ERICSSON

Unlocking the smart factory:

Why 5G private networks are essential for autonomous things

IndustryWeek

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Introduction

The march towards smarter factories is undeniable, driven by the relentless pursuit of efficiency, quality, and agility in a competitive global market. But navigating the path can be overwhelming, leaving manufacturers unsure of where to begin, what technologies to invest in, and how to scale. Achieving success requires investing in three key areas: autonomous things, Industrial IoT (IIoT), and advanced analytics.

However, a crucial fourth element is often overlooked: advanced connectivity, and the network infrastructure to support it. Traditional wired and wireless networks simply won't support the ever-growing demands of sensors, mobile devices, data transfer, and real-time communication demanded by a truly smart factory.

This paper focuses on autonomous things, such as robots, drones, and other intelligent machines, highlighting their crucial significance in forging a smarter manufacturing future. It underscores the vital relationship between these technologies and the use of private 5G cellular networks required for their use. We'll explore:

- Harnessing the power of autonomous things: Learn about the benefits, categories, and use cases of autonomous things specifically for manufacturing.
- Unleash the potential of 5G: Understand why 5G private networks are the key to seamless data transfer, enhanced security, and future-proof scalability.
- Optimize deployment: Gain practical tips for successfully implementing autonomous systems in your operations.

For those aiming to increase efficiency, productivity, quality, or profitability, the time to act is now. This paper is crafted to provide the insights and confidence necessary to guide and expedite the smart factory journey. Remaining at the forefront of smart manufacturing and partnering with manufacturers worldwide, Ericsson continues to implement and capitalize on the advantages of private 5G networks. It is our hope that our experience will facilitate the unlocking of the power of autonomous things and network technology to realize a smarter, more efficient manufacturing future.

Harnessing the power of autonomous things

The rise of autonomous things (AuT) is a defining trend in the manufacturing industry. These intelligent machines — encompassing mobile robots (AMRs), drones, and other advanced systems — are revolutionizing production by automating tasks and augmenting human capabilities. Unlike traditional industrial robots that are confined to a specific location and function, autonomous things are equipped with sensors, artificial intelligence (AI), and machine learning (ML) algorithms, allowing them to navigate their environment, perceive obstacles, and make real-time decisions. This on-board intelligence is a critical piece of the puzzle, but it's only half the equation.

Autonomous things also require reliable connectivity to a central network or cloud platform. This connectivity serves several important purposes:

- Real-time data exchange: AuT can continuously transmit sensor data (e.g., location, temperature, object recognition) to a central system. This real-time data exchange allows for continuous learning, improved decision-making, and remote monitoring of AuT performance.
- Advanced analytics and optimization: The data collected from AuT can be analyzed by powerful AI and machine learning tools in the cloud. These insights can be used to further optimize AuT behavior, refine workflows, and improve overall manufacturing efficiency.
- Remote control and supervision: In some cases, human oversight or intervention might still be necessary. Reliable connectivity allows for remote control and supervision of AuT, ensuring their safe and effective operation.

Ultimately, the combination of on-board intelligence and robust connectivity empowers autonomous things to transform their environment, becoming versatile tools for optimizing manufacturing processes.

Automation versus Autonomous Things

Automation: Focuses on automating repetitive tasks through pre-programmed instructions. These tasks are typically well-defined and occur in a controlled environment. A prime example involves robots on a car assembly line executing identical welds repetitively. Human oversight and intervention are often required.

Autonomous Things (AuT): Involves intelligent devices capable of perceiving their environment and making decisions based on this information. These devices can function with greater autonomy and adapt to changing situations. Examples of autonomous things include self-driving cars or robots adept at navigating a warehouse and retrieving specific items.

