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Making manufacturing wireless and smarter

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January 2019

Making manufacturing wireless and smarter

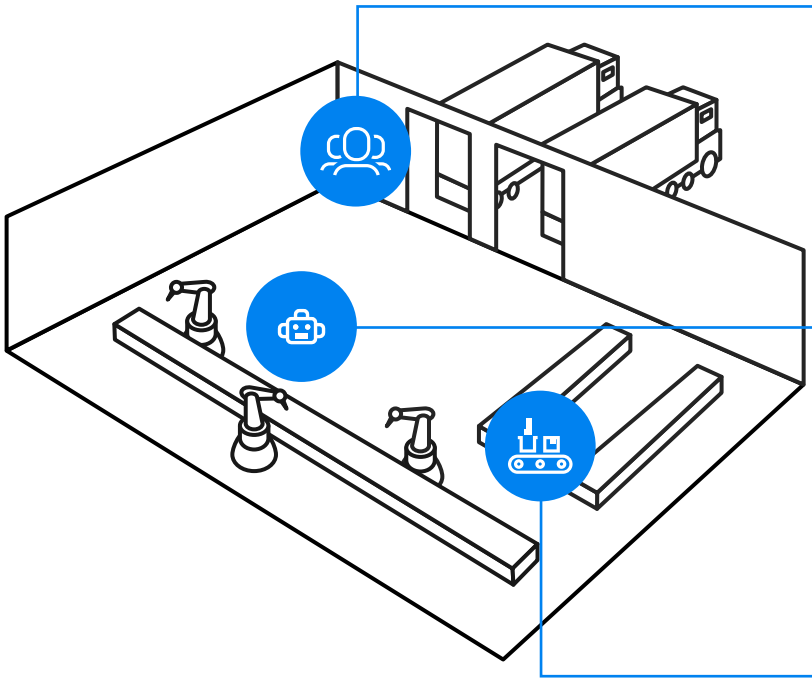
With the new cellular connectivity standards, almost every factory asset can be connected and managed to realize the benefits of smart manufacturing.

The traditional connectivity paradigm is being challenged by flexible production and wireless Industrial IoT (IIoT). Currently, production and most use cases in IIoT on manufacturing sites are based on wired connections. However, as the evolving cellular capabilities are challenging industrial ethernet solutions, wires will in many cases become redundant, introducing opportunities for more flexible production and faster line changes. The new 5G standard will further enable expansion of digital operations, addressing the challenges of manufacturing while exploiting the potential of Industry 4.0.

Realizing Industry 4.0 and unlocking value with cellular connectivity

To be competitive, manufacturers seek efficiencies in production and the ability to deliver a broader mix of customized products. This requires operational processes and production lines to be integrated and adaptable for fast configuration changes and reduced lead times, without compromising on safety or quality. But this is affected by limitations of present legacy network connectivity. Choice of connectivity determines the quality and flexibility of a manufacturer's digital foundation, as well as the possibilities and ultimately the operational value it will bring. It affects which equipment and operations can be connected, how many assets and processes can run simultaneously, and how well it scales beyond one geographical site.

Example of use cases enabled by cellular networks in a digital factory



Location use cases
- Asset management
- Warehouse management
- Workforce safety and utilization

Automation use cases
- Supply chain automation and assembly control
- Overview of entire production line and value chain processes for operational efficiency and quality
- Robot controller as cloud-based application
- Artificial intelligence automated quality testing
- Flexible production with cloud robotics

Monitoring use cases
- Remote plant monitoring
- Traffic management and route optimization (internal logistics, automated guided vehicles)
- Preventive and prescriptive maintenance
- Environmental compliance and regulations
- Workforce efficiency and manufacturing quality

Note: Based on articles published in Ericsson Mobility Report, June and November 2018

Connectivity with reach limited to the factory premises will not be sufficient to meet future operational challenges, as external flows and resource logistics also contribute to total cost and lead times of final products.

