WHITEPAPER

The cellular connected enterprise – from products to production

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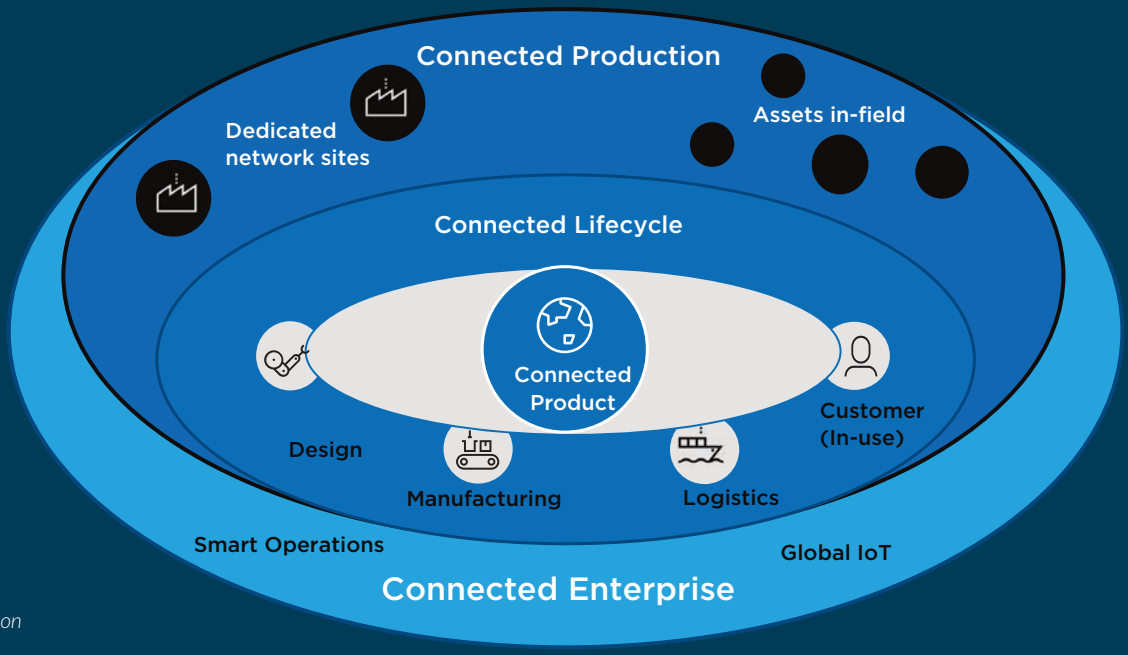
Introduction

The future industrial enterprise is digitally connected and globally dispersed. To leverage supply chains and multiple factories across the globe, the enterprise must collect and seek more data than ever before, using connected products, machines, and emerging digital technologies.

This paper addresses the need to support smart, connected things, assets and applications in the different dimensions an enterprise operates in. As agility is fast becoming a competitive benchmark, the capability of connecting entire processes with ease and accessing or servicing products wirelessly and remotely follows as a high stakes priority. Although there are multiple connectivity standards available and one might be fitting in one domain, it may be lacking in another – especially when it comes to future-proofing operations that must be interlinked to be improved *(see figure 1, below)*.

Figure 1: Global Digital Threads & Domains of the Connected Enterprise



Source: Ericsson

The cellular standard has the ability to cover multiple enterprise domains, be it through private or public networks, effectively bridging local and global needs. This brings a new foundation to enable digital threads across the enterprise, whether it be on manufacturing sites or in the field at customer premises (see figure 2, below).

Figure 2: Evolving industrial and enterprise trends drive need for cellular connectivity

Enterprise connectivity challenges	Industry trends
– Multiple separate networks for communication	– Innovations shifts from core applications to the edge
– High cost of ownership and complex integration	– Proliferation of IoT
– Performance limitations: Reliability, coverage, interference, mobility and speed	– Servitisation of products
– Cross-geography compatibility	– Industry 4.0 transformation

The Challenge in Production for Enterprise

Today, fixed networks dominate factories and restrict the efficiency of manufacturing. Production lines remain wired and inflexible, not delivering on high mix production or quick changes in production lines. Materials, assets and workflows are either unconnected and unmeasured, or still unreliable or unsecure due to the limitations of alternative wireless solutions. Currently, 80% of Industrial IoT is wired and costly retrofitted on equipment, creating data and platform silos.