Benefits of Autonomous Things

The integration of autonomous things offers a multitude of benefits for manufacturers, including:

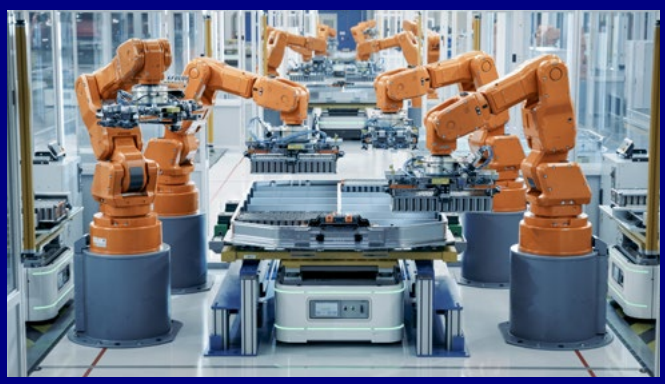
- Increased efficiency and productivity: Autonomous things excel at executing repetitive tasks with tireless precision, significantly reducing cycle times and boosting overall production output. For example, AMRs, such as forklifts, can efficiently transport materials between workstations, freeing up human workers for more complex tasks.
- Improved safety: By automating hazardous tasks like handling heavy materials or working in confined spaces, autonomous things significantly reduce the risk of workplace injuries. This allows human workers to focus on higher-level activities in a safer environment.
- Enhanced quality control: Equipped with high-resolution cameras and sensors, autonomous things conduct automated inspections with heightened precision and consistency compared to manual methods. Consequently, this results in fewer defects and waste, along with enhanced product quality.
- Reduced costs: While acquiring AuTs requires an initial investment, the long-term benefits accrue through increased efficiency, reduced waste, and minimized labor costs related to repetitive tasks.

Examples of autonomous things in manufacturing

Robots

- Smart robots: Industrial robots that work autonomously, learning from human-supervised training and demonstrations conducted in short-term intervals. Known for their enhanced reliability, productivity, and lower costs, they excel in executing physical tasks.

- Autonomous Mobile Robots (AMRs): Widely used for material handling within manufacturing facilities. AMRs utilize sensors and AI to navigate autonomously, delivering materials to workstations and optimizing production workflows.



- Collaborative robots (Cobots): Designed to work alongside human workers in shared workspaces, Cobots thrive at performing tasks like assembly, sorting, and packaging, while promoting human-machine collaboration on the factory floor.

Drones

- Unmanned Aerial Vehicles (UAVs): UAVs can be deployed for aerial inspections in hard-to-reach and dangerous areas. By using drones equipped with high-resolution cameras, UAVs can inspect machinery, buildings, and inventory, facilitating preventive maintenance and improving safety protocols.
- Light-cargo delivery drones: These autonomous flying vehicles specialize in delivering small packages, typically weighing under 10 kg. Known for their swift delivery times, they efficiently transport essential supplies within a factory, ensuring timely distribution to designated areas.

Autonomous Vehicles

- Autonomous Guided Vehicles (AGVs): These are driverless vehicles that follow predetermined paths on the factory floor using magnetic strips, wires embedded in the floor, or laser guidance systems. AGVs are ideal for transporting heavy materials over long distances within a manufacturing facility, improving efficiency and reducing reliance on manual labor.
- Autonomous forklifts: Building upon the capabilities of AGVs, autonomous forklifts offer a more versatile solution. These intelligent vehicles can navigate their environment, retrieve and transport pallets of materials, and even stack them on shelves autonomously. This not only significantly reduces the risk of accidents associated with traditional forklifts but also frees up human workers for higher-value tasks.

Autonomous things in the real world: 5G enabling dynamic use cases

The human-machine partnership

It's imperative to underscore that the rise of autonomous things doesn't signify the replacement of human workers. Instead, AuT are engineered to go beyond alleviating the burden of repetitive tasks by handling increasingly complex tasks with little to no need for human intervention. This enables human employees to capitalize on their strengths — critical thinking, problem-solving, and engagement in higher-value activities. Additionally, the integration of AuT has the potential to foster new job prospects in areas such as system maintenance, data analysis, and process optimization, thus attracting a new generation of tech-savvy talent to the manufacturing sector.

Use case: Hitachi Rail's digital factory

Hitachi is building what it aspires to be the most advanced digital factory in the United States. This extraordinary effort requires the coordination of and connectivity to a myriad of advanced autonomous technologies.

