

Device Requirements and Compliance Framework

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This document gives an overview of the Vodafone Device Requirements and Compliance Framework. Suppliers that work with Vodafone need to fulfil a more comprehensive set of requirements, which goes beyond this extract. The full set of requirements will be made available once an NDA is in place.

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Table of content:

[Part 1: Extract of Legislative and Industry Standards for Device Compliancy](#)

[Part 2: Extract of Vodafone Quality & Safety criteria for Device Compliancy](#)

[Part 3: Vodafone Device Requirements for Services & Applications](#)

Part 1: Extract of Legislative and Industry Standards for Device Compliancy

Extract Legislative and Industry Standards	Content	Reference
Android	The device shall pass the Android Compatibility Test Suite (CTS) & if it includes Google's services (like Maps, Play Store, Chrome & Search) shall pass the GMS Test Suite (GMS) and have a current (less than 90 days old at time of launch) "Android security patch level" (available in the Phone's Settings)	https://source.android.com/compatibility/cts https://www.android.com/intl/en_en/gms/
Battery	Battery compliant with UN38.3, 2006/66/EC, IEC62133-2:2017, UL1642 (2012-03-13), IEC/EN 62368-1 (2017-07) and MSDS	<ul style="list-style-type: none"> • UN38.3 - shipment certificate • 2006/66/EC - Europe battery regulation • IEC 62133 - battery cell safety • UL1642 - battery cell safety test requirements • EN/IEC 62368 - battery pack / electrical safety • MSDS - Material Safety Data Sheet (REACH) • IEEE 1725 - recommended to verify e.g. battery production processes
Bluetooth	Bluetooth qualified by Bluetooth SIG	https://www.bluetooth.com/specifications/bluetooth-core-specification/
Charger and power supply efficiency	Charger and power supply efficiency level VI according to Commission Regulation and Department of Energy: (EC) No 278/2009 and Department of Energy, 10 CFR Parts 429 and 430 EN50563 (Phone chargers) or EN50564 (Power Supplies)	https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/ecodesign/powersupplies_en
DoC	Conformity Assessment was done according to RE-D Annex III module B and with EU27 based NB, EU Declaration of Conformity (DoC) signed, available and translated to local languages	https://ec.europa.eu/info/sites/info/files/qa_brexit_industrial_products_en.pdf
Electrical Safety	Compliant with electrical safety EN60950 or with the new IEC62368	https://webstore.ansi.org/standards/iec/iec62368ed2014?qclid=EAlalQobChMlk8jp77HA4qIVzuF3Ch0f_QibEAMYASAAEqJnNvD_BwE
eSIM	The eUICC and the device has to pass the GSMA's eSIM compliance process (GSMA SGP.24)	www.gsma.com

FCC	Compliant with FCC requirements mandatory for devices which can operate in US bands	https://www.fcc.gov/general/equipment-authorization-procedures
GCF	GCF certification passed	https://www.globalcertificationforum.org/
GDPR	Compliant with EU General Data Protection Regulation (GDPR)	https://gdpr.eu/
Low Voltage Directive	Compliant with Low Voltage Directive 2014/35/EU	https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-5291384/public-consultation_en
REACH	Compliant with REACH incl. the latest restriction list	http://ec.europa.eu/environment/chemicals/reach/reach_en.htm
RE-D	Compliant with RE-D directive 2014/53/EU	https://ec.europa.eu/growth/sectors/electrical-engineering/red-directive_en
RoHS	Compliant with RoHS 2011/65/EU and its latest amendment lists	http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm
SAR	SAR hear and body certification passed	https://www.bfs.de/EN/topics/emf/mobile-communication/protection/precaution/sar-mobile-phone.html
TAC	TAC code for the product registered at GSMA, IMEI security in accordance to 3GPP TS22.016 confirmed and IMEI range reserved/registered for the product	www.gsma.com
Waste	Compliant with Packaging Waste Directive 94/62/EC	http://ec.europa.eu/environment/waste/packaging/legis.htm
WEEE	Compliant with WEEE	http://ec.europa.eu/environment/waste/weee/index_en.htm
WiFi	Compliant with Wifi norms EN 300 328 and EN 301 893	https://www.etsi.org/deliver/etsi_en/300300/300399/300328/02.01.01_60/en_300328v020101p.pdf ; https://www.etsi.org/deliver/etsi_en/301800/301899/301893/02.00.07_20/en_301893v020007a.pdf

Part 2: Extract of Vodafone Quality & Safety criteria for Device Compliancy

Vodafone Quality & Safety criteria	Content	Reference
Acoustic Safety	Acoustic Shock and long term exposure tests done according to Vodafone specifications	see Appendix 1
Antenna	Antenna test has been conducted by a Vodafone approved Antenna laboratory and are compliance with Vodafone Antenna specification	see Appendix 2
Release Notes	Release Notes must be provided prior to acceptance start (for both new devices and MRs).	Details will be provided during RFQ
Safety manual	Content of Safety manual is compliant with Vodafone EMF policy	Details will be provided during RFQ
SAR	SAR test has been conducted at Vodafone approved SAR laboratory	Details will be provided during RFQ
Temperature	Max temperature must stay with the limits as specified in Vodafone Spec for Terminals on Temperature of Touchable Surfaces	see Appendix 3
Type Acceptance	No blocking defect after Vodafone own Type Acceptance	
Vodafone Requirements	All features and applications are implemented as specified in Request for Proposal and Vodafone Terminal Requirements	Details will be provided during RFQ
Vodafone Settings	All required country variants and language versions are available and compliant to Vodafone variant settings database	Details will be provided during RFQ
Vodafone Tests	agreed set of Vodafone test cases executed by supplier and test results provided	Details will be provided during RFQ

Appendix 1: Extract of Acoustic Safety Requirements

1. Acoustic Shock

The test methodology for maximum acoustic output of terminal equipment as described in ETSI EG 202 518 allows the use of type 3.3 or type 3.4 artificial ears. Depending on the ear type strong variation of the measured maximum peak level can be detected especially for the abnormal use case applying the hands-free speaker (usually also used for ringtone playback) to the artificial ear with high application force”.

- Requirement 1: Sound pressure level peaks for the sound outlet of the receiver of a terminal must never exceed 135 dBSPL (C) during first two seconds of time
- Requirement 2: Sound pressure level peaks for the sound outlet of the receiver must under no circumstances exceed 140 dBSPL (C)

2. Long Term Exposure

According to EN 60950-A12, no further safety actions are necessary for PMP's (Personal Music Player) which are distributed with headsets when it is ensured that the acoustical output L_{Aeq} (equivalent sound pressure level) is not higher than 85dB(A) when playback “program simulating noise” as described in EN 50332-1 and furthermore a maximum electrical output voltage of 27mV will not be exceeded on the electrical audio output connector.

All other devices must provide actions to protect the user against levels which are higher as mentioned above.

These actions are:

- a.) Any kind of action which is able to protect the user against unintended SPL (Sound Pressure Level) which is higher than mentioned above.
- b.) The PMP needs to have a default acoustical output level (standard level when powering on the PMP) which is not higher than mentioned above.
Furthermore it must be ensured that the PMP returns automatically to this default level when it is switched off no matter which output level the user has been adjusted before switching off the PMP.
- c.) The PMP must proactively inform the user in case the user is adjusting the settings so that an acoustical output level will be reached which is higher than the level mentioned above.
The user needs in any case to confirm the activation of a higher acoustical output level before this setting will be activated.
This confirmation must be provided by the terminal once within every 20 hours of cumulated listening. The cumulated listening time is independently from the time and frequency the PMP has been switched off.
- d.) The max. acoustic output level of PMP's while playback program simulating noise must not exceed a L_{Aeq} of 100 dB(A). Settings which may lead to higher acoustical output (e.g. setting of equalizer, bass boost function etc.) must be considered.
- e.) If an audio connector (audio jack) is available a max. electrical output voltage of 150mV RMS must not be exceeded while play back program simulation noise. Settings which may lead to higher acoustical output (e.g. setting of equalizer, bass boost function etc.) must be considered.
- f.) A warning symbol and a warning text according to EN 60950-A12 must be presented



Appendix 2: Extract of Vodafone Antenna Requirements

Acceptance Limits for Narrow Phones (width: 56 - 72 mm)

Radio Technology	Freq./MHz	Band	TRP			TIS		
			Limit [dBm]	tol.[dB]	Final [dBm]	Limit [dBm]	tol.[dB]	Final [dBm]
2G /GSM	900		19	0	19	-95	0	-95
	1800		19	0	19	-97	0	-97
3G / UMTS	2100	I	14	0	14	-100	0	-100
	900	VIII	11	0	11	-96	0	-96
4G / LTE	800	20	11	0	11	-86	0	-86
	1800	3	14	0	14	-90	0	-90
	2600	7	15	1	14	-91	1	-90
	700	28	10	1	9	-85	2	-83
	2100	1	14	1	13	-90	2	-88
	2600 TDD	38	15	1	14	-91	2	-89
	1400 (DL)	32	n.a.	n.a.	n.a.	-88	2	-86
	900	8	11	1	10	-86	2	-84

tol. =Tolerance

Acceptance Limits for Wide Phones (width: >72 - 92 mm)

Radio Technology	Freq./MHz	Band	TRP			TIS		
			Limit [dBm]	tol.[dB]	Final [dBm]	Limit [dBm]	tol.[dB]	Final [dBm]
2G /GSM	900		19	1	18	-95	1	-94
	1800		19	1	18	-97	1	-96
3G / UMTS	2100	I	14	1	13	-100	1	-99
	900	VIII	11	1	10	-96	1	-95
4G / LTE	800	20	11	1	10	-86	1	-85
	1800	3	14	1	13	-90	1	-89
	2600	7	15	1	14	-91	1	-90
	700	28	10	2	8	-85	3	-82
	2100	1	14	2	12	-90	3	-87
	2600 TDD	38	15	2	13	-91	3	-88
	1400 (DL)	32	n.a.	n.a.	n.a.	-88	3	-85
	900	8	11	2	9	-86	3	-83

tol. =Tolerance

Appendix 3: Extract of Heating Safety Requirements

Heating Safety Limits

The classification for determining the Vodafone limits is the same as in EN 60950. Vodafone requires evaluating temperatures of touchable surface for an ambient temperature at 21°C, the limits stated below are 15 K lower than the limits (valid for any environment) defined by EN 60950.

	External surface of equipment which may be touched	Knobs touched for a short period (10 s)	Handles or grips continuously held in normal use
Metal	55°C	45°C	40°C
Ceramic and glass	65°C	55°C	50°C
Plastic and rubber	80°C	70°C	60°C

Vodafone temperature limits valid for an ambient temperature of 21°C for relevant conditions.

Part 3: Extract of Vodafone Device Requirements for Services & Applications

Section	Technology/ proposition	SubSection	Requirement Name	Requirement Description	Impact Analysis/Supplementary Information	Refs.
SIM	Dual SIM		IMS Services Continuation	Based on device Capabilities: the IMS services (VoLTE, VoWiFi), shall continue to work regardless of SIM card change or SIM swap. The device shall support an unlimited number of IMS re-configuration for both SIM slots.	If re-configuration is not supported, customers losing IMS services at SIM change or SIM swap (operator switch).	N/A
SIM	Consumer eSIM		Confirmation Code Request	When downloading an eSIM profile, the device shall prompt the user to enter a confirmation code only if „Confirmation Code Required Flag“ (ccRequiredFlag) is set to True in smdpSigned2. The device shall NOT prompt the user to enter the Confirmation Code in case that Confirmation Code Required Flag is ONLY set in Activation Code AND NOT in smdpSigned2.	Confirmation Code Request shall depend on SM-DP+ profile setting (smdpSigned2) only	GSMA SGP.22
SIM	Consumer eSIM		Profile Download Procedures	The device shall support Profile download via SM-DS service discovery (based on the GSMA Root SM-DS address stored on the eUICC) and via the Activation Code procedure.	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		Activation Code Entry	The device (LPA) shall support entry of the Activation Code by manual typing (including copy/paste function) and QR code scanning.	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		Support of network attach repetitions	After successfully enabling a profile (see GSMA SGP.22, section 3.2.1) the device shall repeat the network attach procedure for 2 minutes in case the network rejects the attach attempt with reject cause "IMSI unknown in HLR".	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		eUICC GSMA RSP specification compliance	If the device embeds an eUICC, the eUICC shall be fully compliant to GSMA RSP Architecture (SGP.21 v2.2 or higher) and GSMA RSP Technical Specification (SGP.22 v2.2 or higher)	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.21 GSMA SGP.22
SIM	Consumer eSIM		eUICC minimal category	If the device embeds an eUICC, the minimal category of the eUICC shall be 'Medium eUICC' (CAT2) as defined in GSMA SGP.22	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		GSMA RSP specification compliance	The device (LPA) shall be fully compliant to GSMA RSP Architecture (SGP.21 v2.2 or higher) and GSMA RSP Technical Specification (SGP.22 v2.2 or higher)	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.21 GSMA SGP.22
SIM	Consumer eSIM		Display of Error Indications	The device/LPA shall provide an appropriate error indication to the user in case of detected failures during the profile download and installation procedures.	Required for Devices supporting GSMA Consumer RSP	

SIM	Consumer eSIM		eUICC GSMA RSP compliance process	<p>If the device embeds an eUICC, the eUICC has to pass the GSMA's RSP compliance process (SGP.24) and shall have a PKI certificate from a GSMA certificate issuer. See "http://www.gsma.com/rsp/guide-rsp-compliance-process/".</p> <p>The related self-declaration form shall be provided to Vodafone</p>	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.24
SIM	Consumer eSIM		GSMA RSP compliance process	<p>The device (LPA) has to pass the GSMA's RSP compliance process (SGP.24). See "http://www.gsma.com/rsp/guide-rsp-compliance-process/"</p> <p>The related self-declaration form shall be provided to Vodafone</p>	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.24
SIM	General		ADN and EXT1	The MS shall support the reading of a 40 digit dialling number in the USIM using EF_ADN and EF_EXT1.	The ADN (Abbreviated Dialling Number) is a series of files in a SIM which contains phonebook information for users.	
SIM	General		Number of PLMN entries to be read from a USIM	The terminal shall read and utilise, for the purpose of network selection, at least the first 127 entries from OPLMNwACT where a USIM is used with the terminal.	To ensure a list of at least 127 operators can be listed in the SIM for preferred network lists - for roaming.	
SIM	General		Display of Service Provider name	The terminal shall support displaying of the Service Provide Name (based on content of EF_SPN).	To ensure that the handset is able to display Service Provider Name as defined by the operator by EF_SPN	
SIM	General		Standards support for UICC-Terminal Interface	Terminal shall be fully compliant to Release 8 (or higher) of the ETSI TS 102 221 "UICC-Terminal interface" specification	This requirement mandates the compliancy to the UICC-Terminal interface specification	ETSI TS 102 221
SIM	Security Codes		PIN/PUK Remaining Number of Attempts Notification	During PIN/PIN2 and PUK/PUK2 entry, the terminal shall display the remaining number of entry attempts.	<p>Description: This requirement describes how UI handling must be done for SIM/USIM activation PINs</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliances might result in user blocking the SIM/USIM and calling the customer care for help.</p>	
SIM	Security Codes		PUK prompt	If the user fails to correctly enter their PIN 3 consecutive times, causing the (U)SIM to be locked the terminal shall prompt the user to enter the PUK code. Additionally the terminal shall prompt the user to contact their customer care to obtain their PUK code. The last prompt should be customisable per OpCo.	<p>Description: This requirement describes how UI handling must be done for SIM/USIM activation PINs</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliances might result in user blocking the SIM/USIM and calling the customer care for help. This can increase the load on VF Customer care calls.</p> <p>Impact for Embedded SIM:</p>	

					<p>Why Required: To meet some Vodafone Operator security requirements</p> <p>What happens if not implemented? Acceptance criteria for launch will not be met in some Vodafone markets</p>	
SIM	Security Codes		PUK2 Prompt	<p>If the user fails to correctly enter their PIN2 code 3 consecutive times, the terminal shall prompt the user that PIN2 is locked and that some functions will be unavailable. The terminal shall prompt the user to enter the PUK2 code. Additionally the terminal shall prompt the user to contact their customer care to obtain their PUK2 code. The last prompt should be customisable per OpCo.</p>	<p>Description: This requirement describes how UI handling must be done for SIM/USIM activation codes PIN2.</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliances might result in user blocking the SIM/USIM and calling the customer care for help. This can increase the load on VF Customer care calls.</p> <p>Impact for Embedded SIM: Why Required: To meet some Vodafone Operator security requirements</p> <p>What happens if not implemented? Acceptance criteria for launch will not be met in some Vodafone markets</p>	
SIM	Security Codes		PUK Entry Failure Prompt	<p>If the user fails to correctly enter their PIN Unlocking Code (PUK code) 10 consecutive times, causing the (U)SIM to be locked, the terminal shall prompt the user that the (U)SIM card is locked completely and to contact their customer center.</p>	<p>Description: This requirement describes how UI handling must be done for SIM/USIM unblocking PINs (PUK).</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliances might result in users completely blocking their the SIM/USIM and requiring a replacement SIM/USIM.</p> <p>Impact for Embedded SIM: Why Required: To meet some Vodafone Operator security requirements</p> <p>What happens if not implemented? Acceptance criteria for launch will not be met in some Vodafone markets</p>	
SIM	Security Codes		PUK2 Entry Failure Prompt	<p>If the user fails to correctly enter their PUK2 code 10 consecutive times, causing the (U)SIM to be locked the terminal shall prompt the user that the (U)SIM card is locked completely and to contact their customer center.</p>	<p>Description: This requirement describes how UI handling must be done for SIM/USIM unblocking PINs (PUK2).</p>	

					<p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliances might result in users completely blocking their the SIM/USIM and requiring a replacement SIM/USIM.</p> <p>Impact for Embedded SIM: Why Required: To meet some Vodafone Operator security requirements</p> <p>What happens if not implemented? Acceptance criteria for launch will not be met in some Vodafone markets</p>	
SIM	SIM Application Toolkit		Letter class "e" (BIP) support	<p>The terminal shall support SIM Application Toolkit as per letter class "e" (support of BIP channels) defined in ETSI TS 102 223 for:</p> <ul style="list-style-type: none"> - TCP and UDP in UICC client mode shall be supported - TCP in terminal server mode should be supported 	<p>This requirement defines the class of the STK implementation required.</p>	ETSI TS 102 223
SIM	SIM Application Toolkit		Refresh mode support	<p>All refresh modes as defined in ETSI 102 223 and 3GPP TS 31.111 shall be supported. The list of current refresh modes is:</p> <ul style="list-style-type: none"> • NAA Initialization • File Change Notification • NAA Initialization and File Change Notification • NAA Initialization and Full File Change Notification • UICC Reset • NAA Application Reset • NAA Session Reset • Steering of Roaming <p>Upon reception of REFRESH command during ongoing data connection (PDP context) the execution of the command has precedence. The terminal shall execute the REFRESH rather than answer with busy statement.</p>	<p>The purpose of this command is to enable the handset to be notified of the changes to the SIM configuration that have occurred as the result of a SIM application activity.</p> <p>Impact for Embedded SIM: For Embedded SIM terminals the NAA Initialization and Full File Change Notification mode must be supported. Why Required: To notify the Terminal that the SIM Profile has changed after SIM transformation. The specific mode that is used notifies the Terminal to reread the SIM profile without requiring a device reboot.</p> <p>What happens if not implemented? Not having this feature will affect the user experience as the Terminal will need to be manually powered down and power up again after the SIM transformation.</p>	3GPP TS 31.111 ETSI TS 102 223
SIM	SIM Application Toolkit		SIM OTA capability	<p>The Terminal shall support the SMS-PP DOWNLOAD and SEND SHORT MESSAGE proactive commands. These commands are required to support the update of file content on the SIM profile via OTA-RFM operation</p>	<p>Required to support the update of file content on the SIM profile via OTA-RFM operation</p>	
SIM	SIM Application Toolkit		Standards support for SIM Application Toolkit	<p>Terminal shall be fully compliant to Release 10 (or higher) of the following ETSI and 3GPP specifications:</p> <ul style="list-style-type: none"> - 3GPP TS 31.111 "Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)" - ETSI TS 102 223 "Smart Cards; Card Application Toolkit". - 3GPP TS 31.124 "Universal Subscriber 	<p>This requirement mandates the standards compliance for terminals.</p>	3GPP TS 31.111 ETSI TS 102 223 3GPP TS 31.124

				Identity Module Application Toolkit (USAT) conformance test specification", Annex B		
SIM	SIM Application Toolkit		BIP over IPv6	If BIP is supported, the end to end connection shall also operate via IPv6.	IPv6 support needed for all internet connections	
SIM	SIM Application Toolkit		Refresh mode "NAA Initialization and Full File Change Notification" support in managed roaming case	<p>In the case of a REFRESH with command qualifier "NAA Initialization and Full File Change Notification" the network attachment parameters may have changed, so it is essential to set-up new connections (voice and data) according to the following requirements:</p> <ul style="list-style-type: none"> - terminate all data connections (internet, BIP, etc.) and DO NOT answer with "Terminal busy" or similar Terminal Response to active Toolkit applications - Disconnect from the current network immediately and connect to the target network (using freshly read PLMN files, EFLoci, EFPSLoc) - Shall not send a TERMINAL PROFILE while executing the REFRESH procedure; - Shall not update any files on the UICC between reception of the REFRESH command and executing the REFRESH procedure (e.g. to avoid updating of network related EFs) - Send a TERMINAL RESPONSE to indicate a successful REFRESH procedure 	<p>This requirement is needed to ensure the correct support of a current SIM based VF solution for Steering of Roaming.</p> <p>Why Required: To notify the Terminal that the SIM Profile (including network attachment parameters) has changed and a new network attachment (using freshly read PLMN files, EFLoci, EFPSLoc) has to be done. The specific REFRESH mode that is used does not require a new PIN verification.</p> <p>What happens if not implemented? Non-support of this feature will restrain VF of carrying out successful SIM based Steering of Roaming.</p>	
SIM	Consumer eSIM		Profile Deletion Visual Confirmation	Upon eSIM Profile deletion, the device shall advise the end user to keep an internet connectivity during and after the deletion to ensure the sending of the Delete Notification to the SM-DP+. Once Delete Notification is sent, the device shall give a visual confirmation to the end user. This can be achieved through a message, through a visual aid (delete icon turning green) or another appropriate mean.	Required for Devices supporting GSMA Consumer RSP	
SIM	Dual SIM		IMS (VoLTE, VoWiFi) support for all SIM's identity	The device shall support IMS (VoLTE, VoWiFi) registration simultaneously with all SIM identities enabled in the device.	Necessary for reliable service continuation available for the user.	N/A
SIM	Dual SIM		IMS call service transparency to the user	The device shall handle IMS calls (VoLTE, VoWiFi) in same way (transparent) as cellular speech calls for both SIM identities to the user.	Necessary to ensure a seamless call service experience in Multi-SIM environment.	N/A
SIM	Consumer eSIM		Master software	A PC software should be available to enable the customer care to initiate a 'eUICC Memory Reset' (according to GSMA SGP.22) via USB cable connection.	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		eUICC Test Profile support	If the device embeds an eUICC, the eUICC shall support 'Test Profiles' as defined in GSMA SGP.22	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22

SIM	Consumer eSIM		Device Test Mode support	The device and LPAd shall support 'Device Test Mode' as defined in GSMA SGP.22	Required for Devices supporting GSMA Consumer RSP	GSMA SGP.22
SIM	Consumer eSIM		Download Progress Indication	A progress indication for the profile download status shall be shown to the user on Primary or Companion Device (depending on UI availability)	Required for Devices supporting GSMA Consumer RSP	
SIM	Customization		Operation without SIM / Emergency call	The device shall support appropriate operation without SIM (i.e. all functions that do not require cellular), in particular the implementation shall comply with the respective OpCo and legal requirements for emergency calls.		
SIM	Device Access Control		UICC Carrier Privileges Rules in ARF	In case no ARA-D/ARA-M exist on the UICC, the Access Control Enforcer (ACE) shall retrieve access rules with the AID (or tag AID-REF-DO) set to "FF FF FF FF FF" as a UICC Carrier Privilege rule.	Required to support UICC Carrier Privileges with existing VF SIM cards	
SIM	Device Access Control		UICC Carrier Privileges	The Terminal shall support GlobalPlatform 'Device API Access Control' (DAC) version 1.0 (or higher). In case an ARA-D/ARA-M application exists on the UICC, it shall be used to retrieve access rules.	Required to support UICC Carrier Privileges	GlobalPlatform 'Device API Access Control' (DAC)
SIM	Dual SIM		Network Operator name	Network operator name short code shall be shown in the UI where applicable to differentiate both SIM cards.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated in GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Roaming indicator	A Dual SIM capable terminal shall indicate a separate roaming indicator for each of the two network connections along with the network received signal strength	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated in GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Emergency call	A Dual SIM capable terminal shall attempt to make emergency calls using the network connected by the SIM chosen as Primary SIM, and if this is not successful should then attempt to	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated in GSMA daft spec TS 37, (tested in TS	N/A

				use the network connected by the Secondary SIM, If this also fails then standard emergency call access procedures should be used.	42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	
SIM	Dual SIM		Network settings are supported on per SIM basis	A Dual SIM capable terminal shall have separate network settings per SIM. For example: Typical network settings such as COLP, CLIP/CLIR, APN are applicable to SIM slot 1 and 2.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Single SIM requirements are applicable.	Dual SIMs shall be compliant to requirements defined in SIM section: SIMs i.e. UICC / eUICC used in Dual SIM Devices shall work in same way as designed in Single SIM devices. I.e. they shall support relevant capabilities as defined in SIM requirement section of this TCD document	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Dual SIM Network signal strength indication	The device need to indicate Network signal strength on a per SIM card basis.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		IMEI-SV	As an IMEI must be assigned per SIM slot, the following definition shall apply: The SV digits of a multi - IMEI-SV device must be identical to reflect the same SW version for one product with	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS	N/A

				assigned different IMEIs. In case a primary IMEI is defined, the IMEI-SV shall be assigned to this primary IMEI.	42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	
SIM	Dual SIM		Operator and Radio Access Technology (RAT) Indication	The Dual SIM device needs to indicate the Mobile Operator / related service operator network name and Radio Access Technology (e.g. E, H+, etc) on per SIM basis.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		SIM Call Log	The device has to ensure that call logging is performed on per SIM basis in order to let the end user identify calls history per SIM	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		SIM SMS Log	The device has to ensure that the SMS history are correctly logged on per SIM basis. For example, this means that SMS received on SIM 2 card are kept and linked to SIM 2 phone number which separate & different from SMS history for SIM 1 card.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Data download	If the data download is interrupted (e.g. incoming call), then it shall resume when applicable (e.g. after hang up of incoming call) on the relevant SIM card (e.g. started on SIM 1 card, the resumed	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated oin GSMA daft spec TS 37, (tested in TS	N/A

				on SIM 1 card).	42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	
SIM	Dual SIM		Emergency call without interrupts/prompts	Whenever an emergency call is initiated there shall be no additional dialog to indicate which SIM card should be used. The emergency call shall be initiated immediately without prompting any further SIM selection pop-ups to the user which might delay/hold/disconnect an emergency call setup.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated on GSMA draft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Primary IMEI on Dual SIM devices	In a Dual SIM capable terminal (2 separate physical SIM card readers or 1 SIM card reader = Hybrid SD/SIM), the device shall have a primary IMEI assigned. Even if the Dual SIM terminal utilizes simultaneously active SIM implementation (e.g. DSDA), there shall be only one IMEI designated as primary.	This Dual SIM requirement is valid as long as a GSMA and GCF specifications are not in place and approved, as currently stated on GSMA draft spec TS 37, (tested in TS 42). Once a GSMA standard is covering this requirements, this requirements will be replaced by a support reference to relevant standard requirement. Supported in terminals which are ranged as Dual SIM devices for specific requested countries, implementation details as specified in the device TPD, specific Dual SIM settings per country as noted in VVS apply.	N/A
SIM	Dual SIM		Vodafone Network Settings	Upon Vodafone SIM detection, the relevant network settings (eg. APN) as outlined in Vodafone Variant Settings (VVS) database are applied in multi-SIM environment.	All Vodafone services shall be supported on Vodafone SIMs and shall work regardless of physical and/or eSIM combinations.	N/A
SIM	Dual SIM		Vodafone Network Service Configuration	Upon Vodafone SIM detection, the relevant network service configuration settings (eg. VoLTE, VoWiFi, etc.) as outlined in Vodafone Variant Settings (VVS) database are applied in multi-SIM environment.	All Vodafone services shall be supported on Vodafone SIMs and shall work regardless of physical and/or eSIM combinations.	N/A
SIM	Dual SIM		UX SIM management handling	The UX SIM management and relevant user experience shall be the same for a physical SIM and/or an eSIM combination	All Vodafone services shall be supported on Vodafone SIMs and shall work regardless of physical and/or eSIM combinations.	N/A
SIM	Dual SIM		Service setup at Vodafone SIM detection	Upon Vodafone SIM insertion and/or active eSIM profile, the relevant Vodafone Service settings and customization shall apply during setup (OOBE) on applicable SIM slot/eProfile.	Upon Vodafone SIM insertion on a DSIM device, all Vodafone services shall be supported on Vodafone SIMs and shall work regardless of physical and/or eSIM combinations.	N/A

SIM	Dual SIM		SIM Service Settings	On Dual-SIM phone, the service options should be visible to the user (e.g. icon/text/etc) Current selection choice on „preferred/always ask“ for voice, data, IMS and SMS per SIM visibility to users		N/A
SIM	Dual SIM		OOBE Vodafone Network settings	In DSIM OOBE or any SIM card change (e.g. swap, additional SIM card, new eSIM profile, 2x VF SIMs, etc.) with detected VF SIM following SIM Management parameters shall be preset: SIM slot name= Vodafone, MSIDN to be displayed and Voice/SMS/Data = Vodafone. However, the end user is allowed to edit these settings. In case of 2 VF SIMs inserted, then the all Services (Voice/Data/SMS) shall be applied to the slot with highest Radio Access Technology (RAT). For example, SIM Slot 1= VF SIM with 4G and SIM slot 2= VF SIM with 3G, the SIM slot 1 will be the default for all services.		N/A
SIM	Dual SIM		SIM Mgmt Default settings	During OOBE and/or any SIM change with detected VF SIM , VF Services shall be set as default in SIM Mgmt settings for Voice/SMS/Data. The default settings can be changed by the end user.		N/A
SIM	Dual SIM		Device Capability	A Dual SIM device shall support the latest radio technology (e.g. 4G, 5G, IMS services, etc.) on the each active SIM/eSIM. This requirement is dependant on the product definition and/or proposition.	This varies based on the device tier. For example: Flagship devices = Slot 1 & 2 = 4G, Mid tier device = Slot 1 (4G) & Slot 2 (3G/2G)	N/A
SIM	Dual SIM		Call Handling in Multi SIM environment - Incoming calls	When each MSISDN (e.g. SIM card, eSIM) receives an incoming call at the same time or sequential, then the expected behaviour shall be based on the Dual SIM (DS) implementation: 1) DSSA (Single Active): This will behave as Single SIM device. 2) DSDS (Dual Standby) : Only one call can be received and other call behaviour (e.g. not available, busy, call diversion, etc.) shall adhere to relevant standards. 3) DSDA (Dual Active): Should receive and handle (e.g. hold, connect, swap, merge, call knocking, etc.) both calls as defined in relevant standards.		N/A
SIM	Dual SIM		VF IMS Services (VoLTE, VoWiFi, ViLTE, etc.)	The IMS Service experience should be similar as an inbound/outbound CS call. For example, the device is registered in 2 IMS stacks If the device is registered in a VF IMS service (e.g. VoLTE, ViLTE, VoWiFi), then it shall be possible to use those service irrespective of the data connection on a different network. For example, VF SIM with VoLTE is registered on SIM slot 1 and then the data barrier is changed to SIM slot 2, a VoLTE call WiFi data connection available as selection on DSIM (with or without		N/A

				cellular connection): All IMS service relevant settings / APN's should be available as OOB at Vodafone SIM detection when SIM is authorized for this service (EAP-SIM for VoWiFi etc.) with enabled IMS services for Vodafone networks (VoLTE, VoWiFi and ViLTE).		
SIM	Dual SIM		IMS Service Authorization	As soon as Cellular data connection available (not WiFi), all IMS relevant service settings (e.g. APN's) should be available during OOB upon Vodafone SIM detection. When SIM is authorized for a service (e.g. EAP-SIM for VoWiFi, etc.), the enabled IMS services shall apply to the relevant Vodafone networks (VoLTE, VoWiFi and ViLTE).		N/A
SIM	Dual SIM		IMS Service Continuation	Upon detection of IMS enabled Vodafone SIM, the Vodafone IMS setup shall be done during OOB and VF IMS service shall be set as default with possibility to be changed later by end user.		N/A
SIM	Dual SIM		IMS Services for Vodafone Network	Upon Vodafone SIM insertion, the available IMS services shall be setup as preferred but later on the end user change/adjust it accordingly.		N/A
SIM	Dual SIM		UX SIM Management - Inbound/Outbound call	<p>The end user should have full control which MSISDN (e.g. SIM card) to be used in a call scenario. For example, SIM card 1 is set as default for outgoing calls. When an incoming call is received on SIM card 2 and the end user performs a call back via the call history log, then end user be presented a choice which MSISDN (e.g. SIM card) to call back the B-party on. This is applicable in Business vs. Private Dual SIM use case.</p> <p>User should have full control of assigned or selected MSISDN of outgoing (MO) and incoming (MT) calls.</p>		N/A
SIM	Dual SIM		SIM swap or change - History/Preferences	<p>Upon SIM swap or SIM change, the relevant history (e.g. call log, data preferences) shall follow the MSISDN (e.g. SIM card).</p> <p>For example, SIM Slot 1 = Business SIM card (which is selected for data) and SIM slot 2 = Private SIM; then upon SIM swap (Slot 1= Private SIM card & Slot 2= Business SIM card) this means that when end user can still see the call/SMS history of Business SIM and that it is remained as the preferred SIM card for data connection.</p>		N/A
SIM	Dual SIM		Application level	The data connection preferences shall be defined in SIM Mgmt menu and additionally it shall be possible to define the data per applications. For example, Browsing on SIM 1 and Instagram on SIM 2.		N/A
SIM	Dual SIM		SIM Swap	A SIM swap scenario shall not impact private data or settings (e.g. change widget, delete pictures, etc.) except the SIM Management settings (e.g. SIM		N/A

				Mgmt pop up window). During a SIM swap scenario and VF SIM is inserted in SIM slot 1 or 2, the existing IMS service shall continue working.		
SIM	Dual SIM		Single SIM Insertion in Multi-SIM environment	If there is only 1 SIM is inserted or 1 activated eSIM profile, then SIM management shall behave as Single SIM device. This means that all applicable services are enabled on the only active SIM.		N/A
SIM	GBA		Support for GBA for establishing TLS connections	The device browser shall support GBA for establishing TLS connections according to 3GPP TS 33.222.	This is to show intent for future requirements, and compliance is encouraged rather than mandated at this stage.	3GPP TS 33.222
SIM	GBA		SIM mechanisms for managing secret keys on devices	The IoT device shall support USIM including the commands defined in ISO/IEC 7816-4. The access can be provided by use of the AT+CSIM commands of class 00 over a serial modem interface, or by a library function if such exists. The support of the AUTHENTICATE command is essential. Supporting the access to UICC required also: - An HTTP networking interface to enable the device to communicate with the servers over the internet. - Sufficient space to be installed both for code and memory. Where modems are provided documentation and configuration information shall be supplied to define how the GBA AT+CSIM commands should be submitted from the modem to the SIM.	Required to ensure secure handling of secret keys on IoT devices.	ISO/IEC 7816-4
SIM	General		PPS Support	The terminal shall support the PPS procedure (selective and negotiable mode) according to ETSI 102 221 section 6.3.2. The minimal supported Fi/Di factor, which is given inside the ATR of the SIM card, shall be '96' (Fi = 512 / Di = 32). If this requirement is not supported the communication between the UICC and the terminal will be too slow and the user experience will degrade.	PPS is the baud rate of data transfer of files between the SIM and the terminal	ETSI TS 102 221
SIM	General		ICCID retrieval	The device shall expose a API that allows a device application to retrieve the ICCID of the UICC that is placed inside the device.		
SIM	General		SIM Lock	OpCos requesting SIM lock shall be supported using a MCC MNC locking mechanism.		
SIM	General		Operation with SIMs	The terminal shall support operation with at least 1.8V technology UICCs.	to ensure that VF SIM cards are supported	

SIM	General		Copying of USIM phonebook and internal terminal phonebook entries	The MS shall support an automatic function to import all entries of the USIM phonebook to the phonebook in the handset when a new USIM is inserted. The MS shall also support separate menu functions to: i) Import all the USIM phonebook to the phone book in the handset. ii) Export phone book entries in the handset to the USIM phonebook.	SIM Addressbook related. This provides the user with an easy means to transfer numbers from the SIM to the terminal and vice versa.	
SIM	General		Display of Operator defined network name	The terminal shall reading of the Operator PLMN List (EF_OPL) and the PLMN Network Name (EF_PNN) files.	To indicate for which Location Area Identities a required network name is to be displayed	
SIM	General		SDN support	The handset shall be able read EF_SDN and shall be able to display SDN entries.	SDN = Service Dialling Number.	
SIM	SIM Application Toolkit		SIM Card busy	In case that a LOCATION_STATUS_EVENT is sent to the card and the card responds with 93 00 (SIM application busy) the handset shall resend the LOCATION_STATUS_EVENT to the card. If the location information and/or the location status changes during the retry period the MS shall use the latest information for the LOCATION_STATUS_EVENT.	Feature is in use by OpCos like VF DE for their local applications and is required to retry event if the SIM card is busy.	
SIM	UICC Access Control		OMAPI support	In order to enable mobile applications accessing the UICC, the terminal shall support GlobalPlatform 'Open Mobile API Specification' (OMAPI) version 3.2 (or higher).		GlobalPlatform 'Open Mobile API Specification' (OMAPI)
Device Management	OMA CP		OTA Provisioning of service access settings	The terminal shall provide the ability to configure network, access and routing information via OTA mechanisms acceptable to Vodafone but with suitable protection to avoid fraudulent or inappropriate changes. At least it must be possible to configure over the air all the following network configuration settings (where features are available on the terminal): 1) GPRS NAP 2) WAP access 3) MMS access 4) Email settings	To enable access to Vodafone services (e. g. VF MobileMail, MMS, WAP Portal) and increase the take-rate, devices have to be provisioned via OMA CP. If client provisioning via OMA CP fails, the following opportunities are not working: - Provisioning of non-Vodafone branded devices - Correction of misconfigured clients - Reconfiguration of devices in case of changes of network elements and their access parameters Impact for Embedded SIM (preferred): Why Required: For device configuration and settings. What happens if not implemented? For the network to be able to send settings to the device. If not present, the user must manually configure the device OR the OEM must pre-installed device settings.	N/A

Device Management	FOTA		Firmware Update over the air (FOTA) normal and emergency updates	FOTA needs to be supported in two variants: FOTA updates with required user consent via the user interface for normal (scheduled) FOTA updates, as well as FOTA updates without user consent for emergency FOTA Updates e.g. critical patches.		
Device Management	FOTA		Firmware Update over the air (FOTA) general requirements	The FOTA client shall support: - regular polling for new firmware version - power state / battery level check before FOTA update - full recovery in case of loss of power or coverage - seamless user experience and protection of all user data		
Device Management	OMA CP		OTA Update on multiple Applications	A single provisioning document may include all settings of multiple applications (e.g. Browser, MMS, APN settings, ...), subject to Operator transport size limitations. The maximal number of supported concatenated SMS for each OpCO is described in Vodafone Variant Sheet (VVS).	To ensure that multiple applications can be provisioned by using one client provisioning message and the installation of "Combined Settings" is implemented correctly. To ensure settings sent in more than one SMS are implemented correctly	N/A
Device Management	OMA CP		PIN Code Input Screen	The device shall support USERPIN & NETWORKPIN security mechanisms. If USERPIN mechanism is used, the device shall also display PIN code input screen for authorization. If NETWPIN mechanism is used, there shall be no user notification and the message shall be stored automatically in the background.	Essential for customer care configurator tools and service provisioning (example Voice over Wifi)	N/A
Device Management	OMA LwM2M		OMA LwM2M 1.0 support	Compliance to LwM2M 1.0 is requested which includes support of all mandatory protocol features plus all mandatory Objects and Resources. The LWM2M Client shall reside on the device e.g. integrated as SW library or build-in function.	Essential for all IoT devices in order to support standardised device management mechanism for: - Service Configuration - Device Status - Maintenance - Alert-System - Data Records - Reports	http://member.openmobilealliance.org/ftp/Public_documents/DM/LightweightM2M/Permanent_documents/OMA-TS-LightweightM2M-V1_0-20170208-A.zip (check for latest version)
Device Management	OMA LwM2M		OMA LwM2M 1.1 support	Compliance to LwM2M 1.1 is preferred, however, standard was only released in 2018. LwM2M 1.1 provides improved support for NB-IoT, and other significant enhancements.	High Q4 2018	
Device Management	OMA LwM2M		De-registration	Support of "De-register" operation enables the LwM2M Client to de-register from the LwM2M Server.	High Q4 2017	

Device Management	OMA LwM2M		Observe parameters	Support of the following Observe parameters: Minimum Period, Maximum Period, Greater Than, Less Than, Step, Cancel	High Q4 2017	
Device Management	OMA LwM2M		Default Min/Max Period Resources of LwM2M Server Object	The device shall support Default Min/Max Period Resources of the LwM2M Server Object. This is an alternative way of configuring periodic reporting - via the LwM2M Server Object instead via the "Write Attribute" command.	High Q4 2017	
Device Management	OMA LwM2M		Multiple server access control	The Access Control Object is required to manage access rights in a multiple server scenario.	Low Q1 2018	
Device Management	OMA LwM2M		Device Info	The device shall provide Manufacturer, Model Number, Serial number, Device Type, and Hardware Version via the Device Object.	Med Q4 2017	
Device Management	OMA LwM2M		Battery Level	Expose the remaining battery level percentage via the Device Object	High Q4 2017	
Device Management	OMA LwM2M		Available Power Sources, Power Source Current, Battery Status	The device shall provide the Available Power Sources, Power Source Current, and Battery Status via the Device Object.	Med Q4 2017	
Device Management	OMA LwM2M		Memory Free and Memory Total	The device shall expose Memory Free and Memory Total via the Device Object.	Med Q4 2017	
Device Management	OMA LwM2M		Error reset	The device shall support the Reset Error Code command via the Device Object.	Med Q4 2017	
Device Management	OMA LwM2M		Read/write device time	The device shall support read/write of Current Time, UTC Offset, and Timezone via the Device Object.	Med Q4 2017	
Device Management	OMA LwM2M		read APN	The device shall expose the currently used APN via the Connectivity Monitoring Object (this requirement is read-only).	High Q4 2017	http://member.openmobilealliance.org/ftp/Public_documents/DM/LightweightM2M/Permanent_documents/OMA-TS-LWM2M_ConnMgmt-V1_1-20170201-D.zip (check for latest

						version)
Device Management	OMA LwM2M		APN configuration	Exposure of APN configuration parameters via the APN Connection Profile Object. This is essential in case the device doesn't support the auto-APN feature.	Med Q4 2017	
Device Management	OMA LwM2M		Lock and wipe	The device shall support lock and wipe commands via the LOCKWIPE Object.	Med Q4 2017	
Device Management	OMA LwM2M		Software management	The device shall support software management via the SWMGMT Objects.	Med Q1 2018	
Device Management	OMA LwM2M		LwM2M factory bootstrap	The device shall support LwM2M factory bootstrap. Security credentials and LwM2M server address(es) are pre-configured on the device.	High Q4 2017	
Device Management	OMA LwM2M		LwM2M OTA bootstrap	The device shall support LwM2M OTA (over-the-air) bootstrap over any supported bearer (not limited to SMS). OTA bootstrap is the alternative mechanism to factory or smartcard bootstrap.	Med Q2 2018	
Device Management	OMA LwM2M		WLAN settings	The device shall support configuration of WLAN settings via the WLAN Connectivity Object.	Low Q4 2017	
Device Management	OMA LwM2M		SMS settings	The device shall support configuration of SMS settings. The SMSC address can be configured via the Cellular Network Connectivity Object.	Low Q4 2017	
Device Management	OMA LwM2M		CoAP over TCP	The LwM2M protocol stack shall utilize IETF CoAP (Constrained Application Protocol) as underlying transfer protocol over TCP.	Low Q4 2017	
Device Management	OMA LwM2M		CoAP over non-IP	The LwM2M protocol stack shall utilize IETF CoAP (Constrained Application Protocol) as underlying transfer protocol over 3GPP NAS non-IP transport.	Low Q4 2017	
Device Management	OMA LwM2M		Power Source Voltage	Expose the current voltage (mV) of the available power source e.g. battery via the Device Object	Med Q4 2017	
Device Management	OMA LwM2M		Radio Signal Strength and Link Quality	Expose the Radio Signal Strength and Link Quality via the Device Object. Parameters are dependent on the bearer used (see OMA LwM2M 1.0).	High Q4 2017	
Device Management	OMA LwM2M		Radio Signal Strength and Link Quality for NB-IoT	Expose the NRSRP and NRSRQ via the Device Object	High Q4 2017	
Device Management	OMA LwM2M		Location (cell-id)	Expose the cell-ID via the Device Object	High Q4 2017	

