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Exploratory study

Mission critical voice service based on LTE450 in the Dutch part of the North Sea

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Management summary

There is increasingly more economic activity at sea. In addition to transport ships, the North Sea houses more and more wind farms, energy hubs and (foreseen for the future) food production facilities. This development leads to an increasing demand for communication and digital connectivity, which in some cases can also be of a mission critical nature. At sea, however, the availability of communication networks that can provide this is currently more limited than on land. This study answers the following main research question: **What are the opportunities and barriers for developing a mission critical voice service based on LTE450 in the Dutch part of the North Sea[1]?** The answer to this question is structured around a SWOT analysis for a hypothetical future LTE450-based mission critical service, as well as four specific questions detailed below.

Strengths, weaknesses, opportunities and threats for LTE450 at sea

The main strengths, weaknesses, opportunities and threats for a mission critical LTE450-based voice service at sea are the following:

- Strengths: The 450 MHz-band can enable mission critical communication at sea. There is a global momentum for using LTE/5G in the 450 MHz band for data as well as voice communication, primarily from the utilities sector. Coverage can be achieved at sea relatively quickly using spectrum in the 450 MHz band. Spectrum availability is assured until at least 2050 due to the current assignment to Utility Connect. The impact of interference appears to be limited and manageable.
- Weaknesses: The 450 MHz band is not natively supported by regular LTE/5G devices. The ecosystem for handsets with support for LTE450 is much smaller than that for regular LTE and 5G bands. Utility Connect will (on land) only be able to deploy a single carrier based on LTE-M until at the latest July 2035. 3GPP standardized mission-critical voice (MCX) is however likely not supported in combination with LTE-M.
- Opportunities: There is limited availability of digital connectivity at sea, and hence LTE450 could provide a good "ultimate fallback option" for critical voice and low-data volume IoT communication. The LTE450 network could be completely independent from other public mobile networks, which has advantages in terms of control, security, and life cycle management. Deployment of 3GPP MCX can also provide valuable insights for VMX, the successor to C2000 (the current Dutch PPDR mobile communications system based on TETRA).

[1] The Dutch part of the North Sea refers to the Dutch territorial waters as well as the Dutch Exclusive Economic Zone.

- Threats: Alternatives on the North Sea are increasingly available, though most cannot (yet) comply with mission critical requirements. These include public mobile networks in "regular" LTE/5G bands and direct-to-device satellite communication. Their availability is good news for users with a need for digital connectivity on sea, but it means that the LTE450 network might eventually be overshadowed. On one hand, relatively cheap broadband connectivity becomes available for non-critical applications and as a fallback or standard option for critical applications. Satellite communication can provide the ultimate fallback option for critical voice communication. On the other hand, (local) narrowband networks might be easier to realize or adapt to specific situations, depending on the situation. Accessing public mobile networks at sea would offer access to a much larger ecosystem, more freedom of choice, as well as connectivity with VMX.

The most important issue for the future viability of LTE450 at sea is its positioning and added value compared to real alternatives. Globally, there is a trend towards using a mix of both public infrastructure (mobile networks) and dedicated spectrum and infrastructure for PPDR networks. LTE450 could serve as an "ultimate fallback option" by offering limited capacity but high reliability (especially in emergencies). This could however also be achieved through satellite connectivity (direct-to-device). A further disadvantage of LTE450 is its limited handset ecosystem and the need to realize and maintain a radio network at sea. With all other options, standard handsets can be used, and existing network infrastructure can be utilized.

To what extent can TETRA based handsets be ad-hoc linked with LTE450 handsets in mission-critical first responder/PPDR applications?

TETRA *networks* can be linked with 3GPP MCX-based systems, allowing users on both platforms to communicate with each other. There are however no available *handsets* that support both TETRA and LTE450, so emergency responders cannot use a single device for connecting both to C2000 when on land (using TETRA) as well as via LTE450 network when at sea (unless ad-hoc C2000 TETRA base stations are set up at sea, employing LTE450 or alternatives mentioned above for backhaul connectivity).

How future-proof is the 2×3 MHz spectrum granted to Utility Connect until 2050 regarding the usability of 3GPP technologies (LTE450 and successors)?

Utility Connect has secured the availability of the 2×3 MHz of spectrum until 2050. However, limited use can be made of it on land up to 2035 due to the need to maintain a CDMA450 carrier. Based on the 1.5 MHz spectrum available by that time, there are limited possibilities for realizing a mission-critical voice service (in terms of capacity and support for LTE-M speech equipment).

To what extent does a mission-critical mobile network for PPDR based on LTE450 fit into European harmonization and interoperability developments such as BroadEU.net and the EU Spicenet reference architecture?

The reference architectures developed at the European level provide a framework for connecting different types of PPDR networks, including TETRA and 3GPP MCX, on a higher level. Based on these developments, we see no limitations regarding the

achievable LTE450 network. In practice, the implementation of the mentioned reference architectures still seems to be barely underway.

What limitations, if any, can be expected regarding the use of LTE450 in the North Sea, in connection with interference from and by foreign usage in and around the 450 MHz band?

The UK's usage must be primarily considered, which is mostly narrowband in nature. Notably the 450 band in the UK is configured such that uplink and downlink are exactly opposite to that of the Netherlands. Impact on the network from the UK (and indeed Belgium, where the entire 450 - 470 MHz band is used for PMR) is expected to be limited or easily mitigated. Broadband LTE- and 5G technology is relatively robust for narrowband interference. An LTE450 network at sea could additionally be designed so that base stations (aimed at the Dutch mainland) send as few signals in the direction of the UK as possible and receive as few as possible. Conversely, the network may hinder narrowband users across the border, and this could be a limiting factor.

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