Beyond hard-wired connections, it is expected that Wi-Fi and cellular will coexist for a while, but Wi-Fi technology often falls short in reliability, security, and device density, meaning it doesn't meet the increasing connectivity needs of advanced industrial applications such as asset tracking or autonomous guided vehicles. Manufacturing campuses often require indoor as well as outdoor connectivity given workflows between lots and warehouses.

Furthermore, the enterprise might depend on a seamless coordination of an entire network of factories and suppliers not limited to one dedicated site for smart manufacturing. With production at multiple sites, copying best production practices, securing transfer of expert knowledge and real-time assistance across plants would improve quality and efficiency.

The process of integrating the networks of one or more manufacturing sites can be triggered by a need to replace legacy networks or increasing mobility requirements. Many sites currently run multiple connectivity platforms (LMR, cables, Wi-Fi et cetera) for specific functions. This has been a challenge for enterprise digitalization efforts, which essentially need to pull together and structure diverse data sets. A unified platform is required which integrates voice, data, video and IoT.

The Challenge of Global Services for Enterprise

As much as production on site must be securely connected, improved and automated, the benefits are limited by the scope. An industrial plant does not operate in isolation, depending on incoming and outgoing flows of goods and services. Timely tracking and shipping of assets and components would lead to better planning, reduced warehousing and increased manufacturing efficiency. In addition, having connected products would benefit manufacturers with insights, and offer simpler serviceability to OEMs and users of their installed products in the field.

However, the road to Global IoT services is marred by lack of interoperability, from local integration to deployment and data exploitation. Yet, offering services where end-customers are assisted and serviced remotely, even before errors occur, would position enterprises perfectly to gain competitive advantage in Industry 4.0. Attention is now broadening from lighthouse cases to mainstream operations, and the next step is focusing on standardized connectivity across company sites and their installed product base, in addition to improved visibility across end-to-end supply chains and lifecycles.

The value of a common digital thread

A digital thread refers to the communication framework that allows a connected data flow and integrated view of the asset's data across traditionally siloed functional perspectives. According to PTC, a global solution provider, data silos is a challenge internally for enterprises, regardless of worldwide operations and marketplaces. The concept of the digital thread raises the bar for delivering information in the right context at the right time to the right stakeholders.

New cellular standards mean almost every asset in a factory can be connected and managed to solve operational challenges, and once products leave the factory, they can be connected and managed to solve service challenges in the field.

Gaining real-time visibility into factories, products, processes and people across the enterprise is one of the most effective ways to achieve a more agile organization. However, critical enterprise data is often siloed, living in multiple operational domains with no common thread. In 2019, the global Digital Thread market size was $222.7 million and it is expected to reach $3.48 billion by the end of 2026, with a CAGR of 47.6% between 2021 and 2026.

The cellular standard can grow this and other smart manufacturing segments remarkably by serving local and private sites in addition to enabling global services. Naturally, adhering to real-time industrial requirements with new 5G releases will also expand the definition of digital threads, delivering instantaneous updates where needed. A common digital thread will help create a full lifecycle loop from product design and engineering, to manufacturing, service and back again.

From an industrial age with little communication between engineering and service, cellular can enable better integrated value chains, improve product and customer journeys, and help deliver the fully digital enterprise regardless of location and global dispersal. The merger of physical and digital worlds can only truly materialize by connecting and managing billions of devices and applications easily, seamlessly and globally.

The value of cellular across the enterprise

Industry 4.0 cannot depend on wired connections to enable next-generation solutions, nor can the fragmented connectivity landscape provide simple end-to-end visibility and insights. Cellular connectivity introduces several new features to industrial manufacturing, including mobility, reliability, deterministic networking and standardized technology, coupled with low module and device costs due to global economies of scale. This means it can connect, protect, and orchestrate assets and data on one secure connectivity platform, unlocking the full value of Industrial IoT to deliver:.

1. Connected product and lifecycle, covering manufacture, tracking and shipping, along with monitoring in the field using global IoT connectivity.

