



5G 101 For Industry CIOs: **What You Need To Know To Deploy 5G For Industry 4.0**



Industry 4.0, the factory of the future, the fourth industrial revolution and IIoT - all of these terms have been around for quite a while with the promise of digital transformation in the manufacturing industry.

It seems that in the past few months things are moving faster, and we are seeing more and more announcements about industrial companies deploying trial networks in their facilities.

The factory of the future is where industry breaks away from the traditional model of efficiency through automation, specialization, and scale and enters the world of big data. Advances in robotics, materials and production techniques join forces with artificial intelligence (AI), the Internet of Things (IoT), and even Augmented Reality (AR) to make flexibility and customization the new competitive edge. Every object in the factory will communicate with the others. Decisions and directions for assembly will be made at the product level and adapted to current conditions.

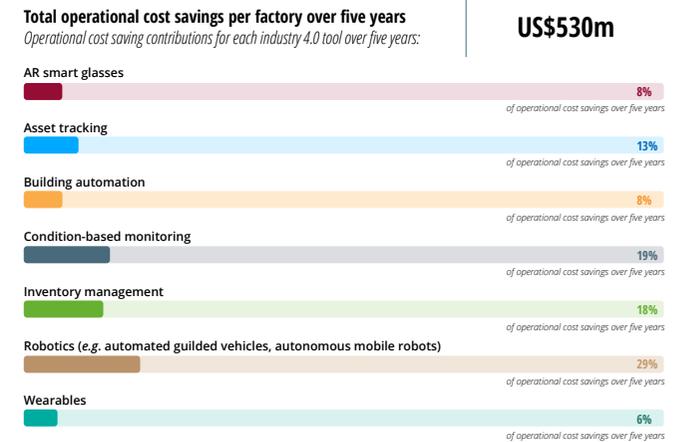
The manufacturing sector has experienced a stagnation in the past decade, with its contribution to the world's Gross Domestic Product (GDP) remaining at 16% since 2010. This represents an overall decrease in manufacturing value from its 17.5% high back in 1997*

For manufacturers to reduce cost and increase production capacity, the shift to industry 4.0 tools must happen. ABI Research quantified these operational cost savings of using seven private LTE-enabled technologies, demonstrating the increasing payoffs of investing early in such tools. They performed analysis at a German premium automotive manufacturing facility using industry 4.0 tools (for a 350,000 m2 factory over a five-year period 2021 to 2025). The results showed savings of \$530M in operational costs per factory and a 4.7% increase in production capacity over the course of 5 years.

Such automation and flexibility require high-performance wireless communications between machines, people, and even the walls and floors of the facilities themselves.

Until recently, achieving the required level of connectivity was simply not possible. Think about the number of devices that need to be connected, the amount of data that needs to be transferred, the reliability, latency, and the security requirements - all of these cannot be achieved with previous technologies. That is why many Industry 4.0 announcements also include a reference to a 5G private network launch. In this article, we will discuss what 5G is and some key 5G terms, to familiarize industry CIOs with the 5G discipline.

Premium automotive manufacturing facility saves \$530M in OPEX as a result of using industry 4.0 tools



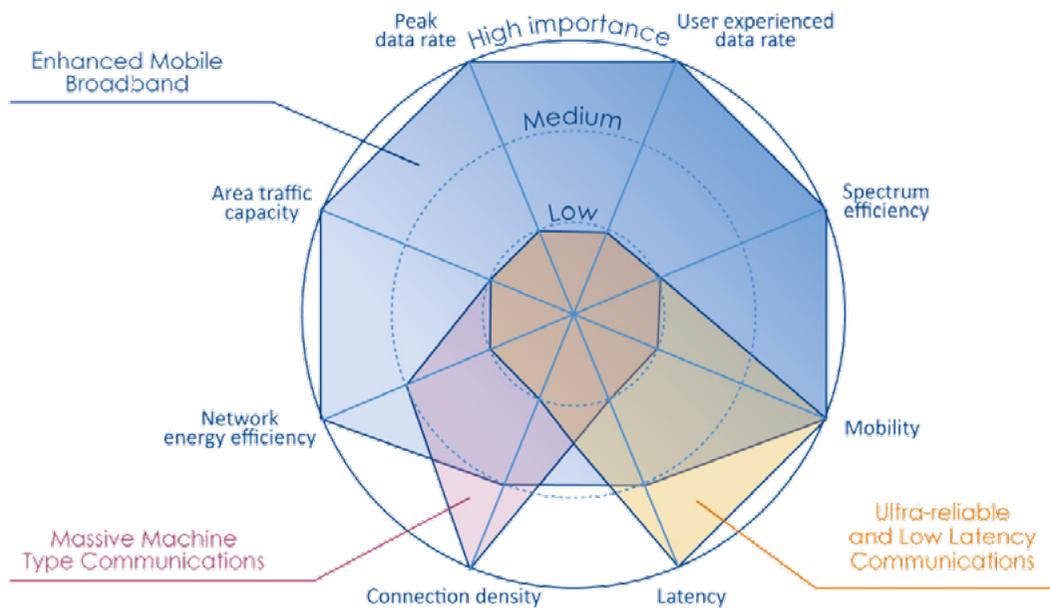
* Source: Enterprise Digital Transformation Through Industry 4.0, ABI Research, 2020