Device Management	OMA LwM2M		Location (long, lat, altitude)	Expose longitude, latitude, altitude of device via the Location Object	High Q4 2017	
Device Management	OMA LwM2M		Firmware update	Enables "pull" of firmware update via the Firmware Update Object.	High Q4 2017. The Firmware Update Object may also be used for application file and configuration file transfer.	
Device Management	OMA LwM2M		Sensor value	Exposes any sensor values via IPSO Object(s)	Medium Q4 2017	
Device Management	OMA LwM2M		PSM timer	Exposure of the Power Save Mode Timer via the Cellular Network Connectivity Object. AT command +CPSMS needs to be supported for this.	High Q4 2017	
Device Management	OMA LwM2M		Active timer	Exposure of Active Timer via the Cellular Network Connectivity Object. Active Timer (T3324) controls the time the device remains reachable after transitioning to idle state in case there is pending data from the network.	High Q4 2017	
Device Management	OMA LwM2M		Supported Power Saving Mode	Exposure of the supported Power Saving Modes (PSM, eDRX) via the Cellular Network Connectivity Object. This indicates which power saving modes (PSM and/or eDRX) are supported by the device.	High Q4 2017	
Device Management	OMA LwM2M		Active Power Saving Mode	Exposure of the Active Power Saving Modes (PSM and/or eDRX) via the Cellular Network Connectivity Object. This indicates which power saving modes (PSM and/or eDRX) are currently active.	High Q4 2017	
Device Management	OMA LwM2M		Serving PLMN Rate Control	Exposure of Serving PLMN Rate control via the Cellular Network Connectivity Object. Only for when using signalling radio bearers (c.f. data over NAS), it indicates the maximum the number of allowed uplink PDU transmissions per time interval aggregated across all PDN connections. +CGCONTRDP needs to be supported for this.	Med Q4 2017	
Device Management	OMA LwM2M		APN Rate Control	Exposure of APN Rate Control via the APN Connection Profile Object. Determines the number of allowed uplink PDU transmissions per time interval per APN. +CGAPNRC needs to be supported in order to provide this functionality.	Med Q4 2017	
Device Management	OMA LwM2M		eDRX parameters for NB-S1 mode	Exposure of Extended DRX parameters (Paging Time Window and eDRX value) via the Cellular Network Connectivity Object.	High Q1 2018	
Device Management	OMA LwM2M		TotalPacketsSent counter	Exposure of TotalPacketsSent via the APN Connection Profile Object. Rolling counter for total number of packets sent via this interface since last device reset.	Med Q4 2017	
Device Management	OMA LwM2M		Priority transmission	ExceptionDataReportingAllowed exposure via the NAS Configuration Object. Enables the device to use the 'exception data' mode for priority transmission.	High Q4 2017	

Device Management	OMA LwM2M		NAS configuration	Exposure of NAS (Non-Access Stratum) configuration parameters via the NAS Configuration Object (derived from 3GPP TS 24.368). It enables for example: - request device to attach with IMSI - set minimum periodic search timer	Med Q4 2017	
Device Management	OMA LwM2M		CoAP parameters configuration	Exposure of CoAP parameters via the Communications Characteristics Object. In case CoAP default values don't provide maximum communications efficiency the parameters can be changed via this LwM2M Object e.g. may number of re-transmissions.	Med Q4 2017	
Device Management	OMA LwM2M		PDN type control	Exposure of PDN Type via the APN Connection Profile Object. Configuring the device to select Non-IP, IPv4, IPv6, IPv4v6.	High Q4 2017	
Device Management	OMA LwM2M		Bearer selection	Exposure of Preferred communications bearer via the Bearer Selection Object (e.g. 2G, 3G, 4G, NB-IoT Control Plane, NB-IoT User Plane, Cat-M)	High Q4 2017	
Device Management	OMA LwM2M		Acceptable RSRP, RSSI, RSCP for network selection	Exposure of acceptable RSSI, RSCP, RSRP via the Bearer Selection Object. Provides guide to the application when performing "manual" network selection e.g. switch from GPRS to NB-IoT.	Medium Q1 2018	
Device Management	OMA LwM2M		Higher Priority PLMN Search Timer	Exposure of Higher Priority PLMN Search Timer via the Bearer Selection Object. Interval between periodic searches for higher priority PLMNs of the same country when camped on a visited PLMN, i.e. roaming scenario.	High Q4 2017	
Device Management	OMA LwM2M		Attach without PDN connection	Exposure of Attach Without PDN Connection via the Bearer Selection Object. Forces the device to either 'attach with PDN connection' or 'attach without PDN connection' (e.g. for SMS transport only).	Med Q4 2017	
Device Management	OMA LwM2M		Maximum uplink/downlink packet size	Exposure of Maximum Uplink/Downlink Packet Size via the Communications Characteristics Object. Enables the server to retrieve this information from the device e.g. no become aware of limitations on the control plane path. Furthermore, the server shall be able to set the Max uplink packet size on the device.	Med Q4 2017	
Device Management	OMA LwM2M		Disable radio	Exposure of Disable Radio Period via the Cellular Network Connectivity Object. Time period for which the device shall disconnect from cellular radio (PS detach, CS detach if applicable).	High Q4 2017	
Device Management	OMA LwM2M		Read/update PLMN list	Exposure of Operator List, Operator List Mode, and List of available PLMNs via the Bearer Selection Object stored on the device.	Med Q4 2017	
Device Management	OMA LwM2M		LwM2M Server SMS Number	Exposed via the LwM2M Security Object: MSISDN used by the LwM2M Client to send messages to the LwM2M Server via the SMS binding.	Med Q1 2018	

Device Management	OMA LwM2M		Raw Public Key mode of DTLS security	Support of Raw Public Key mode of DTLS (see OMA LwM2M 1.0)	Med Q4 2017	
Device Management	OMA LwM2M		X.509 Certificate mode	Support of X.509 Certificate mode for DTLS (see OMA LwM2M 1.0)	Med Q4 2017	
Device Management	OMA LwM2M		Pre-Shared Key mode of DTLS security	Support of Pre-Shared Key mode of DTLS (see OMA LwM2M 1.0) . The following cipher suite is mandatory to support: TLS_PSK_WITH_AES_128_CCM_8. The following cipher suite is optional: TLS_PSK_WITH_AES_128_CBC_SHA256	High Q4 2017	
Device Management	OMA LwM2M		Bootstrap-Server Account Timeout	Bootstrap-Server Account Timeout exposed via the LwM2M Security Object. The LwM2M Client MUST purge the LwM2M Bootstrap-Server Account after this timeout.	Med Q2 2018	
Device Management	OMA LwM2M		CoAP Protocol	The LWM2M protocol stack shall utilize IETF CoAP (Constrained Application Protocol) as underlying transfer protocol.	Essential for M2M devices that support OMA lightweight	OMA Lightweight LWM2M 1.0 or later release
Device Management	OMA LwM2M		DTLS security	A secure channel between LWM2M client and server shall be secured by DTLS (Datagram Transport Layer Security)	Essential for M2M devices that support OMA lightweight	OMA Lightweight LWM2M 1.0 or later release
Device Management	OMA LwM2M		Pre-Shared Key mode of DTLS security	Support of Pre-Shared Key mode of DTLS with the following cypher suites: TLS_PSK_WITH_AES_128_CCM_8 and TLS_PSK_WITH_AES_128_CBC_SHA256 For all Cipher Suites using AES in an LWM2M implementation the hashing functions SHALL NOT be SHA-1. The use of SHA256 is recommended. An LWM2M client will negotiate with the LWM2M server the best method during the DTLS handshake for establishing the DTLS session.	Essential for M2M devices that support OMA lightweight	OMA Lightweight LWM2M 1.0 or later release
Device Management	OMA LwM2M		SMS Bearer	SMS Binding with CoAP shall be supported to allow LWM2M interaction via SMS bearer	Essential for M2M devices that support OMA lightweight	OMA Lightweight LWM2M 1.0 or later release
Device Management	OMA LwM2M		UDP Bearer	UDP Binding with CoAP is mandatory to allow LWM2M interaction via UDP bearer	Essential for M2M devices that support OMA lightweight	OMA Lightweight LWM2M 1.0 or later release
IoT	General Requirements	Configuration	IMSI exposure	The IoT terminal shall expose the IMSI to the end-user in the local device configuration UI to serve installation and troubleshoot purpose. The IMSI should not be exposed via SDK or other	For IoT Devices, it is a business requirement of the IoT team to have the IMSI displayed in the web-UI.	N/A

				means to 3rd party apps running on the device.		
IoT	General Requirements	eCall	eCall end to end conformance testing	The eCall capable IoT device shall have passed eCall end to end testing according to CEN/TS 16454, based on EN 15722, EN 16062 and EN 16072. This is to ensure the IVS does not perform PLMN registration after power-up.	Important to ensure the IVS does not perform PLMN registration after power-up.	N/A
IoT	General Requirements	eCall	re-configuration number	The eCall capable IoT device shall support reconfiguration number to allow the user to re-configure the eCall-only module to a combined eCall/IoT service device.	It is important that a eCall only device can be configured in a way that additionally to eCall also other IoT services are possible.	N/A
IoT	General Requirements	General M2M	MT SMS to non SMS capable device	Robustness of non-SMS device: The non-SMS capable IoT device shall ignore incoming SMS (also concatenated).	Essential to ensure robustness of the IoT device, the non-SMS device shall ignore SMS	N/A
IoT	General Requirements	General M2M	SMS PDU mode	The IoT module shall support the following SMS command in PDU mode according to 3GPP 23.040 and 23.038	Important to support SMS PDU mode based applications for IoT services	3GPP 23.040 and 23.038
IoT	General Requirements	General M2M	SMS text mode	The IoT module shall support the following SMS command in text mode according to 3GPP 23.040 and 23.038	Important to support SMS text mode based applications for IoT services	3GPP 23.040 and 23.038
IoT	General Requirements	General M2M	Time to first Service at power on	The IoT device shall provide an AT command to allow applications to check the "Service Registration" status after device was powered on. See 3GPP 27.007 +CREG.	For a IoT application it is important to check the status of the device, e.g. whether device is attached to the network. Therefore an AT command shall be able to e.g. read out signalling messages as "attach accept" before starting any other actions.	N/A
IoT	General Requirements	General M2M	Time to first Service at power on with SIM-Profile change	The IoT device shall provide an AT command to allow applications to check the "Service Registration" status after device was powered on with changed SIM profile. See 3GPP 27.007 +CREG.	For a IoT application it is important to check the status of the device, e.g. whether device is attached to the network. Therefore an AT command shall be able to e.g. read out signalling messages as "attach accept" before starting any other actions.	N/A
IoT	General Requirements	General M2M	Transactional SMS support	The IoT device shall be able to support transactional SMS messaging and the associated AT-command set.	Lower cost for end customer if SMS-t used rather than having to send ACK/NACK with dedicated acknowledge-SMS. Instant feedback about command execution success.	N/A
IoT	General Requirements	General M2M	Voice call with GDSP SIM	The IoT device shall support voice calls when GDSP SIM card is inserted. This requirement includes also Emergency calls.	It is planned to deploy also voice functionality to the GDSP. The support of voice calls is important for IoT applications, e.g. elevator emergency calls	N/A
IoT	General Requirements	Registration	Blank APN connect	When used with a regular VF-operator SIM: A database of Vodafone APN settings is stored on the device and will be used to determine the correct configuration. When using a VF GDSP/IoT SIM the device supports the APN assignment from the backend.	Eliminating the need for device configuration. Allowing near plug-and-play performance	N/A

IoT	General Requirements	Registration	Graceful backoff if SIM suspended	Upon registration rejects, the device will exponentially back-off from registration attempts until a maximum wait time of 20 minutes. Then the device will flush any network blacklist to allow a fresh cycle (e.g. power cycle after 20 minutes or appropriate). The max back-off time needs to be remotely configurable.	To prevent devices from creating excess signalling from failed registration attempts if the SIM was customer-deactivated on the VF IoT platform GDSP.	N/A
IoT	General Requirements	Roaming	Fall-back roaming	The device shall detect the presence of a GDSP SIM and in that case execute an alternative roaming algorithm based on a text or XML file of carriers. The typical size of this file is 500 entries. The text file needs to be remote updateable e.g. by administrable SMS, TR-069, OMA LwM2M.	For extension of the current preferred network list functionality to allow for use of global roaming SIMs where large numbers of overlaid and adjacent roaming networks may be encountered. Secondly to be able to optimise the roaming behaviour of IoT devices to always chose the most cost efficient and reliable network.	N/A
IoT	General Requirements	SMS	SMS to GDSP shortcode	When using the GDSP SIM the device is able to send SMS to GDSP shortcode numbers e.g. 310000214.	When using the VF IoT SIM the VF IoT platform GDSP need to be used to send and receive SMS. Devices are not addressable by their MSISDN.	N/A
IoT	General Requirements	Wakeup	Dial-in on demand / wakeup on LAN	Device can automatically establish an active PDP context upon receiving a trigger (activity) from the connected host application through the LAN connection on the ethernet port. Device will check if the IP range of the data packet is outside it's own routing area and in this case establish a connection.	Primarily for fixed-router replacement devices, this feature is required to allow automatic response to requests from LAN-side equipment to establish a PDP context for WAN transfer of those packets.	N/A
IoT	General Requirements	Wakeup	Hold time on LAN wakeup	Configurable hold time for active but data-idle PDP context after LAN wakeup. (i.e. How long will the device continue to "listen" for incoming data before going back to simple GPRS attach again).	If not supported, could result in devices holding session indefinitely, or constantly raising and lowering PDP context hold resources or generate excessive signalling. Excessive signalling can result in a network incident event.	N/A
IoT	General Requirements	Wakeup	Hold time on SMS wakeup	Configurable hold time for active but data-idle PDP context after receiving wakeup. (i.e. How long will device "listen" for incoming data before going back to simple GPRS attach again).	If not supported, could result in devices holding session indefinitely, or constantly raising and lowering PDP context hold resources or generate excessive signalling. Excessive signalling can result in a network incident event.	N/A
IoT	General Requirements	Wakeup	SMS wakeup	Device can wake up from simple GSM and GPRS attached state and establish an active PDP context upon receiving an SMS from the GDSP platform. Device needs to listen to an empty class 1 SMS from a predefined, configurable number.	If not supported, the device will not be compatible with the Vodafone IoT Service operating characteristics. Integrator of a device will have to develop their own wakeup scheme over and above the device, exposing the device to potentially negative operating conditions.	N/A
IoT	PDP context handling	Authentication	PAP/CHAP	The IoT device shall support PAP (Password Authentication Protocol) and CHAP (challenge handshake Authentication Protocol)	PAP and CHAP are authentication protocols used to authenticate a user to a server.	N/A
IoT	PDP context handling	PDP context	Simultaneous PDP contexts	The IoT device shall support simultaneous PDP contexts as follow: It shall be capable to support two simultaneous PDP contexts to the same APN, one for device management (OMA LwM2M, TR.69) and one for services.	Simultaneous primary APN are essential to support device management via TR69 and IoT services.	N/A

IP Protocol	General Requirements	DNS Requirements	DNS Server Address	The terminal shall use the DNS server address noticed by Activate PDP Context Accept.	Resolve IP addresses from names. Non-compliance breaks everything	N/A
IP Protocol	General Requirements	IP Requirements	Dual IP stack	A dual IPv4/ IPv6 stack shall be supported for application user plane and for control plane. The LTE UE must also be able to support simultaneous PDN connections to different APN and IP version . The terminal is required to support IPv4 and IPv6 PDP contexts as follow: 1- It shall be capable to request and support a dual address PDP context according to 3GPP R8 (PDP Type value Hex 8D). 2- It shall be capable to support two simultaneous primary PDP contexts to the same APN, one with PDP Type IPv4 and one with PDP Type IPv6. 3- It shall be capable to fallback to (2) if (1) results in a single IP address being allocated with SM cause #52 'Single address bearer only allowed' or if (1) results in a successful PDP Context activation with address IPv4.	This is essential for LTE and especially VoLTE Terminals as our APN strategy is based on IPv6.	N/A
IP Protocol	General Requirements	IP Requirements	IPv6 Interface Identifier	When the device generates its own interface identifiers rather than using interface identifiers provided by the network, the interface identifier shall be randomly generated for each new IPv6 address required (except for link-local addresses) in compliance with 3GPP TS 23.221 and IETF RFC 4941. The device shall not use any pre calculated / embedded data to compute a static post-fix (e.g. not IMEI, not IMSI, not MSISDN, not ICCID, not MAC) .	This is to ensure that the PDP context is setup correctly. Failure to do this will result in connection issues for APNs. Device must not be trackable.	3GPP TS 23.221 IETF RFC 4941
IP Protocol	General Requirements	IPv6	IPv6 Application	IPv6 shall be also handled by the application layer. This is particularly requested for a closed OS. Applications should prefer IPv6 over IPv4 if there is a choice	IPv6 support needed for all internet connections	N/A
IP Protocol	Security Requirements	HTTP Generic Requirements	Support for GBA for establishing TLS and DTLS connections	The device HTTP stack shall support GBA for establishing TLS and DTLS connections according to 3GPP TS 33.222.	Required for establishing a secure connection from the device to an application server.	http://www.3gpp.org/ftp/Specs/html-info/33222.htm
IP Protocol	General Requirements	IPv6	MMS over IPv6	MMS shall operate over IPv6	IPv6 support needed for all internet connections	N/A
IP Protocol	SIP-IMS	General Requirements	Standards Compliance	The SIP/IMS implementation shall be compliant with the following Specifications and Referenced Specifications. Non compliance to the standards shall be highlighted in details.	Standards compliance	latest approved releases of 3GPP TS 23.228, 3GPP TS 24.229, OMA Standard

						s for IMS
IP Protocol	SIP-IMS	IMS Client Upgrade	Configuration Managed Object	The terminal shall support configuration by the network using the OMA CP Application Characteristics specified in 3GPP TS 24.167	Device management. This is needed e.g. for provisioning of the VoWiFi service of VF UK.	N/A
IP Protocol	SIP-IMS	IMS protocol stack	List of SIP methods supported	The terminal shall support the following SIP methods: REGISTER/INVITE/ACK/BYE/CANCEL/SUBSCRIBE/NOTIFY/PUBLISH/REFER/UPDATE/PRACK/OPTIONS/MESSAGE	we need to have a clear view of all the SIP methods supported.	N/A
IP Protocol	SIP-IMS	IMS protocol stack	Open API for SIP stack	The IMS stack shall support open API in order to allow 3rd Party IMS services to use the IMS Framework.	Important for VoLTE client behaviour	N/A
IP Protocol	SIP-IMS	IMS protocol stack	Single SIP stack	A single SIP stack - which is part of the OS - shall be implemented by the device and used by all the relevant applications (VoLTE, RCS, other Apps). No other SIP stack shall be accessible by any applications.	important for security and efficiency. The 3GPP compliant SIP stack has to have low level integration in order to support the necessary security mechanism.	N/A
IP Protocol	SIP-IMS	IMS protocol stack	SIP stack framework	The VoLTE UE shall have a single IMS Stack Framework including SW and Modem in order to run IMS services (VoLTE, SMSoIP, VT, etc) as well as RCS. The common IMS stack shall allow dual registration: In current implementation a device provides both RCS and VoLTE clients as completely separate implementations, the RCS client shall behave as a non-embedded client and shall consider the device to be in RCS-CS mode whenever in cellular coverage. Meaning that for the first years of VoLTE deployments it is assumed that the single stack will be capable of issuing one registration for VoLTE services and another registration based on ACS data for RCS service.	Important for VoLTE client behaviour	GSMA joyn Blackbird Product Definition Document Version 1.1, Table 2: RCS Device Modes
IP Protocol	SIP-IMS	QoS Management	Authorization Token Handling	In order to properly perform in Vodafone network and guarantee user experience as appropriate, a UE activating or updating a secondary PDP context SHALL always populate the TFT filters with at least the following information when TFT operation is 'create new TFT', 'add packet filters to existing TFT' or 'replace packet filters to existing TFT': - source IP address (IPv4 or IPv6) - source port (single or range), if available to the UE - destination port (single or range) In case of SIP/SDP (IMS) and RTSP (Streaming), the UE SHALL derive the above listed packet filters information from the application signalling exchanged between end points	Non support means handset multiplexing media flows (of different media components/sessions) on the same transport port number will not enable the Vodafone network (i.e. E-PDF) to identify the appropriate policy to apply. This will result in: - the UE not gaining QoS resources from the network; and - the user being potentially wrongly charged since it is not possible to differentiate between media flows.	3GPP TS 24.008

IP Protocol	SIP-IMS	Security	API's access	The access to the API's SIP/IMS stack shall be dependent on application authorisation level and be configurable by Vodafone.	Security and business control, Vodafone can control which applications can use the IMS infrastructure: might be hard to implement. Supported in Java.	N/A
IP Protocol	SIP-IMS	Security	Full IMS security solution 3GPP	Full IMS security mechanism The terminal shall support the full IMS security mechanism defined in the latest approved release of 3GPP TS 33.203. Any non compliances to the TS should be clearly specified.	This relates to Ipv6 support. The interim security solution is the bottom line. Vendors should support this security solution.	3GPP TS 33.203
IP Protocol	SIP-IMS	Support for IMS services	Codecs accessibility	All speech/video/audio codecs supported by the terminal shall be accessible by the IMS clients.	IMS applications being able to make use of all the device content/format.	N/A
IP Protocol	SIP-IMS	Transport Network and IP connectivity	Overriding configurations from the network.	The terminal SHALL accept overriding configurations from the network i.e., it SHALL, upon PDP establishment, accept suitable DHCP extensions to set its hostname to one sent from The network. This override may come from The DHCP or AAA servers depending on local architecture restrictions.	Important for IPv6 communication (AAAA response)	N/A
IP Protocol	SIP-IMS	Transport Network and IP connectivity	ROHC support	ROHC (RObust Header Compression) shall be supported as defined in 3GPP TS35.206 and RFC3095 and RFC 4815.	Necessary for IPv6 header compression. Saves bandwidth and transfer speed of packets. But it is not currently supported on the network side.	N/A
IP Protocol	SIP-IMS	Support for IMS services	Support of "anonymous" Emergency Call for S8HR VoLTE roamers	If the UE receives a SIP 403 (Forbidden) as a response of an IMS Emergency registration attempt, the UE must attempt an unauthenticated IMS emergency session request (INVITE) including an "anonymous user" parameter in the SIP INVITE message.	This allows VoLTE Emergency calls when Roaming	N/A
IP Protocol	SIP-IMS	Support for IMS services	Support of ICSI service tag	VoLTE devices must populate the ICSI service tag "urn:urn-7:3gpp-service.ims.icsi.mmtel" in the SIP Invite to indicate they wish to establish a VoLTE call for originating calls, and in the SIP response (183, 200) to indicate they are ready to accept a VoLTE call for terminating calls.	This allows VoLTE Supplementary Services execution.	N/A
IP Protocol	SIP-IMS	Support for IMS services	CS fallback when "IMS" APN is not included in the Subscription profile	Under outbound roaming, if the UE receives a "PDN Connectivity Reject" from MME with cause code "Unknown APN" when it asks for a PDN connection with the IMS APN (due to the fact that IMS APN is not in the Subscription profile for the specific VPLMN), the UE shall perform a CS Fallback and shall not ask for an IMS PDN connection again until it changes VPLMN.	This is a requirement to enable VoLTE Roaming restriction from the Home Network in the S8HR VoLTE Roaming.	N/A
IP Protocol	SIP-IMS	Support for IMS services	Provide the last cell-id information under VoWiFi in an emergency INVITE	Under VoWiFi and when the UE sends an emergency INVITE, it shall include the last cell-id information used under 4G. This is needed from the network in order to route the emergency call to the proper PSAP.	This is a requirement to enable VoWiFi Emergency calls and to comply with relevant regulations.	N/A
IP Protocol	SIP-IMS	Support for IMS services	Provide the GPS location co-ordinates (longitue and	Under VoWiFi and when the UE sends an emergency INVITE, it shall include the GPS co-ordinates. This is needed from the network in order to route the	This is a requirement to enhance VoWiFi Emergency calls and to comply with relevant regulations.	N/A

		s	latitude) under VoWiFi in an emergency INVITE	emergency call to the proper PSAP.		
IP Protocol	SIP-IMS	Support for IMS services	Support of UE undetected emergency calls under S8HR roaming	In the case of an S8HR UE undetected emergency call (SIP INVITE towards the Home PLMN), the UE shall understand the SIP 380 redirect response from the Home P-CSCF and either perform an emergency call in CS in the Visited network or an unauthorized emergency call in VPLMN with emergency Registration.	This is a requirement to enable S8HR Roaming VoLTE Emergency calls.	N/A
IP Protocol	SIP-IMS	Support for IMS services	Support of network provided emergency number list in S8HR VoLTE Roaming.	The UE shall support the emergency number list provided by the MME during attachment in the S8HR Roaming case. This list shall be used for emergency call detection and shall be discarded upon attachment to another VPLMN.	This is a requirement to enhance S8HR VoLTE emergency calls by reducing the time for setting up an emergency call when using the visited network's emergency number list.	N/A
IP Protocol	General Requirements	4G enhancements	Named APN per UE App (Android and iOS)	Any terminal application (on Android, iOS, etc) should be able to use a named APN (e.g. gaming app to use a "low latency APN")	This allows scenarios for e.g. Low Latency and Enterprise services based on dedicated NW core resources	N/A
IP Protocol	LTE	VoLTE	VoLTE roaming: IPv4/IPv6 support for APN IMS	The UE must support both IPv4/IPv6 for IMS APN. The requirement is applicable both for 4G and 5G devices when the 5G devices are under Opcion 3x handling the voice over LTE	already	N/A
Local Connectivity	Bluetooth Requirements	General Bluetooth Requirements	Bluetooth 5.0	The terminal should support Bluetooth 5.0	Bluetooth 5.0 offers enhanced data rates. Bluetooth 5.0 should be supported by high tier terminals.	
Local Connectivity	Bluetooth Requirements	General Bluetooth Requirements	Bluetooth 4.2	The terminal shall support Bluetooth 4.2	Bluetooth 4.2 offers more resilient connections and improved battery performance. This is the minimum requirement for 4G smartphones.	N/A
Local Connectivity	Bluetooth Requirements	General Bluetooth Requirements	Bluetooth 4.0	The terminal shall support Bluetooth 4.0	The main improvement in Bluetooth 4.0 is the low energy support. This is the minimum requirement for entry phones, 3G smartphones and accessories.	
Local Connectivity	Bluetooth Requirements	General Bluetooth Requirements	Bluetooth Certification	The terminal shall pass tests and obtain certification for Logo authentication defined by BQTF (Bluetooth Qualification Test Facility). Testing must be carried out by a certified authentication institution.	Part of the Bluetooth certification process - logo cannot be used otherwise. Terminal could potentially not support the Bluetooth standard.	N/A
Local Connectivity	Bluetooth Requirements	General Bluetooth Requirements	Bluetooth Factory Settings	Factory settings shall be as follows: - Bluetooth shall be turned off as default. (see note below) - Bluetooth shall be set to non-discoverable as default These default settings shall be stated in the user manual, along with information regarding potential	If not supported, the terminal will be in the state where Bluetooth is already activated at the time of terminal purchase. Therefore, security is not maintained.	N/A

				<p>security risks.</p> <p>nb: Turning Bluetooth on shall NOT automatically set the state as being discoverable</p>		
Local Connectivity	Local Connectivity Requirements	Data security and privacy	Activity Notification	<p>In any case, whether wireless or wired, the device shall display an indication to the user eg 'Connecting..."/>"Connected", "Sending message..." etc. LED indication shall be available for devices without display.</p> <p>Although Bluetooth is the main threat, IrDA to a lesser extent (as it requires Line of Sight to connect), there is still a potential threat from using a wired cable connection. Although the user physically connects to another device eg laptop, there is still a threat from malicious code running on the connected device that may trigger chargeable events.</p>	Without a notification, an application could cause chargeable events for the user.	N/A
Local Connectivity	Local Connectivity Requirements	Data security and privacy	Connection Request Confirmation	<p>The device shall prompt the user via device display or WEB interface for terminals without display when a Wireless 'connected' device is requesting connection to it. (ie over BT). The</p> <p>Eg, the requesting device may be requesting a connection to the network to make a chargeable to make a connection to the network (eg SMS, MMS, VT Call, Voice Call etc.)</p> <p>The user shall be given the option to switch the request off: eg - Permanently (ie never ask), - Per Session (ie ask once per connection), or - Always (always ask).</p> <p>The user shall be able to configure connected devices profiles individually ie allow certain devices full access, others that must prompt the user.</p>	Usability and security.	N/A
Local Connectivity	Local Connectivity Requirements	Data security and privacy	Inbound connection management	<p>WiFi: When connected to a wireless network, the device shall not allow a listening port to accept inbound connections to view the terminal, file system or registry.</p>	Non compliance may result in exposure to security vulnerabilities, causing possible breach of data protection.	N/A
Local Connectivity	Local Connectivity Requirements	Data security and privacy	Wireless connection integrity	<p>Any access to the terminal via manufacturer supplied management tools over WiFi or Bluetooth, must be made over an authenticated and encrypted connection. The authentication method used may include use of random or user generated passcodes.</p>	Non-compliance leaves data transferred to and from terminal over WiFi and Bluetooth open to interception by a third party.	N/A
Local Connectivity	Local Connectivity Requirements	Device Software Upgrade Support	Local SW upgrade	<p>For security reason, It shall NOT be possible to upgrade the SW of the device by connecting it to an external device (eg PC) via bluetooth or IrDA, but it shall be possible through USB cable, or other Vodafone approved methods (e.g. OMA DM).</p>	This prevents core terminal software being replaced via Bluetooth/IrDA.	N/A

Local Connectivity	Local Connectivity Requirements	Modem and PC support	USB Tethering Support	The Terminal shall support USB Tethering	Enhance data usage	N/A
Local Connectivity	Local Connectivity Requirements	Modem and PC support	Wi-Fi Tethering Support	The Terminal shall support Wi-Fi Tethering (or Hotspot Wi-Fi or Router Wi-Fi)	Enhance data usage	N/A
Local Connectivity	Local Connectivity Requirements	PC Backup/Synchronisation	PC Sync	The terminal shall support synchronisation of Contacts and Calendar with a PC. Appropriate software shall be included with the terminal.	If unsupported it becomes impossible for user data, such as a telephone directory and a scheduler, to take a synchronization between a terminal and PC.	N/A
Local Connectivity	Local Connectivity Requirements	Wireless Office & Dashboard Requirements	AT Commands Specification	The terminal shall be compliant to all mandatory parts of 3GPP TS 27.005 and TS 27.007.	Important for phones to be able to access all the relevant AT commands specification	N/A
Local Connectivity	Modem	Data access to PC	Simultaneous APN PDP Contexts	The device shall support simultaneous PDP contexts to different APNs (and not allow multiple PDP contexts to the same APN in order to preserve network resources)	Mandatory to allow the user to make use of all devices applications while data modem is active.	N/A
Local Connectivity	MTP Requirements	MTP Specification	Device Stage metadata	The Device Stage metadata corresponding to each Vodafone Model ID shall be customized according to Vodafone requirements.	Device Stage Metadata is for when the device is connected to a Windows 7/8/10 PC via USB. Automatic metadata is loaded based upon the Vodafone Model ID. Essential to leverage Vodafone experience and services.	N/A
Local Connectivity	MTP Requirements	MTP Specification	Model ID customization	The terminal shall implement a unique Vodafone Model ID value for each device model. For which of the Operating Companies or Partner Networks the Vodafone ModelID shall be supported will be indicated at each device project level.	Essential for customized Device Stage experience for Vodafone	N/A
Local Connectivity	MTP Requirements	MTP Specification	Model ID support	The terminal shall implement the Model ID (128-bit GUID) property according to the MTP Device Service Extension specifications.	Essential for customized Device Stage experience for Vodafone	N/A
Local Connectivity	USB Requirements	General USB Requirements	USB Cable and Connector	Device shall support a USB Type-C connector (for legacy devices USB Micro connector is acceptable) (to be connected to a power plug or PC).	Connections must meet the relevant standard to allow interoperability between devices.	http://www.usb.org/developers/usbtypec/
Local Connectivity	USB Requirements	General USB Requirements	USB support	The terminal must provide a wired USB connection. The USB port preferably should support USB 3.0. As a minimum it must be compliant with USB 2.0 and maintain backwards compatibility with previous versions.	Required for USB connectivity.	http://www.usb.org/developers/docs/
Local Connectivity	USB Requirements	General USB Requirements	USB-on-the-Go	The terminal shall support USB-on-the-go devices like a USB mouse, USB-external-harddrive, USB-keyboard, USB-Memory Stick and it shall be possible to use the USBotG with the	Important for Smartphones to use on-the-go accessory. Essential for Tablets to use on-the-go keyboard.	N/A

				terminal.		
Local Connectivity	USB Requirements	Security	Require device unlock	All devices should prompt end user to authenticate using Activesync enforced pass code to access device prior to connecting device to laptop for synchronising data and services. Only if the activesync Device Lock security policy is enforced, any options in the device menu which control the behaviour of the phone when connected via USB cable to a PC, shall be defaulted to provide a prompt to the user and defaulted to "charge only" mode if no action is taken. This will enforce the user to unlock the phone with required pass code in order to be able to access the selection prompt, where "USB Mass Storage", "Internet Sharing" or "PC Suite" can be selected. Also, the options in the device menu which control the behaviour of the phone when connected via USB cable to a PC, must be greyed out and unchangeable by the user. NOTE: On Android, "USB debugging" must also be unticked and greyed out as long as the activesync Device Lock security policy is enforced.	To prevent access to device USB mass storage or internal memory, without unlocking the phone.	N/A
Local Connectivity	USB Requirements	USB Profiles	Maintenance Mode via USB	Maintenance Mode(A tool which can take the logs of sequences between the terminal and the network as well as radio parameter) shall be provided by the USB connection.	Vodafone want the protocol messaging log for testing. This tool shall operate via USB I/F. When terminal cannot support this function, then we need to check whether the handset vendor can provide the emulator tool.	N/A
Local Connectivity	VPN	Technology	VPN	The terminal shall support the creation of VPN connectivity.	Enabling connection to a private network.	N/A
Local Connectivity	WLAN	Authentication	Authentication when device is acting as a host	The devices authentication (WPA/WPA2) shall be available when acting as a host device i.e mobile hotspot mode.	Increased security authentication when device is being used as a personal hotspot.	N/A
Local Connectivity	WLAN	Authentication	EAP-AKA Authentication	The device shall support EAP-AKA authentication (as specified in RFC 4187) or EAP-AKA' (as specified in RFC 5448 and 3GPP TS 33.402) with IKEv2 key exchange (as specified in RFC 7296)	EAP-AKA or EAP-AKA' authentication mechanism is required as part of the WiFi Calling (VoWiFi) solution. Without this the terminal can not connect to Wi-Fi	N/A
Local Connectivity	WLAN	Authentication	EAP-SIM authentication	The device shall support EAP-SIM authentication, as described in RFC 4186	Ensure implementation according to standards Essential authentication mechanism for all devices that have Wi-Fi Offload capability. For Wi-Fi Calling (VoWiFi) EAP-AKA will be required in place of EAP-SIM.	N/A
Local Connectivity	WLAN	Authentication	WPA2	The device shall support WPA2 (Personal and Enterprise) encryption	WPA2 provides better security of connection for WiFi connections than WEP and WPA. Should be supported for all terminals with WiFi.	N/A

Local Connectivity	WLAN	Authentication	WPA-PSK Authentication	The device shall be able to connect to a secure WLAN network using the WPA-PSK authentication key.	Allow connection to host devices using WPA-PSK authentication key.	N/A
Local Connectivity	WLAN	General Requirements	802.11k Support	All devices should support 802.11k where the OS allows it. The device should ALWAYS have this enabled by Default whether it is in software (hidden) or selectable on the UI.	VF UK is looking to launch EAP SIM Wi-Fi for London Underground, the Service will aim to use 802.11k to reduce network load from authentications	N/A
Local Connectivity	WLAN	General Requirements	802.11r support	All devices should support 802.11r using Fast Basic Service Set Transition (FT) where the OS allows it. The device should ALWAYS have this enabled by Default whether it is in software (hidden) or selectable on the UI.	VF UK is looking to launch EAP SIM Wi-Fi for London Underground, the Service will aim to use 802.11r to reduce network load from authentications	N/A
Local Connectivity	WLAN	General Requirements	Auto-Join	Terminal SHALL allow user to override automatic WLAN network selection function for EAP-SIM and EAP-AKA OpCos pre-installed profiles (listed in VVS). The user must be able to disable automatic connection (auto-join) to only one or more individual EAP-SIM/AKA WLAN access points, without affecting automatic connection to other available access points. Also, the OpCos pre-installed EAP-SIM and EAP-AKA profiles must be "read-only", and it must not be possible for the end user to Delete permanently one or all the pre-configured profiles, i.e., the options to "Forget/Delete" or "Modify" them shall be removed.	To ensure Auto-Join can be selected/deselected by the user. Essential for VF UK OpCo in relation to EAP-SIM.	EAP_SIM_VFUK_v1.3_issued.pdf
Local Connectivity	WLAN	General Requirements	Automatic Scan	If the terminal is capable to perform automatic scan on WLAN network; 1. the terminal shall not be set on automatic search as default. 2. the user shall be able to disable the automatic search of new network However the device should offer the user during first time start up sequence the option to turn WLAN on and perform a search	Protect device resources (e.g. Battery)	N/A
Local Connectivity	WLAN	General Requirements	Captive portal	Terminal SHALL provide user with a notification that log-in to a captive portal is required	Device needs to know that a captive portal log on is needed	N/A
Local Connectivity	WLAN	General Requirements	EAP - New Access Point Connections	Device should not connect to new Wi-Fi access points while the screen is off or in standby	Required for EAP-SIM Programmed AP's (e.g., 'Auto-BTWiFi'). To avoid high load of authentication servers on the network. Essential enabler for WiFi Calling (VoWiFi) feature	N/A
Local Connectivity	WLAN	General Requirements	Hotspot2.0	The terminal shall be HotSpot certified against Wi-Fi Alliance Passpoint	A minimum of Passpoint Release 1 features is required. For release 2 features Online singup is not a priority and operator policy should be delivered via ANDSF.	Hotspot 2.0
Local Connectivity	WLAN	General Requirements	IEEE 802.1X	The terminal shall support IEEE 802.1X	Important for Data offload	IEEE 802.1X

Local Connectivity	WLAN	General Requirements	IPv6 over WLAN	If WLAN is supported, IPv6 shall be equally possible via WLAN / Wi-Fi	Will impact consistent access to IPv6 services	N/A
Local Connectivity	WLAN	General Requirements	Maintain simultaneous Wi-Fi and Cellular connections	Terminal SHALL be able to maintain cellular and Wi-Fi connections simultaneously	This is required to enable support of separate IP flows distributed on cellular and Wi-Fi (REF: GSMA PRD: TSG22_CM_13). Essential for WiFi Calling propositions	N/A
Local Connectivity	WLAN	General Requirements	Minimum simultaneous connections	When being used as a Wi-Fi Hotspot the terminal shall support a minimum of 10 simultaneous connections.	Failure to comply will lead to poor level of accessibility for many users	N/A
Local Connectivity	WLAN	General Requirements	PMIP	Support of IP session persistence between operator configured WiFi and operator's 3G/LTE networks using PMIP with IP address anchored at HA.	To support Wi-Fi deployments	N/A
Local Connectivity	WLAN	General Requirements	VPN Auto Start	In case device is connected to an open, untrusted Wi-Fi network, the device shall have the capability to configure to start automatically a VPN client to an Enterprise or the Vodafone infrastructure.	Ensures user data can be secured via VPN	N/A
Local Connectivity	WLAN	General Requirements	Wi-Fi hysteresis	Terminal SHALL implement a hysteresis mechanism to avoid connection to/disconnection from the same Wi-Fi AP within a minimum time interval to be configured by operator	Considering Wi-Fi link quality can be varying quickly, client should not keep disconnecting and connecting to the same Wi-Fi AP. REF: GSMA PRD TSG22_CM_56	N/A
Local Connectivity	WLAN	General Requirements	Wi-Fi Provisioning	Terminals SHALL support provisioning with priorities and/or thresholds related to RSSI, BSS load information, Passpoint™ WAN metrics information and minimum Wi-Fi data throughput level e.g. pre-configured or as part of operator policies.	The operator SHALL be able to override default priorities and/or thresholds (outlined by requirements 1 and 2) using proprietary means e.g. Operator can use proprietary Management object (XML file download) to push values for configurable thresholds and/or priorities, or, for IoT Devices the LwM2M standard may be used. Note that the acceptable quality of service threshold for WiFi Calling and Messaging services will need to be managed in addition to this basic connectivity requirement Essential for management of WiFi connections for WiFi Calling (VoWiFi)	N/A
Local Connectivity	WLAN	General Requirements	Wi-Fi Provisioning Priority	Terminals SHOULD use provisioned priorities and /or thresholds by the operator, when present, with higher priority than default manufacturer priorities/thresholds.	If there is pre-configured minimum throughput policy by the operator the default terminal implementation value shall not be used.	N/A
Local Connectivity	WLAN	General Requirements	Wi-Fi Quality - Association	Terminals SHALL consider the following parameters, when available, in selection of a Wi-Fi AP, based on default priorities and/or thresholds for those parameters specified by the manufacturer: - Wi-Fi RSSI - IEEE 802.11 BSS load IE - Passpoint™ WAN Metrics IE	Terminal may have its default minimum RSSI threshold or this threshold can be preconfigured/provisioned by the operator in the terminal. A minimum threshold of -85dBm is recommended. This is to ensure the terminal only connects to quality Access Points. Note that the acceptable quality of service threshold for WiFi Calling and Messaging services will need to be managed in addition to this basic connectivity requirement Essential for WiFi connection	N/A

					management for WiFi Calling	
Local Connectivity	WLAN	General Requirements	Wi-Fi Quality Monitoring	Once associated with a Wi-Fi AP, Terminals SHALL monitor the following parameters when evaluating whether to disassociate and switch back to the 3GPP network based on default priorities and/or thresholds for those parameters specified by the manufacturer - Wi-Fi RSSI - Data throughput - Latency	Terminal may have its default minimum RSSI threshold or this threshold can be preconfigured/provisioned by the operator in the terminal. A minimum threshold of -85dBm is recommended. This is to ensure the terminal only remains on good quality Access Point. Essential for WiFi Calling (VoWiFi) connection management	N/A
Local Connectivity	WLAN	General Requirements	Wi-Fi retry limit	The terminal SHALL limit the number of access retries to the same Access Point when it receives temporary denied access notification from that Access Point.(as e.g. RFC 4186 1026 notification with EAPSIM)	Important that the client does not keep retrying Wi-Fi access after it is denied access. REF: GSMA PRD TSG22_CM_57	N/A
Local Connectivity	WLAN	General Requirements	WLAN - Screen Timeout	Wi-Fi should be set to 'Always on' when Screen is switched off to avoid bill shock.	Where implementation allows, we should ensure that the default is to leave Wi-Fi on when the screen times-out or is switched off by the user.	N/A
Local Connectivity	WLAN	Security	SSID	The device shall be able to connect to a wireless device which has its SSID hidden.	Allow connection to networks with SSID hidden	N/A
Local Connectivity	WLAN	Security	WLAN Security	The device shall be able to connect to insecure WLAN networks that require no security key to connect. The device should display a security warning when associating with an insecure SSID.	Allow connectivity to networks with no security key enabled	N/A
Local Connectivity	WLAN	Security	WPS Key Timeout for bruteforce attack prevention	To prevent WPS Key bruteforce attacks being attempted easily by connecting devices the device firmware will provide the ability to track the attempted incorrect WPS Key entries. Should the "user" enter the WPS Key incorrectly 3 times in succession the device will not accept any further WPS Key entries for a initial configurable interval. The default value for the interval will be one minute with each increment being a further interval (one minute) + the previous countdown time. For Example Incorrect Attempt 1 Incorrect Attempt 2 Incorrect Attempt 3 //Timer Waits 1 Minute Incorrect Attempt 4 //Timer Waits 2 Minutes Incorrect Attempt 5 //Timer Waits 3 Minutes Incorrect Attempt 6 //Timer Waits 4 Minutes Upon a WPS key being entered successfully or the device rebooted then the WPS Key timer and counter will reset again.	To implement lock out policy for WPS key brute force attempts. Security implications.	N/A