2. Connected operations on dedicated sites, inside a factory or plant with private, local networks.

The case for dedicated private networks and smart operations on site

Enterprises are seeking to increase operational efficiencies by improving workforce productivity, performance management or asset optimization. They can also require future-proof wireless connectivity for applications involving asset tracking, predictive maintenance, digital twins, human-robot workflow integration and more.

For example, in millions of factories with more than 100 employees, typical business cases revolve around controlling the production process; improving material management and safety, and introducing new tools. Various industry case studies point to typical revenue increases of 2% to 3% from boosting throughput and quality, cost savings through improved capital efficiency (5% to 10%) and decreased manufacturing costs (4% to 8%). Additionally, ABI Research data shows manufacturers can expect to see a tenfold increase in their returns on investment (RoI) for cellular Industry 4.0 solutions, while warehouse owners can expect a staggering fourteen-fold increase.

Dedicated private cellular networks are better positioned to provide reliable coverage, predictable connectivity, and mobility for enterprise Industrial IoT use cases. They can deliver the capacity to support both high- and low-data requirements, for example 300Mb/s for downlink and 150Mb/s up. LTE also enables predictable latency in the range of 30 milliseconds (ms), even when there are multiple devices on the network.

Wireless connectivity is increasingly becoming a necessity for business-critical services in industrial processes, such as those related to assembly lines and other modes of production. For manufacturers producing high-quantity and high-value products — for example, vehicles — high network availability and reliability are crucial. Considering vehicle manufacturers complete a new $20,000 to $80,000 product roughly every 60 seconds, even a few minutes of assembly line downtime could potentially mean severe revenue losses. For many industries, service-level agreements (SLAs) will satisfy and regulate such needs for guaranteed network uptime and quality.

As industries become more digitalized, their dependence on connectivity increases and poses uncompromising requirements on availability and reliability. Unsurprisingly, there are different needs regarding the type of connectivity required. In the industrial manufacturing domain, connectivity and networking requirements are specific and diverse, therefore networks that can encompass all these cost-effectively and securely are a quantum leap in simplification. An electronic component factory, for example, might realistically need to power thousands of simple sensors in an energy-efficient way while also requiring low-latency, cloud-based steering of robotic arms. Furthermore, a machine vision application for predictive maintenance will require a high-bandwidth, low-latency connection to carry out its analysis in near-real time (see Table 1, on the next page)

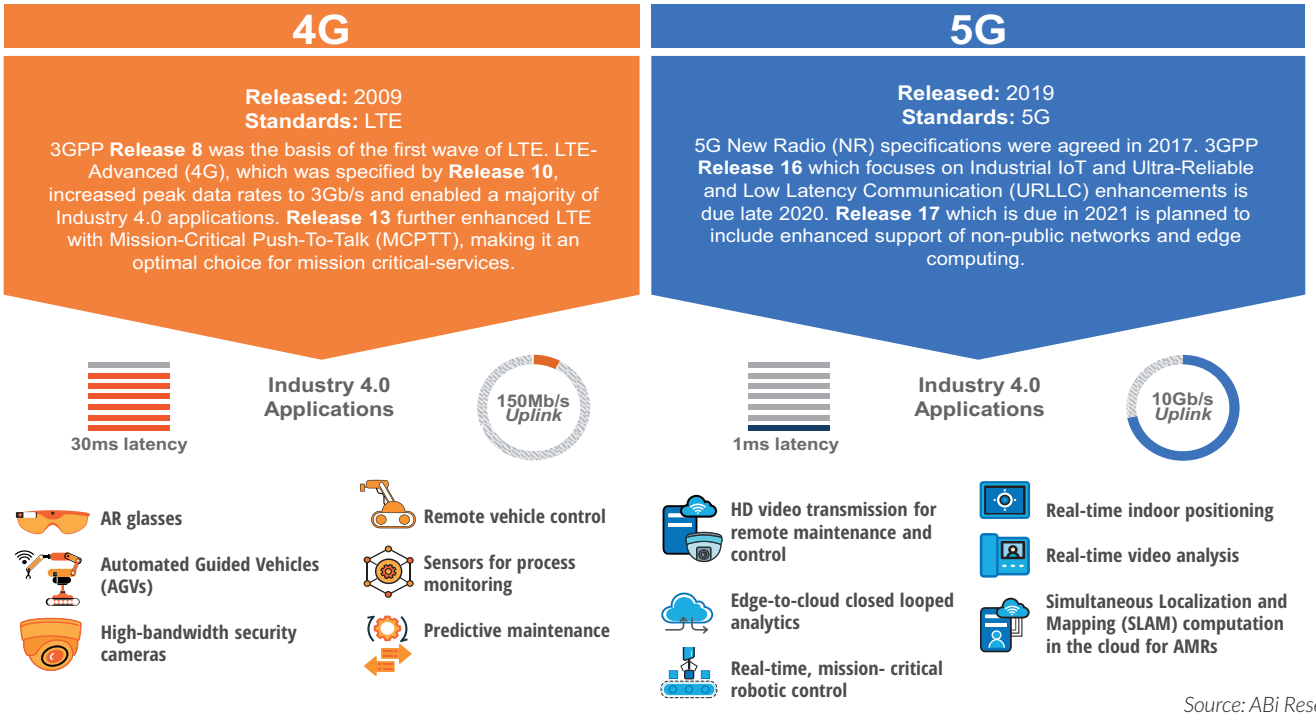
Table 1: Industry 4.0 Connectivity Network Requirement