So, What Exactly Is 5G?

5G is the fifth and most recent generation of wireless technology for digital cellular networks. Commercial 5G deployments have started in 2019 and are slowly picking up pace in numerous countries. Often referred to as 5G NR (New Radio), it is the first network standard to specifically acknowledge and address new network uses such as critical communications, private mobile networks, and IoT.

5G is actually a combination of three communications technologies: eMBB (enhanced Mobile BroadBand), URLLC (Ultra Reliable Low Latency Communications), and mMTC (massive Machine Type Communications). Each offers new and unique capabilities and advantages over other wireless connectivity solutions.

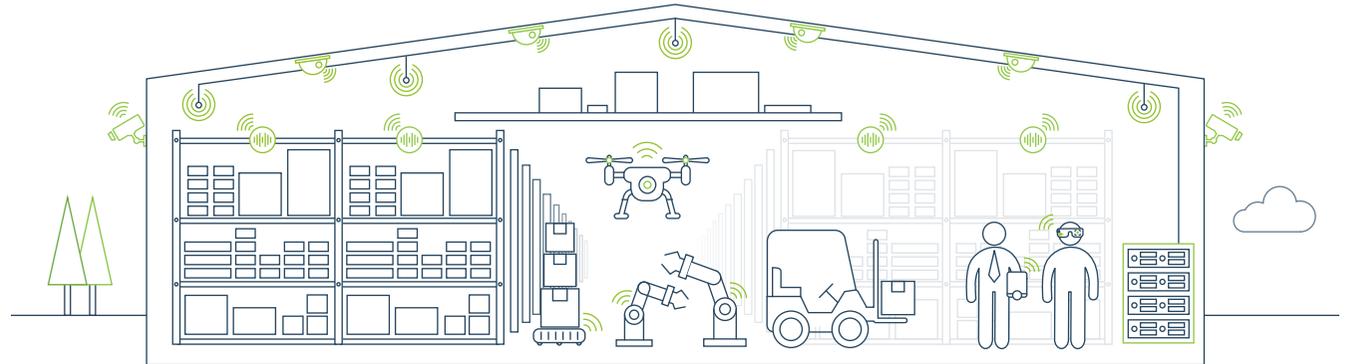


Source:
ETSI

Standards are specified by 3GPP (3rd Generation Partnership Project). This is a collaboration of industry players that started with the definition of 3G (hence the 3). Standards are published on an evolving, continuous basis.

5G Key Benefits For Industry

5G is seen by many in the manufacturing industry as a necessary driver for Industry 4.0 and the automation of manufacturing processes. Currently, connecting machines and devices on the factory floor requires specialized wireless equipment that still fails to provide the reliability and security levels needed for such mission-critical applications.



Here are the key benefits of 5G for industrial enterprises.



Benefit #1:
High reliability

Reliability is defined by the number of packets lost in the transmission or arriving with errors, per a given period of time (In this case a thousandth of one second - ms). With mission-critical applications, or when transmitting a large number of small bits of data (as is the case with sensor data and monitoring applications), even a small amount of data loss can have detrimental effects.



Benefits #2:
Low latency

Latency is the delay in the time it takes data to reach its target destination. Latency can make a significant difference when it comes to applications that need near-real-time connectivity (for example, augmented or virtual reality). The latency one can expect today from 4G networks is around 50ms-70ms (0.05 seconds). With 5G, it is reduced to 2ms-5ms and a theoretical target latency of 1ms, **with advances made in both Radio Access Network (RAN) and Core components.** 5G enables the introduction of TSN - Time Sensitive Networking as well.



