LTE/HRPD systems before taking over control for GSM/UMTS scans. c. When the data transceiver and voice transceiver are both OoS, the throttling of the GSM/UMTS scans should not be applied. Instead, the UE shall perform alternate searches on the data transceiver and the voice transceiver until one transceiver acquires service taking into account OoS timelines. Then,			

Req. #	Requirement	Category	Remarks	References
	throttling mechanism shall be followed.			
6.1.8	Device power up for the first time 1. The device shall scan for available systems from the voice transceiver for 1xRTT systems and GSM/UMTS systems sequentially. The order of the 1X, GSM, UMTS scans are determined by the ToT table. The voice transceiver completes MMSS-based scans for 1X, GSM, and UMTS systems and camps on the most preferred system available taking the following constraint into account. a. Note that the LTE/HRPD scans may be run by the data transceiver when 1xRTT scans are run by the voice transceiver. When GSM/UMTS scans are initiated by the voice transceiver, it is assumed that the data transceiver cannot search as simultaneous LTE with GSM/UMTS is not supported. When the LTE/HRPD scans find an LTE/HRPD system, the UE shall wait to hear from the voice transceiver on the found system or having declared OoS before camping on the found system. 2. Once the voice transceiver has completed its scans and found a system to camp on, transceiver are activated based on Req. # 6.1.7 step 2 or Req. # 6.1.7 step 3. If no systems are found by the voice transceiver, the UE hands over control to the data transceiver to find available LTE/HRPD systems. a. Each time the voice transceiver hands over control to the data transceiver, it shall allow the data transceiver to run one full scan of LTE/HRPD systems before taking over control for GSM/UMTS scans.	M		
6.1.9	Device subsequent powerup 1. The MRU for the voice transceiver and the data transceiver shall be managed independently. 2. The voice transceiver system	M		

Req. #	Requirement	Category	Remarks	References
	selection shall be executed first before the data transceiver similar to Req. # 6.1.7			
6.1.10	Better system reselection 1. The VOICE TRANSCEIVER shall run MMSS BSR procedures looking for more preferred 1X/GSM/UMTS systems. When the 1X system that the UE is camping on changes, the new 1X system information is provided to the DATA TRANSCEIVER. 2. The VOICE TRANSCEIVER shall run HPPLMN scan per 3GPP procedures looking for more preferred 3GPP GSM/UMTS systems. 3. The DATA TRANSCEIVER shall run BSR procedures looking for more preferred system across LTE and HRPD systems per the MMSS procedures. 4. If the DATA TRANSCEIVER is camped on an HRPD system, THE DATA TRANSCEIVER shall run HRPD BSR based on PRL. a. If 1X system is acquired in VOICE TRANSCEIVER, it will try to move to a better HRPD within the same association tag. b. If no system is acquired in THE VOICE TRANSCEIVER, it will try to move to a better HRPD system in the same GEO. 5. When a 1X system is acquired and a more preferred GSM/UMTS is defined in the MMSS tables: a. GSM/UMTS scans will be run per the BSR procedures. THE DATA TRANSCEIVER operation will be preempted, including Connected mode operation when GSM/UMTS scans need to be run. So, GSM/UMTS scans shall not start when LTE/HRPD are in the Connected state. b. Each time the VOICE TRANSCEIVER hands over control to the DATA TRANSCEIVER, it shall allow the DATA TRANSCEIVER to run one full scan of LTE/HRPD systems before taking over control for GSM/UMTS scans.	M		