Local Connectivity	WLAN	Standards	5GHz Wi-Fi	The terminal shall support Wi-Fi in the 5Ghz band	Important especially for high tier smartphone/tablets to allow users increased data speeds over WiFi. Essential for WiFi Calling (VoWiFi)	N/A
Local Connectivity	WLAN	Standards	IEEE Standard	The WLAN terminal shall comply with the IEEE 802.11 b/g, 802.11 N and N-MIMO standards.	Offers increased speed and Wi-Fi range	N/A
Local Connectivity	WLAN	Standards	Wi-Fi 802.11ac	The WLAN terminal shall comply with the IEEE 802.11ac standards.	Important to offer increased speeds over Wi-Fi.	N/A
Local Connectivity	WLAN	Standards	WPS Standard	The terminal shall support the WPS (Wi-Fi Protected Setup) standard for easy and secure establishment of a wireless home network.	Easier to connect to a WLAN network	N/A
Local Connectivity	WLAN		Wi-Fi authentication time	The terminal should send an authentication request within 10ms of identifying a network.	This would improve the time a terminal takes to connect to an AP. Essential for Wi-Fi Calling (VoWiFi)	N/A
Local Connectivity	WLAN		Wi-Fi Beaconing	The terminal scans once on UE activation from standby then after every minute, while device is active. Wi-Fi beaoning to be completely off during standby, unless UE connected to Wi-Fi. (unless user intervenes)	This would enable us to control/reduce the noise floor of 2.4GHz and 5GHz.	N/A
Local Connectivity	WLAN	Standards	Wi-Fi 802.11v	The device shall comply with the IEEE 802.11v standard.	802.11v – Wireless Network Management – Among other features, it works closely with 802.11k and 802.11r for Fast BSS Transitions - moving the client to a different AP within the network in a seamless way.	N/A
Local Connectivity	WLAN	Standards	Wi-Fi 802.11w	The device shall comply with the IEEE 802.11w standard.	802.11w – Protected Management Frames – is used to achieve a level of protection regarding wireless network management frames in order to avoid forgery and subsequent attacks on the wireless medium.	N/A
Local Connectivity	WLAN	Security	WPA3	The device shall support WPA3.	WPA3 provides several security improvements over WPA2.	N/A
Location Based Service	A-GPS Configuration	SUPL Server settings	SUPL Server configuration	The SUPL-server address shall be configured in accordance with the Vodafone Variant Settings (VVS). For Vodafone OpCos the address will be: supl.vodafone.com, Port 7275 following SUPL standard unless otherwise specified in the VVS.	Essential to use Vodafone's SUPL servers	N/A
Location Based Service	A-GPS Configuration	SUPL Server settings	SUPL V1.0	The device shall support as a minimum SUPL v1.0.	Essential to use Vodafone's SUPL servers. Ideally SUPL 2.0 shall be supported also.	N/A
Location Based Service	GPS Requirements	AGPS	AGPS performance criteria	The integrated GPS receiver must conform to the relevant performance requirements defined in 3GPP TS 25.171.	The GPS receiver's performance cannot be guaranteed. This could lead to degraded performance, i.e. a longer Time to First Fix (TTFF), less accurate positioning etc.	3GPP TS 25.171

Location Based Service	GPS Requirements	GPS	Autonomous GPS support	The terminal shall support the Autonomous GPS mode of operation.	If the terminal supports GPS it must support the Autonomous GPS mode of operation to allow GPS to be used when assistance data is not available, e.g. due to lack of network coverage or incorrect configuration. Note that any implementation of GPS that does not support the Autonomous GPS mode of operation as a fallback for Assisted GPS should be questioned as it is not a sensible implementation.	N/A
Location Based Service	Security Requirements	chipset level access	Access to location information	The device chipset must be allowed to access and request a full GPS location and/or A-GPS location and/or any location information provided by the location services APIs of the device OS during an emergency call.	This is required as part of the AML (advanced Mobile location) service launched in the UK (currently only applicable for Android, but potentially valid for other platform for the future). This is only relevant to any device that can make emergency calls and which has a location services capabilities.	N/A
Location Based Service	Security Requirements	chipset level access	Access to SMS APIs	The device chipset must be allowed to send a binary SMS during an emergency call (not after the call has ended).	This is required as part of the AML (advanced Mobile location) service launched in the UK (currently only applicable for Android, but potentially valid for other platform for the future). The device must be able to send the SMS with the location info to the ECC number.	N/A
Location Based Service	Security Requirements	Privacy	API for location information	Execution environments that provide APIs for applications to access location information, including (A)GPS and Cell-ID information, must control access to those APIs by applications through the implementation of an appropriate security framework. The security framework should use install and/or runtime notification/confirmation to make the user aware that the application is accessing location information. It must not be possible for an application to access location information without using one of the APIs provided by the execution environment.	Uncontrolled access to location information by applications is likely to result in the user's privacy being compromised. This could have serious legal and public relation implications for Vodafone. The use of a security framework not only protects the user but enables different requirements (i.e. notification and confirmation) to be imposed on different applications when accessing location information.	N/A
Location Based Service	Security Requirements	User Privacy	Global (A)GPS On/Off switch	The user shall be able to enable and disable (A)GPS through a simple user interface. The setting shall be applied globally, i.e. across all applications. Note that in addition to this global control, execution environments are expected to provide their own controls that allow users to enable or disable mobile originating location requests on a per application basis (see TCD-LBS_ -REQ-001270). The UI can be on the device itself, or via a suitable connected device such as a laptop. The laptop may display a UI generated using an exposed device API or by any other mechanism such as an on device web server.	The user may not want their location revealed at specific times or when they are in specific locations. Unless a global on/off switch is provided the user will not be able to enable/disable mobile based positioning without changing the settings for each individual application (which in turn would require the user to remember which applications had access to location). The functionality is limited to (A)GPS as providing control over other positioning methods is extremely complicated both to implement and to explain to the user. In addition, (A)GPS allows for a much more accurate location fix.	N/A

Location Based Service	User Plane positioning	Concurrent location requests	Support for concurrent User Plane location requests	If the terminal supports SUPL 1.0 it must support concurrent location requests	Concurrent location requests could occur either because multiple applications are making location requests at the same time or because a single application requests a coarse and fine grained location at the same time (to get a rough location before a GPS position is available). Inability to support concurrent requests will lead to a significantly worse user experience in either of the above cases.	N/A
Location Based Service	User Plane positioning	Default settings	H-SLP Address Settings	<p>The terminal shall store and determine the H-SLP address in accordance with section 6.2 of OMA SUPL 2.0. Specifically the terminal shall first attempt to read the H-SLP address from the UICC (USIM/SIM). If no H-SLP address is stored on the UICC the terminal shall check if the H-SLP address is stored in the terminal. If no H-SLP address is found in the UICC or terminal, then the terminal shall configure a default H-SLP address based on the IMSI as described in OMA SUPL 2.0.</p> <p>The storage of the H-SLP on the terminal must be secure.</p>	<p>If the H-SLP address is not stored in a secure location it could be modified by a malicious application. This could compromise the user's privacy and deny access to the AGPS server / location services.</p> <p>Support for the different methods for provisioning the H-SLP address is required to ensure that it is possible to automatically re-configure terminals if the address of Vodafone's H-SLP changes. It will also help customise vanilla terminals.</p>	OMA SUPL 2.0 TS
Location Based Service	User Plane positioning	Positioning schemes	User Plane support for Terminal Initiated Area Event Triggered Services	The terminal should support Terminal (SET) Initiated, area event triggered services as defined in SUPL 2.0	Vodafone expects SUPL 2.0 support on the server side in the near future, therefore device support is expected.	OMA SUPL 2.0 TS
Location Based Service	User Plane positioning	Positioning schemes	User Plane support for Terminal Initiated Immediate location requests	The terminal shall support Terminal (SET) Initiated, Immediate location requests as defined in SUPL 1.0	Non-compliance will mean that services that use Terminal Initiated Immediate location requests will not work with this terminal. This is the main positioning scheme used by location based services clients and must be supported.	OMA SUPL 1.0 ERELD
Location Based Service	User Plane positioning	Positioning technologies	Support Cell ID positioning	The terminal shall support the E-CID (Cell ID) positioning calculation function, as defined in OMA SUPL 1.0	Cell-ID positioning is used to give a quick, coarse location. As such Cell-ID positioning may be used to give a rough location 1.) before a more accurate (A)GPS position can be established or 2.) in situations where (A)GPS information is not available (i.e. indoors) or 3.) where a rough location is good enough. Failure to support SUPL 1.0 Enhanced Cell-ID positioning will mean that applications on the terminal will not be able to take advantage of Vodafone's SUPL server and Cell-ID database, which will in turn lead to a significantly worse user experience in many applications.	OMA SUPL 1.0 ERELD
Location Based Service	User Plane positioning	Positioning technologies	Support WLAN positioning	If the terminal supports WiFi, the terminal should support the use WLAN Access Points as Network Measurement information, as defined in OMA SUPL 2.0. Specifically, the terminal should support the use of WLAN AP Info parameter.	Vodafone expects SUPL 2.0 support on the server side in the near future, therefore device support is expected.	OMA SUPL 2.0 TS

Location Based Service	User Plane positioning	Positioning technologies	User plane support for AGPS	<p>The terminal shall support A-GPS SET based position calculation function defined in OMA SUPL 1.0</p> <p>The terminal may support the A-GPS SET assisted position calculation function defined in OMA SUPL 1.0</p>	Applications on the terminal will not be able to use the AGPS functionality supported by SUPL 1.0 or take advantage of Vodafone's SUPL server. This will result in the terminal falling back to Autonomous GPS, which in turn will lead to significantly longer Time To First Fix (TIFF), and/or result in the terminal falling back to other positioning technologies such as Cell ID. Note that many location based services require the accuracy provided by (A)GPS and therefore other positioning technologies are unlikely to suffice.	OMA SUPL 1.0 ERELD
Location Based Service	GPS Requirements	GPS	Galileo	The device shall support the Galileo satellite based location system	Important to offer increase accuracy in GPS location, can be compromised in lower tier devices	Location Based Service
Location Based Service	GPS Requirements	GPS	Glionass	The devices shall support the Glionass satellite system	Important to offer increase accuracy in GPS location, can be compromised in lower tier devices	Location Based Service
Location Based Service	User Plane positioning	Positioning schemes	User Plane support for Network Initiated Area Event Triggered Services	The terminal should support Network Initiated, area event triggered services as defined in SUPL 2.0	Vodafone expects SUPL 2.0 support on the server side in the near future, therefore device support is expected.	Location Based Service
Location Based Service	User Plane positioning	Positioning schemes	User Plane support for Network Initiated Immediate location requests	The terminal shall support Network Initiated, Immediate location requests as defined in SUPL 1.0 / 2.0	Non-compliance will mean that services that use Network Initiated Immediate location requests will not work with this terminal. Network Initiated services include services such as track and trace, friend finder etc.	Location Based Service
Location Based Service	User Plane positioning	Positioning schemes	User Plane support for Network Initiated Periodic location requests	The terminal shall support Network Initiated, Periodic location requests as defined in SUPL 2.0	<p>Non-compliance will mean that services that use Network Initiated periodic location requests will not work with this terminal. Services that may use this service include route trackers, track and trace etc.</p> <p>This functionality was only introduced in SUPL 2.0 and therefore may not be widely supported. The same functionality can be achieved (but less efficiently) using multiple Immediate location requests.</p>	Location Based Service
Messaging	SMS	Standard configuration	settings and configuration	<p>Terminal shall support the country specific settings for the service configuration and correct operation on Vodafone network.</p> <p>Afore mentioned settings can be access using the latest version of VVS (Vodafone Variant Setting repository) (note: in case you do not have access, please request it to your Vodafone counterpart)</p>	Essential for interworking	VVS

				In case some settings cannot be supported or configured country per country; please state all limitations in the comment section		
Messaging	RCS	Standard reference	Standard compliancy	Terminal shall support RCS according GSMA specification. In case of non or partial compliance, please state the known limitations in the comment sections.	Essential for Vodafone business	
Messaging	SMS	General Requirements	Extended 3GPP character set	<p>"The terminal shall fully support the input, transmission and display of the extended character sets according to 3GPP TS23.038, including: UCS2 (unicode), GSM7-bit (simple) GSM7-bit (extended) encoding with National Language Single Shift and Shift Locking Mechanism. reference - 3GPP TS 23.040 and 23.038</p> <p>Please note, that 2 input modes are required to be supported to ensure good experience and avoid over charging the customer in Vodafone territories:</p> <p>a) Mode 1: Automatic (default for all languages): -Use GSM 7 bit encoding as long as simple characters are typed. - When user attempts to type a non-simple character (not in GSM 7 bit table): 1. Change encoding into GSM 7 bit extended: single shift or shift lock 2. Change encoding to unicode (16 bit encoding) if it doesn't match above 3 tables. (note, for good UX: if the user deletes the character, the encoding should revert to simple)</p> <p>a) Mode 2 : restriction to simple characters (default for Portuguese, Spanish and Greek languages) -Use GSM 7 bit encoding as long as simple characters are typed. -When user attempts to type a non-simple character (not in GSM 7 bit table): 1. Change encoding into GSM 7 bit extended: single shift or shift lock 2. Doesn't allow however the input of characters outside the 3 above tables (whatever the method used) -Prevent the user typing those characters (hide in the keyboard used) -Pop up giving option to user to switch to Unicode with warning in less characters available in each SMS 3. Change into closest matches (ó into o, û into u, etc...)</p> <p>Finally, Vodafone requires : -That an option is given in setting to allow the customers to edit default mode. -That mode 2: Automatic is set as default for ALL languages with the exception of Spanish, Portuguese and</p>	Impact for interoperability.	<p>characters: -3GPP TS 23.040 -3GPP TS 23.038 Conversion: -3GPP TS 27.005</p>

				Greek , where Mode 1 : restriction to simple characters should be default. (note: instead of tying the mode to the language, OEM may also decide to configure it according country in use, in which case Mode 1 should be default for Spain, Portugal and Greece and Mode 2 for all other countries.)		
Messaging	SMS	General Requirements	Type 0 support	The terminal shall support the receipt of Type 0 (silent SMS) Short Messages according to the requirements described in 3GPP TS23.040. I.e. the successful delivery shall be acknowledged to the network, but no indication to the user shall be given.	Impact for network connection.	3GPP TS 23.040
Messaging	SMS	General Requirements	Independent operation	Terminal should support Short Message Service-Cell Broadcast. (SMS-CB) and correctly display them.	Essential for interworking	
Messaging	MMS	General Requirements	OMA MMS 1.2 support	The terminal client shall comply with the OMA MMS specification suite version 1.2	Impact for network connection. CP: MMS Core suggests a move towards MMS 1.3	
Messaging	E-mail	General Requirements	Email configuration and Vodafone mail	Terminal should first offer the possibility for users to use an email service (create an account, log in to existing account, use emails, delete their accounts) and support popular email protocols (pop3, IMAP, exchange...). In addition, terminal should support easy configuration by preloading server settings from Vodafone Mail for supported countries. [Also refer to VVS for pre-configured e-mail per market]	Without the setting the user will not be able to use Vodafone Mail. May result in additional calls to Customer Care	
Messaging	RCS	Battery Consumption	Minimize impact of RCS/Message + native or pre-embedded client solution implementation on battery consumption	N shall not be higher than 12 with: N = Average RCS in idle power consumption in mW multiplied with 8760h devided by the standard device battery capacity in mWh. To determine the average RCS in idle power consumption, compare energy consumption of: (A) Device with exchange active sync and OS-specific sync (e.g. Google or Live or BlackBerry account) active, ~1500 contacts with MSISDN in address book, screen off, Always-On-Display configured to off, device connected to data, device not moving, RCS off. and (B) same as A but RCS on, and initial contacts discovery finished.	With N=12: - The RCS in idle additional power consumption in one year (8760h) will be equivalent to 12 times the power contained in a fully charged device battery. - A user draining the battery from full to empty within 24 hours without RCS, would drain the battery within 23:14 hours with RCS in idle. - A user draining the battery from full to empty within 5 days without RCS, would drain the battery within 4 days and 7 hours with RCS in idle. - A user draining the battery from full to empty within X hours without RCS, would drain the battery within 1/(1/730+1/X) hours with RCS in idle. - A user draining the battery from full to R% within H hours without RCS, would drain the battery to (R-H/7,3)% after H hours with RCS in idle. Remark: Negative results indicate battery at 0% before H hours - This will happen in case R < H/7,3	

Messaging	RCS	Battery Consumption	Minimize impact of RCS/Message + native or pre-embedded client solution implementation on battery consumption	The average RCS in idle power consumption shall not be higher than 9 mW. To determine the average RCS in idle power consumption, use method described in TCD-RCS_-REQ-012147	An analysis of CTC measurements in 2016 has shown the majority of devices is able consuming less than 9 mW average for RCS (in idle). Devices shall fulfil this requirement to offer best possible user experience / lowest possible battery consumption compared with state of the art / technical feasibility.	
Messaging	RCS	Stack Enablement	RCS only active with unlocked SIM	An RCS configuration shall only be active (provisioning xml usable, identity registered) while the related SIM is in the device and unlocked (SIM-PIN entered and valid or SIM doesn't require PIN).	The user identity is bound to the SIM, not to the device. When the user removes the SIM or when the SIM is not (yet) unlocked, it shall not be possible using the identity for communicating.	
Messaging	RCS	File Transfer	RCS file transfer file name length limitation	The file name submitted for file transfer shall be 250 bytes long maximum within the respective encoding. If the user tries submitting files with longer names (e.g. with special characters consuming several bytes each), the name shall be shortened automatically.	Very long file names currently cannot be handled by Vodafone servers so file transfer will fail.	
Messaging	RCS	Client integration	Android Messages	Pre-embed Google's Android Messages as the default SMS/MMS/RCS messaging application, with placement in the Hot Seat for all Android Compatible Devices. The latest commercial version should be sourced from Google, and follow Google's integration guidelines. Support on Vodafone customised and Open Market devices is requested. OEM will need to make their own commercial arrangements with Google.	Required to support Vodafone's RCS penetration ambition	
Messaging	RCS	Client integration	Google Carrier Services APK	Pre-embed Google's Carrier Services APK which is required to support RCS, ensuring that RCS is excluded from power and data saver according to Google's integration guidelines. OEM will need to make their own commercial arrangements with Google.	CS.APK is an essential component for Google RCS support to Android Messages and Google Phone applications. Without exclusion from power saving, the user won't be reachable via RCS after the device was in idle on battery for a long time without significant movement	
Messaging	MaaP	Messaging as a platform	Maap compliance	Terminal supplier shall indicate if device supports following functions: Messaging as a platform In case of support, Vodafone requires compliance with industry established standards to ensure the correct operation on Vodafone networks. Following standards shall be observed: GSMA RCS UP latest published version at the time TCD feedback is provided. In case of non or partial compliance, please state the known limitations in the comment sections.	restriction in A2P revenue	
Messaging	Dual SIM	RCS	RCS support for all SIMs' identities	The device shall support RCS simultaneously with all SIM identities enabled in the device.	Necessary for reliable continuous RCS service availability for the user and reachability for his contacts.	
Messaging	Dual SIM	RCS	SIM identity selection in messaging	If the user has made the choice sending a message with a specific SIM/identity, this shall be valid for SMS, MMS and RCS at the same time.	If requirement is not fulfilled, contacts might get confused by getting messages from an unknown MSISDN and by getting messages from the same person within	GMSA had specified differently

				<p>Same is valid for all communication in the messaging area (chat, group chat, file share, location share, ...)</p> <p>E.g.: If the user choses sending a message from MSISDN A, the device shall not try sending the message via RCS from MSISDN B.</p>	multiple conversation threads.	initially. Ensure not implementing old GSMA spec.
Messaging	Dual SIM	RCS	SIM selection UI	<p>All RCS user dialogues that might refer to one of the SIMs only shall clearly specify to which SIM they are related.</p> <p>The means used for differentiating SIMs (i.e. names, icons, colours) shall be consistent across all the device.</p> <p>Notes: - In RCS context especially relevant for RCS-master-switch, provisioning MSISDN request, RCS related settings if differentiated between SIMs. - Avoid confusion between references to SIMs and to SIM slots. - Ensure other visuals (e.g. xMS/Chat differentiation) aren't lost by introducing Dual SIM indications.</p>		
Messaging	Dual SIM	RCS	Differentiate SIMs for receiving OTP during provisioning	<p>During RCS authentication related to a specific SIM RCS identity using One-Time-Password (OTP) via SMS, only SMS messages received with the same specific SIM shall be considered for extracting the OTP.</p>	Prevent provisioning fail and prevent provisioning with wrong identity.	
Messaging	Dual SIM	RCS	Using other SIM's mobile data channel during identification or authentication	<p>For RCS identification and authentication purposes related to a specific SIM identity (i.e. initial provisioning using network authentication), the mobile data channels of other SIMs shall be considered same way as a Wi-Fi network.</p> <p>Example: SIM1 mobile data is active / Wi-Fi off / other SIM = SIM2 is trying to provision with RCS --> The provisioning procedures for Wi-Fi need to be used.</p>	Prevent provisioning fail and prevent provisioning with wrong identity.	
Messaging	Dual SIM	RCS	Using other SIM's mobile data not related to identification or authentication	<p>In case RCS needs to consider the data bearer for purposes not related to identification or authentication while RCS data is routed via mobile data of the SIM which is not related to the RCS identity, the actual connection mode shall be considered.</p> <p>NOTE: E.g. for RCS video share codec negotiation, the correct connection mode of the mobile data SIM currently in use needs to be considered.</p>	Correctly consider expected available bandwidth e.g. to avoid drops and bad quality in video share.	
Messaging	RCS	Stack Enablement	2 Factor Authentication provisioning	<p>Devices should support 2 factor authentication as described in the RCS GSMA specs. Please refer to the latest publish version of the spec (RCC.71) for details. 2 factor authentication means users getting provisioned over any bearer, including where HE is available, they will receive an OTP to ensure the received MSISDN is the real MSISDN in the device - HE + SMS OTP</p>	<p>Main areas to be improved: * Make HE even more trustable * Avoid hotspot scenarios, where the user getting provisioned 'steal' credentials from the user/device providing wifi</p>	

Messaging	CBS	Basic requirements	MNPWS Service – Cell Broadcast	<p>The device with connected display shall support the Mobile Network Public Warning System (MNPWS) based on 3GPP Rel-11 (EU-Alert).</p> <p>The warning messages shall be delivered by Cell Broadcast System via 2G, 3G, 4G and later 5G Network. The messages shall be displayed without user action and with distinct warning tone sounded. The device shall support multiple languages. For OpCo specific cell broadcast channels and settings please refer to Vodafone VVS.</p>	The MNPWS Service is relevant for NL and RO. In addition to GR, ES and IT are planning MNPWS, timeline tbd.	<p>ETSI TR 102 900, ETSI TR 102 850 3GPP TS 22.268 3GPP TS 23.041 Radio interface :</p> <p>3GPP TS 25.304, 3GPP TS 25.331, 3GPP TS 36.304, 3GPP TS 36.331, 3GPP TS 45.002, 3GPP TS 44.018, Vodafone VVS</p>
Mobile Broadband	Generic	Device	TAC / GSMA registration	<p>The Vendor shall register a Vodafone-branded Mobile Broadband device with the GSMA. The registration must be inline with the Vodafone template (see MBB reference document).</p> <p>The TAC code shall be uniquely identifiable as a Vodafone device.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Generic	Device	Operating System Support	<p>The Device shall support the following Operating Systems:</p> <ul style="list-style-type: none"> • Windows XP/Vista/7, 8.1 and 10 (32 and 64 Bit) • Apple Mac OS X 10.5.8 Leopard (Intel/PPC) • Apple Mac OS X 10.6.x Snow Leopard (Intel) • Apple Mac OS X 10.7.x Lion (Intel) • Apple Mac OS X 10.8.x Mountain Lion (Intel) • Apple Mac OS X 10.9.x Mavericks (Intel) • Apple Mac OS X 10.10.x Yosemite (Intel) • Apple Mac OS X 10.11.x El Capitan (Intel) <p>Wi-Fi Hotspots shall be OS agnostic.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Generic	Device	Network Lock/Unlock	The Device shall support Network Lock / Unlock as specified by 3GPP.	Required for mobile broadband devices	N/A

Mobile Broadband	Generic	Device	Network Lock/Unlock Tools	<p>The Vendor shall provide development tools that can be used to network lock and unlock the Device. The tools shall support Windows 7 , 8 and 10.</p> <p>The tools are also required to validate the Network Lock / Unlock features.</p>	<p>Required for mobile broadband devices</p> <p>Dependency: Network Lock/Unlock</p>	N/A
Mobile Broadband	Generic	Device	USB 2.0 High Speed, USB 3.0	<p>The Device shall be compliant with USB 2.0 and maintain backwards compatibility with previous versions as specified by the USBIF.</p>	<p>Required for mobile broadband devices</p>	N/A
Mobile Broadband	Generic	Device	Unique USB VID / PID Combination	<p>All Vodafone-branded MBB devices shall have a unique VID / PID Combination. The device shall expose a unique VID/PID combination both before and after the conversion process.</p> <p>The VID/PID must be consistent across all interfaces (e.g. RNDIS, MBIM & Update interfaces).</p> <p>Details on the PID / VID structure are available in the MBB Reference document.</p>	<p>Required for mobile broadband devices</p>	<p>Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface</p>
Mobile Broadband	Generic	Device	Vodafone Common Update Framework	<p>The Vendor shall support the Vodafone Common Update Framework when providing firmware updates for Vodafone branded devices.</p> <p>Detailed information is available in the MBB reference document.</p>	<p>Required for mobile broadband devices</p>	<p>Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface</p>
Mobile Broadband	Generic	Drivers	No Vendor Name Displayed during Driver Install	<p>The Device shall not display the Vendor name to the customer during driver installation.</p>	<p>Required for mobile broadband devices</p>	N/A
Mobile Broadband	Generic	Drivers	Open Source Linux Drivers with GPL Licence	<p>The Vendor shall supply GPL open source drivers for all devices.</p>	<p>Required for mobile broadband devices</p>	N/A
Mobile Broadband	Generic	IPv6	IPv6 - PDP Contexts	<p>(1) The Device shall be capable of requesting and supporting a dual address PDP context according to 3GPP TS 24.008 clause 10.5.6.4 R8 (PDP Type value Hex 8D)</p> <p>(2) The Device shall be capable of supporting two simultaneous primary PDP contexts to the same APN, one with PDP Type IPv4 and one with PDP Type IPv6 as defined in 3GPP TS 23.060 clause 9.2.1</p> <p>(3) The Device shall be capable of falling back to (2) if (1) results in a single IP address being allocated with SM cause #52 'Single address bearer</p>	<p>Required for mobile broadband devices</p>	N/A

				only allowed' or if (1) results in a successful PDP Context activation with address IPv4. as defined 3GPP TS 23.060 clause 9.2.1 and 24.008 clause 10.5.6.6		
Mobile Broadband	MBIM	Custom CID / Device Services	MBIM Device Service - CellID & LAC (AT+CREG)	The Device shall support CellID & LAC (AT+CREG) via MBIM Device Services and shall expose an object which includes the following information as per the AT+CREG Command: <ul style="list-style-type: none"> • CellID • RNCID • LAC 	Required for mobile broadband devices Dependency will be on MBIM_CID_DEVICE_SERVICES	N/A
Mobile Broadband	MBIM	Custom CID / Device Services	MBIM Device Service - Hard reset	The Device shall support "Hard reset" via MBIM Device Services. The desired behaviour is as follows: <ul style="list-style-type: none"> • Hard reset triggered • Remove from Device Manager • Re-enumerate and boot from fresh • Delete all NvRAM configuration 	Required for mobile broadband devices Dependency will be on MBIM_CID_DEVICE_SERVICES	N/A
Mobile Broadband	MBIM	Custom CID / Device Services	MBIM Device Service - Soft reset	The Device shall support "Soft reset" via MBIM Device Services. The desired behaviour is as follows: <ul style="list-style-type: none"> • Soft reset triggered • Keep device in Device Manager • Reboot the device and re-initialise from Pin "Enter", all the way up the stack 	Required for mobile broadband devices Dependency will be on MBIM_CID_DEVICE_SERVICES	N/A
Mobile Broadband	MBIM	Custom CID / Device Services	MBIM Device Service - Write MSISDN to SIM	The Device shall have the ability to write the MSISDN to the SIM card via MBIM Device Services. This capability shall be accessible via the MBN APIs.	Required for mobile broadband devices Dependency will be on MBIM_CID_DEVICE_SERVICES	N/A
Mobile Broadband	MBIM	Device	MBIM Support	The Device shall comply with the MBIM 1.0 specification and shall support all mandatory MBIM CIDs.	Required for mobile broadband devices	http://www.usb.org/developers/devclass_docs/MBIM10.zip
Mobile Broadband	MBIM	Device	Windows 10 MBIM Support	The Device shall support MBIM-Based Mobile Broadband Requirements for Windows 10	Required for mobile broadband devices Dependency: MBIM Support	http://msdn.microsoft.com/en-us/windows/hardware/h918600
Mobile Broadband	MBIM	Device	USBIF Compliance	The Device MBIM Interface must pass the USBIF compliance program.	Required for mobile broadband devices Dependency: MBIM Support	http://www.usb.org/developers/compliance/
Mobile Broadband	MBIM	Device	Windows Hardware Certification Program	The Device shall comply with the Windows Hardware Certification (WHC) Program for Mobile Broadband. For Vodafone Branded Devices, the following values should be used for the Logo submission:	Required for mobile broadband devices	http://msdn.microsoft.com/en-us/library/windows/desktop/br230808.a

				<p>Product name: Vodafone <model name></p> <p>Marketing name: Leave Blank</p> <p>Device metadata category: Network > Mobile Broadband Network</p>		spx
Mobile Broadband	MBIM	Device	WHC Certificate Transfer to Vodafone	<p>The Vendor shall transfer the WHC Certificate to "Vodafone Group Service" via WHDC.</p> <p>Vodafone require the following items before Technical Acceptance can be granted:</p> <ul style="list-style-type: none"> • A copy of the passed WQReady.xml file generated by the Logo Test Kit • An email containing the Submission ID 	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Device	Identity Morphing	<p>The Device shall support "Identity Morphing" as specified by Microsoft to allow different USB interfaces to be exposed on different operating systems.</p> <p>Details on the USB interface specification can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	MBIM	Device	MBIM USB Device naming for Vodafone Branded Devices	<p>The Vendor shall comply the Vodafone specification for MBIM USB Device naming.</p> <p>The definition shall be found in the MMB Reference document.</p> <p>This requirement is only applicable to Vodafone Branded Devices.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	MBIM	Device	Network Unlock via MBIM CID	<p>The Vendor shall map the SIM lock OID to the following OID: MBN_PIN_TYPE_NETWORK_PIN</p> <p>This is PH-NET PIN from 3gpp TS27-007</p> <p>The Vodafone VMBAE will provide a UI to perform network unlock on Windows 10</p>	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_STK_PAC	This CID is used to propagate proactive commands from the SIM card to the host. A proactive command is always triggered from the SIM card.		N/A

Mobile Broadband	MBIM	Generic CID	MBIM_CID_STK_Device_RESPONSE	This CID is used to send a Device response to a proactive command.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_STK_ENVELOPE	This CID is used to send an envelope command from the host to the SIM card.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_AKAP_AUTH	This CID is used to send an authentication challenge to the device. The device must use the AKA 3rd generation Authentication and Key Agreement mechanism, specified for Universal Mobile Telecommunications System (UMTS) in [TS33.102].	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SIM_AUTH	This CID is used to send an authentication challenge to the device. The device must use the authentication mechanism that is based on the GSM authentication and key agreement primitives which is a 2nd generation mobile network standard.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_AKA_AUTH	This CID is used to send an authentication challenge to the device. The device must use the AKA 3rd generation Authentication and Key Agreement mechanism, specified for Universal Mobile Telecommunications System (UMTS) in [TS33.102].	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SERVICE_ACTIVATION	This command instructs devices to initiate service activation in order to gain access to the provider's network.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PHONEBOOK_CONFIGURATION	This CID is used to retrieve information of the device phonebook.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PHONEBOOK_READ	This CID is used to read one or all entries from the device phonebook.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PHONEBOOK_DELETE	This CID is used to delete one or all entries in the device phonebook.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PHONEBOOK_WRITE	This CID is used to write an entry to the device phonebook.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_DEVICE_CAPS	The function prepares and returns an MBIM_DEVICE_CAPS_INFO structure in response to a MBIM_COMMAND_MSG with UUID_BASIC_CONNECT and CID MBIM_CID_DEVICE_CAPS.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PACKET_SERVICE	This command is used to instruct devices to perform packet service attach or detach actions on the current registered provider's network for GSM-based. In addition to the packet service attach/detach status, this CID is used to determine data class availability, the currently used data	Required for mobile broadband devices	N/A

				class information, and the uplink and downlink speeds.		
Mobile Broadband	MBIM	Generic CID	MBIM_CID_CO_NNECT	This command activates or deactivates a particular IP data stream session and reads the activation state of a session.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PROVISIONED_CONTEXTS	This command reads or updates the provisioned context entries stored on the MB device or the Subscriber Identity Module (SIM).		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_IP_CONFIGURATION	Sometimes, some or all of the IP configuration information is obtained as part of the procedure in which the link-layer for data services is established. In such cases, the MBIM function acquires IP configuration information from the carrier network on behalf of the host. This CID is used to transfer such IP configuration information from an MBIM function to the host.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PACKET_STATISTICS	This command returns the packet statistics for all the Raw IP Data Streams kept by the device. These are IP packet statistics, unrelated to the underlying NTB transport used to transfer the IP packets.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_IP_PACKET_FILTER	This command returns information about the list of packet filters and allows that list to be set. These packet filters apply exclusively to IP data stream sessions.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_RADIO_STATE	The command sets or returns information about a MB device's radio power state.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_HOME_PROVIDER	This command sets or returns information about the home provider of the cellular service subscription. For GSM-based devices and CDMA-based device with U-RIM, this information should be stored on the Subscriber Identity Module (SIM card).	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PREFERRED_PROVIDERS	This command returns information about the list of preferred providers for GSM-based devices.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_VISIBLE_PROVIDERS	This command returns a list of network providers currently visible within the MB device's range.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_REGISTER_STATE	This command selects a network provider with which to register. MBIM supports two registration methods: automatic and manual.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SIGNAL_STATE	This command returns or sets the current signal state.	Required for mobile broadband devices	N/A

Mobile Broadband	MBIM	Generic CID	MBIM_CID_MULTICARRIER_PROVIDERS	This command returns a list of network providers that are the preferred providers for a multi-carrier function. The CID is supported when the device reports support for MBIM_CTRL_CAPS_MULTI_CARRIER.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SUBSCRIBER_READY_STATUS	The function prepares and returns an MBIM_SUBSCRIBER_READY_INFO structure in response to an MBIM_COMMAND_MSG with UUID_BASIC_CONNECT and MBIM_CID_SUBSCRIBER_READY_STATUS. This structure contains the Subscriber Identity Module (SIM) card ready state as well as some information on the SIM card (SubscriberId, IccId, Telephone numbers).	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PIN	During the initialization process, the host does not proceed to registration until PIN1 is successfully unlocked, if enabled. The host provides a PIN value, entered by the end user, in the Pin member of the MBIM_SET_PIN structure when processing set requests. The function must process the request only when the PIN value matches the value stored in the SIM card. Otherwise, functions must fail the set request with status code MBIM_STATUS_FAILURE.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_PIN_LIST	This command returns a list of all the different types of Personal Identification Numbers (PINs) that are supported by the MB device and additional details for each PIN type, such as the length of the PIN (minimum and maximum lengths), PIN format, PIN-entry mode (enabled/disabled/not-available). This CID also specifies the current mode of each PIN supported by the function.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_EMERGENCY_MODE	This CID returns information about an MBIM function's emergency mode state. This CID applies to functions that are capable of supporting emergency mode. Emergency mode could be over the traditional voice or over VoIP.		N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_USSD	This CID is used to control the Unstructured Supplementary Service Data (USSD) according to 3GPP TS 22.090 [3GPP22090].	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SMS_CONFIGURATION	This command indicates the state of the SMS storage and also sets or returns a MB device's SMS text message configuration.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SMS_READ	This command reads SMS text messages stored in the MB device, or Subscriber Identity Module (SIM card), or any other auxiliary non-volatile memory or memories.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SMS_SEND	This command sends SMS text messages to another device capable of receiving SMS.	Required for mobile broadband devices	N/A

Mobile Broadband	MBIM	Generic CID	MBIM_CID_SMS_DELETE	This command deletes SMS text messages stored in the MB device, or Subscriber Identity Module (SIM card), or any other auxiliary non-volatile memory or memories.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_SMS_MESSAGE_STORE_STATUS	This command reports the status of the MB device's message store.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_DEVICE_SERVICES	This CID is used to query the device services supported by the MBIM devices and their properties.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_DEVICE_SERVICES_SUBSCRIBE_LIST	The host uses this CID to inform the function of the CIDs for which the host wishes to receive unsolicited events via MBIM_INDICATE_STATUS_MESSAGE. As a result, the function must only indicate notifications for CIDs which have been enabled via this CID. The host updates this list appropriately as its state changes. State changes at the host are possibly triggered by events received from the function (including "wake up" from dormant states). Upon re-enabling suppressed notifications the host is responsible for synchronizing to the latest device state by performing queries for those CIDs.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_DS_CONNECT	This CID activates and deactivates a data stream channel over the bulk pipe for a non-IP based Device Service.	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Generic CID	MBIM_CID_NETWORK_IDLE_HINT	This CID is a network idle mode hint from the host to the function. The MBIM function can use this hint in its heuristics to enable mechanisms such as 'Fast Dormancy', and to faster enter low power modes in its network operations. The tradeoff, of course, is potentially longer latency. The host also uses its own heuristics to determine when to send this hint to the function, and may typically happen when the host estimates that for a period of time there will be a reduction in network traffic via this MBIM function, or if the host is entering some idle state.		N/A
Mobile Broadband	Mobile Wi-Fi	Device	UPNP Support	The Device shall support UPNP. Must be disabled for Mobile WiFi by default with possibility to turn on in Web Interface.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	UPNP Support for SD Card File Access via WLAN	The Device shall support SD Card file access via WLAN using UPNP.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Windows 10	Network Cost Information exposed via Wi-Fi Beacon	The Device shall provide Network Cost Information Element via WiFi Beacon.	Required for mobile broadband devices	http://msdn.microsoft.com/en-us/library/windows/hard

						ware/hh770509 MBB Reference document
Mobile Broadband	Mobile Wi-Fi	Windows 10	PnP-X Support	The Device shall support the PnP-X protocol as specified by Microsoft.	Required for mobile broadband devices	<ul style="list-style-type: none"> • PnP-X (http://msdn.microsoft.com/en-us/windows/hardware/gg463082.aspx/) • Windows Rally(http://msdn.microsoft.com/en-us/windows/hardware/gg463018.aspx/)
Mobile Broadband	Mobile Wi-Fi	Windows 10	Vodafone Branded PnP-X Elements	The Vendor shall ensure that all PnP-X Elements are Vodafone Branded. The Vendor name shall not be visible to the user.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	Firmware Size & AutoRun volume	For a USB Modem which requires an Autorun volume. A minimum of 128MB of available memory should be provided with at least 90MB of it available for Vodafone Mobile Broadband dashboards and additional value added software.	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	Drivers	ECM Driver for Apple Mac	The Vendor shall provide an ECM Driver for Apple Mac.	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	Drivers	Vodafone Branded Windows Drivers for Firmware Update	The Vendor shall provide Vodafone Branded Windows drivers for firmware update.	Required for mobile broadband devices	N/A

Mobile Broadband	Generic	Device	Apple Mac Ethernet Emulation (RNDIS Style)	The Vendor shall provide Ethernet style device drivers which support high speed data transfer (100mbs+). These drivers shall work on all required versions of MAC OS in both x32 & x64 architecture.	Required for mobile broadband devices	N/A
Mobile Broadband	Generic	Device	Linux Ethernet Emulation (RNDIS Style)	The Linux driver for Vodafone-branded MBB shall expose the device as an Ethernet interface (CDC_Ether) or provide kernel extensions allowing the device to support high speed data throughput (100mbs+).	Required for mobile broadband devices	N/A
Mobile Broadband	MBIM	Device	Bearer Type - MBIM	The Vendor shall implement the Vodafone definition of the MBIMDATACLASSCUSTOM for all MBIM devices. The definition shall be found in the MMB Reference document.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Certification	USBIF Compliance for Mobile Wi-Fi Devices	The Device shall be certified by the USBIF Compliance Program.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Certification	Windows Hardware Certification - Windows logo program for Routers	The Device shall be certified by the Windows Hardware Certification Program and be compliant with all mandatory requirements for routers.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Certification	Wi-Fi Alliance Certification	The Device shall be certified by the Wi-Fi Alliance.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Auto APN configuration	The Device shall automatically connect to the internet once it receives power. <ul style="list-style-type: none"> • The Device shall store a table with APNs for all Vodafone Operators in the device firmware • The Device will automatically try and connect to each APN in the order defined in the lookup table • Once the device makes a successful connection, the APN profile is set as default and placed in the highest priority in the APN list for future use. • The Device shall provide the ability to manually select an APN in the WebUI • If a custom APN profile is created in the WebUI, this is set as the default profile for future use <p>Further details on the APN database and connection logic can be found on the Microsoft web site.</p>	Required for mobile broadband devices	Further information is publicly available on the Microsoft web site

