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PPDR Rugged Handheld Device for heavy use v1.0

NCCOM White Paper

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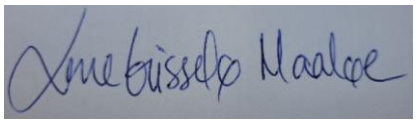

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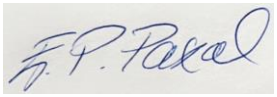

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Introduction

PPDR network operators in the Nordic countries have ongoing projects for planning, implementing, and launching next-generation PPDR networks based on LTE/5G with MCX services, which will replace the current TETRA networks. NCCOM (Nordic Critical Communication Operators Meeting) has conducted an overview of the most important requirements for PPDR rugged handheld devices for heavy use, as an addition to functionality in the commercial devices.

NCCOM is a forum for co-operation among PPDR operators in the Nordic countries.[1] This white paper provides guidelines for device manufacturers to gain an understanding of our common requirements for PPDR users. Country-specific requirements will be announced through national procurement processes, and could differ due to product maturity and market availability.

This document is divided into minimum, complementary, and future requirements, and focuses on rugged handheld devices to be used in harsh conditions. White papers regarding requirements for other use cases, such as in-vehicle, ATEX devices, and modems, may be published at a later stage.

PPDR users are accustomed to rugged TETRA devices with physical buttons for PTT, emergency calls, etc. Some of these requirements are carried forward to next-generation devices. A long lifecycle, with continuing support for hardware, chipset, battery, and software are also essential for these devices. The physical characteristics of the device shall support missions in all conditions, which include shifting temperatures, humidity, and wet conditions, as well as heavy-handed handling. Equally important is compliance with 3GPP standards, including MCX services. Operating within a secure PPDR network, the devices and their vendors shall provide capabilities to maintain software and security updates without dependencies upon external networks, e.g. the internet.

This white paper is focused on devices replacing TETRA terminals and replicating existing functionality. However, the new PPDR networks will be continuously developing and Nordic operators will ensure that new features and functionality are provided to the PPDR community in the coming years, thus placing additional requirements on the devices.

[1] Denmark, Finland, Iceland, Norway and Sweden.

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1 Minimum requirements

Minimum requirements cover the minimum necessities to be met in order to provide end users with reliable and rugged handheld devices that can function in challenging environments. All devices are expected to fulfil these requirements today, or in the near future.

1.1 Environmental

Rugged devices intended for heavy use shall be able to function effectively in harsh environments and withstand physical hazards such as moisture, water, dust, heat, and cold. The devices shall be designed to withstand repeated drops from typical operating heights onto hard surfaces without sustaining damage. Additionally, touch screens and other displays shall be easily readable under all lighting conditions, from bright sunshine to complete darkness.

Specific requirements that shall be met:

- operational temperature range -20 to +55 Celsius
- storage temperature range -30 to +65 Celsius
- protection class IP68
- cleaning and disinfecting compatible, e.g. wet wipe Triamin Disinfection, Ultraviolet (UV) Disinfection and Otson Disinfection methods
- dropping the device without damage from 1.5 metres onto hard, rough surfaces

1.2 Hardware

1.2.1 PTT button

To facilitate an easy and intuitive hardware platform, on the primary talk group in an MC PTT application, the device shall feature a dedicated push-to-talk button that is tactile, easily identifiable, and easy to operate, including while wearing protective gloves.

1.2.2 Emergency button

To facilitate an easy and intuitive hardware platform, using the emergency function in an MC PTT application, the device shall feature a dedicated emergency button that is tactile, colour-coded, e.g. red, and placed at the top of the device. The design shall support usage of the emergency button even while wearing protective gloves.

1.2.3 Talk group selection switch

The device shall feature easy-to-operate, by touch alone button(s), for easy and seamless toggling between talk groups. The button(s) shall be protected from unintentional use, manageable while wearing protective gloves, and without the need for visual assistance.

1.2.4 Display

The display and resolution shall be sized in a way that supports effective interaction with MCX applications. It shall also be scratch-resistant and readable in both bright sunlight and complete darkness. To conserve battery, the display shall automatically adjust to changing lighting conditions and it shall also be possible to have the display switched off during PTT operations.

