Celab
COMMUNICATIONS

What Private 5G can enable

What needs and problems can dedicated mobile networks actually help solve?

Introduction

In articles about digitalization, automation and new communication solutions, it is common to read that organizations are "currently undergoing a major digital transformation". At the same time, these articles often describe how the demands on automation are increasing as more systems, machines and workflows become connected and data-driven.

There is, of course, a lot of truth in this, but development and efficiency improvement are not new phenomena. Organizations have worked with improvement and optimization for centuries, and with automation and digitalization for decades — to directly or indirectly increase competitiveness.

As before, there is still no obligation or intrinsic value in introducing or increasing automation, digitalization or artificial intelligence. However, these technologies can help organizations increase productivity, quality and safety in order to create better products and services. In other words, factors that contribute to business value and improved profitability.

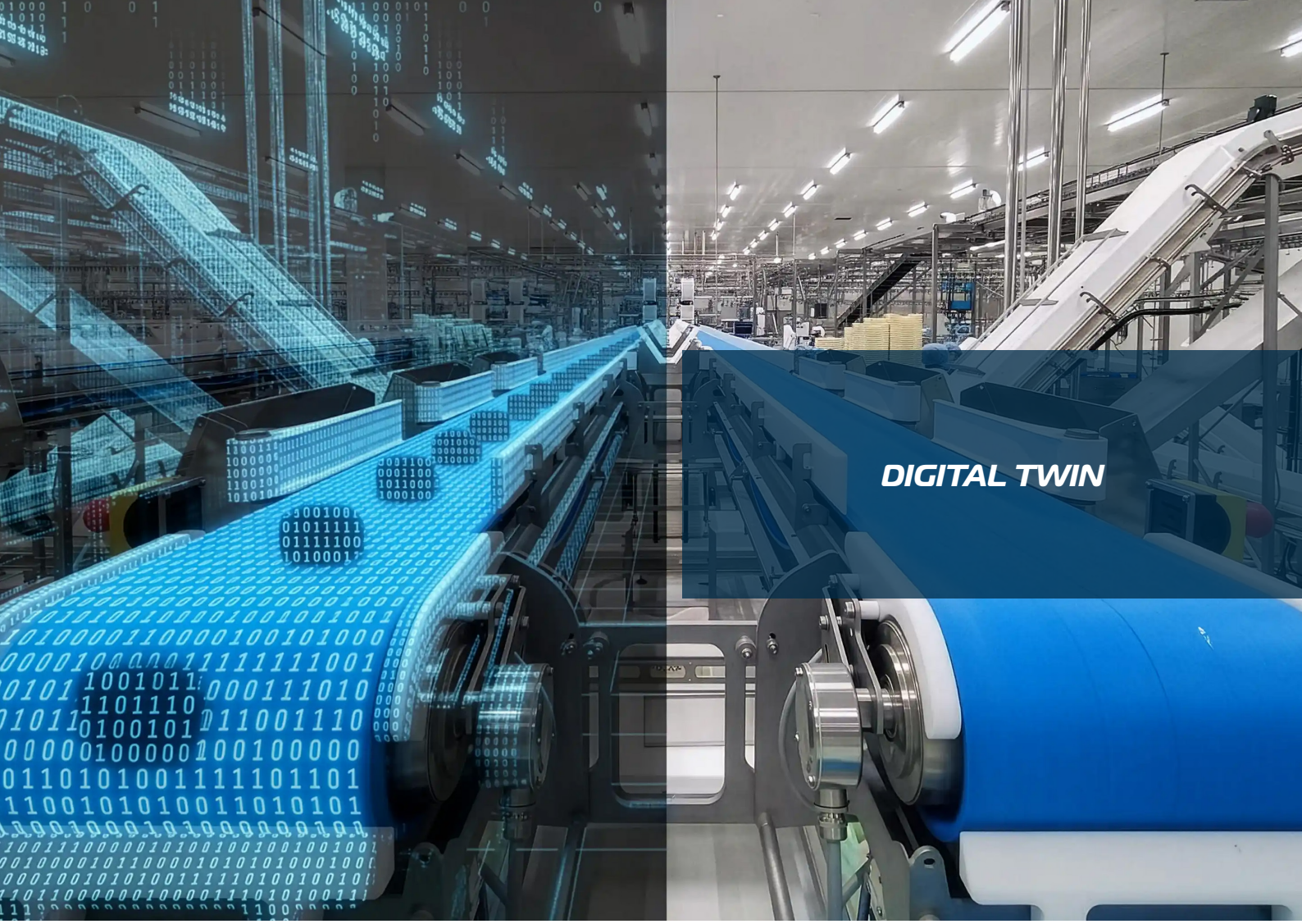
It is therefore essential to be pragmatic and distinguish between trendy technology and value-creating technology, without forgetting that some technologies meet both criteria.