To learn more about this emerging story, visit:
Smart Factory inspections with private 5G - Ericsson

Use case: autonomous mobile robots in smart manufacturing

Ubiquitous connectivity is essential for the seamless operation of Autonomous Mobile Robots (AMRs) within a smart factory. A prime illustration is the Industry 4.0 facility in Lewisville, Texas, where a private 5G network supports a fleet of AMRs. These intelligent robots undertake a variety of tasks, including material movement and transporting circuit boards between assembly, testing, and shipping stations.

5G Benefits for AMRs

- Ubiquitous coverage: Reliable wireless coverage spanning the entire 300,000 sq. ft. facility ensures smooth, uninterrupted AMR operation.
- Low latency: Real-time data transmission between AMRs and control systems is critical for efficient task coordination and avoiding bottlenecks.
- Scalability and flexibility: A 5G network exhibits the capability to accommodate future expansion and modifications in AMR deployment.

For more information, visit:
AMRs communicate with factory of the future using private 5G network | Control Design

Turkcell and Ericsson execute 5G-supported Autonomous Mobile Robot solution

Use case: autonomous electric trucks powered by 5G

In Sweden, a pioneering initiative is underway, featuring a pilot project aimed at testing Einride's T-pod, an autonomous electric truck, within a DB Schenker facility. This driverless vehicle operates autonomously within the facility under remote supervision. The seamless 5G connectivity, provided by Ericsson and Telia, ensures reliable communication for safe and efficient operation.

The project highlights the potential of autonomous electric trucks for:

- Cost efficiency: Reduced operation and production costs
- Safety: Improved safety through reliable 5G connections
- Sustainability: Environmentally friendly electric technology

This collaboration demonstrates how 5G can revolutionize transportation with autonomous electric trucks.

To read the full article, visit:
Ericsson 5G tech on trial in Einride T-pod autonomous truck | Article | automotiveIT International

Use case: extending drones beyond line of sight — the power of mobile networks

Harnessing the capabilities of mobile network coverage and intelligence unlocks the potential for safer long-distance flights for autonomous drones, enabling their unprecedented reach. In a collaborative effort, Ericsson partnered with Vodafone to successfully test safe "sky corridors" for drones, enabling Beyond Visual Line of Sight (BVLOS) operations.

Challenges of BVLOS Drones

- Maintaining safe flight paths: Limited visibility beyond the pilot's line of sight raises safety concerns for ground and air traffic.
- Network security: Safeguarding drones from unauthorized access and ensuring secure communication is crucial.
- Reliable video streaming: Seamless transmission of high-quality video is essential for remote monitoring and control.

Solutions via mobile networks

- Drone mission control (DMC): A cloud-based platform for planning, monitoring, and controlling drone fleets remotely.
- Ericsson network protocols: These protocols enable secure communication, authorization, and Quality-of-Service (QoS) management for video streaming.

For more information, visit:
Vodafone tests safe sky corridors for drones with Ericsson

Autonomous Cycle Counting | Modex 2024 (cypherrobotics.com)

Building the foundation for autonomous things: the crucial role of private networks

A private network encompasses a localized area network using licensed, shared, or unlicensed wireless spectrum coupled with LTE or 5G cellular technology. Designed to be configured to an enterprise's specific needs within a defined area, it offers numerous advantages over traditional wired and Wi-Fi networks, particularly in supporting autonomous things (AuT).

Benefits of private networks for autonomous things

- Speed and flexibility: Rapid data transmission enables real-time communication between AuT devices and central control systems, allowing for faster decision-making and adjustments within automated processes.
- Lower and predictable latency: Minimized signal delay is essential for AuT applications like autonomous robots and vehicles. Precise and timely data exchange ensures smooth operation and avoids errors or accidents.
- Expanded device connectivity: Private networks can handle numerous connections to a vast array of machines and sensors, which are essential for collecting the requisite data for AuT devices to function intelligently and interact with their environment.
- Enhanced security: Dedicated frequencies and end-to-end encryption provide a secure network environment for AuT communication, protecting sensitive data and safeguarding against cyberattacks that could disrupt operations.
- Superior, seamless coverage: Consistent and reliable coverage across all environments, including indoor and outdoor, ensure uninterrupted connectivity for AuT devices, regardless of their location within the network.
- Better governance: Granular control over authorized devices on the network prevents unauthorized access and ensures only approved AuT devices can connect, enhancing overall system reliability.
- Built-in mobility: Seamless handovers as devices move within the network guarantee uninterrupted communication for AuT applications, even when robots or vehicles are in motion.