Benefits #3:
Higher device density

Industrial IoT comes with a massive increase in the number of connected devices per square meter, making private 5G networks almost mandatory. 5G networks can support 1 million devices for every square kilometer, making them perfect for heavily connected wireless environments.



Benefit # 4:
Speed of implementation

Deployment of 4G/LTE private enterprise networks today is not only tricky because of the shortage in publically available ranges upon which to transmit, but also because deploying it can take months and get quite costly. With 5G, service deployment time can be significantly shortened to a matter of days or hours. And since time is money, that's a lot of money saved



Benefit #6:
Security

The security and integrity of business data traversing within your private network is a top priority.

With 5G, you can deploy and manage your own private cellular networks without depending on third-party providers to properly implement security and QoS policies across private company networks. All data remains within the private network and does not traverse the public network. In addition, 5G technology in itself provides new security measures, namely resilience, communication security, identity management, privacy and security assurance.



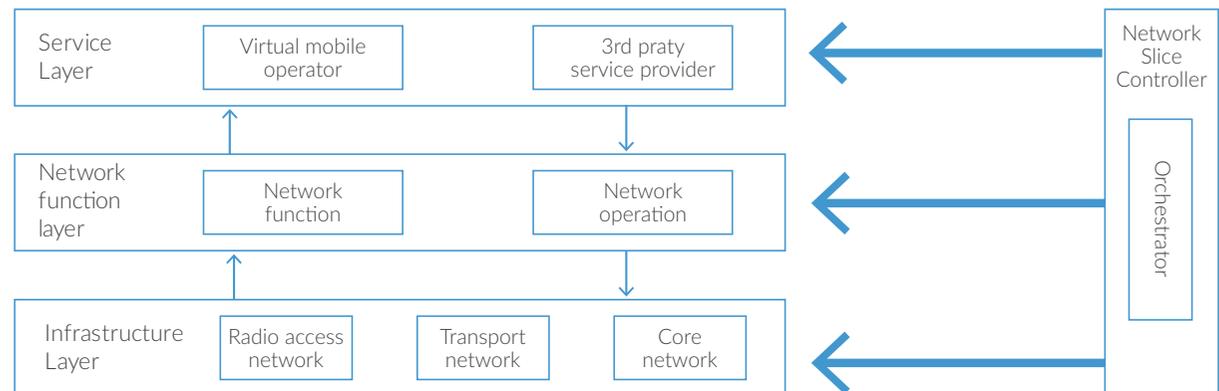
Benefit # 5:
New levels of virtualization

5G also heralds a new era of virtualization. Not only does virtualization offer speed of deployment, it also presents the notion of elastics scalability, where network capacity can be increased or reduced based on actual needs. NFV - with its central orchestration, remote configuration and management - also introduces the ability to easily implement new services and new business models. Another aspect is the use of standard equipment such as COTS servers, Ethernet cables, etc. Deployment becomes an IT task, just as with Wi-Fi.



Benefit #7:
Network slicing

5G network slicing allows network managers to create multiple functionality-specific virtual private networks using the same network infrastructure. Being able to configure each slice as an independent network can ensure SLAs for mission-critical application connectivity and effective utilization of bandwidth resources. For example, traffic coming from autonomous robots on the factory floor can be on a different (and higher priority) network slice than the one serving office workstations.





A Cloud-Native Network

Another important aspect of the technology is that it incorporates recent networking revolutions such as NFV (Network functions Virtualization) and SDN (Software Defined Networks), making its deployment and management more similar to cloud-based IT services.

SDN separates the control plane from the forwarding or data plane. The result is the ability to control and configure your network remotely, for easier and more flexible network management.

A cloud-native network allows flexible resource deployment and scaling, and the use of standard servers - just like in an IT cloud.

NFV is about the cloudification of network applications. It decouples the application software from the hardware and introduces the concepts of orchestration. This allows flexible resource deployment and scaling, and the use of standard servers - just like in an IT cloud.

Welcome New Spectrum

One of the key aspects related to 5G is the fact that an operator is no longer a prerequisite for creating a local cellular network.

There has been a worldwide move to allocate specific radio frequencies for public use with no need for licensing. What this means is that with the proper equipment in place, you can set up your own private network which you fully control, without the need to rely on an external provider or share the network with others.

Recent 3GPP versions are detailing the rules of engagement between the public and private networks.