Mobile Broadband	Mobile Wi-Fi	Device	RNDIS Utility	<p>The Vendor shall provide a "Convert to RNDIS" utility.</p> <p>This tool shall support all devices (e.g. Routers and USB sticks) currently supplied by the Vendor to Vodafone.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Custom Vodafone SSID	<p>The Vendor shall implement SKU aware Vodafone SSIDs.</p> <p>Further details are available in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Device	Device Connectivity Behaviour - Initial Power On	<p>- Initial Power On when on Automatic Modem</p> <p>The Device shall automatically connect to a network when switched on and configured in "Automatic modem" mode. The Device shall enter a power saving mode if no devices are attached via WiFi. The Device shall switch off WiFi after 10 minute and 3G after 60 minutes. The user will be required to press a button on the device (power button) to wake up the device. When the charger is connected to the device, 3G and WIFI should always remain switched on.</p> <p>- Initial Power On when on Manual Modem via WiFi</p> <p>The Device shall require user input to connect to the network when configured in "Manual modem" mode. This can be accomplished via the Web UI.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Device Connectivity Behaviour - Monitoring associated devices	<p>Powered by Battery</p> <p>The Device shall disconnect from the 3G network and enter sleep mode when powered by battery and no users are connected to WiFi for a period of 10 minutes.</p> <p>Powered by USB Cable or via Mains Power</p> <p>The Device shall not enter Sleep mode when powered by USB Cable or Mains Power. If the device was previously in sleep mode (e.g. if previously powered by battery), the Device shall automatically establish a WiFi connection and connect to the 3G</p>	Required for mobile broadband devices	N/A

				<p>network when in "Automatic mode". In "Manual mode" the device shall only establish a WiFi connection but shall not connect to a 3G network.</p> <p>On Demand Mode</p> <p>The Device shall support an "On demand mode" where use of the 3G backhaul should only be on a "On demand" basis.</p>		
Mobile Broadband	Mobile Wi-Fi	Device	Product naming	The Vendor shall use the Vodafone product name instead of the Vendor's generic product name. The product name must be used in a consistent way. The Vendor shall implement the Vodafone- branded model for all of the possible elements which are exposed via the device.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Device	DLNA Media Server	<p>The Device shall preinstall a licensed copy of the TwonkyMedia Server software from PacketVideo.</p> <p>TwonkyMedia server can be used to share and stream media to most UPnP AV or DLNA-compliant clients, in addition to non-UPnP devices through the HTML, RSS, and JSON supported front-ends.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Linux Operating Systems Environment	The Device shall support Linux development environment.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Linux Tool Chain & Compilers	The Vendor shall provide the Linux Tool Chain and Compilers to allow Vodafone to develop Linux binaries and components that run on the Mobile Wi-Fi hardware.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	No Throughput Limitation	The Device shall expose the maximum uplink and downlink of the baseband chipset to the client that is connected to the device via WiFi & USB.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Non Plug-and-Play Variant	The Device shall only expose Network Adapters when operating in a non plug-and-play mode. The CD-ROM or SD Card shall not be exposed. The Device shall behave / assume that the software and drivers are already pre-installed.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	Required RAM	The Device shall provide a minimum of 512MB RAM. 1GB is preferred.	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	SD Card Support	The Device shall support SD Cards.	Required for mobile broadband devices	N/A

Mobile Broadband	Mobile Wi-Fi	Device	SIM / Product SKU	<p>The Device shall support multiple SKUs.</p> <p>NVRAM parameters shall be used to denote the SKU. The SKU will be determined during the factory provisioning process and will identify the end Vodafone target.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	Device	USB Requirements	<p>The Device shall expose Vodafone defined USB interfaces based on the OS.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Display	Network Names	<p>The Device shall display the network name based on the VF operator SIM Card. The Device shall display the LONG network name. (e.g. "Vodafone.de" should be shown when a VF Germany SIM is detected and the customer is registered on the Vodafone Germany network. If a VF Germany customer is roaming in the UK, the bearer should be 3G HSDPA while the network name should match the PLMN that the user is on eg 23415 = "Vodafone UK")</p> <p>The Vendor shall display the default device name when the network cannot be recognised.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Display	Opco Specific Network Bearer Names	<p>The Device shall display the bearer name based on the Vodafone Operator SIM card. The bearer name shall be displayed in the connectivity bar and also when showing the "Available Mobile Networks" – preferred networks and service when a network scan is performed.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	Display	Network band preference	<p>The Device shall provide the ability to select Network Band Preferences. The following 3 modes shall be supported.</p> <ul style="list-style-type: none"> • 3G Preferred – Device will search first and register on 3G Bands with priority ahead of GPRS bands (Default) • 3G Only – Device will only search and register on 3G Bands • GPRS Only – Device will only search 	Required for mobile broadband devices	N/A

				<p>and register on GPRS Bands</p> <p>For 4G capable devices:</p> <ul style="list-style-type: none"> • 4G Preferred – Device will search first and register on 4G bands with priority ahead of 3G and GPRS bands • 4G Only – Device will only search and register on 4G bands <p>The selected mode shall be retained on device reboot.</p>		
Mobile Broadband	Mobile Wi-Fi	Display	Display UI Elements	<p>The Vendor shall support the minimum set of UI Display elements that are needed to support the basic use case.</p> <p>The Vendor shall implement these elements as defined by Vodafone.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	ID	Industrial Design	<p>The Vendor shall adhere to Vodafone Industrial Design guidelines.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	WebUI	Vodafone Mobile Wi-Fi Hardware API	<p>The Device shall support the latest version of the "Vodafone Mobile Wi-Fi Hardware API"</p> <p>The specification is available in the MBB Reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Mobile Wi-Fi	WebUI	Default IP and Hostname	<p>The Device shall use the following default IP address: 192.168.0.1 and hostname: http://VodafoneMobile.wifi</p> <p>For VHA Pocket Wi-Fi devices, the Web UI shall be accessible via the following IP address: http://192.168.0.1 and hostname: http://pocket.wifi/</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	WebUI	SD Card API access	The Device shall support access to the SD Card through Web APIs.	Required for mobile broadband devices	N/A

Mobile Broadband	Mobile Wi-Fi	WebUI	Concurrent Users	<p>The Device shall support a minimum of 5 concurrent users, configurable on per VF OpCo basis, detected by the SIM. The user shall not be able to change the number of concurrent users.</p> <p>The maximum number of concurrent users shall be set by the Vendor prior to shipment. Unless otherwise specified by a Vodafone Operator, the default shall be 10 concurrent users.</p> <p>Should the currently associated users to the hotspot exceed the configured maximum concurrent users then a new user will not be able to locate or associate against the hotspot when performing a network search until the level of concurrent users has dynamically decreased.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	Mobile Wi-Fi	WebUI	DNS Hostname customisation	The Device shall provide the capability for custom DNS Hostnames.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	Auto APN configuration for USB Dongles	<p>The Device shall automatically connect to the internet once it receives power.</p> <ul style="list-style-type: none"> • The Device shall store a table with APNs for all Vodafone Operators in the device firmware • The Device will automatically try and connect to each APN in the order defined in the lookup table • Once the Device makes a successful connection, the APN profile is set as default and placed in the highest priority in the APN list for future use. • The Device shall provide the ability to manually select an APN in the WebUI • If a custom APN profile is created in the WebUI, this is set as the default profile for future use <p>Further details on the APN database and connection logic can be found in the MBB Reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	AutoRun Capability	The Device shall support an embedded solution for Plug & Play for installing software and connecting to the internet.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacti

						ng their Microsoft interface
Mobile Broadband	QuickStart	Device	RNDIS Utility for Quickstart	<p>The Vendor shall provide a "Convert to RNDIS" utility.</p> <p>This tool shall support all devices (e.g. Routers and USB sticks) currently supplied by the Vendor to Vodafone.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	Device	Product naming for Quickstart	<p>The Vendor shall use the Vodafone product name instead of the Vendors generic product name. The product name must be used in a consistent way. The Vendor shall implement the Vodafone- branded model for all of the possible elements which are exposed via the device.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	SIM / Product SKU for USB Dongles	<p>The Device shall support multiple SKUs.</p> <p>NVRAM parameters shall be used to denote the SKU. The SKU will be determined during the factory provisioning process and will identify the end Vodafone target.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	USB Requirements for USB Dongles	<p>The Device shall expose Vodafone defined USB interfaces based on the OS.</p> <p>Details can be found in the MBB reference document.</p>	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	Device	Memory for Vodafone ISO	<p>The Vendor shall reserve a minimum of 90MB of onboard memory on the Device for a Vodafone ISO.</p>	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	WebUI	Vodafone QuickStart Hardware API	<p>The Device shall support the latest version of the "Vodafone Quickstart Hardware API"</p> <p>The specification is available in the MBB Reference document.</p>		Microsoft Partners can obtain the MBB Reference

						Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	WebUI	Default IP and Hostname for USB Dongles	<p>The Device shall use the following default IP address when inserted into a PC: 192.168.9.1. This address has been chosen to ensure that there is no conflict with other “router” products.</p> <p>The default hostname for the device shall be:</p> <ul style="list-style-type: none"> - http://vodafonemobile.vmb - The Vodafone WebUI shall be directly accessible from this URL - The customer shall be able to change this URL in the WebUI <p>The direct access hostname for the device shall be:</p> <ul style="list-style-type: none"> - http://vodafonemobile.api - This hostname is always accessible and not changeable programmatically or via the WebUI - This would be used by the VMB SDK for accessing the Hardware API 	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	WebUI	SD Card API access for USB Dongles	The Device shall support access to the SD Card through Web APIs.	Required for mobile broadband devices	N/A
Mobile Broadband	QuickStart	WebUI	DNS Hostname customisation for USB Dongles	The Device shall provide the capability for custom DNS Hostnames.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	QuickStart	WebUI	HTTP WebUI Server	The Device shall include a HTTP Webserver and WebUI for management.	Required for mobile broadband devices	Microsoft Partners can obtain the MBB Reference Document by

						contacting their Microsoft interface
Mobile Broadband	Generic	Device	Multiple PDP context supported as per MBIM specification	<p>The device shall support multiple PDP context as defined in the MBIM specification and it should pass Windows Hardware Certification Kit (WHCK) tests specific to Multiple PDP Context.</p> <p>Device firmware shall support multiple IP data streams as detailed in section 10.5.12.1 in MBIM specification. This includes supporting all the control implementation of CIDs and IP data streams for full support of multiple PDP contexts.</p> <p>Device firmware shall support a total of 8 dual bearer (IPv4 & IPv6) PDP contexts for usage by Windows. This includes 1 for internet connectivity and 7 additional for Operator Apps.</p> <ul style="list-style-type: none"> o This does not require device managed PDP contexts that the firmware may use for SMS and any other administration contexts. o Device firmware should be able to leverage host OS request for a PDP context that is already device managed internally in its firmware to be handled gracefully. o Device firmware should continue to abstract SMS PDP contexts and route them through the SMS CIDs regardless of the bearer used underneath. 	Required for mobile broadband devices running Windows 10.	Microsoft Partners can obtain the MBB Reference Document by contacting their Microsoft interface
Mobile Broadband	Feature	Core	Voice, FAX, POS support	<p>The Terminal shall support Voice, FAX, POS features via PS.</p> <p>The Terminal shall support multiple simultaneous APNs / PDP contexts with different Quality of Service. (For example, a Voice APN could have two PDP contexts, one with Interactive Gold QOS and the other with Streaming QOS. They can be Always-on and/or On-demand).</p> <p>In case of failure of IMS network, or in case of no data coverage (3g, GPRS), the Terminal shall support Voice via CS.</p>	<p>Priority is "preferred". For USB Sticks supporting VOX.</p> <p>Required to support Voice, Fax, POS features for backup or to allow the user to get online before the Fixed-line connection is activated.</p> <p>Multiple APNs are required for security reasons (to avoid exposing voice APN to public internet because it is connected to IMS Vodafone network) and for billing (data and voice have different billing mechanisms based on APN activation)</p>	N/A
Mobile Broadband	Feature	Legal	Cell ID and LAC	<p>The Terminal shall support AT commands to retrieve location information (i.e. Cell ID and LAC).</p>	<p>Priority is "preferred". For USB Sticks supporting VOX.</p> <p>Location information is required to resolve legal issue for Vodafone Italy. It is not possible to use a Geographic Number of a telephone district if you are not physically there. This is an issue as the VOX box is portable and can be moved to other physical locations. The location information allows Vodafone to restrict voice calls to the location that has been registered.</p>	N/A

Mobile Broadband	Feature	Legal	Emergency call support	The Terminal shall support emergency calls (1) without SIM (2) with PIN locked SIM (3) when attached to a forbidden network.	Priority is "preferred". For USB Sticks supporting VOX. Required to fulfil legal requirements around emergency calls.	N/A
OneNumber	Vodafone OneNumber	Connectivity	SIM connectivity	The device should have: either a classic SIM slot, compatible with Vodafone SIMs in the target markets; or an integrated eSIM module that can be provisioned with Vodafone eSIM profiles.	Devices without mobile connectivity, (e.g. wifi tablets) are not considered in the current phase of the MD proposition.	
OneNumber	Vodafone OneNumber	Functionality	Standalone calling	The device shall be able to place and receive voice calls directly on the mobile network, without having to be connected to a primary device either via Bluetooth or remotely.		
OneNumber	Vodafone OneNumber	Onboarding	Provisioning	Devices that are designed to be provisioned with the help of a primary device (eg. android app on the phone) shall support at least one of the GSMA pull or push methods. Custom activation journeys would have to be agreed but are not recommended.		
OneNumber	Vodafone OneNumber	User Experience	OneNumber	The operating system and possible companion app shall be designed with the concept of the secondary device having the same MSISDN as the user's primary phone.		
Security	GSM Security	Ciphering Algorithms	GSM Ciphering Algorithms	Ciphering algorithms shall be supported as specified in 3GPP TS 43.020. Refer to VVS (Vodafone Variant Settings) for further Vodafone OPCO roll out status. Clause 4.9 specifies which encryption algorithms are mandatory and which are optional.	It's important to note that A5/4 is one of the mandated algorithms. Further, A5/2 must not be supported.	3GPP TS 43.020
Security	GPRS Security	Ciphering Algorithms	GPRS Ciphering Algorithms	Ciphering algorithms shall be supported as specified in 3GPP TS 43.020, clause D.4.9. In addition, Vodafone requires support for GEA4 as a mandatory feature (not optional as TS 43.020 states).		3GPP TS 43.020
Security	3G Security	Ciphering and Integrity Algorithms	Ciphering and Integrity protection	Ciphering and integrity protection as specified in 3GPP TS 33.102 shall be supported for all 3G capable devices. TS 33.102 clause 6.6.6 specifies which encryption algorithms are mandatory; likewise clause 6.5.6 specifies which integrity algorithms are mandatory. For the avoidance of doubt, the null integrity algorithm (that might be called "UIAO") must not be supported; and whenever applicable according to the standard, integrity verification on received messages must be enforced.		3GPP TS 33.102
Security	LTE	Ciphering and Integrity Algorithms	Ciphering and integrity algorithms	For all LTE capable devices ciphering and integrity algorithms shall be supported as specified in 3GPP TS 33.401. Clause 5.1.3.2 specifies which encryption algorithms are mandatory and which are optional; likewise clause 5.1.4.2 specifies which integrity algorithms are mandatory and which are optional. For the avoidance of doubt, the null integrity algorithm (EIAO) may only be used for unauthenticated emergency calls; in all other contexts, whenever applicable		3GPP TS 33.401

				according to the standard, integrity verification on received messages (using a non-null algorithm) must be enforced.		
Security	Android	Bootloader	Unlocking the Bootloader	Unlocking the boot loader for Android devices shall be enabled only when the specific requirements as described in the reference document, Bootloader Unlock_Sept_2011.pdf, are satisfied.	Ensures that Vodafone is indemnified of obligations once the bootloader is unlocked. The bootloader unlock is to enable those customers who are technically willing/able to reflash their device to any software build they wish. This is only possible if the bootloader is not locked down as this controls the ability to manually flash software. Relevant to Android platform.	Bootloader Unlock_Sept_2011.pdf
Security	Application Security		PC access to Locked Device	When connected to a PC, if the device is locked when connected, no storage systems will mount.	<ul style="list-style-type: none"> - Applicable to Voice and Data devices - Applicable to all with tech but Mid to High with risk - Needed within Release Timescale - If non compliant, manufacturer must state why. Unless exceptional reasons provided, non compliance should not be acceptable as it allows an easy avenue for attack 	N/A
Security	Bluetooth Security	General	Protection against Unauthorised Access	<p>It shall NOT be possible for an unauthorised person to access any information (e.g. phone book, calendar, images, etc) stored on the terminal without the user's knowledge or approval. Specifically, the terminal shall not be vulnerable to so called "Bluesnarfing" attack described in the public domain.</p> <p>It shall NOT be possible for an unauthorised person to make phone calls or send/receive messages from the terminal using Bluetooth without the user's knowledge or approval.</p> <p>All access to the terminal shall comply with the security requirements described in the Bluetooth specifications and Vodafone's Terminal requirements for Bluetooth Security.</p>	<p>Description: Bluesnarfing is well-known attack that affected mainly Nokia and SonyEricsson terminals in the past. Most of the problematic handsets have been reported to be fixed.</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: It is critical that terminal is not vulnerable to any known attacks such as "Bluesnarfing". VF can not accept the terminal if it has a known Bluetooth vulnerability.</p>	N/A
Security	Core Terminal	Debug Ports	OMTP TRO Debug Port requirements	<p>The terminal shall satisfy Debug Port requirements (DP1-5) in Section 7.2 of the OMTP Trusted Environment TRO recommendations.</p> <p>If the terminal is only partially compliant, please state which requirements are not satisfied.</p>	<p>Description: A debug port allows external hardware and/or software to connect to ME debugging software components and on chip debugging support logic. This will typically allow run-time control, memory read/write access, access to trace information etc. As such, debug ports can be used to circumvent many security controls.</p> <p>Impact: Access to software or hardware debug ports is likely to allow the security mechanisms that underpin features such as SIM lock and IMEI protection to be compromised. There is no reason to allow debug port access in consumer terminals. Non-compliance should be questioned. Partial compliance may be accepted depending on the explanation provided by the vendor.</p>	OMTP TRO, available from https://www.gsma.com/newsroom/gsmadocuments/omtp-documents/

					Contact Person: Steve Babbage	
Security	Core Terminal	General	Protection of low level operation of communications protocols	It shall not be possible for unauthorised modifications to be applied to the software and/or hardware that controls the communications parts of the terminal. This includes but is not limited to: GSM, 3G, 4G, Bluetooth and Wi-Fi.	<p>Description: This requirement ensures that the terminal cannot be modified in such a way that could cause radio interference in the network or other communication channels.</p> <p>Priority: Essential</p> <p>Non-Compliance Impact: This is to avoid the device turning into a rogue device e.g. causing radio interference in the network or causing local interference, i.e. over WiFi.</p> <p>The kind of things we would be concerned about would be where the code that encrypted data/voice communication was bypassed so that user privacy was compromised. Another example would be if mechanisms were bypassed, that were being used to authenticate the basestation the terminal is communicating with. This could leave the terminal open to “man in the middle” attacks.</p> <p>Basically we require any wireless access communications software to be protected against change to prevent generic threats which could take many forms.</p>	N/A
Security	Core Terminal	General Security features	OMTP TRO requirements on use of cryptography	<p>The terminal shall satisfy cryptographic requirements (HU9-11) in Section 6.2 of the OMTP Trusted Environment TRO recommendations.</p> <p>If the terminal is only partially compliant, please state which requirements are not satisfied.</p>	<p>Description: Hardware Unique (HU) keys are used to support the secure implementation of critical mechanisms on the device, e.g. Secure Boot. The HU keys should meet the cryptographic requirements defined by the OMTP to ensure that they are resistant to cryptanalysis attacks.</p> <p>Priority: Important</p> <p>Non Compliance Impact: It is more likely that cryptanalysis attacks against HU keys could be successful. As such, the security critical mechanisms that rely on HU keys will be weaker. This functionality is starting to make its way into mobile devices and should be on vendors roadmaps. Non-compliance can be compromised but likely to become an essential requirement in the next requirements release.</p>	OMTP TRO, available from https://www.gsma.com/newsroom/gsmadocuments/omtp-documents/

Security	Core Terminal	General Security Features	Support for GAA server APIs	The device SHALL provide GAA server APIs according to the security guidelines in 3GPP TS 33.220. For this the support of AT+CSIM is required.	Important for supporting the latest authentication mechanisms	http://www.3gpp.org/ftp/Specs/html-info/33220.htm
Security	Core Terminal	General Security features	Support for Trusted Execution Environment (TEE)	Support of Trusted Execution Environment (TEE) (e.g. ARM Trustzone) is strongly recommended	Trusted Execution Environment (TEE) is a validated security mechanism that will ensure protection of essential terminal security and application data management functions	N/A
Security	Core Terminal	General Security features	UE GBA procedure support	The device shall support the UE Generic Bootstrapping Architecture (GBA) procedures defined in 3GPP TS 33.220 for both GBA_U and GBA. 2G GBA as detailed in Annex I of 3GPP TS 33.220 is not required to be supported. Note: This does not mean no support for GBA over GSM. It means that 3G authentication for GBA should be used even when there is a GSM network. (Annex I is clear on this) Where supported by the SIM the modem shall also support the protocol.	Allows the terminal/SIM to be authenticated by the network as part of the boot sequence	3GPP TS 33.220
Security	Core Terminal	Hardware Unique Key	OMTP TRO HU key requirements	The terminal shall satisfy HU key requirements (HU1-8) in Section 6.2 of the OMTP Trusted Environment TRO recommendations. If the terminal is only partially compliant, please state which requirements are not satisfied.	Description: Hardware Unique (HU) keys are used to support the secure implementation of critical mechanisms on the device, e.g. Secure Boot. Priority: Important Impact: The security of other security critical mechanisms, and therefore the overall terminal, is likely to be weaker. This functionality is starting to make its way into mobile devices and should be on vendors roadmaps. Non-compliance can be compromised but likely to become an essential requirement in the next requirements release. Contact Person: Steve Babbage	OMTP TRO, available from https://www.gsma.com/newsroom/gsmadocuments/omtp-documents/
Security	Core Terminal	IMEI Protection	OMTP TRO IMEI protection requirements	The terminal shall satisfy IMEI protection requirements (IM1-12) in Section 8.2 of the OMTP Trusted Environment TRO recommendations. If the terminal is only partially compliant, please state which requirements are not satisfied.	Description: Non-compliance suggests that vulnerabilities could exist, increasing the risk that the IMEI protection mechanism could be compromised. Priority: Essential Impact: The IMEI is used to blacklist stolen devices via the CIER. If the IMEI protection mechanism can be compromised, the IMEIs of stolen phones will be reprogrammed to stop them being effectively blacklisted. Unless IMEI protection mechanisms and the blacklisting mechanism are effective across Vodafone's terminal portfolio, IMEI blacklisting will not act as an effective deterrent to mobile phone	OMTP TRO, available from https://www.gsma.com/newsroom/gsmadocuments/omtp-documents/

					theft. Contact person: Steve Babbage	
Security	Core Terminal	IMSI Protection	IMSI exposure disallowed	The terminal shall not expose the IMSI or TMSI to the end-user or to 3rd party applications.	Description: This requirement limits access to the IMSI to authorised applications. Non-Compliance Impact: Probably the biggest risk of exposing IMSI is that it can be used as the NETWORKPIN for OMA DM/CP. This requirement helps prevent an OMA DM/CP attacker being able to discover a given user's IMSI by fooling the user to provide his IMSI via a social engineering attack, or by fooling the user into installing a 3rd party application which transmits IMSI to the attacker. Any non-compliance must be explained.	N/A
Security	Core Terminal	Secure Boot	OMTP TRO Secure Boot requirements	The terminal shall satisfy Secure Boot requirements (SB1-10) in Section 11 of the OMTP Trusted Environment TRO recommendations. If the terminal is only partially compliant, please state which requirements are not satisfied.	Description: Secure boot mechanisms verify the authenticity and integrity of critical SW components such as the boot loader, the core OS and other security critical components such as the SIM lock mechanism and IMEI protection, when the terminal is turned on. Secure boot mechanisms may be used to underpin the verification of other SW components. Priority: Essential Impact: Non compliance is likely to mean that attacks which modify critical SW components aren't detected, leading to overall weaker platform security. Non or partial compliance may be accepted depending on the vendors explanation. Secure boot should be on vendors roadmaps. Contact Person: Steve Babbage	OMTP TRO, available from https://www.gsma.com/newsroom/gsmadocuments/omtp-documents/
Security	Core Terminal	Secure Boot	Protection of core operating system	The secure boot mechanism must prevent the unauthorised rollback to older versions of the OS core code and the loading of OS core code not intended for the terminal in question.	Description: The secure boot mechanism must prevent the rollback to older versions of the operating system core code. Priority: Essential Non-Compliance Impact: Non-compliance could result in compromise of core code such as the OS as older versions on the OS core code may have been replaced in order to address security vulnerabilities.	N/A
Security	Core Terminal	Secure Boot	Secure Firmware Update	Any authorised updates (e.g. Firmware updates) to code checked by the Secure Boot Process must include mechanisms to securely update the boot process, i.e. the terminal must implement a Flexible Secure Boot Process to avoid conflict with legitimate updates.	Description: Flexible Secure Boot compliments the secure boot mechanism by adding the possibility of modifying the code base checked as part of the secure boot process via an update code base image obtained via an over-the-air download or via some other connection to the	https://www.gsma.com/newsroom/gsmadocuments/omtp-

				The terminal shall satisfy the Flexible Secure Boot requirements (ATE-FSB-1140 to ATE-FSB-1310) in Section 6.4 of the OMTP Advanced Trusted Environment TR1 recommendations.	terminal. Priority: Important Non Compliance Impact: Non-compliance will either mean that any component checked by the secure boot process cannot be modified or that the boot process is not secure. Either of these impacts is serious and may expose the used and Vodafone to security vulnerabilities (e.g. firmware can't be updated to fix known security issues or firmware can be updated to unauthorised (insecure) firmware. Vendors should be strongly encouraged to support this functionality.	documents/
Security	Core Terminal	Secure Flash	Verification of downloaded code	The secure flash download mechanism shall prevent roll-back to previous firmware versions unless the rollback has been authorised by the owner of the currently installed firmware.	Description: We must be sure that all downloaded code is from a trusted source and is unmodified before being executed or installed Priority: Essential Non-Compliance Impact: Non-compliance could result in the terminal being re-flashed with firmware that is known to contain security vulnerabilities. This could ultimately lead to the compromise of the terminals OS and other security critical mechanisms such as SIM lock and IMEI protection.	N/A
Security	Core Terminal	Secure Flash Update	OMTP TRO Secure Flash requirements	If the terminal supports a flash update mechanism, the mechanism shall satisfy Secure Flash requirements (SF1-5) in Section 13 of the OMTP Trusted Environment TRO recommendations. If the terminal is only partially compliant, please state which requirements are not satisfied.	Description: Secure flash mechanisms are used to provide a mechanism by which authorized parties can install code updates into the non-volatile storage of the terminal using the local interfaces of the ME. Typically serial ports or USB ports are used for this purpose. Secure flash mechanisms must not provide a way to bypass the other security mechanisms implemented by the terminal. Priority: Essential Impact: Non-compliance may allow other security mechanisms - IMEI protection, SIM lock secure boot - to be bypassed, i.e. by allowing unauthorised code updates into the non-volatile storage of the terminal. There should be no reason for vendors not to implement flash mechanisms securely. Partial compliance may be compromised depending on the vendors comments. Contact Person: Steve Babbage	OMTP TRO, available from https://www.gsmarena.com/newsroom/gsmadocuments/omtp-documents/
Security	Core Terminal	SIM Lock Protection	Emergency SIM Lock	The state "Locked" or "Blocked" of a SIM-Lock shall have no influence on the emergency call function	Global standardisation for SIM-Lock	3GPP TS 22.101 - 10 (Emergency)

						Calls), 3GPP TS 22.022 - Annex A2
Security	Core Terminal	SIM Lock Protec tion	Language of displayed messages	Any malfunction and changes in the SIM-lock status are displayed immediately to the user. The output status message must be displayed in the language of the SIM-lock network or alternatively in English.	Global standardisation for SIM-Lock	N/A
Security	Core Terminal	SIM Lock Protec tion	Lock Function	The SIM Lock device is completely identical to devices without any Lock. SIM-card-lock: It means that each mobile device can be used only with a specific SIM-card. The device is bound by the configured in the device SIM-lock on the activation and operation with exactly this SIM-card or SIM-card-number. If the card is not working or damaged, the device is no longer operational and it needs to be repaired.	Global standardisation for SIM-Lock	3GPP TS 22.022
Security	Core Terminal	SIM Lock Protec tion	Lock Function Security	A SW update, upgrade or downgrade of the terminal must not change the SIM-Lock status of the device. It is to be excluded to deactivate the lock-mechanism by reprogramming any external device memory. It is not possible to calculate the unlock-codes subsequently with help of the IMEI-numbers. The mobile-code for SIM-Lock-data has to be completely ciphered on the device.	Global standardisation for SIM-Lock	3GPP TS 22.022 - 14 (Security)
Security	Core Terminal	SIM Lock Protec tion	Lock Function Security - SIM Card	Independently from the value in the administrative SIM data field "6FAD" (e.g. '81 00 00'), the SIM-Lock-mobile should only work, if additionally the valid entries in the IMSI data field "6F07" are out of the defined SIM-Lock ranges (MCC, MNC, HLR and Prefix) or the IMSI data field "6F07" has got the entry "MCC=001 MNC=01".	Global standardisation for SIM-Lock	3GPP TS 31.102 - 4.2.18 EFAD (Adminis trative Data)
Security	Core Terminal	SIM Lock Protec tion	OMTP TRO SIM lock requirements	The terminal shall satisfy SIM lock protection requirements (SL1-22) in Section 9.2 of the OMTP Trusted Environment TRO recommendations.	Description: Non-compliance suggests that vulnerabilities could exist, increasing the risk that the SIM lock mechanism could be compromised. Impact: SIM lock is used to protect the Vodafone's subsidy of terminals in most European markets. Weak SIM lock mechanisms will allow the SIM lock to be removed. Impact for Embedded SIM (preferred): Why Required: To protect the partnership and revenue by preventing use of the device with other network operator SIMs. What happens if not implemented? Loss of revenue	OMTP TRO, available from https:// www.gs ma.com /newsro om/gsm adocum ents/om tp- docume nts/
Security	Core Terminal	SIM Lock Protec tion	Unlock Function	The unlock-code must have minimum 8 digits, maximum 20 digits. After entering the unlock-code the SIM-Lock-device should be completely unlocked and there is no possibility to	Global standardisation for SIM-Lock	3GPP TS 22.022 - 14g (security)

				change this unlockmode again. A customer has five trials to enter the unlock-code. After the 5th attempt using a wrong code the device should be blocked and it can only be unblocked in the manufacturer service.		
Security	General & User Security	User Data Protection	Phone access control	The terminal shall support a setting that requires password entry or other user authentication to access the phone after turning it on.	Essential for security of user data.	N/A
Security	General & User Security	User Data Protection	PIN codes not stored on the terminal or accessible by downloaded applications	<p>PIN codes verified by the UICC ((U)SIM or WIM) shall not be retained within the terminal.</p> <p>It shall not be possible for applications on the terminal or external applications interacting with terminal UE at the time of PIN entry to access/store PIN details as they are entered by the user.</p>	<p>Description: This requirement ensures that PIN codes destined for the SIM card cannot be intercepted and stored on the terminal.</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: If a PIN is retained, it could be possible for the terminal (or an application on the terminal) to reuse it without the user's permission.</p>	N/A
Security	General & User Security	User Data Protection	Telephony URI Scheme and MMI	MMI codes as specified in 3GPP TS 22.030 as well device specific MMI codes (e.g. factory reset, network monitor, etc...) shall not be accessible and executed by any external application except for SIM applications. The exception of SIM-application is necessary since operator specific SIM applications might use certain codes (e.g. send USSD, ...) which shall not be blocked.	Non support would result in a serious security breach	N/A
Security	General & User Security	User Data Protection	User interface access timeout	The terminal shall support a setting that locks the device after a certain elapsed time with no user activity, requiring password entry or other user authentication to unlock it. A locked device should still allow incoming calls to be answered.	Essential for security of user data.	N/A
Security	General Security Features		Certificate details must be listed to user	<p>The certificates supported shall be clearly listed and accessible in the device menu.</p> <p>When listing the certificates, the following relevant details of each one must be shown:</p> <ul style="list-style-type: none"> Subject Authority Issuer Valid from Valid to Certificate Type Version Serial Number Signature Algorithm Fingerprint 	Useful for developers & users to verify certificates.	N/A
Security	Network Protocols	TLS	Displaying a Warning when transiting from https to http	The terminal shall display a warning to the user informing them when the terminal changes from https to http, i.e. changes from a secure to a non-secure session. An example of an appropriate message would be "Connection no longer secure"	<p>Description: This describes the UI behaviour of the terminal during a TLS session.</p> <p>Priority: Important</p>	N/A

					<p>Non-Compliance Impact: If the terminal does not show that a TLS session has been terminated the user may enter sensitive information in the pages thinking that they are still protected by TLS.</p>	
Security	Network Protocols	TLS	Displaying details of any certificate in the certificate chain	The terminal should be able to display upon user request the Subject DN, Issuer DN, Serial number, and Expiry date of all certificates in the certificate chain, i.e. all Server, Root CA or Immediate CA certificates	<p>Description: Displaying information about the TLS session will give users the ability to check the level of security provided.</p> <p>Priority: Nice to have</p> <p>Non-Compliance Impact: This functionality is likely to only be used by security conscious users when using applications such as banking/m-commerce.</p>	N/A
Security	Network Protocols	TLS	Initiate TLS 1.2 or higher when using https	The terminal shall initiate TLS 1.2 or higher when making a request to a URL that starts with https:// as defined in RFC 2818	<p>Description: This is the expected behaviour of any standard HTTP over TLS implementation. Further, upcoming industry-wide disabling of TLS 1.0/1.1 is expected.</p> <p>Priority: Essential</p> <p>Non-Compliance Impact: Non compliance will mean HTTP over TLS Can not be used. Should be very unlikely that any vendors are non-compliant as this is a well established behaviour.</p>	RFC 5246
Security	Network Protocols	TLS	Signature algorithms	The terminal shall be capable of verifying signatures made with RSA keys including 3072 bits as a minimum.	<p>Description: This requirement is needed to ensure support as a minimum for 3072 bit certificates for improved security.</p> <p>Priority: Mandatory</p> <p>Non-Compliance Impact: Non-compliance will result in the terminal not being able to verify some web sites that use 2048 bit certificates.</p>	N/A
Security	Network Protocols	TLS	Support TLS 1.2 or higher tunnelling	<p>In order to maintain the end to end security at the transport layer while using a proxy, TLS 1.2 or higher tunnelling shall be used between the client and the origin server.</p> <p>All mandatory requirements specified in A.2.3 Section of WAP TLS Profile and Tunnelling (WAP-219-TLS) Specification shall be Supported.</p>	<p>Description</p> <p>This requirement is essential to allow TLS 1.2 or higher tunnelling via VF Internet Gateways (proxies).</p> <p>Priority: Mandatory</p>	N/A

					<p>Non-Compliance Impact</p> <p>Non-compliance will mean that TLS sessions can not be initiated over Internet Gateways (Proxies).</p>	
Security	5G	Ciphering and Integrity Algorithms	Ciphering and integrity algorithms (dual connectivity)	For all devices supporting dual connectivity between LTE and 5G NR, ciphering and integrity protection shall be supported as specified in 3GPP TS 33.401 clause E.3. Clause 3.10.1 specifies which encryption and integrity algorithms are mandatory and which are optional. For the avoidance of doubt, the null integrity algorithm (NIAO) may only be used for unauthenticated emergency calls; in all other contexts, whenever applicable according to the standard, integrity verification on received messages (using a non-null algorithm) must be enforced.		3GPP TS 33.401
Security	5G	Ciphering and Integrity Algorithms	Ciphering and integrity algorithms (NR standalone)	For all devices supporting 5G NR standalone, ciphering and integrity protection shall be supported as specified in 3GPP TS 33.501. Clause 5.2.2 specifies which encryption algorithms are mandatory and which are optional; likewise clause 5.2.3 specifies which integrity algorithms are mandatory and which are optional. For the avoidance of doubt, the null integrity algorithm (NIAO) may only be used for unauthenticated emergency calls; in all other contexts, whenever applicable according to the standard, integrity verification on received messages (using a non-null algorithm) must be enforced.		3GPP TS 33.501
Security	5G	Ciphering and Integrity Algorithms	SUPI encryption	For all devices supporting 5G NR standalone, privacy protection of SUPI shall be supported as specified in 3GPP TS 33.501.		3GPP TS 33.501
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE and VoWiFi	Implementation according to GSMA PRD IR.92	<p>The Implementation of VoLTE and VoWiFi in the terminal shall be according to GSMA PRD IR.92 (latest version)</p> <p>This includes:</p> <ul style="list-style-type: none"> * The SIP registration process / IMS Authentication * Early Media (P-Early-Media header * Supplementary Services and Configuration (both MAP/CS and XCAP/Ut) * Explicit Call Transfer (ECT) - Consultative * SIP Precondition Consideration * SMSoIP * AMR and EVS Speechcodecs * DTMF Events * RoCH * Radio Bearers * DRX mode * RLC configurations (UM, AM, QCI) * GBR and NGBR Services 	Essential to adapt latest changes and recommendations in IR.92 (Version 10.0) to ensure compliance to our VoLTE implementation in NW.	GSMA IR.92 Version 12.0 or later

				<ul style="list-style-type: none"> * E-UTRA NR Dual Connectivity (5G Terminals) * Bearer Management for SIP, XCAP, Voice and Emergency Calls * Emergency Service * usage of well known APN according IR.88 * Data Off and Services Availability * ISR (Idlemode Signaling Reduction) * SRVCC procedures (to 2G or 3G) * Roaming Considerations <p>In case of non or partial compliance, please state the known limitations in the comment sections.</p>		
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE and VoWiFi	Domain selection - IMS PS voice preferred	<p>The VoLTE and CSFB capable device shall support Domain selection: UE has the setting of "IMS PS Voice preferred, CS Voice as secondary".</p> <p>The feature must be available in order to assure that SMS, USSD, emergency calls and location can work in parallel to VoLTE service.</p>	Essential for all VoLTE terminals in order to allow Voice Service according to operators implementation.	3GPP TS 24.008
Voice & Video	Video Call	Generic IMS functions for ViLTE	Implementation according to GSMA PRD IR.94	<p>The Implementation of Conversational Video Service the terminal shall be according to GSMA PRD IR.94 (latest Verion) in addition to IR.92</p> <p>This Contains the support of:</p> <ul style="list-style-type: none"> * Adding a "video" media feature tag in the REGISTER request * Support of H.264 Constrain Baseline Profile (CBP) Level 1.2 * Continue of a Voice call if the video GBR bearer is lost * Continue a Voice Call in case of SRVCC (i.e. keep the voice part and drop video media) <p>In case of non or partial compliance, please state the known limitations in the comment sections.</p>	Implementation according to GSMA Profile is applicable for all VoLTE Terminals supporting ViLTE to guarantee the maximum of interoperability.	GSMA IR.94 Version 13 or later
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE	Implementation according to GSMA PRD IR.64	<p>The Implementation of IMS Service Centralisation and Continuity of the terminal shall be according to GSMA PRD IR.64 (latest version) to support anchoring of IMS services (e.g. SRVCC) in CS domain.</p>	Implementation according to GSMA Profile is applicable for all VoLTE Terminals to guarantee the maximum of interoperability.	GSMA IR.64 Version 16 or later
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE	Early Media	<p>The UE must support reception of voice and video media associated with one early dialogue.</p> <p>The UE shall use the following method for early media (announcements, ringing tones) as described in 3GPP TS 24.628, chapter 4.2.2:</p> <p>Use early media as defined by IETF RFC 3960 and using the P-Early-Media header field authorizing early media as defined in IETF RFC 5009 for the gateway model.</p> <p>The other methods as "Alert-info" header field in the 180 (Ringing) response shall be ignored.</p>	Required for all VoLTE Terminals. This feature is required for launch of VoLTE, and is necessary in order to support "Ringback Tones". The use of P-Early-Media header prevents the exchange of early media between end users. Furthermore P-Early-Media shall be used when interconnect with other unknown SIP networks.	3GPP TS 24.628 IETF RFC 3960 IETF RFC 5009
Voice & Video	VoLTE	Generic functions for VoLTE	SUPL	<p>The UE must support Secure User Plane Location Element (OMA SUPL 2.0) for geolocation information used for e.g. social presence Information SPI</p>	Required for all VoLTE Terminals, necessary to deploy geolocation services.	OMA SUPL 2.0

Voice & Video	VoLTE	Generic functions for VoLTE	Semi Persistent Scheduling(SPS)	VoLTE capable terminals shall support Semi Persistent Scheduling	Essential to support efficient VoLTE implementation in RAN.	TS.36.321
Voice & Video	VoLTE	Generic functions for VoLTE	TTI bundling for voice	VoLTE capable terminals shall support TTI bundling for voice to ensure good voice service coverage	Essential to support higher coverage for VoLTE.	TS.36.321
Voice & Video	Video Call	Generic functions for ViLTE	MBR must be greater than GBR	Terminals supporting Video Telephony over LTE shall utilise MBR values which are greater than GBR values	Essential to support good quality of service for Video over LTE.	N/A
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE	SIP INVITE with SDP-Offer	The VoLTE UE must receive a SDP offer after each SIP INVITE message. Note: In case of INVITE without SDP offer the exchange of SDP Offer/Answer will be realised between 200 OK und ACK. According to RFC 3960 the User Agent (UA) is allowed to play early media packets even if a 200 OK was not received. This causes the risk of "media-clipping" - the cut of first media seconds.	Important to use Early Media as Ringbacktones and announcements without media clipping.	IETF RFC 3960
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic functions for VoLTE	NW generated dial tone	The VoLTE UE shall implement the early media and ringing tone generation according to IETF RFC 3960. The UE shall not generate local ringing tone unless 180 RINGING has been received and no incoming media has been received. In case 180 RINGING has been received and there are incoming media packets these shall be played instead of the local ones.	Important to establish local policy regarding ringing tone generation.	IETF RFC 3960
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE	PANI Header	The VoLTE UE shall send a PANI (P-Access-NW-Info) header containing the UE provided location information (as cgi) within SIP INVITE message. The information is relevant for services that require the LocInfo.	The information is relevant for services that require the LocInfo.	IETF RFC 3455
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic functions for VoLTE	Comfort Tones	The UE shall generate the following comfort tones: - Hold: (Tone pattern is similar to waiting tone described in GSM TS 02.40: 425Hz(400ms), Pause(8s) periodic - Busy: 425 Hz (500ms) , Pause (500ms) periodic - Ringing: 425Hz(1s), Pause (4s) periodic - MPTY Warning: 425 Hz (1s) - Special Info : 950Hz(330ms), 1400Hz(330ms), 1800Hz(330ms), Pause(1s) - Info: 425Hz(200ms),Pause (200ms), 3 cycles - CW: generated by MS only: analogue to Hold tone.	Comfort tones are not always supported by the NW. In order to offer the customer the same experience as with CS voice calls, the tone pattern for comfort tones shall be aligned with CS tone patterns as described in 3GPP TS 22.001	N/A
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Call management	Management of multiple calls	It shall be possible for the user to manage single and multiple calls over LTE and WiFi in the same way as over circuit switched bearers, e.g. Reject,	Essential for consistency of user capabilities for call management etc. across different bearers. Non compliance means potentially	N/A