Use Case	Latency	Bandwidth	Reliability	No. of Devices
AR (8K next-gen 360° video, mixed reality, multi-sensory remote tactile control)	<10 ms (MTP), 0.5 ms for remote tactile control	>50 Mbps-Gbps	99.9999% (for remote tactile control)	–
Collaborative robots (cobots)	1 ms	40 to 250 Bytes/s (bps)	99.9999%	100
Handheld terminal	<10 ms	Varies	99.9%	–
Indoor positioning	0.33 Second (s) refresh rate for real time	–	–	10,000 connections/km^2
Mobile control planes with safety functions	4 to 12 ms	40 to 250 bps	99.9999%	2 to 4
Motion control	<0.5 to 2 ms	20 to 50 bps	99.9999%	50 to 100 or more
Video-operated remote-control robots with haptic feedback	<20 ms	15 to 150 kbps	99.999%	100

Source: ABi Research

As factories are becoming more connected and Industry 4.0 solutions grow more sophisticated and mature, this includes utilization of cloud, running applications closer to the edge and the ability to sync local assets within and across plant networks. 5G is developing as a key enabler of these capabilities (see figure 3, below).

Figure 3: Private LTE as a Road to 5G



Source: ABi Research

The manufacturing industry presents a significant addressable market for 5G service providers which is tipped to reach $132 billion in 2030. Manufacturers viewing 5G as a new platform for their operational technology (OT) often state the need for dedicated resources to guarantee connectivity for critical manufacturing processes. There are various ways to implement this, but early adopters have concluded that they require dedicated, private networks.

Financial objectives and goals for Industry 4.0

Manufacturing initiatives may have changed with Industry 4.0, but financial objectives remains the same:

Maximize revenue growth	Reduce operating costs	Increase asset efficiency
– Increase service levels	– Labor	– Improve asset utilization
– Improve throughput	– Materials	– Reduce capital expenditures
– Drive speed and agility on the factory floor	– Overheads and supply chain	– Decrease inventory
– Build flexible workforce for the "future of work"	– Lower safety and compliance risk	– Reduce changeover times

Improving operational efficiencies and future proofing wireless connectivity with cellular means:

1) Better business insights from an improved flow of information from fully connected systems

2) Increased speed of production and time to value

3) Effective cost savings due to reduced fixed infrastructure and improved operational efficiencies

4) Agility and ability to adapt to new processes and equipment.