Users shall be able to operate the touch screen in wet conditions and while wearing gloves.

1.2.5 Speaker and microphone

To ensure effective communication in all typical environments, the device should include speakers and microphones that allow for clear audio whether held to the ear or worn on the shoulder.

The speaker/microphone setup shall be designed to account for factors such as wind or loud sirens and have the capability to produce intelligible and clear audio allowing for clear audio input and output for participants in a call, even in blue-light/siren situations. Additionally, the device and its accessories shall protect users from sudden high-volume bursts of audio and provide warnings when selected output levels could potentially expose users to such bursts.

1.2.6 Camera

The device shall have a front camera with at least 2 Megapixel resolution and a back camera with at least 8 Megapixel resolution and flash. These cameras shall be capable of capturing high-quality photos and videos with the details and clarity needed for identification purposes of individuals and objects such as licence plates. The camera system shall be able to operate both in bright daylight and under low lighting conditions.

1.2.7 Battery

The device and its battery shall be optimised according to:

- duty cycle 80% standby / 20% for active use at +20 °C and -110 dBm RSRP signal strength, shall be at least 12h when using MCX application.
- duty cycle 80% standby / 20% for active use at -20 °C and -110 dBm RSRP signal strength, shall be at least 6h when using MCX application.
- maintaining at least 85% of the initial capacity after 1000 cycles (from 20% charge to 100% charge) of normal charging.

Devices shall be capable of charging from 0 to 50% in half an hour when a high-power fast charger is in use.

The battery shall be easily replaceable by users without specialised tools or expertise. The IP class of the device shall not be compromised after such a replacement is performed.

1.2.8 Peripherals connectors

All physical connectors for peripherals shall be waterproof, robust, and designed for heavy-handed use. The connectors shall provide robust, easy-to-use, secure locking mechanisms to avoid accidental disconnection. Although USB-C is standardised for all devices, additional connectors are required as a minimum:

- audio jack (2.5 or 3.5 mm) with support for PTT
- side or bottom connector with support for PTT, emergency button, and audio
- exposed charging pins that enable the device to have robust charging contacts. e.g. pogo pins to be used for charging in single- and multi-docking stations
- Bluetooth version 5.0 or higher and NFC for pairing. It shall be possible to block the use of Bluetooth via the EMM. Bluetooth shall support Secure Connections security mode 4, level 4.

All connectors may be used simultaneously to allow multiple accessory connections e.g. body-worn camera, external screen, and RSM.

1.3 Accessories

The device manufacturer shall be able to provide or support several accessories for the device:

- single- and multi-docking stations and charger
- earphone with PTT button connected to device via side connector using robust locking mechanism to avoid accidental disconnections and, e.g., USB-C or audio jack.

All accessories shall be waterproof, robust and designed for heavy-handed use and able to use the device's robust, easy-to-use, secure locking mechanism to avoid accidental disconnections.

1.4 Wi-Fi hotspot

The device shall have the capability to act as a Wi-Fi hotspot. It shall be possible to block the use of this Wi-Fi hotspot via the EMM.

1.5 Device-to-device communication

TETRA DMO (direct-mode operation) operating in TETRA-band (380–430 MHz) will be used until 3GPP technologies can provide a proven solution for device-to-device (D2D) communication, and interoperability to PPDR TETRA DMO is no longer needed.

The DMO capability shall be supported by the device itself, or together with an accessory.

1.6 RF OTA antenna performance

RF performance shall be the best possible, following RF OTA performance criteria measured according to the 3GPP TR 37.977 V17.0.0 (2022-03) and 3GPP TR 25.914 V17.0.0 (2022-03 Technical Specification Group Radio Access Network; Measurements of radio performances for UMTS terminals in speech mode (Release 17).

The device shall support at least ITU Region 1 Band 8 (900 MHz), Band 20 (800MHz), Band 28 (700 MHz), Band 3 (1800 MHz), and Band 1 (2100MHz).

