SEMCO maritime

LTE/4G and 5G technology offshore

LTE/4G and 5G technology offshore:

A gamechanger to ensuring reliable communication?

LTE/4G and 5G technology in offshore renewables will be a gamechanger when it comes to ensuring reliable communication, not only during the critical construction phase, but also for continuous monitoring and control, safety, servicing, training, maintenance, and day-to-day welfare on site ...

There are several potential benefits to deploying private LTE/4G networks offshore, including faster throughput and more stringent requirements than for consumer applications:

- A high level of OT security (as part of critical infrastructure)
- Quality of Service (QoS) and high capacity
- Reliability secured by redundancy
- Low latency
- Coverage and reach in turbine area and inside turbine
- The ability to scale

An increasing need for high-speed network offshore

With the increasing focus on and investment in the offshore wind energy sector, the global growth rate per year is expected to reach 15.7% based on 4C offhore's expectations. To capitalize on the potential of wind energy, the industry will have to solve multiple challenges, including the inherent complexity of the long distances from shore to remote wind farm locations, to operate efficiently and safely, monitor, maintain and service the wind turbines.

Connectivity is critical for various purposes, in-cluding monitoring and control, communication between workers on site and off site and day-to-day welfare on site. LTE/4G and 5G cellular networks provide the necessary coverage, reliability and reach along with the low latency, throughput and scale required for existing and future wind farm use cases.

To obtain better wind conditions and to prevent challenges/resistance from people living close to wind farms, the trend is that the wind farms should be installed far from shore (20-30 km). However, wind farms will be located as far as 100 km from shore. Normally, no commercially operated telecommunication network would be able to support a distance that far, nor could the vendor sufficiently guarantee that the network would always be available, as this type of network is a shared resource with a huge number of other subscribers.

Reliable communication is important, not only during the construction phase, but also for continuous monitoring and control, safety, servicing, training, maintenance and day-to-day welfare on site. Lack of communication during construction might result in costs increasing heavily. Reliable communication is crucial to prevent standby time for crane operators and others and in order for standby crew to be able to fulfil offshore HSE requirements etc.

A reliable communication network can also help optimize the commissioning process of the turbines, which means that the turbines can be commissioned before the power/fibre is established, enabling the turbines to generate power from the first day of connection to the grid.

The communication network is actually supporting the entire system, enabling multiple use cases beyond traditional operations, such as operation teams gathering information from sensors that are measuring wind, humidity and weather patterns and thereby helping to prevent injury to workers or costly and dangerous damage to equipment. Or it could be safety teams remotely monitoring heat/cold exposure and workers' heart rates and exact location. A capable and reliable wireless system can scale the required distances with resilience and performance and is part of the wind farm's end-to-end communication system for multiple applications such as voice communication, online documentation, production data and video streaming.

Will LTE/4G and 5G replace digital trunked radio in the offshore renewable industry?

For the last 10 years, TETRA has been the predominant communication media in the renewable industry, used to support the requirements for a reliable communication technology. We expect that TETRA will still be a requested media within the next 2-3 years. However, the industry also requires further digitalization within the industry, including high-speed data functions offshore.

Based on the information given above we can conclude that cellular communication is uniquely qualified given its ability to generate high throughput at low latency, inherent security and architecture, and high-density connections.

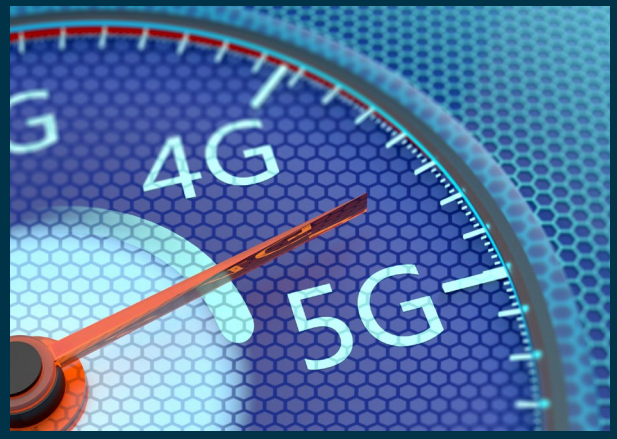
LTE/4G and 5G are the only existing technologies that benefit from both industry and mass consumer acceptance as a single worldwide technology.

In Semco Maritime we have already implemented LTE/4G and 5G technology in our offshore projects, and the number of requests for quotation (RFQs) for this type of technology is rapidly increasing. We expect to use TETRA as a “mission critical” media in the transition period until it is fully replaced by LTE/4G or 5G within the next 2-3 years.

What is LTE/4G and 5G?

LTE/4G and 5G provide crucial advantages for the wind industry, including faster throughput and more stringent requirements than for consumer applications:

- A high level of OT security due to government's operator requirements and part of critical infrastructure.
- Quality of Service (QoS) and high capacity.
- Reliability secured by redundancy.
- Low latency.
- Coverage and reach in turbine area and inside turbine.
- The ability to scale.



Worldwide standards

LTE/4G and 5G are based on the 3rd Generation Partnership Project (3GPP), which is a term used for global cellular-based standards.