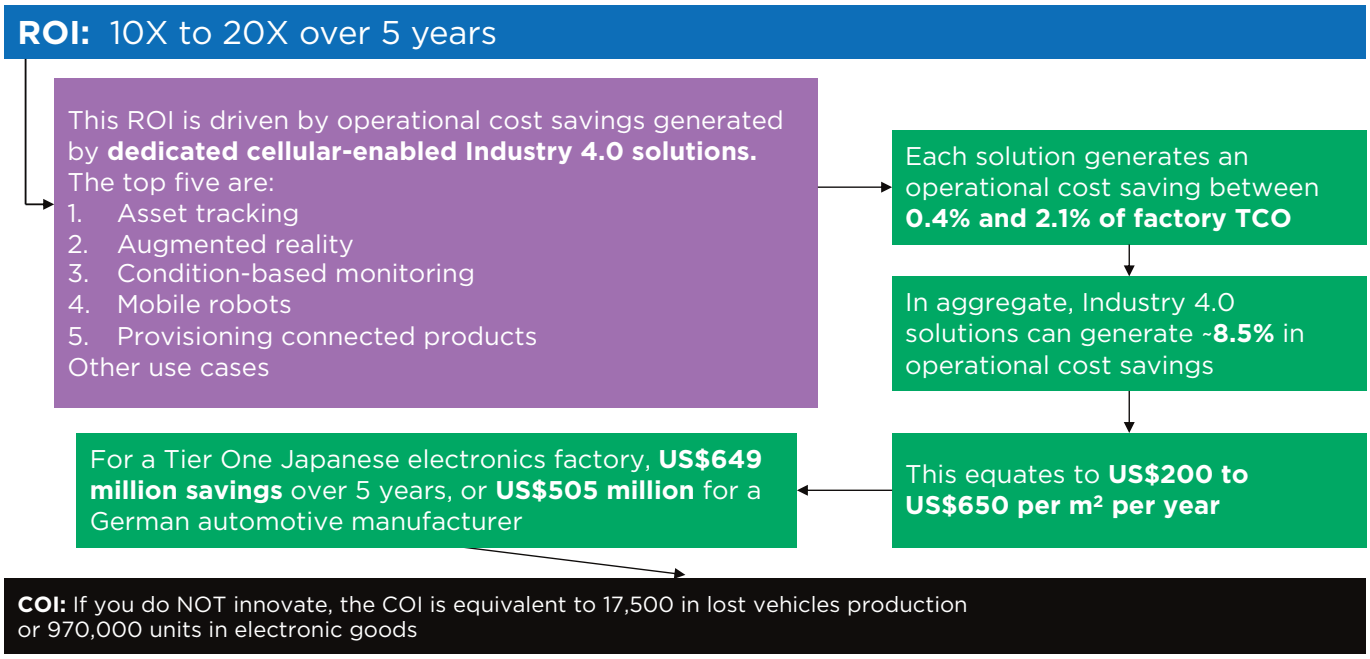
The cost savings of cellular technology and enablement

Cellular networks can mitigate bottlenecks, improve flexibility and streamline production. They enable mobility, reliability, security and a high device density, which refers to the number of connected devices per square metre (sq.m). 4G, with a clear path to 5G, can yield significant operational cost savings for an upgraded smart factory, with RoI of 10-times to 20-times over five years.

In aggregate, these solutions can generate operations cost savings of 8.5%, which equates to $200 to $600 per sq.m/year for a factory or industrial site. RoI and cost of investment (CoI) depend on the use cases and type of manufacturing: in the case of a tier 1 electronics factory, the CoI is $650 million over five years, while a tier-1 automotive manufacturer could save $500 million.

Together with ABI research, Ericsson analyzed and compared financial and operational results from an original factory to one upgraded to support dedicated cellular Industry 4.0 equipment, with results shown below (Figure 4).