Consequently, Industry CISOs have several 5G Deployment Scenarios available to them:

5G deployment scenario #1:

Public deployment

Offered by a mobile operator. In this case, both the Control Plane and the Plane reside in the public network, which means all data generated inside the facility or campus will be transferred to the operator's core network on the public cellular network. Deployment flexibility in this scenario is typically limited and dependent on what the operator has to offer. Privacy in this scenario is insufficient unless additional precaution is added. Quality of service, in this case, is not guaranteed, as it relies on the operator's public network which tends to fluctuate based on demand across the network. Furthermore, as most carriers plan to deploy 5G mainly in heavily populated areas, it is clear that industrial locations will not benefit from 5G macro networks anytime soon.





5G deployment scenario #2:

Semi-public deployment

Offered by a mobile operator, where the operator offers the customer a slice of its network dedicated in theory to the customer. In this scenario, the User Plane can reside within the customer's facility, but the Control Plane still resides in the operator's core network and data will have to travel from the facility to the core on the public network. Deployment flexibility is once again limited and depends on the provider. Privacy is also questionable, as the UEs inside the facility can be visible on the public network. Quality of service, in this case, is "best-effort", as there is still a dependency on the public network.

5G deployment scenario #3:

Private deployment

This type of network deployment can be owned and controlled by the customer itself or via a Systems Integrator. In this case, both the Control Plane and User Plane reside on-site and therefore all data transmitted inside the facility stays within the facility, within the private network, and behind the customer's firewall. Deployment flexibility, in this case, is unlimited – the customer can build the network tailored to their specific requirements and needs. Privacy is optimal, as data never leaves the facility. Quality of service is also optimal, as this is a dedicated network used only by the facility and can be designed to meet any level of service as desired by the customer. Deploying such a network leverages the government allocated spectrum

Naturally, the option of private deployment presents a threat to operators' traditional business models. Most large telecommunication equipment vendors are aligning their products to the needs of their traditional customers - operators. However, the processes described above concerning freeing up spectrum and the shift to open architecture and software based networks, have opened the door for numerous smaller vendors and integrators that allow Industrial enterprises to implement their own private networks.

Some Key 5G Terms



3GPP release 15 (16, 17)

3GPP (3rd Generation Partnership Project) is an industry coalition that defines global communication standards. It was consolidated around 3G, hence the 3 in the name. Release and the number refer to a set of standards that have been officially approved at a specific time. Release 15 is the first to address 5G and the most recent official release. Release 16 is scheduled for mid-2020 and includes many Industry 4.0 related requirements. Having said that, most vendors start developing their solutions based on drafts, before the official version is released.

5G NR

NR stands for New Radio. Originally, this referred to the section in the standard that addressed the RAN (Radio Access Layer). The growing demands from wireless networks and goals that 5G set out to achieve meant that a totally new radio interface and radio access network was required. It is such a significant part of 5G, that these days 5G NR is used for 5G in general.

Some of the new radio technologies and concepts introduced in 5G include the use of new spectrum (radio frequencies), Massive MIMO, Beamforming, Millimeter wave, spectrum sharing, Network slicing and more.

Management and Orchestration

The cloud-native nature of 5G (software-based, virtualization, openness, use of standard hardware, separation of planes...) makes 5G very flexible, but also increases the level of complexity, namely the need to manage and configure the network and its resources remotely. This introduced new components of management and orchestration into the network.

Non-standalone 5G (5G NSA)

A 5G network that is built on existing 4G infrastructure. The main 5G parts are related to the RAN. Most vendors first launched non-standalone products anticipating a desire for simpler deployment.

Standalone 5G (5G SA)

A full 5G network. It does not require any 4G infrastructure and includes more of the expected benefits of 5G.

Licensed Spectrum for Industrial Use

Portions of the spectrum that are free to use. Because these parts of the spectrum are free to use, anyone can use them to create a private network. Multiple users of a specific frequency in the same location can create disturbances. The standard defines rules and methods to deal with these.

Key Elements Of An Industrial 5G Private Network

5G Core Software

Software (known in the telco world as NGC / Packet Core) and underlying hardware. This is the underlying data layer that is in charge of moving data packets as quickly as possible from one place to another. In 5G, it was completely re-engineered to be cloud-native.

5G Access Software

Software (known in the telco world as CU & DU) and underlying hardware. This layer is in charge of transferring data from the core network to its destination.

Radios & Radio Software

Containing the antennas and related software that support the spectrum you will be using. Preferably, PoE Radios (Power over Ethernet) to reduce wiring.