Though LTE/4G and 5G are technically different, they are based on the same foundation. The standards have been developed to allow easier vendor coexistence and upgrade capabilities for the companies using cellular-based products.

For the network owners, this will also give them the freedom to select more competitive phones/terminals instead of more high-end products, depending on their needs.

Investing in a communication infrastructure based on a global standard will also secure that the investment is future proof and that there is interoperability between multiple vendors of network equipment, giving the customer the freedom to expand the network independent of a specific vendor.

Security:

Extremely high focus on IT/OT security

An extremely high focus on IT/OT security is crucial as the wind industry is part of the national infrastructure and requires increased security measures.

Both the LTE/4G and 5G networks are ideal solutions for the wind industry. The network security of both networks is based on the 3GPP standards that govern the safety features, devices and users. Encryption and security keys can only be deciphered through a SIM card installed on the user device. The physical control of the SIM cards will be the responsibility of the IT staff of the wind farm operator or trusted service provider.

A typical private network deployment will create a closed system whereas a typical public LTE/4G or 5G network, through private network architectural deployment, is completely self-contained within the wind farm's IT network, protecting the wind farm's wireless network from exposure caused by multiple paths or vulnerable access points.

Service:

Quality of service and reliability

A second characteristic that stands out for LTE/4G and 5G technologies is reliability and service guarantees. This includes the ability to enable end-to-end Quality of Service (QoS) assignments to different services and streams within the LTE/4G or 5G network.

With deterministic scheduling and QoS controls within the framework of the 3GPP standards, LTE/4G and 5G technologies can adjust for the relative importance of services representing various use cases to prioritise one over the other during periods of congestion. Hence, the typical number of consumers on a private LTE/4G or 5G network is relatively low compared to the number of consumers on a commercially operated network, making the risk of congestion very low.

Functions similar to digital trunked radio system (TETRA)

In the offshore renewable industry, a digital trunked radio system like TETRA is a very common technology used to secure a “mission critical” voice conversion and supporting a project with advanced group features for both the construction and operation phases.

A typical public LTE/4G or 5G network does not support advanced group features, but can provide prioritised voice services in the form of Voice over LTE (VoLTE in LTE / VoNR in 5G).

An “on top” application for the private network is the MCPTT (Mission Critical Press To Talk) application. MCPTT gives us the features a typical digital trunked radio system would provide, based on standard smart phones instead of the relatively expensive terminal for TETRA, for example.

Features like priority call, emergency call/groups are supported, and so are video calls and location services. By implementing a MCPTT application in an LTE/4G or 5G network, the consumers will get “the best “from both technologies.

It should be mentioned that the TETRA-based function DMO, used in case of an infrastructure breakdown, enables radio-to-radio communication. This feature is also available in LTE/4G and 5G, but it is not sufficiently supporting the range between the terminals. This is, however, a feature that should be supported on the terminal side and not through the LTE/4G and 5G infrastructure.

Integration to a telephone exchange (PABX) can be supported by implementing an IP multimedia solution creating an interface between the LTE/4G or 5G network and the telephone exchange, providing voice call from the terminal to subscribers on the telephone exchange or to public network phones.

It should also be mentioned that other applications only requiring a data network are supported by the network as well. This could be applications such as Teams, WhatsApp, video conference systems etc.

Data throughput

One of the main advantages of LTE/4G and 5G networks is the data throughput. Top LTE/4G speeds can reach up to 1Gbps whereas 5G speeds, in principle, can reach up to 10 Gbps.

The practically obtained throughput should, however, be expected to be lower as the selection of frequency, bandwidth, and antenna type as well as the distance to base stations have a huge impact on the throughput. Semco Maritime can be consulted for advice and offers support regarding advanced coverage calculations predicting coverage and throughput for a specific case.

A typical throughput is expected to be 150 Mbps download and 50 Mbps upload per consumer (SIM card). As mentioned above, the carrier frequency is one of the key criteria for a coverage calculation. Standard frequency is in the range of approximately 800 MHz to typically 3.8 GHz. Access to frequency will be based on local standards.

Coverage and reach

Another significant characteristic of the LTE/4G or 5G network is the reach (coverage area).

Cellular-based networks are typically defined as networks transmitting a considerable amount of power to reach the end device, expanding coverage to the wind farm by using fewer base stations than other technologies. Inside coverage in substations and WTGs requires a more detailed approach.

Both the WTGs and the substation steel construction prevent radio signals from outside to penetrate the structure (in principle, all radio signals are blocked). The substation can be covered directly from the base station, if located on the substation, by distributing the signal in a passive or active DAS (Distributed Antenna System) or by placing small low-powered base stations at strategic locations.

The WTGs can be covered by installing micro-base stations to be connected to the central system via fibre or IP network, or a stand-alone repeater could be installed, repeating and distributing the signal inside the WTGs. Semco Maritime is continuously working on developing a cost-effective solution for the WTG coverage.

Some of the functions and applications supported by a private LTE/4G or 5G network:

- Emergency response communication
- Tele medicine
- Drone operation for blade inspection
- Video streaming for remote technical support
- Welfare data
- Remote office on SOV vessel during construction phase
- Online documentation and reports
- IoT
- “Big data” strategy
- Voice data communication supported by MCPTT

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