				Hold, Merge, etc. The terminal shall support a unified UI integrating legacy and new Call management interfaces - Circuit Switched, VoLTE, Call+ etc. This shall include the same ringtone to be used for incoming calls, and logging of calls in call history logs.	poor integration of WiFi Calling and other call management interfaces (legacy circuit switched, VoLTE, Call+).	
Voice & Video	WiFi Calling and messaging	Messaging	SMS over WiFi Bearer	The terminal shall support mobile originated and mobile terminated SMS over WiFi bearer consistent with mechanisms used over circuit switched bearer	Based on market support for IMS messaging, referenced in VVS	VVS
Voice & Video	WiFi Calling and messaging	Messaging	SMS over CS bearer while connected to VoWiFi capable WiFi network	A terminal shall support SMS over any available cellular bearers while being simultaneously connected to VoWiFi bearer for voice services		N/A
Voice & Video	WiFi Calling and messaging	Emergency calls	Emergency Call Notification	<p>The customer shall be informed that emergency calls might not work properly via VoWiFi, especially in areas with no 2G/3G coverage by any operator.</p> <p>An appropriate message (text as specified in reference document by VF DE team) need to be presented on the UE before using the Service. Proposed solution:</p> <ul style="list-style-type: none"> - Customers get a notification windows every time the UE contacts the ePDG. - Customer has to click "OK" to confirm limited emergency call availability in order to use the service, otherwise Wi-Fi Calling is disabled - Customer can suppress the notification window in the future by clicking "do not show again". 	Notification for end user for emergency call scenarios. Legal requirement for the German market.	UX VoWiFi VF DE Emergency call document_June 17.pdf VVS
Voice & Video	WiFi Calling and messaging	Emergency calls	Emergency call according to GSMA IR.51	The terminal shall support emergency sessions for VoWiFi as profiled in IR.51 (latest version): "The UE must support Annex J of 3GPP Release 13 TS 23.167, Annex R of 3GPP Release 13 TS 24.229 (for SIP procedures), and 3GPP Release 13 TS 24.302 (for selection of ePDG for emergency services and for establishment of emergency PDN connection via untrusted EPC-integrated WLAN)."	VF Germany is obliged by Regulation to support IMS based emergency calls over VoWiFi and VoLTE by 2.H 2019. Risk of being forced to switch off service if not supported.	GSMA IR.51 Version 6.0 or later
Voice & Video	WiFi Calling and messaging	Generic IMS functions for VoWiFi	Implementation according to GSMA PRD IR.51	<p>The Implementation of VoLTE and VoWiFi in the terminal shall be according to GSMA PRD IR.51 (latest version)</p> <p>This includes:</p> <ul style="list-style-type: none"> * SIP Registration Procedures * Mobility (VoLTE-VoWiFi HO) * Supplementary Services * Fast-reauthentication * Messaging (SMS) * non-3GPP Access Authentication and Security * APN Considerations for SIP Signalling and XCAP <p>In case of non or partial compliance, please state the known limitations in the comment sections.</p>	<p>a. Non compliance would mean no support of WiFi Calling and Messaging using untrusted WiFi networks</p> <p>b. Failure to comply will result in poor call coverage when terminal is moving in and out of WiFi coverage</p> <p>c. Without fast re-authentication an optimized signalling for re authentication is not possible</p> <p>d. Essential for consistency of user capabilities for call management etc. across different bearers</p>	GSMA IR.51 Version 6.0 or later

Voice & Video	VoLTE	Emergency calls	Emergency cause value in RRC connection request	The terminal shall support the sending of Emergency cause value in an RRC connection request This is also required for current devices.	Essential to comply with legal obligation to provide an emergency call facility	3GPP TS 36.331
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Supplementary Services via IMS	CW configuration	The VoLTE terminal shall support network-based service for Communication Waiting. This is in addition to current GSMA IR.92 proposed terminal-based service for CW.	Network based service for CW is essential to support Vodafone Enterprise Services.	N/A
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Supplementary Services via IMS	Ut authentication and authorization	In order to authenticate and authorize the subscriber for Ut usage, GBA based authentication shall be supported by the VoLTE terminal	Essential for all VoLTE terminals in order to allow supplementary services with IMS.	3GPP TS 33.220, TS 33.222, TS 24.109 and TS 29.109
Voice & Video	WiFi Calling and messaging	Emergency calls	Emergency call over VoWiFi - Location Information	<p>The terminal shall support emergency sessions for VoWiFi including location information according to GSMA IR.51 v6.0: "The UE must support the current location discovery during an emergency call as specified in subclause 5.1.6.8.2, subclause 5.1.6.8.3, subclause 5.1.6.8.4, and subclause 5.1.6.12 of 3GPP Release 14 TS 24.229"</p> <p>* The P-Access-Network-Info (PANI) header allows to identify a call attempt as coming from the WiFi access network (in contrast to 4G/LTE).</p> <p>* The Cellular-Network-Info (CNI) header will provide the last-known CellID which will be the one and only piece of information used by the network operator to determine the correct PSAP (emergency center). It may / should contain a timestamp indicating when the last network contact has been made. The P-Cellular-Network-Info would provide the same information as the Cellular-Network-Info header. Newer implementations should use the standardized CNI rather than the P-CNI header.</p> <p>* The Geolocation header with its associated message (XML) body can be used by the terminal to convey additional location data (such as a geo-coordinate) which will be passed to the PSAP transparently.</p>	VF Germany is obliged by Regulation to support IMS based emergency calls over VoWiFi including the location information by 2.H 2019. Risk of being forced to switch off service if not supported.	GSMA IR.51 version 6.0
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Generic IMS functions for VoLTE and VoWiFi	Implementation according to GSMA PRD IR.88	<p>The UE shall use Access Point Name (APN) according to GSMA PRD IR.88 (latest version) for:</p> <ul style="list-style-type: none"> * IMS based Services (IMS) * IMS Emergency calls (SOS) <p>In case of non or partial compliance, please state the known limitations in the comment sections.</p>	Essential to adapt latest changes and recommendations in IR.88 (latest Version) to ensure compliance to our VoLTE implementation in NW.	GSMA PRD IR.88 Version 18 or later
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	sos APN	The UE shall support the new "sos" APN provided by the network.		

Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	Emergency PDN	For UE detected emergency call, the UE shall set up an emergency PDN connection with the information provided by the network.		
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	IMS Emergency Call and Domain Priority	<p>The UE has to support and handle VoLTE and VoWiFi emergency call on IMS according to 3GPP TS 23.167 and TS 24.229.</p> <p>The UE shall not issue an emergency call over WiFi if the emergency call can be established via 3GPP access, according to 3GPP TS 23.402 (Rel-13 and later)</p> <p>The UE shall select the domain to perform an emergency call considering the following priority list: 4G/3G/2G (accordingly to GSMA IR.92 and 3GPP TS 23.167, Annex H).</p> <p>Accordingly to 3GPP TS 23.402, chapter 7.4.4, the UE shall address an emergency call under WiFi as a last resource, only if no 3GPP access is available, regardless the carrier prioritization for normal calls.</p> <p>UE compliant with TS 23.402, Rel-14 shall attempt to address the emergency call under 4G/3G/2G coverage from another network operator, in case no 3GPP access from their own network operator is available. In any case, also devices compliant with TS 23.402 previous releases shall always consider WiFi as the last resource to address an emergency call.</p>	VF Germany is obliged by Regulation to support IMS based emergency calls over VoWiFi including the location information by 2.H 2019. Risk of being forced to switch off service if not supported.	3GPP TS 23.167, Annex H 3GPP TS 24.229 3GPP TS 23.402
Voice & Video	WiFi Calling and messaging	Emergency calls	Location - Cellular-NW-Info (CNI)	The UE shall send the Cellular-Network-Info (CNI) or the P-CNI in the INVITE message. In this parameter the last Cell-ID field shall be properly set. The last Cell-ID provided by the UE is used to route the call towards the proper PSAP, in case of VoWiFi. In case of no or invalid Last Cell-ID information, the emergency call will be rejected by the CRS.	For VoWiFi scenario, the risk is that the last cell id is not the real one. In case the customer is in a total different location (due to switched off UE during travel) the call could be routed towards a wrong PSAP.	
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	Emergency Registration - Conditions	<p>For a UE detected emergency call the UE shall initiate an IMS emergency registration, before starting the emergency call, when all of the following conditions are met:</p> <ul style="list-style-type: none"> - either the UE is not already IMS registered or the UE is IMS registered but is roaming outside its home network; - the UE has sufficient credentials to authenticate with the IMS network; - the UE is able to detect emergency session <p>Therefore, for a UE with no credentials for the IMS authentication, the UE shall skip the emergency registration and directly initiate the emergency call, with the indication "anonymous user".</p> <p>The UE shall also initiate an IMS emergency registration when it receives an "IMS emergency registration required" response as a result of the emergency session request.</p>	The emergency registration procedure is important to guarantee the availability of the MSISDN to allow the callback from the PSAP. In case of no emergency registration (emergency call as "anonymous user") the callback from the PSAP is not possible. The UE expected behavior is to always perform the emergency registration before the emergency call, unless it is aware not to have sufficient credentials.	

				In case of emergency IMS registration failure the UE shall be able to interpret the indication that anonymous IMS emergency sessions are supported (if present) and the UE shall proceed with an anonymous IMS emergency session. In case the network rejects the emergency registration without giving any indication to the UE, the expected behavior for the UE is to start the emergency call as anonymous.		
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	Emergency Registration - Request	For an emergency registration request, the UE shall indicate that it is an emergency registration adding “sos” in the Contact field in the Request-URI of the REGISTER message. For the emergency registration, the UE shall properly populate the From and To header fields of the REGISTER request with: the first entry in the list of public user identities provisioned in the UE (if present) or the default public user identity obtained during the normal registration (if the UE is not provisioned with a list of public user identities, but the UE is currently registered to the IM CN subsystem) or the derived temporary public user identity (in all other cases).	The emergency registration procedure is important to guarantee the availability of the MSISDN to allow the callback from the PSAP	
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	Emergency Registration - Parallel Registration	As for standard, in case the UE had already a normal IMS registration and then performs an emergency registration, the UE shall be able to maintain in parallel both the normal and the emergency registration.		
Voice & Video	VoLTE	Emergency calls	Emergency Attach Procedure	For VoLTE emergency calls, if the UE is not attached to EPS, the UE shall first initiate an emergency attach procedure.		
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	INVITE - UE Detected Emergency Call	For a UE detected emergency call, in the INVITE request the UE shall properly set: - Request-URI: including service URN (“sos”) - To header field: with the same emergency service URN as in the Request-URI - From header field: in case the user has successfully performed the emergency registration it should include the public user identity registered or the tel URI associated with the public user identity registered. In case the user did not success or was not able to perform the emergency registration, it should set this field as “anonymous” - Triggered as VoLTE emergency call directly. The UE will send an Emergency Attach request to the enodeB if not already attached. The attach type and request type will be “Emergency”. If already attached then an Emergency PDN connectivity procedure will be followed with the request type set to “Emergency”.	The UE behavior is expected as per standard (TS 23.167, TS 24.229) Especially, both 110 and 112 shall be considered as detected emergency number.	3GPP TS 23.167 3GPP TS 24.229

Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	INVITE - IMEI Information	For emergency INVITE, the UE shall send the IMEI information	The IMEI is used to anchor the call on EATF.	3GPP TS 24.229
Voice & Video	IMS Voice (VoLTE & VoWiFi)	Emergency calls	Emergency Call Termination	As for standard, after the emergency call is completed the UE shall stop refreshing the emergency registration. When the emergency registration timer expires on the UE, the UE shall initiate EPC default bearer termination procedure.	Note: It is still under investigation if the default bearer supervision feature in the P-CSCF could be used	
Voice & Video	WiFi Calling and messaging	Emergency calls	List of Emergency Numbers	The UE shall be able to understand the list of emergency numbers provided by the network and use the proper sub-services as indicated by the network. Especially the following numbers shall be considered as emergency number including their subservices: - sos.police for 110 - sos.fire for 112	This requirement reflects current NW behaviour which states that the network shall inform the UE about the local emergency number. Note that at this moment the Cisco ePDG is not able to inform the UE about the local emergency number list, so it is expected that in case of VoWiFi (without a previous attach to 4G) the UE will start a call towards 110 as a normal call and then it will be asked by the P-CSCF to perform the emergency registration.	3GPP TS 24.229, Annex B.2.2.6.1
Voice & Video	WiFi Calling and messaging	Transport Security	IPSEC support for IMS transport for WiFi Calling related functions (voice and messaging)	The terminal shall support IMS IPSEC transport of data towards the ePDG. This shall be implemented according to the local OpCo requirements (VVS). ePDG certificate handling: The terminal shall support ePDG Certificate Request (CERTREQ/38 (RFC7296)) and handling of IKEv2 Critical Bit for CERTREQ. This shall be implemented according to the local OpCo requirements (VVS).	Required to ensure mobile class security of voice and messaging data	VVS
Voice & Video	WiFi Calling and messaging	User Interface	User management of WiFi Calling	If enabled via the network configuration, it shall be possible for the user to enable/disable WiFi Calling in the user interface. The default setting shall be WiFi Calling disabled.	Essential to allow user control of the WiFi Calling solution	N/A
Voice & Video	WiFi Calling and messaging	Configuration	Priority of bearers - cellular and WiFi	The terminal shall be configurable such that the priority of bearers for Voice and Messaging can be adjusted between WiFi and cellular bearers. Configuration shall be as determined via VVS settings, and not through the terminal user interface. Default call priority, if not specified in VVS, shall be 4G-3G-2G-VoWiFi	Failure to comply will mean that there is no flexibility to manage the connection preferences	VVS
Voice & Video	WiFi Calling and messaging	User Interface	Notification of WiFi bearer and Wifi calls	For incoming and outgoing voice calls the user interface shall provide confirmation that the call is to be made over WiFi bearer. This shall take the form of an indication of the connected bearer, by displaying the Vodafone Service name as specified per VVS, in the status line when the terminal is IMS registered to the Vodafone network through WiFi. When a call using the WiFi Bearer is in progress, a permanent indication shall be present in the terminal UI that indicates the bearer in use.	Needed to manage user expectation of call quality and lack of handover. Best effort for initial products	VVS

Voice & Video	VoLTE	Generic functions for VoLTE	SR-VCC to 3G+PS Handover to 3G	The VoLTE capable device shall support SR-VCC from LTE layer towards multi-RAB	Allows Multi-RAB calls to continue using 3G when moving out of LTE coverage. Essential for LTE smartphones	3GPP TS 23.216
Voice & Video	VoLTE	Generic functions for VoLTE	LTE Call re-establishment	LTE Call re-establishment needs to be supported in the same way as it's been supported for years in 2G and 3G. The difference is that the re-establishment is now executed of a PS domain (LTE) as part of VoLTE	Lack of support in LTE for VoLTE would create a worse user experience for VoLTE vs 2G or 3G CS call when for any reason the radio connection is temporary lost (e.g. terminal moving across tunnel with bad coverage or non-optimized neighbours)	N/A
Voice & Video	VoLTE	Supplementary Services	Supplementary Service Configuration when Ut data connection not available	<p>1. The UE shall ALWAYS try Ut interface as first option, i.e. when under 4G/3G/2G coverage, with DATA ON or OFF, Wifi ON or OFF, when under HOME NETWORK OPERATOR and when ROAMING.</p> <p>2. In any scenario, use ALWAYS 3GPP TS 24.010 as backup option in case of Ut failure, i.e.:</p> <ul style="list-style-type: none"> - The APN used for UT cannot be activated - The Ut interface is NOT reachable (DNS query failure or NO answer to HTTP request); - The UE is receiving 403 or 5xx error causes to the HTTP XCAP query. - In case the reject cause is permanent the UE shall use TS 24.010 till the next restart as indicated in IR.92 and TS 24.623 Rel-12 - In case the reject cause is temporary the UE shall use TS 24.010 for the current transaction and retry XCAP/Ut for the next transaction. 	The fall back to MAP is essential in case a data connection to Ut is not available (e.g. due to roaming tariff)	3GPP TS 24.010 3GPP TS 24.623 Rel-12 GSM IR.92 latest version
Voice & Video	VoLTE	Generic IMS functions for VoLTE	No IMSI in IMS Registration request	The contact header communicated by the UE during IMS Registration shall include the IP-address but not the IMSI. Unnecessary signalling of the IMSI, e.g. during terminating SIP INVITE, must be avoided.	Essential for VoLTE voice services to minimize signalling containing the IMSI.	3GPP TS 24.229
Voice & Video	WiFi Calling and messaging	Remote VoWiFi Service Provisioning by Network	VoWiFi Provisioning	<p>The device should have the capability to allow VoWiFi Service provisioning/deprovisioning by means of an SMS message compliant with the Vodafone VoWiFi FQDN Provisioning Specification. This function shall be implemented according to the local OpCo requirements (VVS).</p> <p>Handling invalid FQDN information: If the NW sends an invalid FQDN information, the UE should keep the IMS to stay in LTE and will not activate VoWiFi</p>	Without this mechanism terminals that are not used with an appropriate tariff may attempt to access the Voice over WiFi service, causing overload on the WiFi AAA server. The corresponding deprovisioning mechanism allows Vodafone to manage terminals that are no longer permitted to use VoWiFi	"VoWiFi Provisioning Utilising SMS"
Voice & Video	WiFi Calling and messaging	Call management	Terminal based VoWiFi roaming management	<p>The device should have the capability to block WiFi calling in roaming. The setting should not be visible in the UI and be implemented according to the local OpCo requirements (VVS).</p> <p>Basic mechanism</p> <ol style="list-style-type: none"> 1. If the terminal only detects cellular NW's with non home country code, the device should block WiFi calling 2. If the terminal detects via any geo 	VoWiFi will be usable when roaming if not implemented, and subsequent impact on roaming revenues. I.E. no roaming restriction.	VVS

				location function, that the user is outside the home country, the device should block WiFi calling 3. In case the device can't determine based on 1. and 2. (i.e. in flight mode, no coverage areas), WiFi calling should be blocked if the last stored Terminal location information is outside the home network		
Voice & Video	WiFi Calling and messaging	Cellular QoS management	Cellular bearer QoS management for access of VoWiFi service	The terminal shall apply a signal strength threshold for selection of Cellular bearers (4G, 3G, 2G) and WiFi when this is available for VoWiFi. Note that the threshold levels will differ from the usual level at which a terminal would attempt to access another cellular bearer. The threshold levels apply to all cellular bearers used for voice services, whether CS voice on 2G or 3G bearers, or VoLTE on a 4G bearer. The threshold levels are defined on a market by market basis and are documented in the VVS as these will vary according to frequency usage and network coverage conditions in each market. The use cases covered by these threshold values are: Cellular -> Cellular Cellular -> WiFi Cellular -> No service	Essential to ensure that terminals select WiFi for VoWiFi access when existing cellular signal is weak	VVS
Voice & Video	WiFi Calling and messaging	ePDG IP address range	VoWiFi ePDG address range	The terminal shall support 3GPP 24.302, v.13.6.0, 7.2.1.3: "...Upon reception of a DNS response containing one or more IP addresses of ePDGs, the UE shall select an IP address of ePDG with the same IP version as its local IP address. If the UE does not receive a response to an IKE_SA_INIT request message sent towards to any of the received IP addresses of the selected ePDG, then the UE shall repeat the ePDG selection as described in this subclause, excluding the ePDG for which the UE did not receive a response to the IKE_SA_INIT request message.	Necessary to support redundancy. This terminal requirement ensures failover to alternative ePDG in case of primary ePDG outage. Alternative failover mechanism by ePDG availability detection through DNS is not possible due to IKE.	N/A
Voice & Video	WiFi Calling and messaging	VoWiFi Backoff timer	VoWiFi backoff timer (handling)	The terminal shall support the error handling as described in 3GPP 24.302, v14.2.0 chapter 7.2.2.2: a. if no BACKOFF_TIMER Notify payload is included in the received IKE_AUTH response message from ePDG, then the UE shall start an implementation specific backoff timer of 30 min b. specifically handling of the BACKOFF_TIMER Notify payload together with the Notify Payload with Private Notify Message Error Type "NO_APN_SUBSCRIPTION"	a. Necessary to control access request to Wi-Fi in the same way than in 3G and 4G (requested backoff timer in Wi-Fi is equal to backoff timer T3396 used for NAS cause #33 and #27). Autoprovisioning process relies on the terminal repeating the access request and the user experience must be the same in 3G/4G than in Wi-Fi. At the same time the operator needs to be able control the load/TPS on ePDG/AAA/HSS. b. Error handling description in 3gpp 24.302, v14.2.0., Preferred method to have control of backup timer and thus network load from network side.	3GPP 24.302, v14.2.0 chapter 7.2.2.2

Voice & Video	WiFi Calling and messaging	VVS reference	VVS reference	Terminal shall support the country specific settings for the service configuration and correct operation on Vodafone network. Afore mentioned settings can be access using the latest version of VVS (Vodafone Variant Setting repository) ##insert VVS database hyperlink for OEMs## (note: in case you do not have access, please request it to your Vodafone counterpart) In case some settings cannot be supported or configured country per country: please state all limitations in the comment section		VVS
Voice & Video	Legacy Voice	Phone Book	Add country code to contact number when roaming	The device should automatically recommend or insert the appropriate country code (e.g. +44) in front of a contact number stored within the phonebook.	Enhanced user experience to allow the user to use the device contacts when roaming without having to amend the phone number	N/A
Voice & Video	SIMs and USIMs	Dual SIM	Call log integration	In a Dual SIM capable terminal the call log (dialed calls, received calls, missed calls) shall indicate which SIM (Primary or Secondary) was in use for each entry	Only to be supported in terminals as requested by Vodafone Portfolio management team and specified in the device TPD. This Dual SIM requirement is to be applied to specific Vodafone Branded (VFD) terminals for specific markets, NOT generally applied.	N/A
Voice & Video	Legacy Voice	Voice Quality Requirements	Audio performances	The device shall support noise cancellation (Software and Hardware) and audio enhancement technologies in order to meet all acoustic performance thresholds as defined in: -GCF Performance Data Package PDP Acoustic. -Vodafone Acoustic Performance Measurements document (current version VFTST_1.020_Acoustics). Note that for devices with WB-AMR speech coder enabled, the highest targets should be achieved , especially for BGNT.	Required to keep Acoustic performance high	VFTST_1.020_Acoustics.pdf, Acoustic KPI test execution spreadsheet_v06.06.2013.xls, GCF PDP
Voice & Video	Legacy Voice	Voice Quality Requirements	HD-Voice	Devices capable of WB-AMR must be HD-Voice certified (according to the GSMA HD-Voice certification regime) This requirement does not impact the Acoustic KPI requirement	With the HD-Voice certification a minimum of audio quality level is assured by the manufacturer	Minimum Technical Requirements for use of the HD Voice Logo with GSM/UMTS/LTE issued by GSMA Version 1.1
Voice & Video	Legacy Voice	Voice Quality Requirement	Static and non static noise cancellation for headsets	The terminal used in Headset mode shall implement "Noise Suppressor" for calls in order to reduce surrounding noises included in sounds which are collected by the microphone.	To improve the quality of the voice for the users using headsets.	(VT14) : VFTST_1.020_Acoustics.pdf

		s		<p>Please see: Acoustical Quality Evaluations of Terminals VFTST_1.020_Acoustics.</p> <p>Note: This requirement applies for headsets in wired or wireless connection (e.g. Bluetooth).</p> <p>Note2: The Headset mode describes the Terminal used when connected to a headset and the communication is done via this external accessory. For details please refer to VFTST_1.020_Acoustics</p>		
Voice & Video	Video Call	Video call native entry points integration	Video call approved services	At requirement creation, Vodafone approved Video Call services are ViLTE (first priority) and Facetime/Duo (second priority). Native Video Call Entry Points shall only link to video services that are approved by Vodafone.	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - location	Native video call entry points shall be provided next to each Native Voice Calling / Messaging entry point (i.e. within Messaging, Contacts, Call Log)	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - branding	Native video call entry points shall not be branded (e.g. no Facetime/Duo label shall be shown and device native video call glyphs shall be used in line with messaging and calling glyphs)	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - green button experience	<p>Native video call entry points shall only be shown if there is sufficient likelihood for a Video Call to the respective contact to be successful.</p> <p>*For ViLTE calls, the likelihood for success is sufficient if:</p> <p>1.- The respective contact was discovered as ViLTE capable within the last 30 days (SIP OPTIONS return ViLTE capability or device already received ViLTE call from respective contact or the device received ViLTE capabilities during a VoLTE call)</p> <p>2.- in case ViLTE capability is unknown, then try an error maybe used as a capability check to determine if the contact is ViLTE or is not.</p> <p>*For Duo Video Calls, the likelihood for success is sufficient if the contact was discovered as Duo capable within the last 30 days (using Google Duo APIs) or if Duo wasn't yet set up on the device.</p>	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - services integration	The video call entry points shall combine all approved Video Call services that are available on the device in the respective market. When the user selects the Native Video Call entry point and multiple services are available, the device shall seamlessly try establishing video calls service by service according to the respective priority (see previous requirement). If no Video Call could be established, the	Required to only offer video calling when a good video call experience is feasible	

				device shall seamlessly fall back to an operator voice only call (e.g. VoLTE) and display a respective toast message to the user.		
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - service setup	<p>If Duo wasn't yet set up on the device, and the user selects the Native Video Call entry point, and higher priority Video Call services could not be used; then the user should be offered setting up Duo.</p> <ul style="list-style-type: none"> o If the user sets up Duo, the Duo setup request will not appear again later and the device tries setting up a Video Call using Duo. o If the user does not agree setting up Duo, the Duo setup request will appear again next time and the device will try with the next priority (e.g. fall back to voice call). 	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	Video call native entry points - invitation flows	Using Native Video Call entry points, there shall not be any video calling service invitations flows available (e.g. if the other party doesn't support video calling, the user shall not be offered sending an invitation to his contact to install/enable a video calling service/app).	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	End of Video call flow	Once a Video Call is finished, the UI shall return to the point where the Video Call was initiated (e.g. Messaging, Contacts, Call Log). There shall be no need to tap a button to exit the Video Calling UI / app.	Required to only offer video calling when a good video call experience is feasible	
Voice & Video	Video Call	Video call native entry points integration	No 3G Circuit switched Video call button from dialer, call logs, contacts, when RCS available	As 3G Videocall service will be shortly interrupted in the networks. There should be no button to initiate a 3G Circuit switched Video call from dialer, call logs, contacts.	Required to only offer video calling when a good video call experience is feasible	N/A
Wide Area Connectivity	LTE-IoT	RAN Sharing	MOCN - LTE-IoT	The system support MOCN (Multi-Operator Core Network) functionality with up to 3 operators with CAT-M with no restrictions	Allows terminals to utilise Core Network on shared networks	N/A
Wide Area Connectivity	NB-IoT	RAN Sharing	MOCN - NB-IoT	The system support MOCN (Multi-Operator Core Network) functionality with up to 3 operators with NB-IoT with no restrictions	Allows terminals to utilise Core Network on shared networks	N/A
Wide Area Connectivity	LTE	General	FGI bit pattern for Rel-9 onwards, bit 33-64	<p>The following bit pattern (TS 36.331, Annex B, Table B.1-1a) shall be at least supported by the UE:</p> <p>FGI-</p> <ul style="list-style-type: none"> bit 33: X (IRAT ANR UTRAN FDD) bit 34: 1 (IRAT ANR GERAN) bit 35: X (IRAT ANR 1xRTT) bit 36: X (IRAT ANR HRPD) bit 37: X (IRAT ANR UTRAN TDD) bit 38: X (PSHO if UTRA TDD&FDD) bit 39: X (B2 if UTRA TDD&FDD) bit 40: X (CSHO if UTRA TDD&FDD) bit 41: X (B1 if UTRA TDD&FDD) bit 42: X (DCI3a) bit 43-64: undefined <p>-The FGI bits marked with "X" are not</p>	Required for essential NW features, and for NW planning and testing issues in order to select test cases.	3GPP TS 36.331 Annex B

				required to be set. This pattern is valid for all UE from Rel-9 onwards. - In case of non or partial compliance, please state the known limitations in the comment sections.		
Wide Area Connectivity	LTE	Capacity	Downlink E-PDCCH	The UE shall support DL E-PDCCH according to 3GPP Rel-11.	Feature helps reduce congestion when high traffic load in hotspot areas creates congestion in the PDCCH. Essential that we build device penetration of this feature as at NW level the benefit of this feature is linked to the device penetration	3GPP TS 36.211
Wide Area Connectivity	LTE - Voice and Messaging	CSFB	CSFB to UTRAN with Deferred Measurement Control Reading	CSFB to UTRAN with Deferred Measurement Control Reading 3GPP TS 25.331.	Important to reduce the call setup time. Support requested today.	3GPP TS 25.331
Wide Area Connectivity	LTE	General	FGI bit pattern Rel-10 onwards, bit 101-132	The following bit pattern (TS 36.331, Annex C.1, table C.1-1) shall be at least supported by the UE: FGI- bit 101 - X bit 102 - X bit 103 - X bit 104 - X bit 105 - X bit 106 - X bit 107 - X bit 108 - X bit 109 - X bit 110 - X bit 111 - 1 (CA) bit 112 - 1 (CA) bit 113 - X bit 114 - 1 (simult. RSCP and EcNO report) bit 115 - X bit 116 - X bit 117 - 132 undefined - The FGI bits marked with "X" are not required to be set. This pattern is valid for all UE from Rel-10 onwards. - In case of non or partial compliance, please state the known limitations in the comment sections.	Required for essential NW features, and for NW planning and testing issues in order to select test cases.	3GPP TS 36.331, Annex C
Wide Area Connectivity	LTE	General	FGI bit pattern for Rel-9 onwards, bit 1-15	The following bit pattern (TS 36.331, Annex B, Table B.1-1) shall be at least supported by the UE: FGI- bit 1: X bit 2: 1 bit 3: 1 (VoLTE:RLC UM & PDCP SN) bit 4: 1 (short DRX) bit 5: 1 (long DRX) bit 6: 1 (prio bitrate) bit 7: 1 (VoLTE: RLC UM) bit 8: 1 (4G > 3G HO) bit 9: 1 (VoLTE) bit 10: 1 (4G > 2G CCO + NACC) bit 11: X bit 12: X bit 13: 1 (interFreq meas 4G) bit 14: 1 (Event A4, A5) bit 15: 1 (UTRAN Meas, Event B1) - The FGI bits marked with "X" are not required to be set. This pattern is valid for all UE from Rel-9 onwards.	Required for essential NW features, and for NW planning and testing issues in order to select test cases.	3GPP TS 36.331, Annex B

				- In case of non or partial compliance, please state the known limitations in the comment sections.		
Wide Area Connectivity	LTE - Voice and Messaging	USSD via IMS	IMS USSD	The VoLTE capable UE shall support Unstructured Supplementary Service Data (USSD / USSI) using IP multimedia CN Subsystem (IMS) according to 3GPP TS 24.390, Rel-11 and IR.92 v8.0. It is important that all SIP messages (INVITE, INFO & BYE) are supported by the UE in order to enable multiple USSD actions (USSD menu). In case the NW does not support USSD via IMS the UE shall use USSD method selection as described in TS 23.221, Rel-12, June version. Pre-configuration in the UE should be: USSD (USSI) preferred.	Required for VoLTE Terminals to support legacy voice services. This service is relevant for the VoLTE launch in VF D2. It is essential to support USSD method selection according to TS 23.221, Rel-12, June Version, in case the Voice domain is in IMS and USSD is in CS domain of the NW.	3GPP TS 24.390, Rel-11 3GPP TS 23.221, Rel-12, June version GSMA IR.92 v12.0
Wide Area Connectivity	LTE - Voice and Messaging	CSFB	CSFB indication in Paging Response message	The UE must use a CSFB indication in Paging Response message as defined in 3GPP TS 44.018	LTE smartphones using CSFB for voice may experience significant delay in MT call setup if this requirement is not satisfied	3GPP TS 44.018, Rel-11, sections 3.3.2.2, 9.1.25
Wide Area Connectivity	LTE - Voice and Messaging	CSFB	Establishment Cause for CSFB preceded by Location Update	The UE must use an Establishment Cause for CSFB preceded by Location Update as defined in 3GPP TS 44.018	LTE smartphones using CSFB for voice may experience significant delay in call setup if this requirement is not satisfied	3GPP TS 44.018, Rel-11, section 9.1.8
Wide Area Connectivity	LTE	General	LTE bands - mandatory for roaming	The UE shall also support the following roaming Frequency Bands: Band 17 (UL: 704 – 716 MHz, DL: 734 - 746 MHz) Band 5 (UL: 824 - 849 MHz, DL: 869 - 894 MHz) Band 4 (UL: 1710 - 1755 MHz, DL: 2110 - 2155 MHz)	Mandatory for LTE terminals to roam internationally. Note that support of these bands must not negatively impact performance on other primary bands.	N/A
Wide Area Connectivity	LTE - Voice and Messaging	CSFB	Redirection upon RRCConnectionRelease with RIM	Redirection upon RRCConnectionRelease RAT Information Management (RIM) according to 3GPP TS 36.401, Rel-9 shall be implemented as a minimum requirement in the LTE device in order to ensure interoperability and minimise call setup delays.	Essential for LTE terminals offering voice and messaging capability	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	Idle Mode Cell Reselection from eUTRA to GSM/GPRS	The UE shall support Idle Mode Cell Reselection from eUTRA RRC idle state to GSM/GPRS RRC Idle state based on: * subscription/policy criteria * DL radio criteria	Essential for LTE/GSM mobility	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	Idle Mode Cell Reselection from eUTRA to UTRA based on subscription/policy criteria	The UE shall support Idle Mode Cell Reselection from eUTRA RRC Idle state to UTRA RRC Idle state based on: * subscription/policy criteria * DL radio criteria	Essential for LTE/UMTS mobility	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	Idle Mode Cell Reselection from UTRA to eUTRA	The UE shall support Idle Mode Cell Reselection from: * UTRA_Idle to eUTRA RRC_Idle * UTRA_CELL_PCH state to eUTRA RRC_IDLE	Essential for UMTS/LTE mobility	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	Idle Mode Cell Reselection from GSM/GPRS to eUTRA	The UE shall support Idle Mode Cell Reselection from GSM_Idle/GPRS Packet_Idle to eUTRA RRC_IDLE. The priority of E-UTRA cells is: * lower than the serving cell	Essential for GSM/LTE mobility	N/A

			(priority)	* higher than the serving cell		
Wide Area Connectivity	LTE	Idle Mode Mobility	Idle Mode Cell reselection from GSM/GPRS to E-UTRA	The UE shall support Idle Mode Cell Reselection from GSM_Idle/GPRS Packet_Idle to eUTRA RRC_IDLE.	Essential for LTE/GSM mobility	N/A
Wide Area Connectivity	LTE	General	Buffer status reporting procedure	The UE shall support buffer status reporting procedure for suspended bearers.	At the moment there is urgency on the usage of OTDOA as Time Sync is needed in the network. Allocation of UL resources only when UE has something to transmit. Avoid allocating resources when UE has nothing to transmit to save network resources.	3GPP TS 36.321
Wide Area Connectivity	LTE	Uplink	UE transmit antenna selection	The UE shall support UE transmit antenna selection, as specified in 3GPP TS 36.213.	Essential for all LTE terminals in order to allow better performance in uplink	3GPP TS 36.213
Wide Area Connectivity	LTE	Power Management	UE measurement capabilities	The UE shall support the following UE measurement capabilities as specified in 3GPP TS 36.214: * GSM carrier Received Signal Strength Indicator (RSSI) * UTRA FDD CPICH Ec/No * UTRA FDD carrier Received Signal Strength Indicator (RSSI) * UTRA FDD CPICH Received Signal Code Power (RSCP) In case of non or partial compliance, please state the known limitations in the comment sections.	Essential for all LTE terminals in order to allow cell reselection and handover decisions.	3GPP TS 36.214
Wide Area Connectivity	General Requirements	Device mode support	BIP session support	The device SHALL support the BIP session regardless of incoming or outgoing calls, incoming or outgoing MMS, SMS.	Required for registration of the Vodafone services.	N/A
Wide Area Connectivity	LTE-IoT	Services	SMS traffic - IoT	The Cat M device shall support the reception and delivery of SMS		
Wide Area Connectivity	LTE-IoT	Location	Radio Measurements - LTE-IoT	The device shall be capable of measuring up to 8 cell RSRP, Timing Advance Information and UE Rx-Tx time difference measurements and include it in LPP protocol or Measurement Reports. In both CE Mode-A and Mode-B.	Now	
Wide Area Connectivity	NB-IoT	Location	Radio Measurements - NB-IoT	The device shall be capable of measuring up to 8 cell NRSRP, Timing Advance Information and UE Rx-Tx time difference measurements and include it in LPP protocol	Now	
Wide Area Connectivity	LTE-IoT	Location	Idle Mode Measurements - LTE-IoT	The device shall support measurements described in TCD-M2M_-REQ-012486 while being in idle mode as the result of an LPP information request	Now	
Wide Area Connectivity	NB-IoT	Location	Idle Mode Measurements - NB-IoT	The device shall support measurements described in TCD-M2M_-REQ-012486 while being in idle mode as the result of an LPP information request	Now	

Wide Area Connectivity	NB-IoT	Location	LTE Positioning Protocol (LPP) - NB-IoT	The device shall support LPP protocol including Rel-14 enhancements of TS 36.355, section 6.5.3, Enhanced Cell ID Positioning	Now	
Wide Area Connectivity	LTE-IoT	Mobility	InterRAT cell Handover UE triggered	The device shall support UE Assistance Information (3GPP 36.331, Rel-14, Section 5.6.10) to indicate to the network the preference for a configuration that is primarily optimized for power saving (i.e. LTE to Cat-M handover) in both CE Mode A and Mode B.	Now	
Wide Area Connectivity	LTE-IoT	Mobility	InterRAT cell Handover network triggered	The device shall search for any other IoT technology like LTE in case network triggers it based on the UE measurement reports (RSRP) in both CE Mode A and Mode B	Now	
Wide Area Connectivity	LTE-IoT	Mobility	Connected mode inter-frequency mobility	The device shall support connected mode inter-freq. mobility between: 1. CE Mode A - CE ModeA 2. CE Mode B- CE Mode B 3. Normal coverage - CE Mode A 4. CE Mode A - CE Mode B	Enables handover while maintaining data connection. Particularly important for IoT Devices that are mobile and require permanent data connection	
Wide Area Connectivity	LTE-IoT	Mobility	Connected mode intra-frequency mobility	The device shall support connected mode intra-freq. mobility between: 1. CE Mode A - CE ModeA 2. CE Mode B- CE Mode B 3. Normal coverage - CE Mode A 4. CE Mode A - CE Mode B	Enables handover while maintaining data connection. Particularly important for IoT Devices that are mobile and require permanent data connection	
Wide Area Connectivity	LTE-IoT	Mobility	Cell measurements and reporting	The device shall support connected mode serving cell measurements and reporting	Improves network access	
Wide Area Connectivity	LTE-IoT	Mobility	InterRAT cell reselection	The device shall search in an optimum manner for other IoT technologies like NB-IoT, LTE or 2G in case of Cat-M service/coverage loss or for performance improvement (e.g. throughput, battery) if the device supports more than Cat-M	Now	
Wide Area Connectivity	LTE-IoT	Mobility	Inter-frequency interband cell reselection - IoT	The device shall support inter frequency cell reselection in idle if more than 1 band is supported	Improves network access	
Wide Area Connectivity	LTE-IoT	Mobility	Inter-frequency intraband cell reselection - IoT	The device shall support inter frequency cell reselection in idle while in same band	Improves network access	
Wide Area Connectivity	LTE-IoT	Mobility	Intra-frequency cell reselection - IoT	The device shall support intra frequency cell reselection in idle	Improves network access	
Wide Area Connectivity	LTE-IoT	Battery Life Extension	Idle DRX - LTE-IoT	The device shall support DRX in idle mode to maximise battery life	Should be available now	
Wide Area Connectivity	LTE-IoT	Capacity and Scalability	High data rate through increased BW	The device shall support high data rate through increased PUSCH / PDSCH bandwidth as specified in Rel-14. This category will have maximum bandwidth of 5MHz or 20MHz. Larger TBS + up to 10 HARQ processes.	Improves network access	

Wide Area Connectivity	LTE-IoT	Services	VoLTE enhancements (Rel-14)	Support VoLTE coverage for half-duplex FDD/TDD system	Improves VoLTE coverage	
Wide Area Connectivity	LTE-IoT	Upgrades	Firmware upgrades	Multicast: SC-PTM based multicast design	Enables refresh of device firmware	
Wide Area Connectivity	NB-IoT	Mobility	Inter-frequency interband cell reselection - IoT	The device shall support inter frequency cell reselection in idle if more than 1 band is supported	Now	
Wide Area Connectivity	NB-IoT	Mobility	Inter-frequency intraband cell reselection - IoT	The device shall support inter frequency cell reselection in idle while in same band	Now	
Wide Area Connectivity	NB-IoT	Battery Life Extension	Idle DRX - NB-IoT	The device shall support DRX in idle mode to maximise battery life		
Wide Area Connectivity	NB-IoT	Battery Life Extension	Connected DRX - NB-IoT	The device shall support DRX in connected mode to maximise battery life		
Wide Area Connectivity	NB-IoT	Timing	Fast network sync	The device shall support fast network sync when no cell change after PSM mode: No SIB measurement, etc.	Now	
Wide Area Connectivity	NB-IoT	Uplink Transmission Mode	Enhanced data rate	The device shall support Rel-14 Enhanced data rate and latency (2 HARQ + TBS. This increases data rate from 25kbps to 85kbps sustained rate)	Now	
Wide Area Connectivity	NB-IoT	Upgrades	Firmware upgrades	The device shall support 3GPP Rel-14 SC-PTM Multicast feature	Now	
Wide Area Connectivity	NB-IoT	Capacity extension	Guard-band + Anchor PRB	The device shall support anchor PRB where 1 PRB is used for PSS-SSS, PBCH and PDCCH and 1 additional PRB for data shared channel (PDSCH/PUSCH)	Improves network access	
Wide Area Connectivity	NB-IoT	Battery Life Extension	Release Assistance Information	The NB-IoT Device shall support the Release Assistance Information feature. After sending the RAI related information, if the device does not receive the anticipated network initiated release, the device may initiate release of the RRC connection by signalling to the eNB. However, if the device uses this option, the device shall listen to its Idle mode DRX occasion for at least 4 DRX occasions after the release (in order to respond to any MME initiated events triggered by the device's RRC connection establishment)		3GPP TS 24.301, Rel-14
Wide Area Connectivity	NB-IoT	Sending/receiving data via	AT commands for sending and receiving data over control plane	The NB-IoT Device shall support the 3GPP AT commands +CSODCP and +CRTDCP.	High	