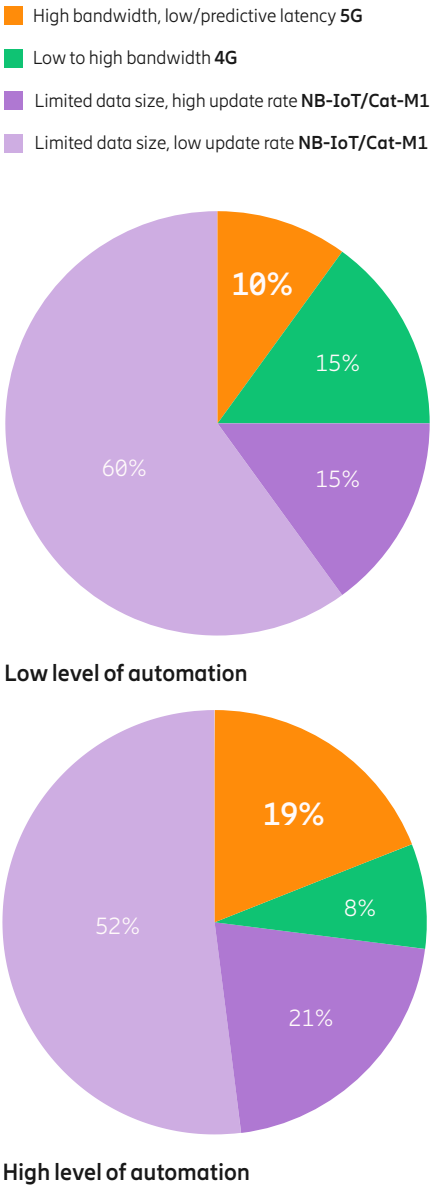
Cellular networks uniquely meet requirements to support different manufacturing use cases, locally and globally. Therefore, it is possible to securely and efficiently optimize all manufacturing variables within one communication system, connecting the factory with its surrounding ecosystem.

The connected factory and cellular use cases

As manufacturers seek to optimize utilization of every variable in production, the current connectivity paradigm is challenged. Today, most factories rely on fixed cabled networks to support critical and real-time applications for stationary machines and often complement with Wi-Fi to support non-critical (massive) applications like sensors and handheld tools. In both cases, scaling and expanding connected operations is difficult, as wires are very costly to install, maintain and retrofit, and Wi-Fi cannot sustain high network performance.

Variables cannot be managed with only a fixed cabled network, as a manufacturing site includes rotating, moving machines and portable items like tools, materials, phones and tablets. By connecting infrastructure, equipment and workers on one platform, cellular technology can be used to maximize data collection and provide actionable insights from different workflow processes. Operational challenges are addressed by three main use case categories (see the figure on the previous page).

Estimated share of different types of connected devices required to support use cases at a typical smart manufacturing site



To realize these, highly diverse assets must be connected on a large scale through a cost-effective and automated onboarding process, plus effective management of the network to secure all use cases. The characteristics of cellular networks make this possible.

Growing device, data and network demands

By 2024, the number of cellular Internet of Things (IoT) connections is forecast to reach 4.1 billion worldwide. Digitization of factory assets, equipment, vehicles and processes means the number of connected devices will increase exponentially. The estimated number of connected devices needed in a typical smart factory is 0.5 per square meter.[1] This calculation is based on potential use cases and assets benefitting from a connection.

The figure to the left illustrates distribution of cellular connectivity requirements (supporting the previously mentioned use cases) in a fully deployed smart factory. The share of each type of connected device[2] depends on whether the site has low- or high-level automation.[3] Evolving to higher automation will lead to a greater share of 5G connected devices. Both high bandwidth and consistently low latency are necessary to support large data volumes and real-time critical data, as well as consistent and secure communication.

[1] Average number based on data from different manufacturing sites. In dense areas, the connection density could be up to one connected device per square meter

[2] The exact distribution figures for a specific manufacturing site depends on the communication needs

[3] The level of automation is a continuum from manual to fully automatic operations (Parasuraman et al., 2000)

Bridging the gap between factory challenges and cellular capabilities

Eventually the installed fixed network technologies will be incapable of managing effectively the use case requirements in advanced manufacturing. Identifying and mitigating factory pain points with cellular network capabilities will more than offset the switching costs, proving the new networks' practical and business value.

Manufacturers will gradually adopt supportive applications to increase efficiency and quality in their activities, from augmented reality (AR) to digital twins. As an example, in Ericsson's factory in Estonia, inspection of assets and products with contextual information (AR) has resulted in consistently improved product quality with reduced lead time and cost.