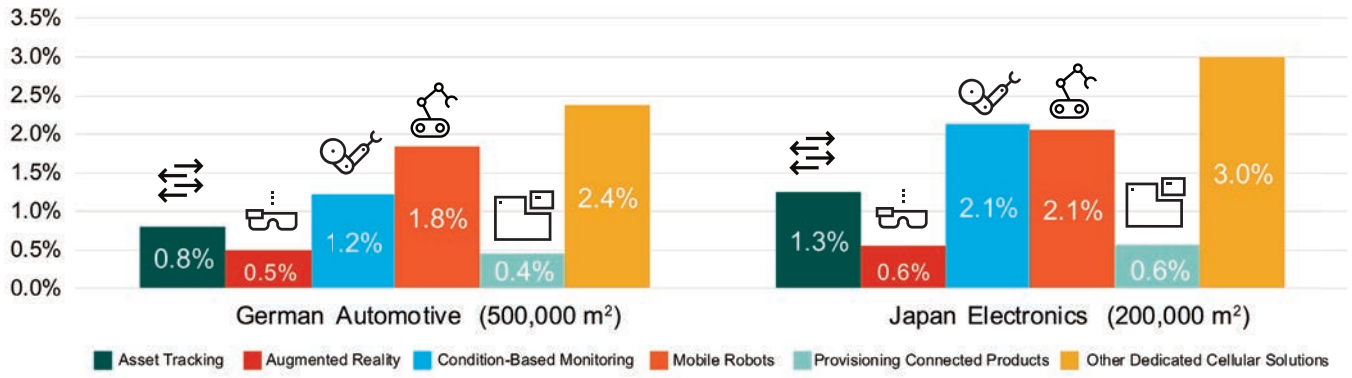
Figure 4: The business case for dedicated networks in smart manufacturing



Optimizing Industry 4.0 with cellular connectivity

As illustrated with these Industry 4.0 use cases, dedicated cellular networks are better positioned than wired to provide reliable coverage, predictable connectivity, and mobility for enterprise Industrial IoT. The coming decade will see 4.7 billion wireless modules deployed across smart manufacturing factory floors to enable $1 trillion dollars in production value by 2030. Dedicated, private cellular networks have the potential to boost gross margin by 5% to 13% for factory and warehouse operations that fully embrace Industry 4.0 (see figure 5, below).

Figure 5: Operational Cost Savings ratio by dedicated cellular Industry 4.0 solution, average over 5 years, forecast: 2021 to 2025. 2 perspectives: German automotive and Japanese electronic factory



Market trends and references:

Among manufacturers, there is an increasing trend to transition to 5G-ready dedicated networks to enable intelligent manufacturing.

For example, ABB Power Grids in Ludvika, Sweden, recently connected cordless screwdrivers in at its manufacturing sites while Scania, Europe's largest manufacturer of trucks and buses, has piloted projects at its Smart Factory Lab to explore how 5G technology can be introduced into its production processes.

Another example includes Atlas Copco Airpower, a leading manufacturer of compressors, vacuum solutions, generators, pumps, power tools, and assembly systems, which is collaborating with Ericsson and Orange Belgium to deliver intelligent manufacturing processes employing 4G and 5G.

Key benefits - Summary of dedicated networks for smart connected operations:

1. Speed of development and time to value with new technologies
2. Cost savings due to reduced fixed infrastructure, consolidating fragmented connectivity platforms
3. Improved operational efficiencies, cost-savings, and higher performance and quality
4. Decreased risk due to dedicated network and on premise solutions
5. Reducing silos of information across disconnected systems and workflows in factory networks

The case for connected products and smart lifecycle with global IoT

The connectivity available at a given manufacturing site is often not enough to cover the complete set of requirements for industries. To enable cost-efficient upgrades in the aftermarket and improve customer experience, manufacturers want the ability to upgrade and track products in the field — an ability for which local, dedicated connectivity is often insufficient.

The fact is that manufactured products ultimately also manufacture or contribute to the making of other products. Therefore, covering the digital thread from cradle to grave becomes increasingly important. In effect, this means the value chains are changing, with manufacturers, OEMs and end-customers becoming more intertwined as product and service strategies align to deliver the best end-results. Gartner predicts 50% of OEMs will use IoT to obtain customer data on product usage by 2021, to boost their own product strategies and, by 2022, 75% will uses IoT to sell new services or consumables. Enterprises have an increasing need to connect assets and improve ability to scale through service optimization, product and services innovation, and remote monitoring.

In many cases they will require global managed connectivity for distributed assets involving multiple geographies. When it comes to a product and its lifecycle, it may be manufactured in one location, land in another and then move again. Gathering secure insight from it – regardless of where it was manufactured, bought or sold - means operational efficiency can be improved, product capabilities can be added, and new business opportunities can be identified.