By addressing these critical requirements, private networks empower the widespread adoption and efficient operation of autonomous things across diverse industries.

Getting started with autonomous things: a guide to successful implementation

Manufacturers must consider a roadmap when integrating autonomous things into their operations.

Building the case for autonomous things: identify where they deliver value

- Collaborative workflows: Design new workflows that leverage the strengths of both AuT and human workers for optimal efficiency.
- Quality improvement: Identify repetitive manual tasks prone to human error, where AuT can ensure consistent quality.
- Safety enhancement: Deploy AuT to perform hazardous activities, minimizing risks to human workers.
- Cost reduction: Strategize how AuT can streamline operations and drive overall cost reductions across manufacturing processes.

Areas for focus during implementation

- Software solutions: Implement device-side software to manage autonomous movement and task execution. Customization may be needed to fulfill specific business requirements.
- Services integration: Integrate data collected from AuT with existing manufacturing systems and analytics platforms to derive actionable insights.
- Hardware procurement: Engage third-party hardware providers offering pre-configured solutions for various AuT applications.
- Connectivity infrastructure: Establish reliable communication channels to facilitate seamless data exchange between AuT devices and centralized systems.

Critical stages of deployment to manage well

- Cross-functional alignment: Ensure collaboration between various departments, such as engineering, operations, and IT.
- Internal resource assessment: Evaluate existing skills and resources within the organization.
- External resources sourcing: Identify and partner with external vendors for expertise or equipment not readily available internally.
- Implementation and integration: Focus on configuring systems, setting up networks, and integrating AuT with existing infrastructure.
- Deployment and operational oversight: Oversee the rollout of AuT and establish procedures for ongoing monitoring and maintenance.

Choosing the right partners for success

When considering AuT integration alongside 5G private networks, selecting the right partners is critical. Here's what to consider:

- AuT expertise: Partner with experts who are well-versed in diverse AuT technologies and their applications within manufacturing environments.
- 5G network planning and integration: Seek partners experienced in planning for, deploying, and managing private 5G networks specifically designed for AuT communication and data transfer is essential.
- Systems integration skills: Prioritize partners with a proven track record of integrating AuT with existing manufacturing systems and software applications.
- Security emphasis: Opt for partners prioritizing robust cybersecurity solutions to safeguard your AuT network and sensitive data.
- Scalability and Adaptability: Choose partners capable of designing scalable solutions that evolve with your future AuT needs.
- Proven implementation track record: Select partners with a demonstrated history of successful AuT implementations in manufacturing, supported by case studies and/or testimonials.

By aligning with partners possessing these attributes, one can anticipate a smoother and more successful AuT integration process.

Conclusion

The convergence of autonomous things (AuT) with 5G private networks marks a transformative chapter in manufacturing. For those yet to begin their AuT journey, now is the time to seize this opportunity, as early adopters are already reaping the benefits, and the technology is quickly maturing. Even for those underway, the journey ahead promises further growth and evolution. With ongoing advancements in AuT technologies and the expanding capabilities of private 5G networks, the potential to streamline operations and optimize manufacturing processes is limitless. Embrace the power of AuT today and unlock a future defined by unparalleled productivity and innovation.

To help you see how far you are on your smart journey, take Ericsson's Smart Manufacturing Maturity Assessment, free of charge, by visiting www.ericsson.com/smart-manufacturing-assessment.

Ericsson enables communications service providers and enterprises to capture the full value of connectivity. The company's portfolio spans the following business areas: Networks, Cloud Software and Services, Enterprise Wireless Solutions, Global Communications Platform, and Technologies and New Businesses. It is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people globally. Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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