Cellular networks have superior capabilities in, for example, mobility, security, availability and reliability. However, there is currently a disconnect between three perspectives among manufacturers: understanding cellular capabilities; the different digital solutions they enable; and how these solutions address manufacturers' pain points. The figure above starts with the manufacturing perspective, illustrating typical factory pain points. It then gives examples of digital solutions, use case categories and enabling cellular capabilities.[4]

Processes benefit from cellular capabilities, supporting Industry 4.0

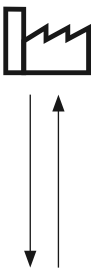
With expected growth in demand for digital twins, and automated, customized, remote and even mobile production, the need for supporting cellular network capabilities will increase. Examples include:

- processes requiring mobility, such as shop floors with automated vehicles and assembly warehouses, which need secure and precise management as well as tracking of traffic, data flows and assets
- low-volume and high-variance manufacturing cases, where wireless machine line configuration is simple and flexible compared to cabled machine lines
- processes that cannot be monitored and controlled via cables but require wireless, real-time critical data transmission and a stable, deterministic network performance (bandwidth and latency) to operate
- processes susceptible to human error, or advanced manufacturing that requires tacit knowledge and skills transfer, with widespread digital tools to mitigate for errors and encourage faster learning
- processes where coordination of factories, resources and components is time-sensitive or crucial (e.g. product quality and timely delivery)

Manufacturing companies that exploit the full value of cellular networks' capabilities beyond a single manufacturing site can also explore increased internal and external collaboration and create tighter ecosystems with partners, stakeholders and customers for optimized manufacturing, and increasingly customized products.

The future connected manufacturing industry

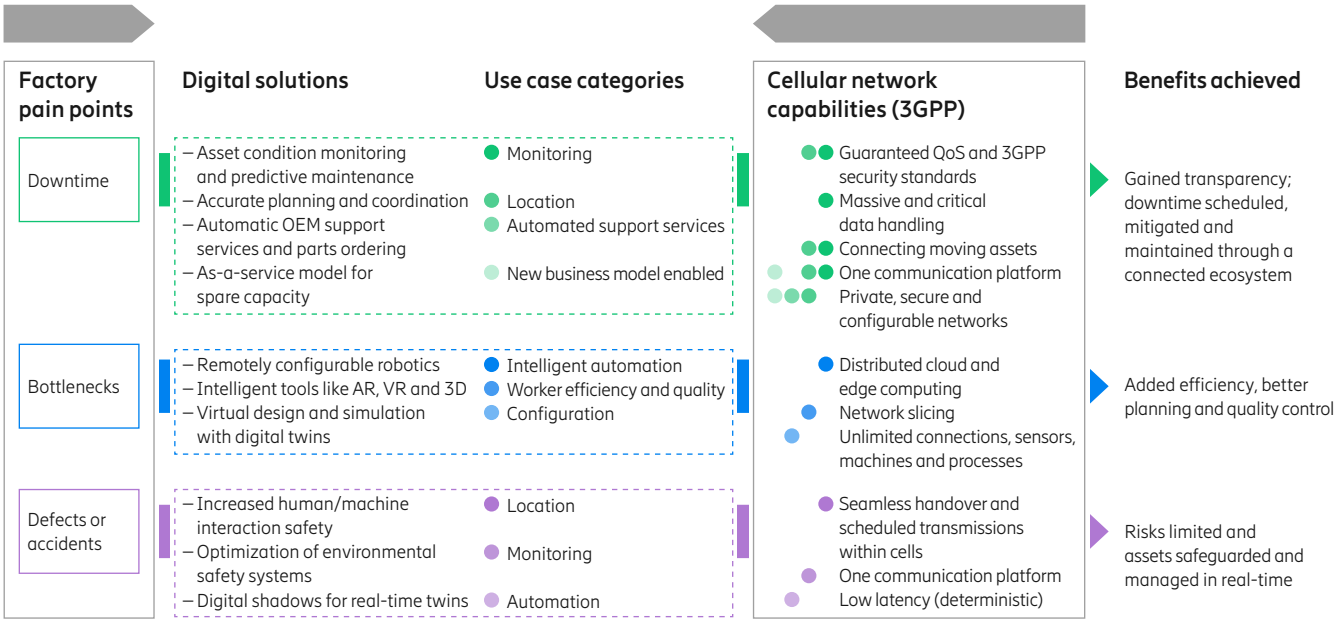
Connected flows
The factory is integrated with wider networks, other factories and logistics.
- Logistics securely tracked throughout manufacturing process
- Awareness of precise location of vehicles



Connected site
The factory floor is a highly specialized environment with diverse needs.
- Extreme reliability and low latency
- Secure, high reliability, high availability network

Globally connected company and products
The factory-shipped, installed and delivered goods are globally connected and serviced.
- New forms of customer engagement
- New services and partner ecosystems enabled

Bridging the gap: linking factory pain points to cellular capabilities



[4] A complete mapping of the solutions needed to address the pain points is substantial and complex. Accordingly, the mentioned actions and enablers are just some highlighted examples

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