

# 5G Deployment in the Oil and Gas Industry

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## Abstract

With high data speeds and superior network reliability and capacity, oil and gas companies can make full use of the 5th generation mobile network (5G) capabilities in mission-critical services, especially in the areas of Augmented/Virtual Reality (AR/VR), the Internet of Things (IoT) and Artificial Intelligence (AI). 5G can accelerate digital transformation in any business by enhancing safety and improving productivity. This article describes the business needs and opportunities of deploying 5G technology in oil and gas facilities. In addition, it illustrates the obstacles of 5G use cases in an industrial environment and how to overcome such challenges.

**Keywords** — 5G, Compliance, Intelligence, Reality, Surveillance.

## I. INTRODUCTION

This article explains 5G deployment in the oil and gas industry by virtually connecting everyone and everything together, including machines, objects, and devices. The article highlights the leverage of 5G in the oil and gas industry that could add significant value to industrial services via ultra-high speed and low latency communication. The second section of this article describes six use cases where 5G can be effectively utilized to replace routine interactive operations. This includes improving field security, enhancing emergency response, ensuring workers' safety, and finally increasing workers' productivity and efficiency. The last part tackles the challenges of introducing 5G into oil and gas areas which cover safety, cybersecurity, and coverage deployment.





## II. 5G AND DIGITALIZATION IN OIL AND GAS

The oil and gas industry is known to be heavily reliant on reliable, secure, and resilient networks in providing seamless communications for their daily operations. The high variety of devices in oil and gas enterprises, i.e., sensors, automated guided vehicles, security cameras, robotic controls, etc., generates very different kinds of requirements for throughput, mobility, latency, density, availability, and power [2].

In addition, Oil and gas platforms' remoteness and isolation, combined with extreme weather conditions such as

strong winds and extreme temperatures, are some of the challenges that strengthening the need for a robust communications system [2]. 4G LTE technology could address some of these needs, but 5G can be an integral part of the evolution of industrial automation, especially with ultra-reliable low latency communications applications. The below table shows the comparison between 5G and the earlier generations [3].

5G vs. 4G: what is the difference?

	3G	4G	5G
 Deployment	2004-05	2006-10	2020
 Bandwidth	2mbps	200mbps	>1gbps
 Latency	100-500 milliseconds	20-30 milliseconds	<10 milliseconds
 Average Speed	144 kbps	25 mbps	200-400 mbps

The 5G networks offer a vast opportunity to replicate the function of wired systems for various industrial applications. 5G is expected to come up with numerous innovations, which will significantly revolutionize our life. Moreover, service providers will have to deal with multiple challenges to meet users' expectations and ensuring customers satisfaction. From a process automation perspective, many industrial processes are already automated, and oil and gas enterprises continue to go after greater efficiency and better production by leveraging new-age communication networks like 5G. 5G is designed to not only deliver faster, better mobile broadband services compared to 4G LTE but can also accelerate the digital transformation for greater automation technologies in terms of Artificial Intelligence (AI) and robotics. 5G networking is on its way to provide boundless connectivity for all, deliver sustainable networks and drive growth in new use cases for massive and critical IoT.



### III. USE CASES

5G doesn't necessarily define the industrial processes but rather acts as an enabler of new use cases and operating models. Some of the most relevant 5G use cases among the oil and gas enterprises are analyzed below.

#### A. Multi-Vision Smart Surveillance (MVSS):

MVSS is a 24/7 live monitoring camera equipped with Artificial intelligence (AI) and Zooming capabilities to analyze video and detect behaviors over 5G. It can be used for Traffic jamming detection, behavioral analysis like (Tripwire Crossing, Fast Movement Detection, Unauthorized Parking, and Abandoned Object Detections). Such cameras are fixed and normally installed inside and around the industrial zones to improve field security and safety.

#### B. Body Worn Camera:

This type is a wearable camera used to broadcast video, audio, and data to the 911 Emergency Call Center. With 5G high-speed data, this camera can provide live video streaming during foot patrolling for incident investigation, record evidence, live commands communication, and timely support request.

#### C. Real-Time Vehicle Surveillance (RTVS):

RTVS is a Vehicle equipped with multiple cameras capable of doing Artificial Intelligence (AI) functions while patrolling. It has several applications, such as facial/plate recognition, authorization checking, and driver safety compliance detection.