Private Network Management Tools

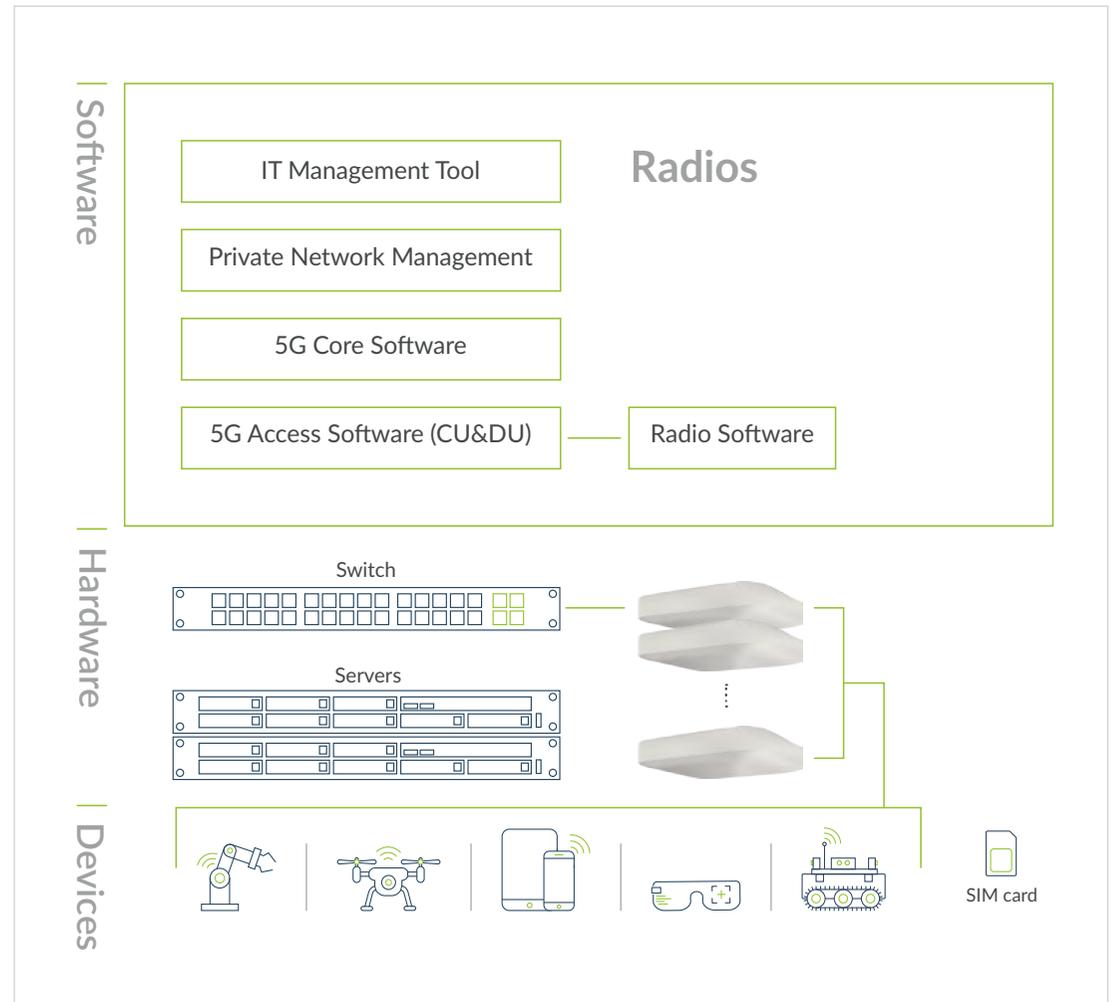
For my IT and for my network (Network Operations Center)