Solving enterprise goals with IoT

Industry 4.0 initiatives may have evolved drastically, but business goals for service leaders remain the same:

- Drive revenue
- Reduce costs
- Improve efficiency
- Improve customer satisfaction

However, unlocking the value of IoT in service of these goals has been hard, given multiple deployment challenges:

1. Slow time to market and lengthy POC periods, cumbersome processes, multiple integrations
2. Multiple, local integrations when connectivity and device management are handled in silos
3. Limited visibility into the IoT device during its global lifecycle
4. Ensuring and delivering high quality end customer experience
5. Global solutions hindered by high roaming costs and deployment obstacles

The cellular standard is the foundation to overcome these challenges because of the **global coverage and scalability,** meaning a single infrastructure can be used for all industries, geographies and uses cases.

Simplified integration unlocks IoT value across Enterprise

To accelerate adoption of global cellular IoT, Ericsson works to simplify deployment for faster time to insight and global IoT management. This includes automation triggers, API and mass management, and zero-touch SIM ordering and factory testing.

Working with multiple telecom operators globally, it limits the enterprise exposure to only one

- Interface and integration
- Sim logistics process
- Support and operations
- Network and service

A one-time unified integration enables an enterprise to cover its entire global footprint with a single access point for connectivity management. Through established networks of operators and service providers, enterprises receive simplified global connectivity management by exploiting eSIM capabilities for seamless device deployment, effectively reducing connectivity and roaming costs.

Key benefits of global IoT Connectivity for smart products:

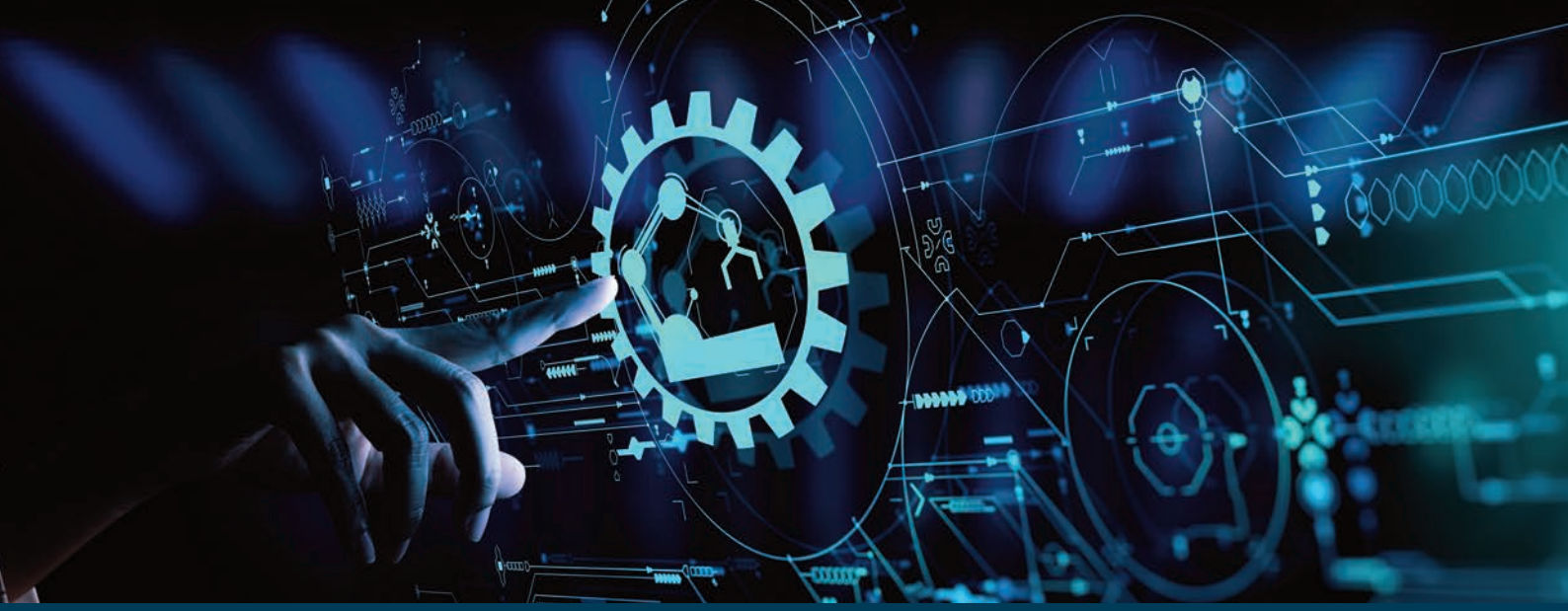
1. Faster time to market, build and scaling global cellular IoT efforts faster
2. Reduced integration costs
3. Future proof products
4. Improved cost savings by tracking and controlling assets remotely
5. Simplified, more integrated supply chain
6. Increased security

IoT in action

Denmark-based pump specialist Grundfos is a good example of how these various elements are employed in the real world.