#### D. 3D Augmented/Virtual Reality (AR/VR) for Maintenance and Troubleshooting:

Digital Helmet will be used to provide the functionalities of 3D augmented/Virtual Reality over a 5G network to improve workers' productivity and efficiency. With ultra-reliable low latency provided by 5G, AR/VR will be able to secure the remote field assistance for the following functions:

- Provide hands-free document review
- Remote video assistance and collaboration with experts
- Facilitate training and field practice for new workers
- Visual predictive maintenance and troubleshooting
- Object recognition
- Real-time visualization of equipment health

#### E. UAV Inspection and Video Surveillance:

The surveillance here is using Unmanned Aerial Vehicle (UAV), also known as drones, over 5G for live video streaming and plant inspection to improve emergency response and control quality. These drones

provide real-time video surveillance in case of an emergency situation to collect field data and ensure precise inspection.

#### F. Scaffolding and PPE (Personnel Protection Equipment) Compliance Detection:

This compliance is designated to ensure workers' safety by using fixed and mobile solutions (Cameras, Drones, and Robots) integrated with AI systems to inspect and ensure safety compliance for scaffolding and PPE activities. 5G technology can provide these solutions to detect the following with high resolution and without human intervention:

- Unused scaffolding for a long time without movement or work activities
- Corrosion and height detection
- Tag validity and expired certificates detection
- Helmet and gloves compliance check

### IV. CHALLENGES of 5G IN OIL AND GAS APPLICATIONS

There are many challenges that could potentially arise from using 5G in the oil and gas industry. This section highlights three of these challenges and recommends solutions to overcome them.

#### ❖ Security and Privacy:

Normally, introducing new technology to any network alters the threat landscape. Vulnerabilities and threats against technology are likely to be unknown at the time of launch. This would be a challenge with any data-driven technology, especially with the extraordinary combination of new technology and differing service models being introduced. 5G is the first generation that recognizes cybersecurity threats and has security at its foundation [5].

The 5G technology improves the security standards; therefore, more development is expected to the privacy and protocols. Moreover, multiple protocols were proposed in 5G devices to eliminate the number of threats. 5G has designed new authentication capabilities and enhanced subscriber identity protection in addition to security mechanisms. Preventative controls are outlined within cybersecurity standards to protect and monitor the network as a whole. The correct implementation of these standards should fulfill an operator's security requirements when deploying 5G. Hence, threat modeling of the 5G services should be part of the service design phase to identify and close key threats the service is likely to be impacted by.

#### ❖ Safety:

With the expansive growth of data flow in the industrial environment, it is necessary to develop 5G intrinsically safe devices to overcome any safety concerns. The safe operation in hazardous locations is always carried out using different types of protection and depends on the function of the

device. Laws, standards, recommendations, and regulations are utilized by different organizations to address explosion protection and the occurrence of sparks inside or outside electrical/electronic equipment in such an environment [7]. The speed and network capability in 5G technology enable more advanced functions and features.

Since 5G applications and use cases have been recently introduced to the industrial environment, it is expected to have an availability limitation for such devices. However, due to the high demand for 5G applications, different service providers and suppliers started manufacturing intrinsically safe devices relying on standardized types of protection. With this in a short period, the market will fulfill the industrial demand having safe equipment and operations over 5G.

❖ **Coverage Deployment**

Despite 5G offering a significant increase in speed and bandwidth, its more limited range will require further infrastructure (base stations, towers, antennas, and repeaters). The challenge is that the 5G structure, while able to handle more users and data, beams out over shorter distances [10]. 5G is a newly established technology. However, it has discovered several improvements and developments in the world of technology. The 5G technology brings more heating problems due to the power consumption required to transmit the signal in a high-frequency band.

Even with antennas and base stations getting smaller in this scenario, more of them would likely have to be installed. Oil and gas facilities will probably need to install extra infrastructure to spread out the waves for an extended range while also maintaining consistent speeds.

**V. Conclusion**

With high speeds, superior reliability, and negligible latency, 5G will expand the mobile ecosystem into a new era. It will have a significant impact on our society, as it provides higher speed, increased bandwidth, and lower latency compared to the existing wireless technologies. Educating the consumer about the Internet of Things and cybersecurity

is extremely necessary, as it will deliver a full understanding of the device’s safety. 5G will impact every industry, making safer transportation, remote healthcare, digitized logistics, and more a reality. It can be used to serve as the foundation for oil and gas organizations' infrastructure, including cloud computing, big data analytics, robot inspection, drone inspection, and augmented/virtual reality [4].

Oil and gas companies could leverage what is being done by their peers in the global markets and replicate those use cases whenever possible and beneficial to their needs. Also, the partnership between companies, vendors, stockholders can be formed to accelerate and ease 5G deployment to have a reliable, safe, and secure business.

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