All required values for the RF OTA performance are presented in Appendix A.

1.7 Security and Firmware

1.7.1 Security classification

The HW solution shall meet the basic level of security requirements for each country, which is the minimum level required for PPDR users. These requirements are typically equivalent to RESTRICTED security classification.

1.7.2 Lifecycle support

For PPDR users, it is crucial to have a long device lifecycle and the ability to provide ongoing support. This encompasses chipset maintenance, firmware updates, and security updates.

Updates to the latest operating system (OS) shall be available throughout the lifecycle, together with the latest security and firmware updates, including fault corrections. Updates containing new features and bug fixes shall be available at regular intervals. Security and emergency updates shall be made available immediately.

The device manufacturer shall provide support for the device for a minimum of five (5) years from its launch date.

1.7.3 Internet access

The device shall be able to function fully without relying on internet access during enrolment or operational use.

1.7.4 Third-party EMM

The device shall be capable of being managed by a third-party EMM solution, which is installed on-premises and may be restricted to a closed network, i.e. completely isolated from public internet connections, for example with AOSP (Android Open Source Project).

It shall be possible to manage all software updates through the EMM.

1.7.5 Controlling external IP connections

To ensure device security, manufacturers should provide detailed information on outgoing connection endpoints during start-up, activation, and operational use, etc. This information includes IP addresses, domain names, and communication protocols. PPDR operators shall have control over these endpoints in order to monitor, block, and allow connections as needed. Device security requires collaboration between the manufacturer and PPDR operator to protect sensitive data and prevent security breaches.

1.7.6 Permitted applications

Only critical system applications and those required for the proper functionality of the device, and necessary for MCX application, should be included in the firmware and operating system. The manufacturer shall provide the PPDR operator with a list of applications and detailed information about their purpose and why they are needed on the device.

1.8 Device access

The device shall support various security methods for accessing it, e.g. PIN, password, fingerprints, and face unlock.

For enhanced security, the device shall support an adjustable failed password attempts feature, which initiates a factory reset when the user exceeds the specified number of incorrect password attempts. The number of failed attempts shall be configurable. The manufacturer should provide guidance on managing this feature to ensure optimal device security.

1.9 Standardisation and Certification

Devices used in PPDR networks based on LTE and 5G technology shall:

- carry a valid CE mark
- have a unique IMEI code, i.e. one that has not and will not be used in other equipment
- be certified by Global Certification Forum (GCF) for 3GPP compliance
- support 3GPP Mission Critical Services including MCX client functionality that conforms with the 3GPP specifications for mission critical communications release 16 or later. This proof is established by providing a certificate of Conformance based upon the GCF Mission Critical Services Certification Procedures
- be accompanied with an RF OTA test report

1.10 Location services

The device shall be compatible with Global Navigation Satellite System (GNSS) receivers, and operate, at minimum, with Galileo and GPS systems, together with locations provided by the mobile network. Indoor location services shall be available using existing technologies, i.e. Bluetooth or Wi-Fi.

1.11 Mission-critical services support

To ensure the success of all operations, it is crucial for PPDR users to have access to reliable Mission-Critical Services. Therefore, device manufacturers are required to incorporate support for 3GPP Mission-Critical Services standardised functionality and demonstrate an ongoing dedication to supporting new 3GPP releases in order to achieve this goal.

The device shall support, at least, the 3GPP Mission-Critical Services dedicated Quality-of-Service (QoS) class identifiers (QCI, 5QI) 65, 67, 69, and 70.

3GPP Mission-Critical Services require that the device supports dedicated functions that include, but are not limited to:

- securing priority access for the MCX client to relevant device resources, such as microphone and speaker, etc.
- dedicated bearers and associated QoS mechanisms
- ambience listening
- contributing to relevant KPIs, e.g. mouth-to-ear latency, can be met end-to-end.

2 Complementary requirements

Complementary requirements may either be more stringent than the minimum requirements or serve as additional specifications to fulfil specific needs. Certain complementary requirements may be mandatory for some national procurements.