		NAS				
Wide Area Connectivity	NB-IoT	IP protocol	UDP	The NB-IoT Device shall support UDP.		
Wide Area Connectivity	NB-IoT	CoAP	CoAP over UDP	The NB-IoT Device shall support CoAP over UDP		
Wide Area Connectivity	NB-IoT	CoAP	CoAP	The NB-IoT Device shall support CoAP (IETF Constrained Application Protocol) for data transport. The CoAP communication endpoint (e.g. IoT server) can be freely configured on the device. The CoAP layer is open to be used by any service/application.		
Wide Area Connectivity	NB-IoT	AT commands	AT commands applicable for NB-IoT	Support of all AT commands applicable for NB-IoT according to 3GPP TS 27.007.		3GPP TS 27.007
Wide Area Connectivity	NB-IoT	Attach	Attach with PDN connection request	The NB-IoT Device shall support the attach with PDN connection. The NB-IoT Device shall be able to read and handle "SystemInformationBlockType1-NB".		3GPP TS 36.331
Wide Area Connectivity	NB-IoT	Location	Positioning	The device shall support LTE Positioning Protocols (LPP and LPPa) to be exchanged between the UE/eNB and the eSMLC, as defined by 3GPP for NB-IoT in Rel-13 (will be at least RSRP). LPP also supports A-GNSS signalling / measurements if the NB-IoT Device has a GPS	High	N/A
Wide Area Connectivity	NB-IoT	Congestion control	UE back off timer	The device shall support UE back-off timer (timer to monitor the queues for outstanding requests and the C-SGN starts to signal the UE to back off when the queues have reached a certain threshold.		N/A
Wide Area Connectivity	NB-IoT	Accessibility	Low access priority UEs	Device (or SIM) may be configured as low priority and the RAN can use this to prohibit access in the case of network congestion		N/A
Wide Area Connectivity	NB-IoT	Accessibility	Long periodic RAU/TAU timer	The device shall support the increase of maximum PLU / PRU timer up to 310 hours.		N/A
Wide Area Connectivity	NB-IoT	Accessibility	Paging Optimisation for IoT Traffic	The device shall support improved paging optimized for IOT traffic. Paging Optimisation and Paging for Coverage Enhancement capable UEs as specified in TS 36.413, version 13.2.0.		3GPP TS 36.413, version 13.2.0
Wide Area Connectivity	NB-IoT	Capacity management	QoS	The NB_IoT Device shall be compliant with the QoS concepts as described in 3GPP TS 23.401 v11.11.0 [2] section 4.7.		N/A
Wide Area Connectivity	NB-IoT	IP protocol	IPv4 & IPv6	The NB_IoT Device shall be compliant with both IP protocol stacks (IPv4 and IPv6)		N/A

Wide Area Connectivity	NB-IoT	Services	SMS traffic - IoT	The NB_IoT Device shall support the reception and delivery of SMS	Low	N/A
Wide Area Connectivity	NB-IoT	Power saving	Sleep Mode	The NB_IoT Device shall support fast return to sleep mode techniques	High	N/A
Wide Area Connectivity	NB-IoT	Security	Encryption and Integrity (user plane)	The device shall support the standards Encryption and Integrity algorithms as part of the basic implementation of NB-IoT for the user plane data sent on Data Radio Bearers	High	N/A
Wide Area Connectivity	NB-IoT	Security	Encryption and Integrity (control plane)	The device shall support the standards Encryption and Integrity algorithms as part of the basic implementation of NB-IoT for the Control Plane channels	High	N/A
Wide Area Connectivity	NB-IoT	Optimised S1 Control plane solution	ROH Compression	The device shall be compliant with ROHC framework as specified in IETF RFC 4995 and realized in "Data over NAS Convergence Protocol". The device will be compliant with the ROHC profiles defined in 36.323 and, at least, will support the following ROHC packet types: - Initialization and Refresh (IR) packet type; - IR dynamic part (IR-DYN) packet type; - Feedback (ACK, NACK, STATIC-NACK) packet type; - Compressed (CO) packet type;	High	N/A
Wide Area Connectivity	NB-IoT	Optimised S1 Control plane solution	Data over NAS (Non-IP)	The device shall support NB-IoT data transmission using S1-MME optimised control plane solution (Data over NAS for IP and Non-IP communications, as specified in TR 23.720 section 6.18.1.3 or the most recent equivalent to be specified in TS 23.401, version 13.6.0.) for NB-IoT users. Mandatory solution.	High	N/A
Wide Area Connectivity	NB-IoT	Optimised S1 User plane solution	Suspend/Resume mode	The device shall support NB-IoT data transmission using S1-U optimised user plane solution (Suspend/Resume mode state) for NB-IoT users. Optional solution	High	N/A
Wide Area Connectivity	NB-IoT	Battery Life Extension	PSM Mode	The device shall support PSM Mode from 3GPP Rel-12 for NB-IoT Devices to maximise battery life.		N/A
Wide Area Connectivity	NB-IoT	Battery Life Extension	Extended DRX - NB-IoT	The device shall support Extended DRX feature from 3GPP Rel-13 for NB-IoT devices to maximise battery life.		N/A
Wide Area Connectivity	NB-IoT	Capacity extension	Anchor PRB	Support for anchor PRB where Primary PRB is used for Paging, NPSS-NSSS, NPBCH, NPDCCH and NPRACH and secondary PRB for data shared channels (PDSCH/PUSCH). One of the PRB can go Guard-Band/In-band, the second PRB can for either Guard-Band or In-Band		N/A
Wide Area Connectivity	NB-IoT	Cell Size	Extended Cell Size	Support the CP length of 266.7 us for the PRACH channel configurable by the operator for a cell size up to 40Km		N/A

Wide Area Connectivity	NB-IoT	Cell Size	Basic Cell Size	The device shall support the basic CP length of 66.7 us for the PRACH channel		N/A
Wide Area Connectivity	NB-IoT	Coverage Extension	20 dB coverage extension in UL	Support of UL modulation in 3GPP (Pi/4-QPSK and Pi/2-BPSK for single tone and QPSK for multitone), the predefined set of repetitions (from 1 to 128), and low index of Transport Block table according to 3GPP to reach 20 dB coverage reaching the 164 dB MCL		N/A
Wide Area Connectivity	NB-IoT	Coverage Extension	20 dB coverage extension in DL	Support of DL modulations in 3GPP (QPSK, Pi/2-BPSK, Pi/4-QPSK) the predefined set of repetitions (from 1 to 2048), and low index of Transport Block table according to 3GPP to reach 20 dB coverage reaching the 164 dB MCL		N/A
Wide Area Connectivity	NB-IoT	Uplink Transmission Mode	3.75 KHz single tone	Support for 3.75 KHz Uplink Transmission mode.	High	N/A
Wide Area Connectivity	NB-IoT	Uplink Transmission Mode	15 KHz multi tone	Support for 15 KHz Multitone Uplink Transmission mode. Please specify multi-tone configuration supported (3, 6, 12 sub-carriers per IoT Device).	High	N/A
Wide Area Connectivity	NB-IoT	Uplink Transmission Mode	15 KHz single tone	Support for 15 KHz Uplink single tone Transmission mode.	High	N/A
Wide Area Connectivity	NB-IoT	Deployment Modes	Standalone mode	Support for NB-IoT standalone deployment mode.		N/A
Wide Area Connectivity	NB-IoT	Deployment Modes	Guard-band mode	Support for NB-IoT guard-band deployment mode (for Bw of 3, 5, 10 and 20 MHz)		N/A
Wide Area Connectivity	NB-IoT	Deployment Modes	DL RB allocation for In-band mode	The device shall support all possible DL RB locations for NB-IoT as defined by 3GPP. Please state what are the DL locations supported (8 locations for 10 MHz LTE in B20 band).		N/A
Wide Area Connectivity	NB-IoT	Deployment Modes	UL/DL RB allocation for In-band mode	The device shall support a flexible configuration of duplex gap between uplink and downlink RB's for NB-IoT in order to optimise the LTE UL performance and NB-IoT performance. Duplex gap for NB-IoT traffic should be operator configurable. This flexibility is critical for the UL performance where the UL transmission use contiguous PRBs		N/A
Wide Area Connectivity	NB-IoT	Deployment Modes	In-band mode	Support for NB-IoT in-band deployment mode (with 164 dB MCL).		N/A
Wide Area Connectivity	NB-IoT	Maximum output Power	CAT-NB1 Output power	The CAT-NB1 device shall be able to reach up to 20 dBm of maximum transmit power (Class 5)		N/A

Wide Area Connectivity	NB-IoT	Maximum output Power	CAT-NB1 Output power	The CAT-NB1 device shall be able to reach up to 23 dBm of maximum transmit power	High	N/A
Wide Area Connectivity	NB-IoT	UE Category "CAT-NB1" for IoT	CAT-NB1 capability	Support for NB-IoT capability Cat-NB1 in the SRAN access node in compliance to 3GPP Rel-13 (min. Mar 2017) protocol specifications (including single/multitone, 3.75 KHz/15 KHz sub-carrier spacing).	High	N/A
Wide Area Connectivity	NB-IoT	3GPP Compliance	Standard compliancy - IoT	The NB-IoT Device shall be complaint to 3GPP Rel-13. The vendor shall state the latest version of the 3GPP standards the product is compliant to and list any restriction		N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	PSM	Support for Power Saving Mode feature from 3GPP Rel-12 for LTE Cat 1, and Cat M devices	High	N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	Extended DRX - LTE-IoT	Support for Extended DRX feature from 3GPP Rel-13 for LTE Cat 1 and Cat M devices.	High	N/A
Wide Area Connectivity	LTE-IoT	Maximum output Power	Cat M Output power II	The Cat M device shall be able to reach up to 20 dBm of maximum transmit power (Class 5)	High	N/A
Wide Area Connectivity	LTE-IoT	Maximum output Power	Cat M Output power	The Cat M device shall be able to reach up to 23 dBm of maximum transmit power	High	N/A
Wide Area Connectivity	LTE-IoT	Coverage Extension	Cat M Deployment Mode B coverage extension	Support for the over 15 dB coverage enhancements features as specified in 3GPP for cat M IoT Devices with deployment mode B	High	N/A
Wide Area Connectivity	LTE-IoT	UE Category M for IoT	Half Duplex Operation Type	Support half-duplex FDD operation for UE cat M IoT Devices.	High	N/A
Wide Area Connectivity	LTE-IoT	UE Category M for IoT	Cat M capability	Support for 3GPP Rel-13 LTE Cat M capability in co-existence with all LTE UE categories.	High	N/A
Wide Area Connectivity	LTE-IoT	UE Category 1 for IoT	Cat 1 capability	Support for 3GPP Rel-8 LTE Cat 1 capability in co-existence with all LTE UE categories	High	N/A
Wide Area Connectivity	LTE	Slicing	4G slicing	The UE shall support any UE application (on Android, iOS, etc.) to be able to use a named APN (e.g. gaming app to use a "low latency APN")	required by 2H19	
Wide Area Connectivity	LTE - Voice and Messaging	VoLTE	VoLTE Interconnect: ICSI service tag	The UE shall support of ICSI service tag: VoLTE UE must populate the ICSI service tag "urn:urn-7:3gpp-service.ims.icsi.mmTel" in the SIP Invite to indicate they wish to establish a VoLTE call for originating calls, and in the SIP response (183, 200) to indicate they are ready to accept a VoLTE call for terminating calls. Requirement is applicable both for 4G	already	

				and 5G devices when the 5G devices are under Option 3x handling the voice over LTE		
Wide Area Connectivity	LTE - Voice and Messaging	VoLTE	VoLTE roaming: Anonymous Emergency Sessions	The UE shall Support of “anonymous” Emergency Call for outbound VoLTE roamers (S8HR): if the UE receives a SIP 4xx as a response of a IMS Emergency registration attempt, then the UE must perform the procedures defined in subclause 5.1.6.8.2 of 3GPP TS 24.229, Rel-14, as mandate by IR.92 v12. The requirement is aplicable both for 4G and 5G devices when the 5G devices are under Option 3x handling the voice over LTE	By Q2/19	
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-38A DL	All UE of Cat 6 or higher have to support downlink CA band 1 (2100) + band 38 (2600 TDD) combination: bandwidth B1 (5-20 MHz); B38 (15-20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates in Europe.	3GPP TS 36.101
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-7C-20A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 7 (2600) contiguous + band20 (800) combination: Bandwidth: B1 (5-20 MHz + B3 (10-20 MHz) + B7 (15-30 MHz)+ B20 (10 MHz)	Important to support higher data rates in the Downlink in Europe and AMAP. Available now in Netherlands and in Malta by 2H20.	3GPP TS 36.101
Wide Area Connectivity	5G	Battery Life Extension	Connected DRX - 5G	SW support of cDRX	By Q219	
Wide Area Connectivity	5G	Battery Life Extension	Cross slot scheduling	SW support of Cross Slot Scheduling [comment] Large reduction in number of PDSCH to be received	By Q420	
Wide Area Connectivity	5G	Latency	Case 2: PDCCH monitoring	The UE shall support Case 2: PDCCH monitoring periodicity of less than 14 symbols This feature is mandatory without UE capability signalling.	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Non-slots: 7-14 OFDM symbols in Dowlink	The device shall support Time-domain resource allocation - PDSCH mapping type A with 7-14 OFDM symbols (This feature is mandatory without UE capability signalling)	By Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Non-slots: 1-14 OFDM symbols in Uplink	The device shall support Time-domain resource allocation - 1-14 OFDM symbols for PUSCH once per slot - Starting symbol, and duration are determined by using the DCI (This feature is mandatory without UE capability signalling)	By Q219	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	PDCCH case 1-2	The device will support Case 1: PDCCH monitoring periodicity of 14 or more symbols. Case 1-2: PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot	By Q219 (now for testing)	3GPP TS 38.306

Wide Area Connectivity	5G	5G NR	PDCCH case 1-1	The device will support Case 1: PDCCH monitoring periodicity of 14 or more symbols. With case 1-1: PDCCH monitoring on up to three OFDM symbols at the beginning of a slot	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	Scheduling type A	Support of data channel allocation Type A.	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	Uplink 256QAM - 5G	256QAM for PUSCH	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	Uplink 64QAM - 5G	64QAM for PUSCH	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	Downlink 256QAM - 5G	256QAM for PDSCH	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	Downlink 64QAM - 5G	64QAM for PDSCH	By Q219 (now for testing)	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	UE Channel Bandwidth for SCS 30 KHz	Support the following UE Channel Bandwidth for SCS of 30kHz: 10 MHz, 15 MHz, 20 MHz, 25 MHz, 40 MHz, 50 MHz, 60 MHz, 80 MHz, 90 MHz, 100 MHz	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	UE Channel Bandwidth for SCS 15KHz	Support the following UE Channel Bandwidth for SCS of 15kHz: 5MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 40 MHz, 50 MHz	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	Diffrent SCS	Simultaneous transmission and reception with same or different numerologies in 5G CA	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_20A-32A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 130 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_8A-20A_n78A combination Min BW: 5+10+20 Max BW: 15+10+100	By 2H19 for UK.	3GPP TS 38.101-3
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A-32A_n78A	Support of Dual Connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 180MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 3DL, 2DL or 1DL (+ 5G NR) DC_1A-7A-20A-32A_n78A combination Min BW: 5+15+10+20+20 Max BW: 20+20+10+20+100	UK now. By 2H20 for IT.	3GPP TS 38.101-3

Wide Area Connectivity	LTE	License Assisted Access	CA_42A-46A	The device shall support License Assisted Access utilising DL carrier aggregation of band 42 (3500) + band 46 (5GHz Unlicense) Bandwidth: B42 (10-20 MHz), B46 (20 MHz)	Important to support higher data rates in DL including the unlicensed spectrum. Support requested in Turkey and EU, by 2H19 TR	3GPP TS 36.101
Wide Area Connectivity	LTE	Massive MIMO	UDC (uplink data compression)	Support for UDC according to 3GPP Rel-15. The vendor shall specify if their solution is 3GPP standard or proprietary.	Required to improve throughput in UL	
Wide Area Connectivity	LTE	Massive MIMO	High power UE (HPUE) - LTE	Support for HPUE providing 26dBm (+3dB) according to 3GPP Rel-14 in mainly for B38 and B41-India. Band 40 and Band 42 are nice to have. The supplier to detail which of the bands support.	Now	
Wide Area Connectivity	LTE	Massive MIMO	FDD + TDD UL CA	Support for FDD + TDD UL CA when FDD or TDD is Pcell. Specific combos requested defined in separate TCD requirements.	Now	
Wide Area Connectivity	LTE	Massive MIMO	FDD + TDD DL CA for TM9 CSI with FDD as Pcell	Support for FDD + TDD DL CA for TDD in TM9 CSI when FDD is Pcell. The vendor shall specify the supported band configurations if not band agnostic. Specific band combination required for FDD+TDD defined in other TCDs	Now	
Wide Area Connectivity	LTE	Massive MIMO	FDD + TDD DL CA for TM7, TM8 or TM9 SRS with TDD as Pcell	Support for FDD + TDD DL CA for TDD in TM7, TM8 or TM9 SRS being TDD set as Pcell. The vendor shall specify the supported band configurations if not band agnostic. Specific combos required for FDD+TDD defined in a different TCDs	Now	
Wide Area Connectivity	LTE	Massive MIMO	TM9 Rel-14 CSI Class B	Support for TM9 Class B based on CSI feedback with 8 ports using for beamformed CSI-RS according to 3GPP Rel-14. Support for up to 4 layers per DL for TM9	By Q219	
Wide Area Connectivity	LTE	Massive MIMO	TM9 Rel-14 CSI Class A	Support for TM9 Class A based on CSI feedback calculated from 32-ports non-beamformed CSI-RS according to 3GPP Rel-14. Support for up to 4 layers per DL for TM9	By Q219	
Wide Area Connectivity	LTE	Massive MIMO	TM9 Rel-14 SRS	Support for TM9 based on SRS feedback according to 3GPP Rel-14. Support for up to 4 layers per DL for TM9	By Q219	
Wide Area Connectivity	LTE	Massive MIMO	TM9 Rel-10 CSI	Support for TM9 based on CSI feedback obtained from 8-ports non-beamformed CSI-RS according to 3GPP Rel-10. Support for up to 4 layers per DL for TM9	Now	
Wide Area Connectivity	LTE	Massive MIMO	TM9 Rel-10 SRS	Support for TM9 based on SRS feedback according to 3GPP Rel-10. Support for up to 4 layers per DL for TM9	Now	
Wide Area Connectivity	General Requirements	Performance	Performance of key services	Key services (e.g. VoLTE and RCS) should be unaffected when a device is connected in EN-DC mode	Ensure that the addition of new 5G bearers do not impact user experience of key features	

Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SDL-SUL - InterB and EN-DC within FR1	DC_8A_SUL_n75/76_n81	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 30 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 10+20	By 2H19 for UK.	ongoing in 3GPP
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SDL-SUL - InterB and EN-DC within FR1	DC_20A_SUL_n75/76_n82	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 30 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 10+20	By 2H19 for UK.	ongoing in 3GPP
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SUL - InterB and EN-DC within FR1	DC_3A_SUL_n78A-n82A	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 115 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 15+100	By 2H19 for UK. By 2H20 for DE and MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SUL - InterB and EN-DC within FR1	DC_3A_SUL_n78A-n80A	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 20+100	By 2H19 for UK and by 2H20 for DE.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SUL - InterB and EN-DC within FR1	DC_1A_SUL_n78A-n84A	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 20+100	By 2H19 for UK and by 2H20 for DE.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SUL - InterB	DC_20A_SUL_n78A-n82A	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 110 MHz, with detailed bandwidth granularity. Min BW: 10+20 Max BW: 10+100	By 1H19 for UK and by 2H20 for DE.	Configuration not in 3GPP 15.2.0

		and EN-DC within FR1				
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_20A_n8A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 25 MHz, with detailed bandwidth granularity. DC_20A_n8A combination Min BW: 10+10 Max BW: 10+15	By 2H19 for UK.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	LTE-IoT	Coverage Extension	Cat M Deployment Mode A coverage extension	Support basic deployment mode A operation mode (both level 1 and 2)	Now	
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A_3A_7A_32A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 32 (1400) combination: (min bandwidth 5 MHz + 5 MHz + 15MHz + 20 MHz; max bandwidth 20 MHz + 20MHz + 20MHz + 20MHz)	Essential to ensure sufficient bandwidth for higher data rates: Italy in 2H19.	3GPP TS 36.101
Wide Area Connectivity	NB-IoT	Frequency bands	Guard-band edge-to-edge separation	The device shall support edge-to-edge separation of 105 KHz	By now	
Wide Area Connectivity	LTE	Latency	Suspend and Resume mode	Support the RRC Light connection including the S1-U optimised user plane solution (Suspend/Resume mode state)	3GPP Rel-13 will improve the latency in control plane. Latency is one of the key factors to enhance the User Experience, and now the current RTT measurements are between 20 and 40 ms	3GPP TS 36.331 Rel-13
Wide Area Connectivity	5G	Location	MDT - idle mode	Support of Logged MDT (Minimization of Drivetest) procedures according to the TS 37.320 Rel-10, chapter 5.1.1. to obtain following information reported by the eNodeB/gNodeB: <ul style="list-style-type: none"> • time stamp • serving cell ID, including both 4G and 5G NR cells • serving cell measurements (RSRP, RSRQ), including both 4G and 5G NR cells • neighbor cell measurements (RSRP, RSRQ, RSCP, Ec/NO, RxLev,...), including also the 5G NR cells • GNSS location (Standalone UE GPS) according to the TS 36.331 Release if available by the UE when taking the measurement • Timing Advance • If there is any parameter not reported in the MDT logs please specify it. • Vendor should specify if there is any limit in logging time. • If there is any limit on number of users please specify it. This information will be available to external tracing tools to estimate the location of the UEs	By Q219 (now for testing)	

Wide Area Connectivity	5G	Location	MDT - connected mode	<p>Support of MDT (Minimization of Drivetest) in RRC_connected mode according to the TS 37.320 Rel-10, chapter 5.2.1.3. to obtain following information reported by the eNodeB/gNodeB:</p> <ul style="list-style-type: none"> • time stamp • serving cell ID, including both 4G and 5G NR cells • serving cell measurements (RSRP, RSRQ), including both 4G and 5G NR cells • neighbor cell measurements (RSRP, RSRQ, RSCP, Ec/NO, RxLev,...), including also the 5G NR cells • GNSS location (Standalone UE GPS) according to the TS 36.331 Release if available by the UE when taking the measurement • Timing Advance <p>• If there is any parameter not reported by MDT please specify it. • If there is any limit on number of users please specify it. This information will be available to external tracing tools to estimate the location of the UEs</p>	By Q219 (now for testing)	
Wide Area Connectivity	5G	Latency	Light Control Plane Connection	The device shall support the RRC Light connection including the S1-U optimised user plane solution (Suspend/Resume mode state) for the NSA Dual Connectivity	By Q219 (now for testing)	
Wide Area Connectivity	5G	Latency	Fast HARQ process	The device shall support operation of fast ACK/NACK and fast scheduling to reduce the latency. Max number of HARQ processes=16, Configurable HARQ DL-UL timing offset, n+ “configurable parameter” per UE	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	DFTS-OFDM	The device shall support the waveform DFTS-OFDM with the different numerology in UL	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	CP-OFDM	The device shall support the waveform CP-OFDM with the different numerology in UL and DL	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	Subcarrier Spacing 60, 120 and 240 KHz	The device shall support 60, 120 and 240 KHz of SCS for mmWave bands	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	Subcarrier Spacing 30 KHz	The device shall support 30 KHz of SCS for band n78	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	Subcarrier Spacing 15 and 30 KHz	The device shall support 15 and 30 KHz of SCS for sub-1 GHz bands (e.g. 700 MHz band)	By Q219 (now for testing)	
Wide Area Connectivity	5G	5G NR	5G NR support as specified in 3GPP Rel-15	Support for 5G NR as per 3GPP Rel-15, Version 15.3.x or later, specification. devices shall support all mandatory 5G NR capabilities to allow full interoperability with Rel-15 5G NR RAN Networks	By Q219 (now for testing)	

Wide Area Connectivity	5G	VoLTE	SRVCC Support	The device will support the current features SRVCC to 2G/3G when there is a 5G NR in NSA link setup	By Q219 (now for testing)	
Wide Area Connectivity	5G	VoLTE	VoLTE Service	The device will support the current VoLTE service including all the 4G features enhancing the performance of VoLTE when there is a 5G NR NSA established	By Q219 (now for testing)	
Wide Area Connectivity	5G	QoS:QCI	Legacy QCI	The device will support the legacy 4G QoS Class Identifier (QCI) with the current 4G QoS parameters including the Guaranteed Bit Rate (GBR).	By Q219 (now for testing)	
Wide Area Connectivity	5G	RAN Sharing	5G Mobility shared and non-shared RAN	As per 3GPP TR 38.801 section 5.5, support of mobility between non-shared RAN and shared RAN	By Q219 (now for testing)	
Wide Area Connectivity	5G	RAN Sharing	MOCN - 5G	As per 3GPP TR 38.801 section 5.5, Multit-Operator Core Network. Support of Shared RAN on shared spectrum. Up to 4 operators, sending multiple PLMNIds	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_8A_n78A	"Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. DC_8A_n78A combination Min BW: 5+20 Max BW: 15+100"	By 2H19 for UK and DE. By 2H20 for NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_28A_n78A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 115 MHz, with detailed bandwidth granularity. DC_28A_n78A combination Min BW: 10+20 Max BW: 15+100	By 2H19 for NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_1A_n78A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. DC_1A_n78A combination Min BW: 5+20 Max BW: 20+100	By now for DE and IT. By 2H19 for NZ and UK. By 2H20 for ES.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_7A_n78A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. DC_7A_n78A combination Min BW: 15+20 Max BW: 20+100	By now for ES, DE, IE and IT. By 2H19 for UK and NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1

Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_3A_n78A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 120 MHz, with detailed bandwidth granularity. DC_3A_n78A combination Min BW: 5+20 Max BW: 20+100	By now for ES, DE and IT. By 2H19 for UK, IE and NZ. By 2H20 for MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_20A_n78A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 110 MHz, with detailed bandwidth granularity. DC_20A_n78A combination Min BW: 10+20 Max BW: 10+100	By now for ES, DE and IT. By 2H19 for UK and IE.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_20_n28A	Support of Dual connectivity between the specified 1 LTE carriers + 1 5G NR carrier up to 20 MHz, with detailed bandwidth granularity. DC_20_n28A combination Min BW: 10+10 Max BW: 10+10	By 2H19 for DE. By 2H20 for UK.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_8A-20A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 125 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_8A-20A_n78A combination Min BW: 5+10+20 Max BW: 15+10+100	By 2H19 for UK and DE. By 2H20 for ES.	Configuration not in 3GPP 15.2.0
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_1A-8A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_1A-8A_n78A combination Min BW: 5+5+20 Max BW: 20+15+100	By 2H19 for UK and DE. By 2H20 for ES and NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_7A-28A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_7A-28A_n78A combination Min BW: 15+10+20 Max BW: 20+15+100	By 2H19 for NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2

Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3A-28A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_3A-28A_n78A combination Min BW: 5+10+20 Max BW: 20+15+100	By 2H19 for NZ. By 2H20 for MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_20A-38A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 130MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_20A-38A_n78A combination Min BW: 10+10+20 Max BW: 10+20+100	By 2H19 for UK and DE.	Configuration not in 3GPP 15.2.0
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3A-38A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 140MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_3A-38A_n78A Min BW: 5+10+20 Max BW: 20+20+100	By 2H19 for DE	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_1A_7A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 140 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_1A_7A_n78A combination Min BW: 5+15+20 Max BW: 20+20+100	By now for DE and IT. By 2H19 for NZ and UK. By 2H20 for ES.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_1A-3A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 140 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_1A-3A_n78A combination Min BW: 5+3+20 Max BW: 20+20+100	In plan for EU and AMAP, IN By now for IT and DE. By 2H19 for UK and NZ. By 2H20 for ES and MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_1A-20A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 130MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_1A-20A_n78A combination Min BW: 5+10+20 Max BW: 20+10+100	EU and AMAP By now for DE and IT. By 2H19 for UK. By 2H20 for ES.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2

Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_3C_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 125 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_3C_n78A contiguous Min BW: 20+5+20 Max BW: 20+15+100	By 2H19 for DE, IE and NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3A-7A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 140MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_3A-7A_n78A coombination Min BW: 5+15+20 Max BW: 20+20+100	Massively rollout in EU and AMAP By now for ES, DE and IT. By 2H19 for IE, UK and NZ. By 2H20 for MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3A-20A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 130MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_3A-20A_n78A Min BW: 5+10+20 Max BW: 20+10+100	EU and AMAP By now for ES, DE and IT. By 2H19 for UK and IE. By 2H20 for MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_7A-20A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 130MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 1DL (+ 5G NR) DC_7A-20A_n78A combination Min BW: 15+10+20 Max BW: 20+10+100	EU and AMAP By now for ES, DE and IT. By 2H19 for UK and IE.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-8A-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 145 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_1A-8A-20A_n78A Min BW: 5+5+10+20 Max BW: 20+15+10+100	By 2H19 for DE and UK. By 2H20 for ES.	Configuration not in 3GPP 15.2.0
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-3A-28A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 155 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_1A-3A-28A_n78A combination Min BW: 5+5+10+20 Max BW: 20+20+15+100	By 2H20 for NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3

Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_3A-7A-28A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 155 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_3A-7A-28A_n78A combination Min BW: 5+15+10+20 Max BW: 20+20+15+100	By 2H19 for NZ. By 2H20 for MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3C-7A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 150 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_3C-7A_n78A contiguous Min BW: 20+5+15+20 Max BW: 20+10+20+100	By 2H19 for De and NZ.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3C-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 140 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_3C-20A_n78A contiguous Min BW: 20+5+10+20 Max BW: 20+10+10+100	By 2H19 for DE and IE.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.2
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-3A-7A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 150 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_1A-3A-7A_n78A combination Min BW: 5+5+15+20 Max BW: 20+20+10+100	EU By now for DE. By 2H19 for UK, IT and NZ. By 2H20 for ES and MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-3A-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 150 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_1A-3A-20A_n78A combination Min BW: 5+5+10+20 Max BW: 20+20+10+100	EU By now for DE and IT. By 2H19 for UK. By 2H20 for ES and MT.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 150 MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_1A-7A-20A_n78A combination Min BW: 5+15+10+20 Max BW: 20+20+10+100	EU By now IT and DE. By 2H19 for UK. By 2H20 for ES.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3

Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_3A-7A-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 150MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 2DL or 1DL (+ 5G NR) DC_3A-7A-20A_n78A combination Min BW: 5+15+10+20 Max BW: 20+20+10+100	EU By now ES, DE and IT. By 2H19 for UK. By 2H20 for AL.	3GPP TS 38.101-3, Rel-15, section 5.5B.4.3
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_3A-7A-20A-32A_n78A	Support of Dual Connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 180MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 3DL, 2DL or 1DL (+ 5G NR) DC_3A-7A-20A-32A_n78A combination Min BW: 5+15+10+20+20 Max BW: 20+20+10+20+100	IT now.By 1H19 for UK. By 2H20 for MT.	Configuration not in 3GPP 15.2.0
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_3A-7A-8A-20A DL	All UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 8 (900) + band 20 (800) combination: (min bandwidth 5 MHz + 15 MHz + 5MHz + 10 MHz; max bandwidth 20 MHz + 20MHz + 15MHz + 10MHz)	Essential to ensure sufficient bandwidth for higher data rates. Available now in Turkey.	3GPP TS 36.101
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-8A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 8 (900) combination: (min bandwidth 5 MHz + 5 MHz + 15MHz + 5 MHz; max bandwidth 20 MHz + 20MHz + 20MHz + 15MHz)	Essential to ensure sufficient bandwidth for higher data rates. In Greece, New Zeland and Germany by 2H19.	3GPP TS 36.101
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A-3A-8A-20A DL	All UEs of Cat11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) + band 20 (800) combination: (min bandwidth 5MHz + 5 MHz + 5MHz + 10MHz; max bandwidth 20 MHz + 10MHz + 10MHz + 10 Mhz)	Essential to ensure sufficient bandwidth for higher data rates. In Turkey, Spain, Greece, Netherlands and Germany by 2H19.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-8A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 20 (800) combination: min bandwidth 5 MHz + 5 MHz + 10 MHz; max bandwidth 20 MHz + 15 MHz + 10 MHz	Essential to ensure sufficient bandwidth for acceptable data rates: Available now in Turkey and Greece.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-8A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 8 (900) + band 20 (800) combination: min bandwidth 5 MHz + 5 MHz + 10 MHz; max bandwidth 20 MHz + 15 MHz + 10 MHz	Essential to ensure sufficient bandwidth for acceptable data rates.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-8A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) combination: (min bandwidth 5MHz + 5MHz + 5MHz; max bandwidth 20MHz + 20MHz +	Essential to ensure sufficient bandwidth for acceptable data rates. In Turkey, South Africa and Egypt available now.	3GPP TS 36.101

				15MHz)		
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_7C DL	All UE of Cat 6 or higher have to support downlink CA band 7 (2600) + band 7 (2600) combination, using continuous bands: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates. In Netherlands and Ireland available now.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_8A-20A DL	All UEs of Cat 6 or higher have to support downlink CA band 8 (900) + band 20 (800) combination: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20 MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-8A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 8 (900) combination: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20 MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-8A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 8 (900) combination: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20 MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates.	3GPP TS 36.101
Wide Area Connectivity	LTE-IoT	Frequency bands	LTE-IoT Band 28	The device shall support B28 frequency band	Mainly for NZ	3GPP TS 36.101, Rel-13
Wide Area Connectivity	LTE-IoT	Frequency bands	LTE-IoT Band 3	The device shall support B3 frequency band	Mainly for IN, NZ	3GPP TS 36.101, Rel-13
Wide Area Connectivity	LTE-IoT	Frequency bands	LTE-IoT Band 8	The device shall support B8 frequency band		3GPP TS 36.101, Rel-13
Wide Area Connectivity	LTE-IoT	Frequency bands	LTE-IoT Band 20	The device shall support B20 frequency band		3GPP TS 36.101, Rel-13
Wide Area Connectivity	NB-IoT	Frequency bands	NB-IoT Bands 28 and 3	The device shall support B28 (NZ) and B3 (NZ,IN) frequency band	Mainly for NZ, IN	
Wide Area Connectivity	NB-IoT	Frequency bands	NB-IoT Bands 20 and 8	The device shall support B20 and B8 frequency bands		
Wide Area Connectivity	General Requirements	Roaming	Data consumption while roaming	The device shall not consume any data while roaming prior to validation of the user data roaming setting	This is required as some UEs have been found to consume a small amount of data while roaming (and thus triggering the roaming charge) even though the user interface has data roaming disabled. In some instances the UE software establishes a data connection before the UI setting has been read by the firmware.	N/A

Wide Area Connectivity	LTE	License Assisted Access	CA_7A-46C	The device shall support License Assisted Access utilising DL carrier aggregation of band 7 (2600) + band 46 (5GHz Unlicensed)+ band 46 (5GHz Unlicensed) (min bandwidth 15 MHz + 20MHz +20MHz; max bandwidth 20MHz + 20MHz +20MHz)	Important to support higher data rates in DL including the unlicensed spectrum. Support requested in Turkey	3GPP TS 36.101
Wide Area Connectivity	LTE	License Assisted Access	CA_3A-46A	The device shall support License Assisted Access utilising DL carrier aggregation of band 3 (1800) + band 46 (5GHz Unlicensed) (min bandwidth 3 MHz + 20MHz; max bandwidth 20MHz + 30MHz)	Important to support higher data rates in DL including the unlicensed spectrum. Support requested in IN and South Africa	3GPP TS 36.101
Wide Area Connectivity	LTE	Latency	L2 Improvements of Rel-14 (Fast UL access)	This included the L2 improvements from Rel-14. Semi Persistent scheduling (SPS) with a periodicity reduction up to 1ms (Removes the scheduling request to get UL transmission) Skip padding transmission in case there is no data to transmit after the grant allocation.	Requested for information. 3GPP Rel-14 will improve the latency, and it is quite important the industry is adopting them tentative by 2H17 as earliest Latency is one of the key factors to enhance the User Experience, and now the current RTT measurements are between 20 and 40 ms •Under investigation the current breakdown of the latency including the UE processing time	N/A
Wide Area Connectivity	LTE	Massive MIMO	TM8	The UE shall support Transmission Mode 8 (TM8). Support for up to 2 layers per in DL for TM8.	Now	3GPP TS 36.213
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-7A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 7 (2600) combination: (min bandwidth 5 MHz + 20 MHz; max bandwidth 15 MHz + 20MHz)	Important to support higher data rates in the Downlink.	3GPP TS 36.101
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 28 (700) combination: (min bandwidth 5 MHz + 5 MHz + 15MHz + 15 MHz; max bandwidth 15 MHz + 20MHz + 15MHz + 15MHz)	Important to support higher data rates in the Downlink. Available now in NZ and in Germany by 2H19.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-20A-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 20 (800) + band 32 (1400) combination: (min bandwidth 5 MHz + 10MHz + 20 MHz; max bandwidth 15 MHz + 10MHz + 20MHz)	Important to support higher data rates in the Downlink. In UK available now. In Greece and Italy by 2H20.	3GPP TS 36.101 Rel-15
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-7A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) combination: (min bandwidth 5 MHz + 5 MHz + 20 MHz; max bandwidth 15 MHz + 20MHz + 20MHz)	Important to support higher data rates in the Downlink. In UK and Portugal available now.	3GPP TS 36.101
Wide Area Connectivity	LTE	MIMO	DL MU MIMO	E-UTRAN shall support the following downlink multi-user MIMO modes: 1) 2x2 (2 users using same PRB's). 2) 4x2 (2 users using same PRB's). Device to support this requirement with TM9 better than TM5	Now	N/A

Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3C-7A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 20 MHz	Important to support higher data rates in the Downlink. In New Zeland and Ireland available now. In Romania and Germany by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3C-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 32 (1400) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 20 MHz	Support for deployment starting by 2H19, in VF DE	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3C-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 20 (800) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 10 MHz	Support for large scale deployment of 1800 in Europe.	3GPP TS 36.101 Rel-14
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-32A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 32 (1400): (min bandwidth 10 MHz + 20 MHz; max bandwidth 20 MHz + 20 MHz)	Important to support higher data rates in the Downlink in Europe. In Greece by 2H20.	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_20A-32A DL	All UEs of Cat 6 or higher have to support downlink CA band 20 (800) + band 32 (1400): (min bandwidth 10 MHz + 20 MHz; max bandwidth 10 MHz + 20 MHz)	Important to support higher data rates in the Downlink in Europe. In UK available now. In Greece by 2H20.	N/A
Wide Area Connectivity	LTE	Carrier Aggregation	Dual Connectivity option 3C support	Support for 3GPP Rel-12 Dual Connectivity according to 3GPP option 3C (RAN PDCP level split - independent RLC) across cells belonging to non co-located eNB's. Feature shall be able to operate with latency tolerance up to least 5 ms one way delay.	Important requirement for D-RAN scenarios where X2 latency are not met or time sync not available. Targeted for single vendor scenarios. More efficient from RAN performance but costly in Tx due to tromboning effect. Expected to implement since 1H17	3GPP TS.36.32 3, TS 36.300 Rel-12
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_3C-7A-20A-32A DL	Starting 2017/18 all UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 20 (800) + band 32 (1400) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 20 MHz + 10 MHz + 20 MHz	Important to support higher data rates in the Downlink in Europe and AMAP	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3C-7A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 20 (800) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 20 MHz + 10 MHz	Important to support higher data rates in the Downlink. In Germany by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-20A-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 20 (800) + band 32 (1400) combination: Bandwidth: 20 MHz + 10 MHz + 20 MHz	Important to support higher data rates in the Downlink. In Greece and Italy by 2H20.	3GPP TS 36.101, Rel-14
Wide Area Connectivity	GSM	VAMOS	VAMOS II	The device shall support VAMOS 2 as specified in 3GPP TS 45.005.	Lack of support will reduce ability of Vodafone operating companies to make efficient use of available network bandwidth for 2G voice. This is particularly important for 2G devices in emerging markets such as India where there is massive growth in voice traffic with limited network resource	N/A

Wide Area Connectivity	LTE	Location	OTDOA	Positioning method based on Observed Time Difference of Arrival, reporting to the eNB the reference signal time difference (RSTD) measurements. The UE will support the Positioning Reference Signals (PRS) to improve the accuracy and performance of the OTDOA method.	Requested for information. It could allow the provision of more accurate location cell based information, however currently this is optional as the major focus is on location based on MDT and RPS. When using Observed Time Difference Of Arrival (OTDOA) positioning the network sends the device multiple copies of the same message from different base stations so that the device can make measurements which allow its position to be worked out more accurately than just using a single cell-ID or Enhanced Cell-ID. The network tells the device what to listen for where, and the device sends back its measurements to the network.	3GPP TS 36.211
Wide Area Connectivity	LTE	Location	MDT - connected mode (GPS)	Support of MDT (Minimization of Drivestests) in RRC_connected mode according to the 3GPP TS 37.320, chapter 5.2.1.3. to obtain all information: <ul style="list-style-type: none"> • time stamp • serving cell ID • serving cell measurements (RSRP, RSRQ) • neighbor cell measurements (RSRP, RSRQ, RSCP, Ec/NO, RxLev,...) • GNSS location (Standalone UE GPS) according to the TS 36.331 Release if available by the UE when taking the measurement • Timing Advance according to TS 36.214 Release. The vendor should specify the feature required for each parameter. If there is any parameter not available on the chipset please specify it.	GPS info is today available to the end user in most smartphones (provided the UE position allows to receive the GPS signal), but it's not available to the Radio Access Layer for any NW optimization based on UE location. GPS accuracy is much better than the one obtained using other methods like OTDOA and its evolutions	3GPP TS 37.320
Wide Area Connectivity	LTE	SON	MDT improvements - multiple PLMN	MDT (Minimization of Drivestests) PLMN indicating the PLMNs where measurement collection and log reporting is allowed. It is either the Management Based MDT PLMN List or the Signalling Based MDT PLMN List, depending on how the Logged MDT task was initiated. As defined in 3GPP TS 37.320.	Essential for all LTE devices - allows networks to self organise	3GPP TS 37.320
Wide Area Connectivity	LTE	SON	MDT improvements - logging of QoS	MDT (Minimization of Drivestests) functionality to assess the QoS experience for a specific UE together with location information. Minimisation of Drive tests as defined in 3GPP TS 37.320.	Essential for all LTE devices - allows networks to self organise	3GPP TS 37.320
Wide Area Connectivity	LTE	SON	MDT improvements - accessibility report	The device shall create logs of failed RRC connection establishments for LTE and UMTS, i.e. a log is created when the RRC connection establishment procedure fails. The UE logs failed RRC connection establishments without the need for prior configuration by the network. As defined in 3GPP TS 37.320, Minimization of Drivestests	Essential for all LTE devices - allows networks to self organise	3GPP TS 37.320