Req. #	Requirement	Category	Remarks	References
6.1.11	Device OoS behavior 1. The VOICE TRANSCEIVER and DATA TRANSCEIVER shall follow the OoS procedures of the individual modems. 2. If a 1xRTT system is acquired in THE VOICE TRANSCEIVER, the knowledge of the acquired system may be used to improve the OoS scan list in the DATA TRANSCEIVER. 3. The VOICE TRANSCEIVER shall coordinate with the DATA TRANSCEIVER for GSM/UMTS search to avoid overlapping OoS search, LTE/HRPD traffic state, and limit impact to LTE/HRPD Idle state. The throttling timeline for GSM/UMTS shall follow $T_{GSMUMTSScansWithCVMOOS}$ timer when LTE/HRPD is acquired and in the Idle state. 4. If the DATA TRANSCEIVER is OoS, the VOICE TRANSCEIVER shall allow the DATA TRANSCEIVER to run one full scan of LTE/HRPD systems before taking over control for GSM/UMTS.	M		
6.1.12	Voice call silent redial 1. The VOICE TRANSCEIVER shall follow the silent redial procedures as specified by [7] while camped on a 1xRTT system.	M	Silent redial across 1xRTT and GSM/UMTS systems is not supported.	
6.1.13	Packet call silent redial 1. The packet call silent redial when in (e)HRPD for DATA TRANSCEIVER will follow the procedures specified for eHRPD devices. 2. The UE shall not transition across the DATA TRANSCEIVER and GSM/UMTS for packet call silent redial functionality.	M		
6.1.14	After redirection from LTE to (e)HRPD or Cell-Reselection from LTE to (e)HRPD, the association tag will be ignored if the 1X system acquired in the VOICE TRANSCEIVER and new DO are not associated. Follow [7] procedures to move to an associated HRPD system.	M		
6.1.15	The AT shall make GSM/UMTS service indication available within the VOICE TRANSCEIVER and	M		

Req. #	Requirement	Category	Remarks	References
	DATA TRANSCEIVER so that data preference can be managed.			

6.2 (e)1xCSFB

Table 6-3 1xCSFB Requirements

Req. #	Requirement	Category	Remarks	References
6.2.1.1	(e)1xCSFB capable UE shall support receiving the *CSFBParam1xRTT* IE in SIB-8 to detect if LTE network supports 1xCSFB.	M		[3][30]
6.2.1.2	UE shall support OMA-DM variables and Domain selection procedures defined in [29] [5].	M	This is required to standardize the behavior when UE encounters a LTE network that does not send *CSFB-Param-1XRTT (doe not support 1xCSFB)*. It is expected that a handset will be set to voice-centric. In which case, the UE that only supports (e)1xCSFB as LTE voice option will leave a LTE network that does not support 1xCSFB and avoid it for an implementation dependent time	[29][5]
6.2.1.3	(e)1xCSFB capable UE shall support the GCSNA protocols as defined [8]	M		[8]
6.2.1.4	A UE capable of e1xCSFB shall set *e-CSFB-1xRTT=TRUE* in the UE capability message	M		[3]
6.2.1.5	A UE capable of e1xCSFB shall set the FGI bits 16, 24 in the UE capability message sent to the LTE network	M	Needed to indicate support for 1x measurements	[3]

Req. #	Requirement	Category	Remarks	References
6.2.1.6	(e)1xCSFB capable UE shall support sending a 1x RGM over the S102 tunnel to update 1x registration state.	M		[8], [30]
6.2.1.7	The UE shall retrieve the *MobilityParametersCDMA2000* through RRC signaling before sending the 1x registration message sent over the tunnel	M		[3]
6.2.1.8	The UE shall use the parameters in the *CSFBParam1xRTT* in SIB-8 and *MobilityParametersCDMA2000* parameters to perform 1x registration based on the following triggers 1) Power-up registration 2) Parameter registration 3) Power-down registration 4) Zone-based registration 5) Timer-based registration	M		[8], [30] [31]
6.2.1.9	(e)1xCSFB capable UE shall perform a PSIST check before sending a 1xRGM over the S102 tunnel.	M	PSIST failure mapped to hard failure	[8], [3]
6.2.1.10	The UE shall use the GCSNAL2Ack received in response to the 1xRGM sent over the S102 tunnel to represent a successful registration	M		
6.2.1.11	If the 1x registration over the S102 tunnel fails, the UE shall be able to classify the failures into two categories 1) Short-term failures 2) Long-Term failures,	M		
6.2.1.12	If a long-term failure occurs during 1x registration over the S102 tunnel, the UE shall use the provisioned OMA-DM variables and Domain selection procedures in [29] [5] to determine if it can camp on LTE without voice service.	M		[5] [29]