2.1 Environmental

Some use cases require further tightening of the minimum requirements, and the device should support:

- operational temperature range -30 to +55 Celsius
- dropping the device without damage from 3 metres onto hard, rough surfaces
- protection mechanism for contacts, gaskets and enclosures to avoid corrosion after contact with salt water

2.2 Hardware

2.2.1 Programmable buttons

The device should have programmable buttons that can be set by using EMM. Each button should be programmable with specific in-app functions, like a second PTT (Push-to-talk) button, sending pre-defined messages, as well as system functions like talk group selection and opening an application.

2.2.2 Battery

The device and its battery should be optimised according to:

- duty cycle 80% standby / 20% for active use at +20 °C and -110 dBm RSRP signal strength, should be at least 16h when using MCX application.
- maintaining 90% of the initial capacity after 2000 cycles (from 20% charge to 100% charge) of normal charging

The device should support a wireless charging solution compatible with Qi 1 and Qi 2.

The battery should be exchangeable without any disconnection in MCX communication, allowing for hot swapping.

2.3 Peripherals connectors

An external antenna connector should be provided to further improve usability and add use cases.

2.4 Accessories

The device manufacturer should be capable of providing or supporting the following accessories for the device:

- single- and multi-battery charging banks, for removable batteries
- vehicle mount that allows for charging and facilitates connectivity with external antennas, audio accessories, and displays mounted in the vehicle.

2.5 Security and Firmware

2.5.1 Lifecycle support

A continuous extension of the lifecycle is important and the device manufacturer should provide full support for the device for six (6) years from its launch date.

2.6 Mission-critical services support

Large operations require solutions that allow the capacity to be shared between many users.

3GPP Mission-Critical Services require that the device supports broadcast multicast service (eMBMS, MBS).

2.7 E2EE

PPDR organisations need to communicate and share information without risking the interception or leaking of sensitive information.

The device should have the capability to support end-to-end encryption solutions that are interoperable with currently deployed end-to-end solutions in TETRA devices.

Third-party vendors are providing this functionality based on a smart card that is to be added to the device.

3 Future requirements

In addition to keeping up with rapid developments in mobile technology and standardisation forums, suppliers should collaborate with the PPDR community to ensure that new features and functionalities are constantly provided and incorporate relevant advancements that can enhance PPDR communications.

3.1 Hardware

3.1.1 Talk group selection with rotatable knob switch

To enable easy and seamless switching between talk groups, even while wearing protective gloves and without the need for visual assistance, the device should feature a button that is easy to operate by touch alone, such as a rotatable knob switch.

3.2 Device-to-device communication

End-users require access to reliable and predictable communication services even when network connectivity is lacking. The device manufacturer is expected to follow and contribute to find a 3GPP standardised solution, which replaces current DMO, to be implemented in the device.

3.3 RF OTA antenna performance

In addition to the minimum and complementary required frequencies, the device should support ITU region 1 B68 (698-703 MHz), and to achieve increased indoor coverage n40 (2300 MHz), n22 (3500 MHz), n74 (1500 MHz), n258 26 GHz (24.25-27.5 GHz).

Wide geographical coverage is essential and to further increase the RF OTA performance to achieve required performance, an external antenna solution compatible with the frequencies below 1GHz could be used.

All required values for RF OTA performance are presented in Appendix A.

3.4 Carrier aggregation

The device shall support the following band combinations for carrier aggregation:

- CA combo LTE B20 + NR28
- CA combo LTE B1+ LTE B3 + LTE B20

3.5 Lifecycle support

In the future, the device manufacturer will be expected to provide full support for the device for six (6) years from its launch date.

3.6 Location

The PPDR community's access to reliable positioning and time information is essential for all mission critical services operations. PPDR users rely on accurate and high-quality positions protected from external impact.

The device shall support Galileo Public Regulated Service (PRS) when available for implementation. This means, among other requirements, that in the future the receiver shall be capable of receiving the PRS signal on frequency bands E1 and E6.

GNSS jamming is interference with frequencies from external sources, which can lead the receiver to lose position and time information. Spoofing occurs when fake GNSS signals interfere with a receiver, thus deceiving users by displaying distinct but inaccurate locations or times.