Wide Area Connectivity	LTE	Advanced Receiver Technologies	2 Way RX Div in idle mode	The device shall implement R/X Diversity IN IDLE MODE to improve performance relative to a standard RAKE receiver	Improved performance/coverage in idle mode	N/A
Wide Area Connectivity	LTE	Heterogeneous Networks	FelCIC	Essential for all LTE devices - allows to efficiently deploy different cell layers within the network. Device base needs to grow in order to take full advantage of the feature as efficiency benefit is relative to number of supporting devices		3GPP TS 36.300 and 3GPP TS 36.331
Wide Area Connectivity	LTE	Carrier Aggregation (Multi Band)	Dual Connectivity for UE	3GPP Rel-12 feature allows CA aggregation for cells that are not co-located. Needed to specify the option supported: - Option 3C async mode. - Synchronisation mode. Band Combination priorities: -800MHz + 1800MHz -800MHz + 2600MH -1800MHz + 2600MHz -800MHz + 1800MHz + 2600MHz	This feature is needed in order to create in 4G Macro to Small Cell carrier aggregation when no ideal backhauling is available for the Small Cells, or for having LTE multi-flow feature for cell edge, allowing the combination of 1 carrier from site 1 and another carrier from site 2. DL and UL aggregation capabilities are standardised for DC, main focus of VF is the DL.	3GPP TS 36.300, Rel-12
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 28 (700 APAC) combination: min bandwidth 5 MHz + 5 MHz + 10 MHz; max bandwidth 20 MHz + 20 MHz + 10 MHz	Important to support higher data rates in the Downlink in New Zealand and Europe.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-7A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 20 (800) combination: min bandwidth 5 MHz + 10 MHz + 20 MHz; max bandwidth 20 MHz + 10 MHz + 20 MHz	Important to support higher data rates in the Downlink in Europe.	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_7A-20A-38A DL	All UEs of Cat 9 or higher have to support downlink CA band 7 (2600) + band 20 (800) + band 38 (2600TDD) combination: min bandwidth 10 MHz + 5 MHz + 20 MHz; max bandwidth 20 MHz + 10 MHz + 20 MHz	All UEs Cat 9 or higher, or Cat6 supporting 3CA have also to support this combination. Important to support higher data rates in the Downlink in Europe.	Not yet in TS 36.101 (Status Aug15)
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-7A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 20 (800) combination: Min bandwidth 5 + 20 + 10 Max bandwidth 20 + 20 + 10	All UEs Cat 9 or higher, or Cat6 supporting 3CA have also to support this combination.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-38A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 38 (2600 TDD) combination: (min bandwidth 5 MHz + 20 MHz; max bandwidth 20 MHz + 20 MHz)	Important to support higher data rates in the Downlink in Europe.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation	CA_1A-20A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 20 (800) combination: (min bandwidth 5 MHz + 10 MHz;	Important to support higher data rates in the Downlink in Europe.	3GPP TS 36.101

		(Multi Band)		max bandwidth 20 MHz + 10 MHz)		
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_7A-28A DL	All UEs of Cat 6 or higher have to support downlink CA band 7 (2600) + band 28 (700 APAC) combination: (min bandwidth 15 MHz + 15 MHz; max bandwidth 15 MHz + 15 MHz)	Important to support higher data rates in the Downlink. In New Zealand available now. In Germany by 2H19. In Ireland by 2H20.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-28A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 28 (700 APAC) combination: (min bandwidth 5 MHz + 15 MHz; max bandwidth 20 MHz + 15 MHz)	Important to support higher data rates in the Downlink.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-3A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band3 (1800) combination, using non-continuous bands: (min bandwidth 5 MHz + 5 MHz; max bandwidth 10 MHz + 15 MHz)	Important to support higher data rates in the Downlink. In Romania available now.	3GPP TS 36.101
Wide Area Connectivity	LTE	License Assisted Access	LAA Co-existence with WiFi	The UE shall support both WiFi and License Assisted Access and should implement measures to ensure that these technologies do not impair each other	Device must be able to support WiFi without interference with License Assisted Access technology. Device support of License Assisted Access must also not impair performance of WiFi	3GPP TS 36.101
Wide Area Connectivity	LTE	License Assisted Access	LAA Listen Before Talk (LBT)	The UE shall support Listen Before Talk, Dynamic Frequency Selection and Transmit Power Control where this is a regulatory requirement	Failure to implement Listen Before Talk will result in regulatory non-compliance in some markets and will potentially impact other transmission technologies utilising the same unlicensed frequencies (e.g. WiFi)	ETSI EN 301 893
Wide Area Connectivity	LTE	License Assisted Access	LAA bands	The UE shall support License Assisted Access on the following frequency ranges: 5150MHz to 5350MHz 5470MHz to 5725MHz 5725MHz to 5875MHz 5825MHz to 5875MHz	Frequency band support and power levels are market specific. See reference document for details.	3GPP TS 36.101
Wide Area Connectivity	LTE	License Assisted Access	LAA standards	The UE shall support a License Assisted Access solution compliant with 3GPP Rel-13 release.	License Assisted Access LTE-U is to be launched in key Vodafone target markets in order to enhance LTE capacity where the licensed bands are limited and also to provide enhanced indoor LTE coverage. Initial priority markets are India, South Africa and Netherlands. Possible extension of deployment to other markets.	3GPP TS 36.101
Wide Area Connectivity	LTE - Voice and Messaging	SMS via IMS	Simultaneous support of SMSoIP and SMS over SGs	Depending on a network configuration, the UE shall be able to support SMSoSGs or SMSoIP; also mixed scenario are possible like originated SMSoIP and terminated SMSoSGs (For further details please refer to VVS)	Important for VoLTE services	VVS
Wide Area Connectivity	General Requirements	NW Release Causes	SM Cause Codes support for back-off timer (Rel-10)	The UE shall be able to understand the SM cause codes #26 "insufficient NW resources" and #27 "unknown/undefined APN" according to 3GPP TS 24.008, Rel-10. These cause codes are necessary to support the new back-off functionality defined in 3GPP TS 23.060, Rel-10.	The support of these cause codes is essential in order to steer the PDP context activation signalling of the terminals e.g. after downtime and recovery of customer servers to avoid signalling load.	3GPP TS 24.008 Rel-10, TS 23.060, Rel-10

Wide Area Connectivity	LTE	General	LTE Band 28	The UE shall support the following additional Frequency Bands: Band 28 (lower duplexer, i.e. (uplink 703-733 MHz and downlink 758-788 MHz) - While supporting the part of band 28 defined above, following out of band emission limit shall be met: "The mobile terminal out of band emission limit into the 470-694 MHz band is -42dBm/(8 MHz) for 10 MHz LTE bandwidth"	Essential for LTE devices as these bands are in use in Vodafone Operating Companies. The out of band emission limit (optional) will be beneficial to harmonise the out of band requirements for 700 MHz mobile terminals between Europe and other regions.	3GPP TS 36.101
Wide Area Connectivity	LTE	General	Blind reselection to LTE after CSFB	The LTE UE shall support "blind" redirection to LTE after CSFB to GSM/GERAN. In some networks some 2G cells are not able to configure LTE neighboring cells. To prevent the UE sticking in 2G after CSFB the UE shall perform blind redirection to the last known LTE Band / Frequency after any CS or Supplementary Service call release or periodic LAU on GERAN.	This workaround is necessary to prevent that the user sticks to 2G after CSFB although 4G cells are available but not configurable as neighbouring cell in the "old" GERAN cell.	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	Packet Measurement Order	The terminals must support the TS 44.060 Packet Measurement Order (PMO) message as well as Priority based Cell Reselection. (To support Subscriber Profile ID (SPID) for RAT/Frequency in BSC)	Important to redirect the UE to the proper frequency / RAT.	3GPP TS 44.060
Wide Area Connectivity	LTE	MIMO	UL MIMO	Single User MIMO (Cat 7 - 100 Mbps)	Now	3GPP TS 36.306, and tables 4.1.1, 4.1.2 and 4.1.3
Wide Area Connectivity	LTE	MIMO	MIMO 4x4 with CA	Support MIMO 4x4 closed loop spatial multiplexing with CA. In that case MIMO 4x4 should be supported in two frequency layers. Priority Band for 4x4: B3, B7. Lower priority: B1, B38.	Now	3GPP TS 36.306, tables 4.1-1, 4.1-2 and 4.1-3
Wide Area Connectivity	LTE	MIMO	MIMO 4x2	4x2: closed loop spatial multiplexing	Now	3GPP TS 36.306, tables 4.1-1, 4.1-2 and 4.1-3
Wide Area Connectivity	LTE	MIMO	MIMO 2x2	2x2: Closed loop spatial multiplexing 2x2. 2x2: Open loop spatial multiplexing 2x2.	Now	3GPP TS 36.306, tables 4.1-1, 4.1-2 and 4.1-3
Wide Area Connectivity	LTE	RAN Sharing	MOCN - LTE	The UE shall support Multi-Operator Core Network functionality for LTE 800, LTE 1800 and LTE 2600.	MOCN (Multi Operator Core Network) is a RAN Sharing feature in theory mandatory in LTE (and band agnostic). Essential now that Radio Access network sharing is becoming increasingly important.	3GPP TS 23.251, 3GPP TS 36.300
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi	CA_1A-3A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 3 (1800) combination: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20 MHz + 20 MHz)	Important to support higher data rates in the Downlink in Europe and AMAP OpCo.	3GPP TS 36.101

		Band)				
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-5A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800 + band 5 (850) combination: (min bandwidth 5 MHz + 5 MHz; max bandwidth 20 MHz + 10 MHz)	Important to support higher data rates in the Downlink in Australian OpCo.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3C DL	All UE of Cat 6 or higher have to support downlink CA band 3 (1800) + band 3 (1800) combination, using continuous bands: (min bandwidth 5 MHz + 20 MHz; max bandwidth 15+ 20 MHz)	Important to support higher data rates in the Downlink.	3GPP TS 36.101
Wide Area Connectivity	UMTS	Inter-system Handover and Cell Reselection	Fast return from 2G to 3G	The UE shall respond as appropriate to the "Cell selection indicator after release of all TCH and SDCCH" Information Element in Channel Release message as specified in 3GPP TS 44.018 section 3.4.13.	This will significantly reduce the time taken by a terminal reselecting 3G after using 2G.	3GPP TS 44.018 section 3.4.13
Wide Area Connectivity	LTE	Idle Mode Mobility	IRAT NACC to 2G	The LTE UE shall support Inter-RAT NW assisted Cell Change (NACC) to GSM	Required for all LTE terminals in order to support IRAT mechanism.	3GPP TS 36.300 and TS 36.331
Wide Area Connectivity	LTE	General	TM1-TM4	This requirement will apply to both MIMO and MaMIMO: The UE shall support Transmission Modes: TM1, TM2, TM3 and TM4 according to 3GPP Rel-8. Support for up to 4 layers per UE in DL for TM3/TM4.	TM1 to TM4: needed to support all the MIMO requirements	3GPP TS 36.213
Wide Area Connectivity	UMTS	Home NodeB	Home NodeB icon	The UE shall provide an icon indicating that the UE is using a Vodafone femtocell rather than the macro network. The icon appearance and placement will be as agreed on a product by product basis.	Will become important if networks start charging differently depending if using femtocell or macro network.	N/A
Wide Area Connectivity	UMTS	Home NodeB	Closed Subscriber Group	The UE shall support the Closed Subscriber Group (CSG) feature according to 3GPP TS 25.304 and 25.367.	Required for support of Femto deployments. As Femtocells are now extensively deployed in Vodafone OpCos, it is essential that this is supported	N/A
Wide Area Connectivity	UMTS	General	Handling of incoming calls for data products	If the UE is a data centric device without speech handling capabilities, it shall neither reject nor accept incoming speech calls, i.e. the UE shall respond to paging, establish the call set up and then remain in State U7 (Call Received) without answering (i.e. through-connecting) the call).	Essential for data products to ensure correct behaviour for Multi SIM Subscriptions	N/A
Wide Area Connectivity	General Requirements	Compliance with 3GPP specifications	Compliance with 3GPP Radio Access specifications	The UE shall comply with Rel-13 and later releases of the 3GPP specifications. Any areas of non-compliance should be noted.	3GPP Release 10 is the baseline now for Radio Access features support. Many features of later Releases (Release 11, 12, ..) are now required in addition to this baseline functionality	N/A
Wide Area Connectivity	UMTS	Radio	Data Roaming	The device shall have the option for user to turn on/off data roaming. Data roaming shall be turned OFF by default.	Essential to prevent potential bill shock for roamers using data. Default setting can be modified where appropriate if user has an appropriate data roaming package	N/A

Wide Area Connectivity	LTE	Connected Mode Mobility	Inter-RAT Mobility from eUTRAN connected mode to GSM/GPRS idle mode by RRC Connection Release with redirect	The UE shall support Inter-RAT Mobility from eUTRAN connected mode to GSM/GPRS idle mode by RRC Connection Release with redirect in case PS HO is not implemented	Essential for all LTE terminals in order to allow inter-RAT redirection.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	Inter-RAT Mobility from eUTRAN connected mode to UTRAN Idle mode by RRC Connection Release with redirect	The UE shall support Inter-RAT Mobility from eUTRAN connected mode to UTRAN Idle mode by RRC Connection Release with redirect (in case PS HO is not implemented)	Essential for all LTE terminals in order to allow inter-RAT redirection.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	RRC connection release / redirection from UTRAN to e-UTRAN	The UE shall support RRC connection release / redirection from UTRAN to e-UTRAN	Essential for all LTE terminals in order to allow inter-RAT redirection.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	Redirection to eUTRAN upon the release of the CS connection	The UE shall support Redirection to eUTRAN upon the release of the CS connection.	Essential for all LTE terminals in order to allow inter-RAT redirection.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	Inter-RAT PS HO UTRA HSPA to eUTRA	The UE shall support Inter-RAT Packet Switched handover from UTRA HSPA to eUTRA	Essential for all LTE terminals in order to allow inter-RAT PS handover.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	Inter-RAT PS HO from UTRA to eUTRA	The UE shall support Inter-RAT Packet Switched handover from UTRA to eUTRA	Essential for all LTE terminals in order to allow inter-RAT PS handover.	N/A
Wide Area Connectivity	LTE	Connected Mode Mobility	Inter-RAT PS HO to UTRA PS/HSPA with forwarding	The UE shall support Inter-RAT Packet Switched handover from eUTRA to UTRA PS/HSPA with forwarding	Essential for all LTE terminals in order to allow inter-RAT PS handover.	N/A
Wide Area Connectivity	LTE	Idle Mode Mobility	BPLMN scan	The multi-RAT UE shall support background PLMN scan when camping on GSM or UMTS cell in order to re-select LTE cell when available.	Ensures that LTE network is used wherever possible	N/A
Wide Area Connectivity	LTE	General	Combined Attach	The UE shall support Combined Attach to LTE and 2G/3G network	Essential to ensure good coverage in mixed radio environments	3GPP TS 24.301
Wide Area Connectivity	GPRS	PDP	PDP Type Rel-9 Fallback	If the network has returned a PDP IPv4 assignment to a IPv4v6 request, the device shall immediately request a second primary PDP Context with IPv6 assignment.	Essential for support of IPv6 deployment	N/A
Wide Area Connectivity	GPRS	PDP	PDP Type Rel-9 Handling	The device shall always request a Dual PDP type according to 3GPP Rel-9. ('8Dh'). If the network does not understand this (i.e. only pre-Rel-8 compliant) then it is expected that the network returns PDP IPv4 assignment.	Essential for support of IPv6 deployment	N/A

Wide Area Connectivity	GSM	VAMOS	VAMOS I	The device shall support VAMOS 1 as specified in 3GPP TS 45.005.	Lack of support will reduce ability of Vodafone operating companies to make efficient use of available network bandwidth for 2G voice. This is particularly important for 2G devices in emerging markets where there is massive growth in voice traffic with limited network resource	N/A
Wide Area Connectivity	General Requirements	UI	Emergency state indication on display	The UE shall have an indication on display that informs the user about Limited Service state (only Emergency calls allowed)	Allows user to understand when they are outside of regular coverage	N/A
Wide Area Connectivity	General Requirements	UI	Radio Access Technology Indicator	The UE shall display an indicator to the user, identifying the best radio access technology available from the following list. This shall apply whenever there is an indication of radio access technology to the user: "G" = GPRS "E" = EDGE "3G" = 3G data "H" = HSPA "H+" = HSPA+ (Downlink speed in excess of 14Mbps) "4G" = LTE "4G+" = LTE Carrier Aggregation (Downlink Speed in excess of 150Mbps) "5G" = See note below Menu strings for the Network band selection or any other reference to radio interface technologies across the whole device's UI, should use the terms "2G, 3G, 4G" and not "GSM, WCDMA/UMTS, LTE" or similar. Note that the use of "5G" is only permitted for devices connected to a high data rate bearer with capabilities that meet specific criteria (TBD)	Gives clear indication to the user what to expect in terms of data connectivity	N/A
Wide Area Connectivity	LTE	Power Management	DRX	DRX is a technology in which the user equipment (UE) can switch between active and sleep states. In DRX mode, a DRX cycle consists of active time and sleep time, corresponding to active state and sleep state, respectively. In non-DRX mode, the UE always turns on its receiver and stays in the active state. The UE shall support the Long Cycle, Short Cycle and different DRX per QCI.	Essential for all LTE terminals in order to allow power saving.	3GPP TS 36.321
Wide Area Connectivity	LTE	Power Management	DL reference signal	The UE shall support UE-specific Downlink reference signal.	Essential for all LTE terminals in order to allow measurements, cell search, etc.	3GPP TS 36.211
Wide Area Connectivity	LTE	General	LTE Bands	For European device variants the UE shall support the following Frequency Bands: * Band 3 (UL: 1710 – 1785 MHz, DL: 1805 – 1880 MHz) * Band 7 (UL: 2500 – 2570 MHz, DL: 2620 – 2690 MHz) * Band 20 (UL: 832 – 862 MHz, DL: 791 MHz – 821 MHz) * Band 1 (UL: 1920 – 1980 MHz, DL: 2110 MHz – 2170 MHz) * Band 38 (TDD, UL/DL 2570 – 2620 MHz) * Band 8 (UL: 880 – 915 MHz, DL: 925 –	Essential for LTE devices as these bands are in use in Vodafone Operating Companies. Band 38 is already available in PT,ES,UK,DE, RO,GR and NZ. Band 38 is mainly thought right now for Small cells, then targeting to have first scenarios end next year end 2016 or later. B42 /B43 is starting to be auctioned in Europe, in VF Radar as key band for 5G evolution. already assigned in RO, MT and NZ, and some OpCos from Vodacom group	3GPP TS 36.101

				<p>960 MHz) * Band 32 (DL: 1452-1496) already assigned in DE, IT, and UK. * Band 28 (UL: 703 – 748MHz, DL: 758 – 803MHz) already available in NZ, acquired in DE and IT, in plan for auction in other EU markets.. * B42 assigned in RO an in plan in other markets. B42/B43 are key bands in the evolution to 5G. No current plans to use it in 4G And, on top of Europe: * Band 41 (TDD, UL/DL 2496 – 2690 MHz) acquired in India, with a variety of frequencies in the allocated on a per circle basis. * Band 5 (UL: 824 – 849 MHz, DL: 869 – 894 MHz) already available for Vodafone Australia and in plan in other AMAP markets.</p>	Band 41 essential for Vodafone India, which also seeks Band 40 support for open market products	
Wide Area Connectivity	General Requirements	UI	NITZ - Network Identity	The device shall select and obtain the PLMN ID and display the correct Network Identity information as specified in 3GPP	Particularly relevant for CPE/femtocell units to identify location	3GPP TS 22.042
Wide Area Connectivity	General Requirements	Automated Time Synchronisation	Network based Time update	For device that do not support the use of time management through connection to a Network Time Protocol server on the internet (e.g. apple.time.com) the UE shall support a mechanism to update time and date using network supplied information such as NITZ or NTP	Allows the user to set the time on the phone based on the n/w. Not universally used in Vodafone OpCos but required for some	N/A
Wide Area Connectivity	GPRS	General Requirements	EDGE Coding scheme	The UE shall support Coding schemes MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7, MCS8 & MCS9 as specified in 3GPP TS 45.003 Section 5	Network uses these codecs (MCS 4 not very common). If not supported, UE will not be able to inter-operate	N/A
Wide Area Connectivity	UMTS	General	Device Type Setting	<p>The UE shall support the "Device Type" in the UE Capability Parameter as defined in 3GPP TS25.331.</p> <p>If the "Device Type" is a mains-powered Data device, the field shall be set to <DoesNotBenefitFromBatteryConsumptionOptimisation> (the UE does not benefit from battery consumption optimisations). If the "Device Type" is a battery-powered data device or a handset this parameter shall NOT be set to this value.</p>	Mandatory for data devices only - to do with battery management	N/A
Wide Area Connectivity	UMTS	General	UMTS Bands I & VIII (FDD)	A UMTS UE shall support both UMTS Operating Band I (2100MHz) and UMTS Operating Band VIII (900MHz).	Dependant on the support of UMTS 900 - as specified in the RFP. UMTS 2100 is mandatory for all OpCos and UMTS900 is now widely used in many OpCos too	N/A
Wide Area Connectivity	General Requirements	Roaming	Steering of Roaming (Managed Roaming)	In Automatic Network Selection, after the UE has received the fourth location update reject with Reject Cause #17 'Network Failure (i.e. attempt counter >=4), it shall start a new PLMN search according to 3GPP TS 24.008 section 4.2.1.2, last bullet point. It shall not wait for the T3212 timer to expire. The new PLMN search shall happen according to the following procedure:	Mandatory for roaming - allows the network to steer users to preferred networks to reduce the risk of bill shock.	N/A

				<p>- The PLMN search shall be started in any case, independently from the result of the GPRS Attach / Routing Area Update procedure, independently from the Network Mode of Operation (NMO, i.e. Combined or Separate Routing Area Update) and independently of the content of the Preferred PLMN list on the SIM card.</p> <p>- If other PLMNs can be found, the UE shall attempt to perform an IMSI Attach or a Location Update procedure at each of them taking into account the Attempt Counter, according to 3GPP TS 24.008 sections 4.4.4.5, 4.4.4.6 and 4.4.4.9.</p> <p>- If no different PLMN apart from the rejected can be found, the UE shall attempt to select one of the already rejected networks once more (only one additional Location Update cycle, i.e. 4 LU attempts).</p> <p>Note1: These requirements apply to both, national and international roaming</p> <p>Note2: As per requirements above, if only one PLMN is available and this PLMN was already rejected 4 times with reject cause 17 "network failure" (i.e. attempt counter >=4) the terminal device shall perform a new network scan followed by a new registration process, which may exist of 4 LU Requests attempts to the already rejected network again for one more time (i.e. max. 2 location update cycles on the same network).</p>		
Wide Area Connectivity	GSM	Radio	SAIC	The UE should support techniques to improve downlink performance such as the DARP (Downlink Advance Receiver Performance) Phase I and DARP Phase II feature, whereby the UEs must comply with the DARP radio performance specification given in TS 45.005 and must support DARP signalling as specified in TS 24.008, i.e., the DARP feature must be indicated by the UE in the Classmark 3 IE, and where GPRS is supported in the UE RAC IE.	Radio quality conditions across networks are already tight (e.g. emerging markets) and is becoming tighter (particularly in mature markets where 900MHz band refarming has taken place). DARP capable terminals are more robust against bad radio conditions what enables the use of other features that provides capacity efficiency gains (e.g. AMR, VAMOS etc.). The use of SAIC terminals incorporating DARP is therefore a key priority.	N/A
Wide Area Connectivity	UMTS	HSDPA	UE Downlink Category	The UE capability supported for HSDPA shall be as follows: For data devices the capability supported for HSDPA shall be Category 10 minimum, with Category 24 being preferred For smartphones the capability supported for HSDPA shall be Category 10 minimum, with Category 24 being preferred Please specify Category supported in Vendor Comments field	This should be as specified and agreed in RFI.	N/A
Wide Area Connectivity	GSM	Radio	GSM Bands	The device shall support the following GSM Bands: * 850 MHz * 900 MHz (E-GSM-900) * 1800 MHz	1900MHz can be compromised if absolutely necessary, though will have impact on device roaming capability. All other bands are non-compromisable	N/A

				* 1900 MHz as specified in 3GPP TS 45.005		
Wide Area Connectivity	GPRS	Radio	GPRS Multislot Class	The UE shall support the GPRS Multislot Class greater than Class 8 as specified in 3GPP TS 45.002 Annex B (normative): Multislot capability B.1 MS classes for multislot capability Please state Multi-Slot Class in Vendor Comment section.	This is agreed in the RFP.	3GPP TS 44.018
Wide Area Connectivity	GPRS	APN	APN support	UE shall support a total APN length (Network Identifier+Operator Identifier) of 100 octets.	This is to do with the ability to distinguish the APN on a per operator basis.	N/A
Wide Area Connectivity	General Requirements	Regulations	IMEI SV Support	The UE shall support the IMEI Software Version (IMEISV) and it shall be properly managed by the Manufacturer so that: - The SV shall be incremented for each new software release and maintenance release - The SV number for each Vodafone variant SW must not be the same as the open market variant - In case multiple OpCos share the same ROM the SV number may be the same for those OpCos - SV number shall be independent across different terminals and the vendor can choose the increment pattern for the SV number - All software release notes shall contain a mapping table that specifies the mapping between IMEISV and the device software version	Device will NOT be able to offer IMEI SV (software version) tracking capabilities. Where SV will allow us to track field issues relating to a particular IMEI. Particularly important with devices that can have firmware updated OTA or by user	N/A
Wide Area Connectivity	General Requirements	Regulations	Unique TAC	The UE shall have a TAC allocated by a GSMA or its associated reporting bodies according to the current IMEI allocation rules (GSMA PRD TS.06 & TS.16) allowing the UE type to be identified; in case of large volume of production several TAC codes can be used. The unique TAC (First 8 digits of the IMEI) or the multiple TAC granted to a type of terminal must identify this terminal type without ambiguity. The use of the 9th digit of the IMEI to identify a terminal type or variant is not permitted.	Essential to identify individual devices on the network	GSMA PRD TS.06 & TS.16
Wide Area Connectivity	GSM	PLMN	Preferred PLMN list (PLMNsel or PLMNwAcT)	The preferred PLMN list (PLMNsel or PLMNwAcT) shall only be overwritten by the UE if expressly required by the user, not as a 'by product' of any other action such as a manual network selection. This requirement should not exclude the Operator updating the PLMN list.	Only the user or the operator can be allowed to update the preferred PLMN list. If not supported the network search algorithm would not work correctly.	N/A
Wide Area Connectivity	GSM	Radio	Quadruple Rate Codec	All devices shall have a HR + EFR + FR + AMR/H + AMR/F codec.	Various codecs used. All are important - HR still used	N/A

Wide Area Connectivity	GSM	USSD	USSD Message length	Up to 160 digit/character USSD messages shall be passed on the uplink as defined in 3GPP TS 29.002. USSD shall be supported in dedicated mode	Essential for support of PAYG credit management and other services	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-28A DL	All UE of Cat 6 or higher have to support downlink CA band 1 (2100) + band 28 (700) combination	Essential to ensure sufficient bandwidth for acceptable data rates: In New Zealand available now. In Germany by 2H19	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_7A-8A DL	All UE of Cat 6 or higher have to support downlink CA band 7 (2600) + band 8 (900) combination	Important to support higher data rates in the Downlink in Europe. Support requested by Q4-2015.	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_8A-28A DL	All UE of Cat 6 or higher have to support downlink CA band 8 (900) + band 28 (700) combination	Important to support higher data rates in the Downlink in Europe. Support requested by Q4-2015.	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_7A-32A DL	All UE of Cat 6 or higher have to support downlink CA band 7 (2600) + band 32 (1400) combination	Important to support higher data rates in the Downlink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-32A DL	All UE of Cat 6 or higher have to support downlink CA band 1 (2100) + band 32 (1400) combination	Important to support higher data rates in the Downlink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_20A-28A DL	All UE of Cat 6 or higher have to support downlink CA band 20 (800) + band 28 (700) combination	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-8A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 28 (700 APAC) combination.	Important to support higher data rates in the Downlink.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-8A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 8 (900) + band 28 (700 APAC) combination.	Important to support higher data rates in the Downlink.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_7A-8A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 7 (2600) + band 8 (900) + band 28 (700 APAC) combination.	Important to support higher data rates in the Downlink. In Germany by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3C-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 28 (700 APAC) combination.	Important to support higher data rates in the Downlink. Available now in New Zealand and in Germany by 2H19.	N/A

Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3C DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) combination.	Important to support higher data rates in the Downlink. Available now in New Zeland and Romania.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3C-8A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) combination.	Important to support higher data rates in the Downlink. Available in Romania and Germany by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-8A-38A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 8 (900) + band 38 (2600 TDD) combination.	Important to support higher data rates in the Downlink in Europe.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-8A-38A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 38 (2600 TDD) combination.	Important to support higher data rates in the Downlink in Europe.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_7A-20A-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 7 (2600) + band 20 (800) + band 32 (1400) combination	Important to support higher data rates in the Downlink. Available In UK by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-7A-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 32 (1400) combination	Important to support higher data rates in the Downlink. Available In UK by 2H19.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_8A-20A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 8 (900) + band 20 (800) + band 28 (700 APAC) combination	Important to support higher data rates in the Downlink. Available In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-20A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 20 (800) + band 28 (700 APAC) combination	Important to support higher data rates in the Downlink. Available In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-20A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 20 (800) + band 28 (700 APAC) combination	Important to support higher data rates in the Downlink. Available In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_7A-20A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 7 (2600) + band 20 (800) + band 28 (700 APAC) combination	Important to support higher data rates in the Downlink. Available In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-8A-41A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 41 (2500 TDD) combination	Important to support higher data rates in the Downlink. Available in India by 2H19.	N/A

Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-40A-41A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 40 (2300 TDD) + band 41 (2500 TDD) combination	Important to support higher data rates in the Downlink. Available in India by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3C-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. Available now in New Zeland and in Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3C-7A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 28 (700) combination.	Important to support higher data rates in the Downlink. Available now in New Zeland and in Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3C-7A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) combination.	Important to support higher data rates in the Downlink. Available now in New Zeland and in Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3A-8A-38A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) + band 38 (2600 TDD) combination:	Important to support higher data rates in the Downlink. In Spain and Greece by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3C-8A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) combination.	Important to support higher data rates in the Downlink. In Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3C-8A-38A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 38 (2600 TDD) combination.	Important to support higher data rates in the Downlink. In Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3C-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 20 (800) combination.	Important to support higher data rates in the Downlink. Available now in Romania and in Germany by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-7A-20A-38A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 20 (800) + band 38 (2600 TDD) combination.	Important to support higher data rates in the Downlink. Available now in UK.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-7A-8A-20A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 8 (900) + band 20 (800) combination.	Important to support higher data rates in the Downlink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A

Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 8 (900) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_7A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 7 (2600) + band 8 (900) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3A-7A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3A-8A-41A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) + band 41 (2500 TDD) combination.	Important to support higher data rates in the Downlink. In India by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3A-8A-40A-41A DL	All UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 8 (900) + band 40 (2300 TDD) + band 41 (2500 TDD) combination.	Important to support higher data rates in the Downlink. In India by 2H19.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_1A-3A-40A-41A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 40 (2300 TDD) + band 41 (2500 TDD) combination.	Important to support higher data rates in the Downlink. In India by 2H19.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-3A-8A-38A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 3 (1800) + band 8 (900) + band 38 (2600 TDD) combination	Important to support higher data rates in the Downlink. In Romania by 1H19.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-7A-8A-20A-38A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 8 (900) + band 20 (800) + band 38 (2600 TDD) combination	Important to support higher data rates in the Downlink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-7A-8A-20A-32A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 8 (900) + band 20 (800) + band 32 (1400 SDL) combination	Important to support higher data rates in the Downlink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_3A-7A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 8 (900) + band 20 (800) + band 28 (700) combination	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A

Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 20 (800) + band 28 (700) combination	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) + band 20 (800) + band 28 (700) combination	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-8A-40A-41A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 8 (900) + band 40 (2300 TDD) + band 41 (2500 TDD) combination	Important to support higher data rates in the Downlink. In India by 2H19.	N/A
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-20A-32A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 20 (800) + band 32 (1400 SDL) combination	Important to support higher data rates in the Downlink. Available now in Germany.	N/A
Wide Area Connectivity	LTE	6 Carrier Aggregation (Multi Band)	CA_1A-7A-8A-20A-32A-38A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 8 (900) + band 20 (800) + band 32 (1400 SDL) + band 38 (2600 TDD) combination.	Important to support higher data rates in the Downlink. In UK by 2H20.	N/A
Wide Area Connectivity	LTE	6 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-8A-20A-28A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 8 (900) + band 20 (800) + band 28 (700) combination.	Important to support higher data rates in the Downlink. In Netherlands by 2H20.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3A-8A UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 8 (900)	Important to support higher data rates in the Uplink.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_1A-7A UL	All UEs of Cat 6 or higher have to support CA in UL band 1 (2100) + band 7 (2600)	Important to support higher data rates in the Uplink.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_8A-20A UL	All UEs of Cat 6 or higher have to support CA in UL band 8 (900) + band 20 (800)	Important to support higher data rates in the Uplink. In UK by 2H19.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_1A-8A UL	All UEs of Cat 6 or higher have to support CA in UL band 1 (2100) + band 8 (900)	Important to support higher data rates in the Uplink. In New Zealand by 2H19.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_7A-8A UL	All UEs of Cat 6 or higher have to support CA in UL band 7 (2600) + band 8 (900)	Important to support higher data rates in the Uplink. In New Zealand by 2H19.	N/A
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_8A-28A UL	All UEs of Cat 6 or higher have to support CA in UL band 8 (900) + band 28 (700)	Important to support higher data rates in the Uplink. In New Zealand by 2H19.	N/A
Wide Area Connectivity	LTE	License Assisted Access	CA_41A-46A	The UE shall support License Assisted Access utilising DL carrier aggregation of band 41 (2500 TDD) + band 46 (5GHz Unlicensed)	Important to support higher data rates in DL including the unlicensed spectrum. Support requested in India	N/A

Wide Area Connectivity	LTE	License Assisted Access	CA_41A-46C	The UE shall support License Assisted Access utilising DL carrier aggregation of band 41 (2500 TDD) + band 46 x2 (5GHz Unlicensed)	Important to support higher data rates in DL including the unlicensed spectrum. Support requested in India	N/A
Wide Area Connectivity	LTE	License Assisted Access	CA_1A-46A	The UE shall support License Assisted Access utilising DL carrier aggregation of band 1 (2100) + band 46 (5GHz Unlicensed)	Important to support higher data rates in DL including the unlicensed spectrum. Available in Turkey. In Ireland and Romania by 2H20.	N/A
Wide Area Connectivity	LTE	MIMO	SRS antenna switching	Support for SRS antenna switching for 1T2R	Now	N/A
Wide Area Connectivity	GSM	Ciphering	A5/4 Ciphering Algorithm	KASUMI 128-bit ciphering key encryption for control channels, circuit switched voice traffic channels.	Essential for any GSM device	N/A
Wide Area Connectivity	5G	RRC States	Idle state	Support for prioritisation of 5GC as preferred CN type in RRC_IDLE state when selecting a cell supporting both CN types	By 2H20	N/A
Wide Area Connectivity	5G	VoLTE	VoLTE Service RRC	The device will support RRC release with redirection mechanism to steer the user from option 2 to option 1 for VoLTE service.	By Q419	N/A
Wide Area Connectivity	5G	VoLTE	VoLTE Service PS HO	The device will support PS HO mechanism to steer the user from option 2 to option 1 for VoLTE service.	By Q419	N/A
Wide Area Connectivity	5G	Latency	UE processing time cap#1	UE processing time as defined per 3GPP capability # 1	By Q219	N/A
Wide Area Connectivity	5G	Latency	UE processing time cap#2	UE processing time as defined per 3GPP capability # 2	By 2H20	N/A
Wide Area Connectivity	General Requirements	Location	Cellular assisted Real Time Kinematic (RTK) positioning as defined in Rel-15	The device shall support new high accuracy GNSS positioning method	GPS info is today available to the end user in most smartphones (provided the UE position allows to receive the GPS signal), but it's not available to the Radio Access Layer for any NW optimization based on UE location. GPS accuracy is much better than the one obtained using other methods like OTDOA and its evolutions	N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	Connected DRX - LTE-IoT Mode A	Support DRX in connected mode for deployment mode A	Now	N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	Connected DRX - LTE-IoT Mode B	Support DRX in connected mode for deployment mode B	Now	N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	Wake-up signalling for IDLE mode (Rel-15)	When a UE is in DRX or eDRX, it must regularly check if a paging message is arriving from the core network.	By Q219	N/A

Wide Area Connectivity	LTE-IoT	Battery Life Extension	Early data transmission (Rel-15)	An idle mode UE is able to transmit data in Msg3 of the random access procedure, carrying between 328 and 1000 bits.	By Q219	N/A
Wide Area Connectivity	LTE-IoT	Battery Life Extension	RLC UM (Rel-15)	Support for RLC unacknowledged mode (UM) to complement the acknowledged mode (AM) and transparent mode (TM) introduced in Rel-13	By Q219	N/A
Wide Area Connectivity	NB-IoT	Battery Life Extension	Scheduling request (Rel-15)	In Rel-13/14 NB-IoT, scheduling request (SR) exists only as a higher-layer procedure, which triggers a random access procedure to request sufficient UL resource to send a buffer status report (BSR). For Rel-15 For a connected mode UE, eNB is able to configure by RRC periodic NPUSCH resources for the UE to send BSR, so the eNB is informed when pending traffic has arrived in the UE's buffer	By Q219	N/A
Wide Area Connectivity	NB-IoT	Battery Life Extension	RLC UM (Rel-15)	Support for RLC unacknowledged mode (UM) to complement the acknowledged mode (AM) and transparent mode (TM) introduced in Rel-13	By Q219	N/A
Wide Area Connectivity	NB-IoT	Battery Life Extension	Reduced system acquisition time (Rel-15)	When SIB1-NB is being transmitted with 16 repetitions (the maximum supported), eNB can transmit additional subframes containing SIB1-NB repetitions on anchor carriers and non-anchor carriers to allow faster decoding of SIB1-NB and reduce the UE's power consumption during cell access	By Q219	N/A
Wide Area Connectivity	LTE-IoT	Location	e-CID	Support E-CID based positioning (Rel-13)	By Q219	N/A
Wide Area Connectivity	NB-IoT	Location	e-CID (Rel-14)	The device shall support enhanced Rel-14 positioning protocols: e-CID	Now	N/A
Wide Area Connectivity	NB-IoT	Services	Higher density support (Rel-15)	Improved load control with level-based access class barring (Rel-15). The ACB mechanism shall work in dynamic mode with dynamic Access Class barred per barring period. The barring intensity will be dependent on the status of congestion	By Q219	N/A
Wide Area Connectivity	NB-IoT	Cell Size	Cell size extension 120Km (Rel-15)	NPRACH range enhancement. A new NPRACH format is introduced with a subcarrier spacing of 1.25 kHz and a cyclic prefix of 800 μ s, together with frequency hopping, which is sufficient to allow unambiguous range determination up to 120 km.	By Q419	N/A
Wide Area Connectivity	LTE-IoT	Deployment Option	VoLTE for deployment Mode A	VoLTE service can be supported up to Deployment mode A	Now	N/A
Wide Area Connectivity	LTE-IoT	Deployment Option	VoLTE for deployment Mode B	VoLTE service can be supported up to Deployment mode B	Now	N/A

Wide Area Connectivity	LTE-IoT	Deployment Option	Higher UE velocity (Rel-15)	Enhanced performance requirements are introduced for CE mode A. These requirements are defined for 200 Hz Doppler spread, corresponding to around 240 km/h at 1 GHz and 120 km/h at 2 GHz.	By Q220	N/A
Wide Area Connectivity	LTE-IoT	Deployment Option	UL max Tx power 14 dBms (Rel-15)	eNb can manage devices supporting up to 14 dBms tx power	By Q220	N/A
Wide Area Connectivity	LTE-IoT	Deployment Option	Deployment mode A for any LTE Cat	Support of repetitions with Deployment mode A for all LTE from Cat 1 (included) in LTE eNB in co-existence with all LTE UE categories.	By Q219	N/A
Wide Area Connectivity	LTE-IoT	Deployment Option	Deployment mode B for any LTE Cat	Support of repetitions with Deployment mode B for all LTE from Cat 1 (included) in LTE eNB in co-existence with all LTE UE categories.	By Q219	N/A
Wide Area Connectivity	LTE-IoT	Efficiency	Downlink 64QAM - LTE-IoT	Support for 64QAM modulation for PDSCH unicast transmission without repetition in CE mode A to increase the downlink spectral efficiency	By Q419	N/A
Wide Area Connectivity	LTE-IoT	Efficiency	Uplink sub-PRB allocation	Introduction of PUSCH sub-PRB resource allocation in connected mode. New allocation sizes are $\frac{1}{2}$ PRB (6 subcarriers) or $\frac{1}{4}$ PRB (3 subcarriers). In the latter case, a new $\pi/2$ -BPSK modulation can be used	By Q419	N/A
Wide Area Connectivity	NB-IoT	TDD	TDD support (Rel-15)	UE category NB2, 2 UL/DL HARQ processes, multi-carrier RACH and paging, and OTDOA. All LTE UL/DL subframe configurations are supported, except for configurations 0 and 6, and all LTE special subframe configurations are supported	By Q220	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-3C-7A-28A_n78A	Support of Dual connectivity between the specified 5 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for NZ	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-3A-7A-8A_n78A	Support of Dual connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for DE. By 2H20 for ES and NZ.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC	DC_1A-3C-7A_n78A	Support of Dual connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for NZ and DE.	N/A

		within FR1				
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-3A-8A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for DE. By 2H20 for ES and NZ.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_3A-8A-20A_n78A	Support of Dual connectivity between the specified 3 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for DE and ES.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_3A-8A_n78A	Support of Dual connectivity between the specified 2 LTE carriers + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for DE and ES. By 2H20 for NZ.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_8A_n20A	Support of Dual connectivity between the specified 1 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for TR.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_3A_n28A	Support of Dual connectivity between the specified 1 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for DE. By 2H20 for UK and NL.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC	DC_20A_n3A	Support of Dual connectivity between the specified 1 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for NL.	N/A

		within FR1				
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_8A_SUL_n78A-n81A	Support of Dual connectivity with Supplementary Uplink (SUL) between the specified 1 LTE carriers + 1 5G NR carrier up to 30 MHz, with detailed bandwidth granularity.	By 2H19 for UK and by 2H20 for DE.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_20A_n8-n75/76	Support of Dual connectivity between the specified 1 LTE carrier + 2 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H19 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A_n8A	Support of Dual connectivity between the specified 3 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A-32A_n8A	Support of Dual connectivity between the specified 4 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A-38A_n8A	Support of Dual connectivity between the specified 4 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 6 Bands - InterB and EN-DC	DC_1A-7A-20A-32A-38A_n8A	Support of Dual connectivity between the specified 5 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A

		within FR1				
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_1A-7A-20A_n28A	Support of Dual connectivity between the specified 3 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A_n28A	Support of Dual connectivity between the specified 4 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A_n78A	Support of Dual connectivity between the specified 4 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 6 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A-32A_n28A	Support of Dual connectivity between the specified 5 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 6 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A-32A_n78A	Support of Dual connectivity between the specified 5 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 6 Bands - InterB and EN-DC	DC_1A-7A-8A-20A-38A_n28A	Support of Dual connectivity between the specified 5 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A

		within FR1				
Wide Area Connectivity	5G	Dual Connectivity - 6 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A-38A_n78A	Support of Dual connectivity between the specified 5 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 7 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A-32A-38A_n28A	Support of Dual connectivity between the specified 6 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 7 Bands - InterB and EN-DC within FR1	DC_1A-7A-8A-20A-32A-38A_n78A	Support of Dual connectivity between the specified 6 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for UK.	N/A
Wide Area Connectivity	5G	Dual Connectivity - 3 Bands - InterB and EN-DC within FR1	DC_20A-7A_n3A	Support of Dual connectivity between the specified 2 LTE carrier + 1 5G NR carrier up to 135 MHz, with detailed bandwidth granularity.	By 2H20 for NL.	N/A
Wide Area Connectivity	LTE - Voice and Messaging	CSFB	CSFB Support	<p>The UE shall support CSFB procedures according to 3GPP TS 23.272 Rel-13 or later. This includes:</p> <ul style="list-style-type: none"> * Combined Attach to CS and PS services * Combined TAU * CSFB to UTRAN with RRC connection release and redirection with gap measurements (including RIM procedure) * CSFB to UTRAN with PS handover without measurement gaps * CSFB to GPRS/EDGE with RRC connection release and redirect (including RIM procedure) * CSFB to GPRS/EDGE with CCO (with NACC) * CSFB for Supplementary Services and USSD <p>In case of non or partial compliance,</p>	Essential for LTE UE offering voice and messaging capability	3GPP TS 23.272

				please state the known limitations in the comment sections.		
Wide Area Connectivity	LTE	General	FGI bit pattern for Rel-9 onwards, bit 16-32	<p>The following bit pattern (TS 36.331, Annex B, Table B.1-1) shall be at least supported by the UE:</p> <p>FGI-</p> <p>bit 16: 1 (intra/interfreq & interRAT meas)</p> <p>bit 17: 1 (ANR-intraFreq)</p> <p>bit 18: 1 (ANR-interFreq)</p> <p>bit 19: 1 (ANR-interRAT)</p> <p>bit 20: 1 (DRB combi)</p> <p>bit 21: X</p> <p>bit 22: 1 (UTRAN meas, Event B2)</p> <p>bit 23: 1 (GERAN meas, Event B1)</p> <p>bit 24: X</p> <p>bit 25: 1 (EUTRAN meas, Event B2)</p> <p>bit 26: X</p> <p>bit 27: 1 (VoLTE, SRVCC CS)</p> <p>bit 28: 1 (TTI bundling)</p> <p>bit 29: 1 (SPS)</p> <p>bit 30: 1 (HO FDD<->TDD)</p> <p>bit 31: X</p> <p>bit 32: undefined</p> <p>- The FGI bits marked with "X" are not required to be set. This pattern is valid for all UE from Rel-9 onwards.</p> <p>- In case of non or partial compliance, please state the known limitations in the comment sections.</p>	Required for essential NW features, and for NW planning and testing issues in order to select test cases.	3GPP TS 36.331, Annex B
Wide Area Connectivity	LTE-IoT	Location	LPP A-GNSS LTE-IoT	If the device supports GNSS, it should include GNSS measurements in LPP TS 36.355 (A-GNSS). In both CE Mode A and Mode B.	Now	
Wide Area Connectivity	NB-IoT	Location	LPP A-GNSS NB-IoT	If the device supports GNSS, it should include GNSS measurements in LPP TS36.355 (A-GNSS)	Now	
Wide Area Connectivity	LTE-IoT	Location	MDT (Minimization of Drive Tests - LTE-IoT)	The device shall support Minimization of Drive Test feature including GNSS measurements reports (Standalone UE GPS) in idle and connected mode as defined in TS 37.320 Section 5.4.1 UE capabilities. In both Mode-A and Mode-B.	Now	
Wide Area Connectivity	LTE-IoT	Location	OTDOA - LPP - LTE-IoT	The device shall inform if supports OTDOA and is included in LPP	For Information	
Wide Area Connectivity	NB-IoT	Location	OTDOA - LPP - NB-IoT	The device shall inform if supports OTDOA and is included LPP	For Information	
Wide Area Connectivity	LTE-IoT	Location	LTE Positioning Protocol (LPP) - LTE-IoT	The device shall support LPP protocol including Rel-14 enhancements of 3GPP TS 36.355 section 6.5.3 Enhanced Cell ID Positioning. In both CE Mode A and Mode B.	Now	
Wide Area Connectivity	LTE-IoT	Capacity and Scalability	Hopping in dedicated channels - LTE-IoT	The device shall support frequency hopping on dedicated channels	Improves network access	