Req. #	Requirement	Category	Remarks	References
6.2.1.13	If a short-term failure occurs, the UE should update a failure count. 1)If failure count > N_max_retry, the UE should upgrade the failure to long-term failure and behave like 6.2.1.5 2. If failure count <= N_max_retry, the UE should retry the S102 registration procedure.	O	Silent redial	
6.2.1.14	If a (e)1XCSFB UE is powered down while on LTE and the last received *CSFBParam1xRTT* has enabled power-down registration, the UE shall first perform the 1x power down registration before performing LTE detach if powerDownReg parameter is enabled in CSFBParam1xRTT	M	Power-down registration may be disabled in CSFBParam1xRTT	
6.2.1.15	If the user originates a voice call, the UE shall perform a PSIST check to determine if the call can be originated over the S102 tunnel as a (e)1xCSFB call. .	M		[8]
6.2.1.16	If the PSIST check succeeds, the (e)1xCSFB capable UE shall trigger a ESR procedure over the LTE air-interface with cause-code = MO 1xCSFB	M	PSIST failure mapped to hard failure for silent redial algorithm	[8], [3] [30]
6.2.1.17	The UE shall handle PSIST check failure during MO call through silent redial	M		
6.2.1.18	A e1xCSFB capable UE shall support receiving both *RRC-Connection Release(Redirection)* or *HOFromEUTRAPrepRequest* in response to the ESR	M		
6.2.1.19	If the UE receives a *Redirection message* it shall tune to the 1x channel in the message. It shall go through 1x overhead updating & access procedure to send the ORM.	M		[31]
6.2.1.20	If a failure happens during the MO call flow before the UE receives a redirection message, UHDM or ECAM, the UE shall perform silent redial if the time since the call origination < 30s.	M	CDG 143 requirement	[7]

Req. #	Requirement	Category	Remarks	References
6.2.1.21	If the UE receives a GCSNA message with 1xGPM, it shall send a ESR with cause code = MT 1xCSFB call to initiate MT 1xCSFB call	M		[30]
6.2.1.22	If a failure happens after sending ESR but before receiving redirection, UHDM or ECAM during MT 1xCSFB call, the UE shall remain on the LTE system and wait for repage.	M		
6.2.1.23	After a MO/MT 1xCSFB call ends, the UE shall attempt to re-acquire the LTE network it was previously camped. If LTE is re-acquired, it shall send TAU to resume suspended LTE context.	M	This is proposed to avoid performing 1x registration during every e1xCSFB call.	
6.2.1.24	(e)1xCSFB capable UE camped on LTE and has successfully performed S102 registration shall initiate a emergency call as a MO 1xCSFB call .	M		
6.2.1.25	(e)1xCSFB capable UE shall support a NV parameter callback_mode, which specifies if the UE shall attempt to remain on 1x for callback or return to LTE after E911 call that originated when UE was camped on LTE.	M		

1

Appendix A: Assumptions on the network configuration/operation

Assumption #	Assumption	Category	Remarks	References
7.1.1.1	In callWhen in the footprint of eHRPD and HRPD networks, the network prefers to redirect the device to the eHRPD network accounting for roaming scenarios.	M		
7.1.1.2	When in the footprint of HRPD and 1X networks, the network prefers to redirect the device to the HRPD network accounting for roaming scenarios.	M		
7.1.1.3	The LTE network, when possible, will prefer to use measurements based redirection as opposed to blind redirection.	M		
7.1.1.4	The pre-registered flag in the measurement reports will be set to 1 when after the Attach over the LTE has completed and the corresponding EPC context has been reflected over the eHRPD side via the S101	M		
7.1.1.5	The procedures for allocating traffic channel over HRPD is preferred over redirection to HRPD.	M		
7.1.1.6	SIB-8 should list all HRPD/1x neighbors that the UE can potentially HO to.	M		
7.1.1.7	Blind redirection or measurements based redirection is employed by the network based on current UE activity and network condition.	M		

Assumption #	Assumption	Category	Remarks	References
7.1.1.8	When cell reselection from 1X/(e)HRPD to LTE is enabled, it is recommended that the MMSS databases to be provisioned to treat these LTE, (e)HRPD, and 1xRTT systems to have equal priority.	HD		

1