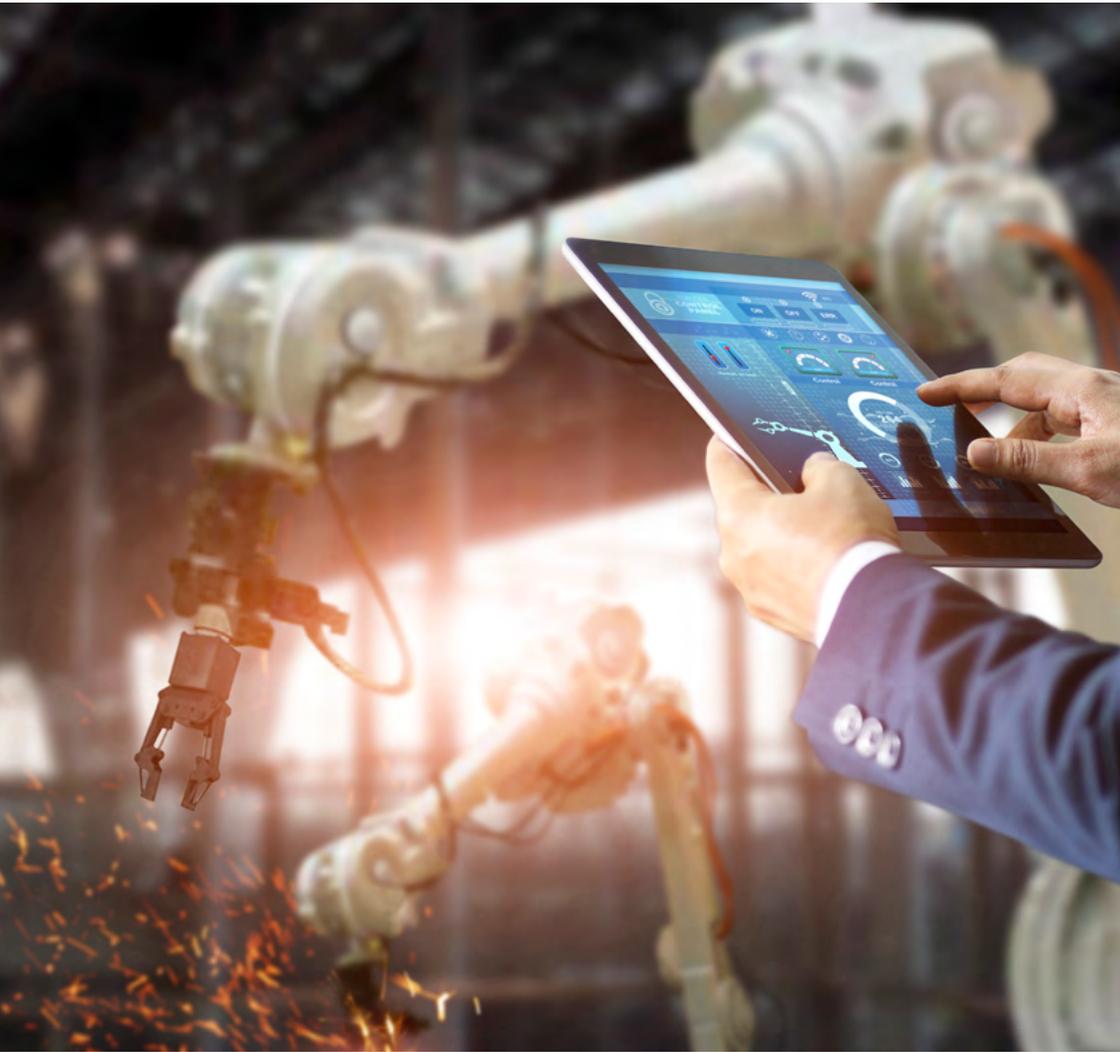
5G-enabled devices

Smartphones, tablets and computers, Cameras, AGVs, connected robots, sensors, drones, etc.

SIM cards and a way to program them

Every mobile connected device requires a SIM card.





Summary:

What Is The Best Way To Implement A Private 5g Network?

5G is expected to be a critical enabler in Industry 4.0 with its device density, low latency, capacity, and reliability.

Operators want to keep you on their network. Incumbent equipment suppliers struggle with adequately serving enterprises and prefer the comfort of traditional deployment business models and product scale.

The fact that 5G is open and cloud-native in nature, bringing it closer to the way other IT tools are deployed and managed, also opens the doors for new vendors and a rich choice of implementation partners and models. The licensed spectrum for industrial use facilitates this option even more.

While we are still in the early days of 5G and industry 4.0, we can see numerous PoCs and initial commercial deployments. Now is a great time to conduct PoCs and evaluate the best implementation model for you.

Identify your specific use cases and needs, find a solution that is cloud-native (i.e. software-based, easily configurable, contains management and orchestration, and more) and an integration partner that understands your needs.



Thinking of deploying your own private 5G network?



Contact us



You are also welcome to follow us on [LinkedIn](#)

About ASOCS

ASOCS is disrupting the industrial network connectivity market with an open and virtualized software solution that delivers 4G and 5G private mobile network solutions in a single software stack. Our on-premise mobile cloud is a truly open solution that allows industrial enterprises to run their networks on their own terms using standard hardware, just as they do with their IT infrastructure. It enables industrial enterprises to easily implement 5G private networks with Time Sensitive Networking (TSN), high network reliability, low latency, and speed, making it ideal for Industry 4.0 applications.