Wide Area Connectivity	LTE-IoT	Capacity and Scalability	Hopping in common channels - NB-IoT	The device shall support frequency hopping on common channels	Improves network access	
Wide Area Connectivity	NB-IoT	Coverage Extension	UL Coverage class selection	The device shall support 3 coverage class selection for NPRACH based on RSRP and SINR	Improves network access	
Wide Area Connectivity	NB-IoT	Services	Class barring	The device shall support access class barring as specified in the 3GPP standard	now	
Wide Area Connectivity	NB-IoT	Mobility	InterRAT cell reselection	The device shall search in an optimum manner for other IoT technologies like CAT-M, LTE or 2G in case of NB-IoT service/coverage loss or for performance improvement (e.g. throughput, battery) if the device supports more than NB-IoT	Now	
Wide Area Connectivity	NB-IoT	Mobility	Intra-frequency cell reselection - IoT	The device shall support intra frequency cell reselection in idle with Rel-14 improvements	Improves network access	
Wide Area Connectivity	NB-IoT	Maximum output Power	CAT-NB1 Lower Output power	The CAT-NB1 device shall be able to reach up to 14 dBm of maximum transmit power (Rel-14)	Now	
Wide Area Connectivity	NB-IoT	IP protocol	TCP	The NB-IoT Device shall support TCP.		
Wide Area Connectivity	NB-IoT	CoAP	CoAP over NAS non-IP	The NB-IoT Device shall support CoAP over NAS non-IP mode		
Wide Area Connectivity	NB-IoT	CoAP	CoAP over TCP	The NB-IoT Device shall support CoAP over TCP		
Wide Area Connectivity	NB-IoT	DECOR support for NB-IoT	Dynamic management of NB-IoT connections	The device shall support Rel-13 Décor functionality, e.g. the ability to reroute the UE's connection to the correct MME.		N/A
Wide Area Connectivity	NB-IoT	Capacity extension	Anchor PRB - coverage	The device shall support 164 dB MCL coverage extension for PUSCH/PDSCH in the additional PRB.		N/A
Wide Area Connectivity	LTE-IoT	DECOR support for NB-IoT	Dynamic management of Cat-M devices	Support Rel-13 Décor functionality, e.g. the ability to reroute the UE's connection to the correct MME.	Medium	N/A
Wide Area Connectivity	LTE-IoT	Radio Robustness and Performance	Enable high speed users to access the network	The device shall support IoT operation at speeds up to 350 km/h. Please specify the top speed supported.	Low	N/A

Wide Area Connectivity	LTE-IoT	Radio Robustness and Performance	Enhanced UL Power Control, to reduce interference and increase resilience.	Support for dynamic adjustment of the uplink PS power control for cat 0, cat 1, and cat M IoT Devices to increase cell edge performance and reduce battery usage.	Medium	N/A
Wide Area Connectivity	LTE-IoT	Capacity and Scalability	MTC Transmission: Congestion Control	Support for the extendedWaitTime parameter in the RRC Connection Release and RRC Connection Reject messages in the event of RAN node congestion.		3GPP TS 36.331
Wide Area Connectivity	LTE-IoT	Capacity and Scalability	Extended Access Barring (EAB)	Feature for controlling Mobile Originating access attempts from UEs that are configured for EAB, specifically M2M devices, in order to prevent overload of the LTE access network and/or the core network generating by these EAB UE. Compliance to Rel-11 required.		3GPP TS 36.331, Rel-11
Wide Area Connectivity	5G	VoLTE	ViLTE	The UE shall support of QCI = 2 for Video (ViLTE)* via 4G eNB when there is a 5G NR NSA established	By Q2/19	
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-7A-8A DL	All UE of Cat 9 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 8(900) combination: Bandwidth B1 (5-20 MHz); B7 (15-20 MHz); B8 (5-20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: TR in 2H 2019	
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-38A DL	All UE of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 38 (2600 TDD) combination: bandwidth B1 (5-20 MHz); B3 (10-20 MHz); B38 (15-20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: TR in 2H 2019	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_7A-8A-20A DL	All UE of Cat 9 or higher have to support downlink CA band 7 (2600) + band 8 (900) + band 20 (700) combination: Bandwidth B7 (15-20 MHz); B8 (5-15 MHz); B20 (10 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: TR in 2H 2018	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-7A-8A DL	All UE of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 8 (900) combination: Bandwidth B3 (10-20 MHz); B7 (15-20 MHz); B8 (5-15 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: TR in 2H 2018	3GPP TS 36.101
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3C-7A-28A DL	all UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 3 (1800) contiguous + band 7 (2600) + band 28 (700) combination: Bandwidth: B1 (5-20 MHz) + B3 (10-25 MHz) + B7 (15-20 MHz) + B28 (5-15 MHz)	Important to support higher data rates in the Downlink in Europe and AMAP. By 2H19 in New Zeland and Germany.	3GPP TS 36.101
Wide Area Connectivity	LTE	5 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-8A-20A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 8 (900) + band20 (800) combination: Bandwidth: B1 (5-20 MHz) + B3 (10-20 MHz) + B7 (15-20 MHz) + B8 (5-15 MHz) + B20 (10 MHz)	Important to support higher data rates in the Downlink in Europe and AMAP. By 2H18 in TR	3GPP TS 36.101
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi	CA_1A_3C_20 A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 3 (1800) contiguous + band 20 (800) combination:	Essential to ensure sufficient bandwidth for higher data rates: Romania by 1H 2019	3GPP TS 36.101

		Band)		(min bandwidth 5 MHz + 20 MHz + 5MHz + 10 MHz; max bandwidth 20 MHz + 20MHz + 5MHz + 20MHz)		
Wide Area Connectivity	5G	5G NR	TDD configuration 8:2	The UE shall support 5G NR 8:2 DL:UL config to sync with 4G TDD config 2, periodicity 5 ms	by Q219	
Wide Area Connectivity	5G	5G NR	TDD configuration 4:1	The UE shall support 5G NR 4:1 DL:UL, periodicity of duty cycle 2.5 ms	by Q219	
Wide Area Connectivity	5G	Latency	short PUCCH channel: PUCCH format 2	Short PUCCH channel: PUCCH format 2 over 1-2 OFDM symbols once per slot with FH	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Short PUCCH channel	Short PUCCH channel: PUCCH format 0 over 1-2 OFDM symbols once per slot with FH	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Uplink DMRS for scheduling type A, support 2 symbols FL-DMRS	Uplink DMRS for scheduling type A, support 2 symbols FL-DMRS	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Uplink DMRS for scheduling type A, support 1 symbol FL DMRS without additional symbol(s)	The UE shall support Uplink DMRS for scheduling type A, support 1 symbol FL DMRS without additional symbol(s)	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Downlink DMRS for scheduling type A, support 2 symbols FL-DMRS	The UE shall support Downlink DMRS for scheduling type A, support of 2 symbols FL-DMRS	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Downlink DMRS for scheduling type A	The UE shall support Downlink DMRS for scheduling type A, support of 1 symbol FL DMRS without additional symbol(s)	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Non-slot feature: PDSCH mapping type A	The UE shall support Non-slot feature: PDSCH mapping type A with less than 7 OFDM symbols	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	Latency	Non-slots feature: Time-domain resource allocation	The UE shall support Non-slots feature: Time-domain resource allocation - 1-14 OFDM symbols for PUSCH once per slot - Starting symbol, and duration are determined by using the DCI - PDSCH mapping type A with 7-14 OFDM symbols - PUSCH mapping type A and type B - For type 1 without dedicated RRC configuration and for type 0, 0A, and 2, PDSCH mapping type A with {4-14} OFDM symbols and type B with {2, 4, 7} OFDM symbols (this last point required with the Ue supports SA)	by Q219	3GPP TS 38.306

Wide Area Connectivity	5G	Latency	Non-slots: less than 7 OFDM symbols	The device shall support Time-domain resource allocation - PDSCH mapping type A with less than 7 OFDM symbols	by Q219	3GPP TS 38.306
Wide Area Connectivity	5G	5G NR	PDCCH case 2	Support Case 2: PDCCH monitoring periodicity of less than 14 symbols	by Q219	3GPP TS 38.306
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_1A-28A UL	All UEs of Cat 6 or higher have to support CA in UL band 1 (2100) + band 28 (700) bandwidth B1 (10-20 MHz) , B28 (10-15 MHz)	Important to support higher data rate in UL By 2H18 for NZ	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_20A-38A UL	All UEs of Cat 6 or higher have to support CA in UL band 20 (800) + band 38 (2600 TDD) (min bandwidth 10 MHz + 15MHz; max bandwidth 10MHz + 20MHz)	Requested for MaMIMO when the Pcell is in the PCC to increase peak rate in the UL	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3A-38A UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 38 (2600 TDD) (min bandwidth 10 MHz + 15MHz; max bandwidth 20MHz + 20MHz)	Requested for MaMIMO when the Pcell is in the PCC to increase peak rate in the UL	3GPP TS 36.101
Wide Area Connectivity	LTE	Massive MIMO	FDD + TDD DL CA for TM2, TM3 and TM4 with FDD as Pcell	Support for FDD + TDD DL CA for TDD in TM2, TM3 and TM4 being FDD set as Pcell. The vendor shall specify the supported band configurations if not band agnostic. Specific combos required for FDD+TDD defined in separate TCDs	Now	
Wide Area Connectivity	General Requirements	UI	Technology selection	The UE user interface shall present the user with configuration options to select the radio access technology to be used from the following when these are supported by the terminal: 2G, 3G, 4G, 5G	Allow user to manually switch technology	
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands + SDL - InterB and EN-DC within FR1	DC_20A_n75/76-n78A	Support of Dual connectivity with Supplementary Downlink (SDL) between the specified 1 LTE carriers + 2 5G NR carrier up to 130 MHz, with detailed bandwidth granularity. Min BW: 10+20+100 Max BW: 10+15+20	By 1H20 for VF UK Requested for UK	ongoing in 3GPP
Wide Area Connectivity	5G	Dual Connectivity - 2 Bands - InterB and EN-DC within FR1	DC_1A_n28A	Support of Dual connectivity between the specified 1 LTE carrier + 1 5G NR carrier up to 20 MHz, with detailed bandwidth granularity. DC_1A_n28A combination Min BW: 10+10 Max BW: 10+10	By 2H20 for UK and DE	3GPP TS 38.101-3, Rel-15, section 5.5B.4.1
Wide Area Connectivity	General Requirements	VVS Reference	VVS Reference	Terminal shall support the country specific settings for the service configuration and correct operation on Vodafone network. Afore mentioned settings can be access using the latest version of VVS (Vodafone Variant Setting repository) ##insert VVS database hyperlink for		VVS: ##insert VVS database hyperlink for OEMs##

				OEMs### (note: in case you do not have access, please request it to your Vodafone counterpart) In case some settings cannot be supported or configured country per country; please state all limitations in the comment section		
Wide Area Connectivity	LTE	Spectrum sharing: 3G-4G or 2G-4G	PUCCH allocation	Support for on-sided PUCCH allocation to allow configuration of PUCCH resources only one side of the 4G spectrum allocation (as opposed to typical edge PUCCH RB allocation on both sides of the spectrum)	Not defined	
Wide Area Connectivity	LTE	Spectrum sharing: 3G-4G or 2G-4G	Partial RB set measurements	Support for allowed measurement bandwidth to control the UE RB set over which the UE performs its mobility measurement (RSRP and RSRQ). UE shall be able to carry out mobility measurements over 6, 15, 25, 50, 75, 100 RB's according to IE AllowedMeasBandwidth as per 3GPP TS 36.331. The vendor shall explicitly state compliance for all values (all values supported or subset) The vendor shall provide following additional information: 1) The vendor shall explicitly state whether RSRP UE measurements reports are based on a reduced transmission bandwidth in non-muted RB's. 2) The vendor shall explicitly state whether RSRQ UE measurements reports are based on a reduced transmission bandwidth in non-muted RB's.	By now	3GPP TS 36.331
Wide Area Connectivity	LTE	Location	Indoor positioning enhancements - Others (Rel-13)	The UE shall support Bluetooth, barometric and proprietary Beacon System measurements defined to assist control plane UE positioning (LPP) as specified in Rel-13. UE-based methods are included.	Improves location accuracy when out of coverage of satellite based system.	3GPP TS 36.455
Wide Area Connectivity	LTE	Location	Indoor positioning enhancements - WiFi (Rel-13)	The UE shall support WiFi measurements defined to assist control plane UE positioning (LPP) as specified in Rel-13. UE-based methods are included.	Improves location accuracy when out of coverage of satellite based system.	3GPP TS 36.455
Wide Area Connectivity	LTE	Latency	1 ms TTI for FDD and TDD Rel-15 latency improvements	Support the improvements being standardised in 3GPP for the 1 ms TTI for 4G	By 2Q19 3GPP Rel-15 will improve the latency, and it is quite important the industry is adopting them tentative by 4Q18 as earliest Latency is one of the key factors to enhance the User Experience, and now the current RTT measurements are between 20 and 40 ms	3GPP TS 36.133 Rel-15
Wide Area Connectivity	LTE	Latency	2 symbols TTI	2 symbols TTI according to 3GPP Rel-15 for all FDD 4G carriers	Required for 2Q19 Latency is one of the key factors to enhance the User Experience, and now the current RTT measurements are between 20 and 40 ms	3GPP TS 36.133 Rel-15
Wide Area Connectivity	General Requirements	Compliance with 3GPP specific	Maintenance of future compatibility - Abuse of spare bits in MIB	Terminal software shall not be implemented such that spare bits in Master Information Block are assumed to be set to zero values. Failure to comply with this requirement would	Essential to ensure that terminals continue to function correctly after infrastructure upgrade. Incorrect implementation can result in loss of network coverage	N/A

		connections		mean that future use of these spare bits causes potential incorrect behaviour. An example of this would be the introduction of additional functionality in 3GPP Rel. 13 to support LTE Cat-M where the previously spare bits are now used to indicate eMTC is supported in the cell		
Wide Area Connectivity	5G	RRC States	RRC States	The device shall support RRC States of connected, idle according to 3GPP definition	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual connectivity UL	Reconfiguration single - dual UL frequency	The device shall support the reconfiguration from single UL frequency operation to dual frequency operation based e.g. on coverage conditions or latency necessities for a single UE	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual connectivity UL	Single frequency UL operation	The device shall support in Dual Connectivity connection, the operation in single UL frequency where LTE UL and NR UL share the same UL frequency band	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual connectivity UL	Normal 5G NR UL operation	The device shall support in Dual Connectivity connection, the operation in dual UL frequency where LTE UL and NR UL have different UL frequencies for a single UE, and NR UL is transmitted using the 5G NR frequency band	By Q219 (now for testing)	
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-3A-7A-28A_n78A	Support of Dual Connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 170MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 3DL, 2DL or 1DL (+ 5G NR) DC_1A-3A-7A-28A_n78A combination Min BW: 5+5+15+15+20 Max BW: 5+20+15+15+100	By 2H19 for NZ and by 2H20 for MT	3GPP TS 38.101-3, Rel-15, section 5.5B.4.4
Wide Area Connectivity	5G	Dual Connectivity - 4 Bands - InterB and EN-DC within FR1	DC_3C-7A-20A_n78A	Support of Dual connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 170MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 3DL, 2DL or 1DL (+ 5G NR) DC_3C-7A-20A_n78A contiguous Min BW: 20+5+20+10+20 Max BW: 20+10+20+10+100	By 2H19 for DE	Configuration not in 3GPP 15.2.0
Wide Area Connectivity	5G	Dual Connectivity - 5 Bands - InterB and EN-DC within FR1	DC_1A-3A-7A-20A_n78A	Support of Dual Connectivity between the specified 4 LTE carriers + 1 5G NR carrier up to 170MHz, with detailed bandwidth granularity. LTE would be with fallbacks to 3DL, 2DL or 1DL (+ 5G NR) DC_1A-3A-7A-20A_n78A combination Min BW: 5+5+20+10+20 Max BW: 15+20+20+10+100	Most common for Europe and AMAP By 2Q19 for ES, DE and IT	3GPP TS 38.101-3, Rel-15, section 5.5B.4.4

Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-41A DL	All UEs of Cat 9 or higher shall support downlink CA band 1 (2100) + band 3 (1800) + band 41 (2500 TDD) combination: (min bandwidth 3 MHz + 3 MHz + 10 MHz; max bandwidth 20MHz + 20 MHz + 10 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: India in 2H 2017	> 5Mhz Rel-14 3GPP TS 36.101 < 5MHz not yet in 3GPP
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-3A-41A DL	All UE of Cat 9 or higher shall support downlink CA band 3 (1800) + band 3 (1800) + band 41 (2500 TDD) combination, using non contiguous bands: (min bandwidth 3 MHz + 5 MHz + 10 MHz; max bandwidth 20MHz + 20 MHz + 10 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates: India in 2H 2017	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_1A-41A DL	All UEs of Cat 6 or higher have to support downlink CA band 1 (2100) + band 41 (2500 TDD) combination: (min bandwidth 3 MHz + 10 MHz; max bandwidth 20 MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates for Vodafone India	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-41A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 41 (2500 TDD) combination: (min bandwidth 3 MHz + 10 MHz; max bandwidth 20 MHz + 20 MHz)	Essential to ensure sufficient bandwidth for acceptable data rates for Vodafone India	3GPP TS 36.101 Rel-14
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_7A-20A UL	All UEs of Cat 6 or higher have to support CA in UL band 7 (2600) + band 20 (800) (min bandwidth 5 MHz + 10MHz; max bandwidth 20MHz + 20MHz)	Important to support higher data rates in the Uplink Support requested by 1H17 in NZ and later in EU	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_1A-20A UL	All UEs of Cat 6 or higher have to support CA in UL band 1 (2100) + band 20 (800) (min bandwidth 5 MHz + 10MHz; max bandwidth 20MHz + 20MHz)	Important to support higher data rates in the uplink Support requested by 1H17 in EU (Spain and UK), AMAP	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_1A-3A UL	All UEs of Cat 6 or higher have to support CA in UL band 1 (2100) + band 3 (1800) (min bandwidth 5 MHz + 5MHz; max bandwidth 20MHz + 20MHz)	Important to support higher data rates in the uplink Support requested by 1H17 in EU, AMAP and IE	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_7A-28A UL	All UEs of Cat 6 or higher have to support CA in UL band 7 (2600) + band 28 (700) (min bandwidth 15 MHz + 15MHz; max bandwidth 15MHz + 15MHz)	Important to support higher data rates in the Uplink Support requested by 1H17 in NZ and later in EU	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3A-28A UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 28 (700) (min bandwidth 5 MHz + 15MHz; max bandwidth 20MHz + 15MHz)	Important to support higher data rates in the Uplink Support requested by 1H17 in NZ and later in EU	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3C UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 3 (1800) (min bandwidth 20 MHz + 5MHz; max bandwidth 20MHz + 15MHz)	Important to support higher data rates in the Uplink Support requested by 1H17 in EU(Romania, DE) and Australia	3GPP TS 36.101
Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3A-7A UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 7 (2600) (min bandwidth 5 MHz + 20MHz; max bandwidth 20MHz + 10MHz)	Important to support higher data rates in the Uplink Support requested by 2H16 in EU	3GPP TS 36.101

Wide Area Connectivity	LTE	UL Carrier Aggregation	CA_3A-20A UL	All UEs of Cat 6 or higher have to support CA in UL band 3 (1800) + band 20 (800) (min bandwidth 5 MHz + 10MHz; max bandwidth 20MHz + 10MHz)	Important to support higher data rates in the Uplink. Support requested by 2H16 in EU and Qatar	3GPP TS 36.101
Wide Area Connectivity	LTE	Speed	UL Compression 4G	Lossless compression of UL payload and headers in the device for 4G	Improved UL data throughput and power consumption, important mainly for congested scenarios as hot spots, big events... with high UL bottleneck. Planned in all market stating since 2H16. Benefits: - Reduced Battery consumption. - Increased Capacity and coverage of a cell. - More available resources - Improved inter active response time results	N/A
Wide Area Connectivity	LTE	Location	UE Rx-Tx time difference measurements	UE Rx-Tx time difference measurements according to TS 25.331.	Required for Location Based Services planned to implement across Vodafone Group by 2017	3GPP TS 25.331.
Wide Area Connectivity	LTE	Location	Timing Advance Information Type 1	The eNB will request the Timing Advance Information Type 1 of every UE according to TS 36.214.	Required for Location Based Services planned to implement across Vodafone Group by 2017	3GPP TS 36.214
Wide Area Connectivity	LTE	Location	UTDOA Rel-12	The UE will support the UTDOA as specified in 3GPP Rel-12. Positioning based on time difference between uplink signals	Optional feature, requested for information, due to no high priority for deployment. This feature enhances the accuracy of UTDOA.	3GPP TS 25.305, Rel-12 3GPP TS 25
Wide Area Connectivity	LTE	Latency	7 symbols TTI	7 symbols TTI according to 3GPP Rel-15 for all FDD 4G carriers and TDD 4G carriers	By 2Q19 Latency is one of the key factors to enhance the User Experience, and now the current RTT measurements are between 20 and 40 ms.	3GPP TS 36.133 Rel-15
Wide Area Connectivity	LTE	Interference Management	PDSCH-IC	Cancellation or Suppression as defined in 3GPP Rel-12, using information about its most relevant interferers to substantially improve demodulation performance in presence of PDSCH interference from neighbour cells.	Previous TCD-BEAR-REQ-012175 requirement. Needed specify the method to support that: - Network Assisted IC - Standalone - Both (Nw assisted + Standalone)	3GPP TS 36.300 Rel-12 and TS 36.331 Rel-12
Wide Area Connectivity	LTE	Interference Management	CRS-IC	Cancellation or Suppression as defined in 3GPP using information about its most relevant interferers to substantially improve demodulation performance in presence of CRS interference from neighbour cells.	Previous TCD-BEAR-REQ-012175 requirement. Needed specify the method to support that: - Network Assisted IC - Standalone - Both (Nw assisted + Standalone) Specify the Release supported (Rel-11, Rel-12 or Rel-13)	3GPP TS 36.300 and 3GPP TS 36.331
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A-7A-20A-32A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 7 (2600) + band 20 (800) + band 32 (1400) combination: (min bandwidth 5 MHz + 20 MHz + 10MHz + 20 MHz; max bandwidth 15 MHz + 20MHz + 10MHz + 20MHz)	Important to support higher data rates in the Downlink. Support requested by 2H17 in DE, IT, UK	3GPP TS 36.101

Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_1A-3A-7A-20A DL	All UEs of Cat 11 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 7 (2600) + band 20 (800) combination: (min bandwidth 5 MHz + 5 MHz + 20MHz + 10 MHz; max bandwidth 15 MHz + 20MHz + 20MHz + 10MHz)	Important to support higher data rates in the Downlink. Support requested by 2H16 in UE	3GPP TS 36.101
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_3C-7A-32A DL	All UEs of Cat11 or higher have to support downlink CA band 3 (1800) + band 3 (1800) + band 7 (2600) + band 32 (1400) combination: (min bandwidth 20MHz + 5 MHz + 20 MHz + 20MHz; max bandwidth 20 MHz + 10MHz + 20MHz + 20 Mhz)	Important to support higher data rates in the Downlink. Support requested for EU by 1H17. Prio for VFDE	3GPP TS 36.101
Wide Area Connectivity	UMTS	HSPA Evolution	3G->4G reselection on Cell FACH State	UE requirement to support mobility from CELL_FACH to E-UTRA RRC_IDLE as defined in the 3GPP TS 36.331 from Rel-11. Possible to implement functionality from Rel-8 UEs onwards.	Relevant for all LTE devices. Useful to accelerate the reselection to LTE while in 3G data connection. Network readiness since 3Q15	N/A
Wide Area Connectivity	LTE	Speed	Downlink 256QAM - LTE	256QAM should be with 4Rx in connected mode. Required support in all carriers when Carrier Aggregation is in place. 256QAM DL should be supported for TM2, TM3, TM4, TM7, TM8 and TM9 any release.	Essential feature to improve the DL user throughput. Expected deployment in 3Q16 in all markets.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi Band)	CA_3A-7A-20A-32A DL	Starting 2017/18 all UEs of Cat 11 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 20 (800) + band 32 (1400) combination: (min bandwidth: 5MHz + 20MHz + 10MHz + 20MHz, max bandwidth: 20 MHz + 20 MHz + 10 MHz + 20 MHz)	Important to support higher data rates in the Downlink. In Greece by 2H20.	N/A
Wide Area Connectivity	LTE	4 Carrier Aggregation (Multi band)	CA_3C-20A-32A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 20 (800) + band 32 (1400) combination: Bandwidth: (20 MHz -lower carrier + 5 MHz -higher carrier) + 10 MHz + 20 MHz	Important to support higher data rates in the Downlink in Europe, in first step for the OpCos with B32 assigned DE and IT. In plan for 1H17	N/A
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-7A-38A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 38 (2600 TDD): (min bandwidth 20 MHz + 20 MHz + 20 MHz; max bandwidth 10 MHz + 20 MHz + 20 MHz)	Important to support higher data rates in the Downlink in Europe. Support requested by 1H17	3GPP TS 36.101
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_1A-3A-20A DL	All UEs of Cat 9 or higher have to support downlink CA band 1 (2100) + band 3 (1800) + band 20 (800): (min bandwidth 5 MHz + 5 MHz + 10 MHz; max bandwidth 20 MHz + 20 MHz + 10 MHz)	Important to support higher data rates in the Downlink in Europe. Support requested by 1H16	3GPP TS 36.101
Wide Area Connectivity	LTE	Location	MDT - Idle mode (Logged)	Support of Logged MDT (Minimization of Drivetest) procedures according to the 3GPP TS 37.320, chapter 5.1.1. to obtain all information: <ul style="list-style-type: none"> • time stamp • serving cell ID • serving cell measurements (RSRP, RSRQ) • neighbor cell measurements (RSRP, RSRQ, RSCP, Ec/NO, RxLev,...) 	requested for deployment for 2H16.	3GPP TS 37.320 3GPP TS 36.214

				<ul style="list-style-type: none"> • GNSS location (Standalone UE GPS) according to the TS 36.331 Release if available by the UE when taking the measurement • Timing Advance according to TS 36.214. <p>If there is any parameter not reported in the MDT logs please specify it. Vendor should specify if there is any limit in logging time. If there is any limit on number of users please specify it.</p>		
Wide Area Connectivity	LTE	Location	Validity Time <= 10secs	Validity timer is used in order to consider that a location measurement taken by the UE in the past is still valid. The timer value is actually set by the UE and is not controlled (as many other timers) from the NW. We set here a range of values we do consider acceptable	Non homogeneous behaviour of different device as far as the reliability of the location information provided by the UE to the NW	N/A
Wide Area Connectivity	LTE	eMBMS	MBMS inter-frequency service awareness	Informing UEs when there is an MBMS service available on another frequency (as opposed to it having dual frequency reception capabilities like in Rel-10)	eMBMS consumes NW resources, so it won't be set-up in all the LTE frequencies/layers of a sector, but only on (e.g.) 1 of them Such a capability allow to notify a UE camped on (e.g.) f2 that eMBMS is available in f1, so the UE can change frequency and camp on the one with eMBMS service available	N/A
Wide Area Connectivity	LTE	eMBMS	MBMS counting of UEs	Indication to inform network that the UE is receiving an MBMS service(s) to allow it to decide whether PTM is useful or if unicast is best.	Needed in order to avoid consuming common channels and resources for eMBMS when the number of UEs willing to receive data from a specific eMBMS channel is low and doesn't justify maintaining the usage of the eMBMS transmission for that specific service	N/A
Wide Area Connectivity	LTE	eMBMS	SIB15	UE support the reading of SIB15, useful for eMBMS operation	Improvement in the signalling in eMBMS that allow introduction of eMBMS enhancement as service continuity TCD-BEAR-REQ-012093 or multiple carriers	N/A
Wide Area Connectivity	LTE	eMBMS	MBMS service interest indication	Allows UE on f1 to indicate that it wishes to receive MBMS being sent on f2.	Needed for eMBMS launch	N/A
Wide Area Connectivity	LTE	eMBMS	Basic MBMS introduction for SFN operation	MBSFN operation requiring network sync	Needed for eMBMS launch	N/A
Wide Area Connectivity	LTE	eMBMS	eMBMS	eMBMS support	Needed for eMBMS launch	N/A
Wide Area Connectivity	LTE	Advanced Receiver Technologies	3 or 4 Way RX diversity	Support of 3 or 4 way RX diversity in the terminal	Important increase of performances in the downlink just due to the receiver side	N/A
Wide Area Connectivity	LTE	Advanced Receiver Techn	IRC receiver	Support of Interference Rejection Combining and, in general, advanced receivers	Important increase of performances in the downlink just due to the receiver side	N/A

		ologies				
Wide Area Connectivity	LTE	Heterogeneous Networks	Cross carrier scheduling	3GPP Rel-10 feature In HetNet deployment where same frequency band is being deployed in both macro and small cells, Carrier Aggregation with CA capable terminals using cross carrier scheduling will provide a higher degree of gain as CA users will be able to avoid interference in control regions	Improved NW performance in terms of resource management consumption as well as higher throughput available to the end user	3GPP TS 36.212
Wide Area Connectivity	LTE	General	TM10	The UE shall support Transmission Mode 10 (TM10)	Needed in order to support: - Coordinated Scheduling improvements (for both non-ideal and ideal backhaul scenarios) and Dynamic Point Selection (ideal backhaul scenarios e.g. intra-eNB or C-RAN) and. Joint Transmission support is low priority as benefits are expected to be lower. - SFN nw vendor improvements, in which different adjacent cells support the same frequencies. Need to specify the 3GPP Rel supported.	3GPP TS 36.213
Wide Area Connectivity	LTE	3 Carrier Aggregation (Multi Band)	CA_3A-7A-28A DL	All UEs of Cat 9 or higher have to support downlink CA band 3 (1800) + band 7 (2600) + band 28 (700APAC) combination: min bandwidth 5 MHz + 15 MHz + 15 MHz; max bandwidth 20 MHz + 20 MHz + 15 MHz	Important to support higher data rates in the Downlink. In New Zeland available now.	3GPP TS 36.101
Wide Area Connectivity	LTE	General	4G Device Behaviour	When the UE receives a Combined Attach or TAU accept for EPS services only with cause #16, #17 or #22, the UE will disable 4G and reselect to 2G or 3G as per 3GPP 24.301. The UE must enable 4G again within 20 minutes so that the UE is ready to perform a cell reselection or PS Handover back to 4G. 4G must be re-enabled without interrupting any on-going data transfer; if the enabling of 4G requires loss of data connectivity, then on expiry of the timer the UE should only enable 4G if in PCH or Idle state. The UE must not wait until the device is down-switched to idle by the NW before re-enabling 4G. Note: The timer T3402 (default 12 minutes) could be used to determine when to enable 4G again.	To ensure that 4G is reconnected once available again.	3GPP TS 24.301
Wide Area Connectivity	LTE - Voice and Messaging	USSD via IMS	CSFB for IMS USSD	In case the VoLTE capable UE does not support Unstructured Supplementary Service Data (USSD) via IMS according to 3GPP TS 24.390 Rel.11, the UE shall perform CSFB including extended service request in order to allow USSD in VoLTE domain. Also SCI (subscriber controlled input, e.g. *21#) shall be supported by the UE.	Important to improve battery lifetime	3GPP TS 23.272

Wide Area Connectivity	LTE	SON	MDT (Minimization of Drive Tests - LTE)	The device shall support measurements for MDT (Minimization of Drivetest) as defined in 3GPP TS 37.320, up to Rel-13	Essential for all LTE terminals - allows networks to self organise	N/A
Wide Area Connectivity	LTE	SON	RACH optimisation	The device shall support measurements for RACH Optimisation as defined in 3GPP 36.300 subsection 22.4.3.	Essential for all LTE terminals - allows networks to self organise	N/A
Wide Area Connectivity	LTE	SON	SON	The device shall support the necessary functions to enable the Self Configuration and Optimisation (SON) capabilities described in 3GPP TS 36.300, subsection 22	Essential for all LTE terminals - allows networks to self organise. Rollout of SON features are being implemented in our LTE networks today.	N/A
Wide Area Connectivity	LTE	Power Management	eMBMS - ES-PSM	The UE shall support eMBMS in order to support "Enhanced Symbol Power Saving Mode". In case the UE does not support eMBMs it shall ignore the eMBMS TTI , also in combination with MBSFN .	Important to improve battery lifetime	3GPP 23.246 (Rel-9)
Wide Area Connectivity	LTE	Connected Mode Mobility	Intra-frequency PS Handover	The UE needs to support intra-frequency PS handover across the necessary frequency bands for service continuity.	Essential standards compliance baseline for all LTE terminals	N/A
Wide Area Connectivity	LTE	Uplink	High Order Modulation	64QAM support	Important to support higher data rates in the Uplink. 64QAM should be supported in all the component carriers when in CA or when the UE is registered in MaMIMO cell.	3GPP TS 36.306, and tables 4.1.1, 4.1.2 and 4.1.3
Wide Area Connectivity	LTE	General	CoOrdinated Multi Point (CoMP)	Intra/Inter eNB Joint Transmission	Important to support higher data rates in the Downlink	3GPP TS 36.306
Wide Area Connectivity	LTE	Heterogeneous Networks	eICIC	The device shall support TDM based enhanced ICIC (eICIC)as defined in 3GPP TS36.300 and 3GPP TS36.331 including; Advanced receiver capability Almost Blank Subframes (ABS) Cell Range Expansion (CRE)	Essential for all LTE terminals - allows to efficiently deploy different cell layers within the network	3GPP TS 36.300 and 3GPP TS 36.331
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_7A-20A DL	All UEs of Cat 6 or higher have to support downlink CA band 7 (2600) + band 20 (800) combination: (min bandwidth 20 MHz + 10 MHz; max bandwidth 20 MHz + 10 MHz)	Support for current network deployment	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-20A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 20 (800) combination: (min bandwidth 5 MHz + 10 MHz ; max bandwidth 20 MHz + 10 MHz)	Support for current network deployment (EU, Qatar).Already rolled out.	3GPP TS 36.101
Wide Area Connectivity	LTE	2 Carrier Aggregation (Multi Band)	CA_3A-7A DL	All UEs of Cat 6 or higher have to support downlink CA band 3 (1800) + band 7 (2600) combination: (min bandwidth 5 MHz + 20 MHz; max bandwidth 20 MHz + 20MHz)	Support for current network deployment	3GPP TS 36.101
Wide Area Connectivity	General Requirements	UI	Data connection set up wizard	1. Device should offer a data connection set up wizard 2. Data set up wizard should be available at first device start up 3. Device should not send any data	Customer must be able to set and modify his/her data connection preferences	N/A

				before the customer has defined data connection settings 4. Data settings can be modified by end user at any time 5. User should be notified that data traffic is disabled if attempting to use a service that requires data connectivity		
Wide Area Connectivity	LTE	General	Default Bearer Modification	After the default bearer has been setup, it might be necessary to establish a redirect to html landing page. This will be realised by assigning or modifying the TFT of the default bearer context.	Essential for all LTE devices in order to allow redirect to html landing page, e.g. in case of throttling.	3GPP TS 24.301
Wide Area Connectivity	LTE	General	Radio Link Failure Report	The UE shall send RLF (Radio Link Failure) Reports for Radio Optimisation according to 3GPP TS 36.331	This is relevant for all device types. This feature is important for network optimisation.	3GPP TS 36.331
Wide Area Connectivity	UMTS	General	UMTS Bands II (1900MHz)	Support for UMTS 1900 shall be as described in 3GPP 25.816, optional for roaming purposed.	Will impact roaming to North America for 3G devices - This is Essential for Enterprise devices, but less important for Consumer devices (particularly in the low tier)	N/A
Wide Area Connectivity	UMTS	General	UMTS Bands V (850MHz)	Support for UMTS 850 shall be as described in 3GPP 25.816, required for products in VHA, Australia.	Essential for products in VHA, Australia	N/A
Wide Area Connectivity	LTE	SON	ANR - Automatic Neighbor Relationship for Inter-RAT	The device shall support measurements for ANR - Automatic Neighbor Relationship as defined in 3GPP 36.300 for Inter-RAT 2G, 3G, LTE.	Essential for all LTE terminals - allows networks to self organise	N/A
Wide Area Connectivity	LTE - Voice and Messaging	SMS via IMS	Connected DRX - LTE	The VoLTE capable device shall support connected mode DRX	Essential for all VoLTE terminals in order to allow power saving.	N/A
Wide Area Connectivity	LTE - Voice and Messaging	SMS via IMS	SMS over IP	The VoLTE capable device shall support SMS over IP according to 3GPP TS 24.341. (The UE shall treat all Applications and SMS content bearer agnostic (e. g. Config-SMS, Push-SMS, Zero-SMS,...) regardless the transport layer used (MAP, NAS or IP)	Essential to provide messaging solution for LTE terminals	N/A
Wide Area Connectivity	UMTS	Home NodeB	VAP Reject#13 Forbidden LAC list	Only applicable to 3G devices When the UE tries to camp or reselect from the standard macro network (either 2G or 3G) to a femtocell (radiating in a different frequency than the standard one and with different Location & Routing Area Codes) and it is rejected by the femtocell using Location / Routing Area Update Reject with reject cause #13 (Roaming not allowed in this location area), the UE shall follow the procedure specified in 3GPP TS 24.008, Rel-8 section 4.4.4.7.	Required for support of Femto deployments. As Femtocells are now extensively deployed in Vodafone OpCos, it is essential that this is supported	N/A
Wide Area Connectivity	UMTS	Home NodeB	VAP Operator logo	Terminal with SIM provisioned in VAP service (femtocell) must display OpCo VAP operator name instead of macro OpCo name in IDLE state. According to 3GPP TS 22.042 Section 6.1 'Network name, time, DST and timezone information can be transferred from the serving PLMN to the MS: ... 4) When the network changes its identity. And Section 6.2: It is expected that the MS will display the most up to date	Needed to support femtocell strategy. Allows user to easily see whether he is using femto or macro network	N/A

				information transferred to it. The name to be displayed in sent during macro cell or femtocell GPRS attach procedure within the GMM information message. The UE shall always display the last operator name that has been received.		
Wide Area Connectivity	LTE	SON	ANR - Automatic Neighbor Relationship for Intra-LTE	The device shall support measurements for ANR - Automatic Neighbor Relationship as defined in 3GPP TS 36.300 for Intra-LTE.	Essential for all LTE terminals - allows networks to self organise	N/A
Wide Area Connectivity	LTE	SMS	SMS via SGs	The device shall support SMS via SGs as defined in 3GPP 23.272.	Essential for LTE Smartphones - provides messaging solution if no IMS based SMS is available	N/A
Wide Area Connectivity	UMTS	HSUPA	UE Uplink Category	The UE capability supported for HSUPA shall be Category 6 minimum, with Category 8 being preferred. Cat 7 is not preferred as strategy is to deploy Cat 8 support in our networks.	Determines Uplink data throughput Essential for UMTS terminals Cat 8 uplink capability is essential for high tier smartphones and other devices with higher data rate capabilities	N/A
Wide Area Connectivity	UMTS	General	UMTS Band VIII (900MHz)	Support for UMTS 900 shall be as described in 3GPP 25.816.	Dependant on the support of UMTS 900 - as specified in the RFP. UMTS 2100 is mandatory for all OpCos and UMTS900 is now widely used in many OpCos too	N/A
Wide Area Connectivity	General Requirements	Regulations	GCF Certification and test results	The device shall be GCF Certified. The applicable GCF release will be the due one at the date of the Vodafone 's qualification. All applicable current Performance criteria defined in GCF PC shall be provided to Vodafone at the start of the acceptance testing.	Device will NOT fulfil legal requirements for approval of a wireless device.	GCF Certification