It is employing analytic capabilities to evolve its business beyond purely sales and into providing maintenance as-a-service, gathering information from IoT sensors covering pressure, temperature and velocity to predict when replacement or repairs are needed.

Working with Telenor Connexion and Ericsson, the company is reducing the number of unplanned outages through more effective maintenance, and offering the potential to significantly reduce power consumption at a global level.



The case for a common digital thread: connecting products and production

Enabling a global digital thread across the enterprise means redefining and optimizing several domains simultaneously. Smart, connected products will substantially affect structure in many industries, but the effects will be greatest in manufacturing:

1. **Manufacturing efficiency**
   Enabling mass customization, globalization and product innovations

2. **Product & service innovation**
   Differentiating through new revenue, services, products and business models

3. **Engineering Excellence**
   Digital thread leveraged and enhanced throughout value chain and lifecycle

4. **Service Optimization**
   Insights from products and customer usage fed back to increase visibility

5. **Sales and Marketing Experience**
   Understanding real world usage and experiences redefines customer relationships

Cellular threads

To address these areas and stay competitive, OEM players like motor and drives specialist ABB Motion are looking at the entire value chain in the context of cellular, from connected products to connected production at customers' sites globally.

Juha Mirsch, cellular lead at ABB Drives and Motors, explains gaining a lifecycle ability on natively connected devices will not only grow smart services, but make workplaces safer and more energy efficient through remote monitoring. Offering higher predictability, unplanned downtime can be reduced by up to 70%.

"Naturally, this means ABB must be compliant, requiring flexibility between public, global IoT and dedicated private networks."

"For example, ABB Drives and Motor must be connected during manufacturing and testing at ABB's premises requiring a private network, then during logistics over a public network and, ultimately, installed and connected at customer premises, either in-field with Global IoT, or in a factory running on a private network."

"This is why OTA provisioning of SIM and localization capabilities are so important."

The holistic case for cellular - weaving global digital threads

Digital threads run through organizations and interact with large ecosystems, locally and globally. To realize the vision of a connected enterprise, choosing the right connectivity foundation to scale, in addition to deliver on different scopes and target dimensions, will be paramount. The dual ability of cellular, covering global and local needs, means enterprises and surrounding value chains can plan for digital transformation journeys more holistically and sustainably. The new 5G standard also pushes the envelope, making wireless a secure choice even in industrial contexts, opening up use cases such as remote control, be it from one side of a production facility to another, or indeed from another country.

Connecting production and products may happen at different rates and sophistication levels, with highly diverse manufacturing segments and more mature enterprise clusters. That said, ultimately, the standard makes it possible to interweave elements and dimensions to optimize processes further and strengthen the competitive position of the enterprise.

Consolidating connectivity platforms and investing in cellular means the value capture can be greater by combining global connectivity with a dedicated private network. Through software partners, enterprises can glean an array of insights, regardless of whether the data is on or off the manufacturing floor. For instance, by applying VR or AR, defects can be found before products leave the factory or end up in other products. That, alone, can eliminate waste, save money and protect reputations.

As the complexity of networking grows, there is a trend to outsource more communications infrastructure. From owning and operating their own networks, enterprises with critical communication needs are now procuring private networks and services which use service providers' existing network assets and operations without compromising required local control.

Similarly, enterprises need partners to connect and manage increasingly complex product portfolios, meeting demands from a globally diverse, challenging and evolving customer base.

Simplifying their IoT journey with one integrated approach, offering seamlessness regardless of field location, enterprises can employ entire networks of communication service providers to connect their operations worldwide and revamp their installed base, changing relationships with their end-customer.

In summary, cellular standards can deliver on all the different dimensions of the connected enterprise, so industries can reap the benefits of weaving and exploiting digital threads.

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