The GNSS receiver used shall have protection mechanisms to avoid jamming and spoofing.

3.7 Satellite-to-device communication

PPDR users operating in rural areas without coverage from the mobile network are dependent on other ways to facilitate communication.

The device manufacturer shall follow, and preferably contribute to, the standardisation initiatives within 3GPP and TCCA to find a solution for satellite-to-device communication (NTN) to be implemented in the device.

Abbreviations & Terms

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3GPP	The 3rd Generation Partnership Project
ATEX	Atmosphère Explosive
D2D	Device-to-Device
DMO	Direct-Mode Operation
eMBMS	Evolved Multimedia Broadcast Multicast Services
EMM	Enterprise Mobility Management
E2EE	End-to-End Encryption
GALILEO	European Global Satellite-Based Navigation System
GPS	Global Positioning System
GCF	Global Certification Forum
GNSS	Global Navigation Satellite Systems
GSM	Global System for Mobile Communications
GSMA	GSM Association
IMEI	International Mobile Equipment Identity
IP	Ingress Protection
MC	Mission Critical
MC PTT	Mission-Critical Push-to-talk
MCX	Mission-Critical services
MBS	Multicast Broadcast Services
NIST	National Institute of Standards and Technology
NFC	Near-Field Communication
NR	New Radio
NTN	Non-Terrestrial Networks
NCCOM	Nordic Critical Communication Operators Meeting
OTA	Over-the-Air
Pogo pin	Spring-loaded, electrical connector pin
PRS	GALILEO Public Regulated Service
PPDR	Public Protection and Disaster Relief
PTT	Push-to-talk
QCI	QoS Class Identifier
QoS	Quality of Service
RF	Radio Frequency
RF OTA	RF performance Over-the-Air
RSRP	Reference Signal Received Power
SIM	Subscriber Identity Module
TETRA	TETRA | Terrestrial Trunked Radio – ETSI
TRP	Total Radiated Power
TRS	Total Radiated Sensitivity
USB-C	Universal Serial Bus Type C

Appendix A

Table 1. RF OTA Required TRP Values for LTE Bands

ITU Region 1 Frequency Band LTE	Required Values for TRP [dBm]		
	BHH	Browsing	Free Space
Band 1 (2100 MHz)	13.5	15.5	18.5
Band 3 (1800 MHz)	13.5	15.5	18.5
Band 7 (2600 MHz)	13.5	15.5	18.5
Band 8 (900 MHz)	14	16	20
Band 20 (800 MHz)	14	16	20
Band 22 (3500 MHz)	13,5	15,5	18,5
Band 28 (700 MHz)	14	16	20
Band 40 (2300 MHz)	13.5	15,5	18,5
Band 68 (698-703 MHz)	14	16	20
Band 74 (1500 MHz)	13,5	15,5	18,5

Table 2. RF OTA Required TRS Values for LTE Bands

Frequency Band LTE	Required Values for TRS [dBm]		
	BHH	Browsing	Free Space
Band 1 (2100 MHz)	-89	-91	-93
Band 3 (1800 MHz)	-89	-91	-93
Band 7 (2600 MHz)	-89	-91	-93
Band 8 (900 MHz)	-92	-93	-95
Band 20 (800 MHz)	-92	-93	-95
Band 22 (3500 MHz)	-89	-91	-93
Band 28 (700 MHz)	-92	-93	-95
Band 30 (2300 MHz)	-89	-91	-93
Band 68 (698-703 MHz)	-92	-93	-95
Band 74 (1500 MHz)	-89	-91	-93

Table 3. RF OTA Required TRP Values for NR Bands

Frequency Band NR	Required Values for TRP [dBm]		
	BHH	Browsing	Free Space
n1, n22, n28, n38, n40, n74, n78, n258	14	16	16

Table 4. RF OTA Required TRS Values for NR Bands

Frequency Band NR	Required Values for TRS [dBm]		
	BHH	Browsing	Free Space
n1, n22, n28, n38, n40, n74, n78, n258	-100	-105	-105