Similarly, Private 5G should not be the objective in itself. Dedicated mobile networks are primarily an enabler of other technologies, systems and processes that were previously difficult, expensive or impractical to realize.

In this article, we therefore take a closer look at practical use cases where dedicated mobile networks can create better conditions for modern ways of working, and explain which characteristics of private mobile networks make these solutions possible.

At the same time, there is a classic catch-22 here. Without the right infrastructure, some solutions are difficult to develop or evaluate in practice. At the same time, there is rarely an incentive to invest in new infrastructure before clear use cases and needs have emerged.

"Infrastructure evolves when use cases drive the need.
Use cases evolve when infrastructure makes them possible."



Digital Twin

A digital twin is a virtual representation of a physical operation or process that is continuously updated with data from its real-world counterpart. It may, for example, be a digital copy of a production line, a logistics flow or a power grid, used to monitor, analyze and improve the operation.

Why is Private 5G relevant for digital twins?

To maximize the value of a digital twin, information from many different sources must be collected and organized in a common context. As the amount of data, the number of devices and the geographical spread increase, connecting the sources also becomes more complex. At the same time, many organizations operate in environments where traditional network infrastructure can be difficult to expand or maintain due to large distances, metal structures, mobile operations and changing environments.

In these scenarios, the communication infrastructure often becomes the practical limitation rather than the software or analytics platform itself.

This is where Private 5G can change the conditions.

Capacity and Scalability

In complex environments, a digital twin may need data from numerous sources:

- **Different sensors**
- **Equipment and machines**
- **Vehicles and user devices**
- **Camera systems**
- **Telemetry and control systems**

Information must be continuously collected and transmitted for the digital representation to remain relevant and useful. As complexity increases, the number of data sources and the geographical spread usually grow as well. In some network solutions, the cost per connected device becomes a practical limitation, while others instead face rapidly increasing infrastructure costs when the coverage area needs to be expanded.

5G technology is designed to handle large numbers of connected devices over larger areas, regardless of whether they are stationary or mobile. In private mobile networks, there is also normally no direct link between the number of users and increased subscription costs.

Each base station also typically covers significantly larger geographical areas than many other wireless network technologies. This can simplify expansion, reduce the amount of network infrastructure and create better conditions for operations that grow and processes that evolve over time.

Mobility

Digital twins are rarely limited to stationary equipment. In many operations and processes, vehicles, machines, handheld terminals and other mobile equipment also need to continuously share data while moving.

Mobile networks are designed for this type of mobility from the ground up, which can simplify data collection and communication in operations that cover larger geographical areas or continuously moving equipment.

Availability and Stability

Digital twins often require continuous real-time data from many different data sources simultaneously. If communication varies or is interrupted under load, the digital representation can quickly become less useful.

5G is designed to handle large numbers of simultaneous connections and continuous data communication, which can create better conditions for stable information collection even under high load.

Private mobile networks also give the organization greater control over how the infrastructure is built and dimensioned. In addition, it is possible to control and adapt the network's information flows to the organization's own needs by dedicating and prioritizing capacity for certain types of communication or equipment.

MACHINE VISION

Machine Vision

Machine Vision means using cameras and image analysis to automatically identify, analyze and respond to events or deviations in an operation. The concept can be used to detect defects and anomalies, analyze flows, monitor specific zones or read different objects or markings. Some parts of Machine Vision can also be referred to as "Critical Video", where video streams are used as part of operational decision-making, safety or surveillance.

Why is Private 5G relevant for machine vision?

Video continuously generates very large amounts of information. In addition, it is rarely a matter of connecting a single camera, but rather of integrating streams from many different cameras with real-time analysis of the video feed, which further increases the amount of data.

Cameras are also often placed in locations where other network infrastructure can be expensive, impractical or difficult to implement and adapt over time.

In these scenarios, the communication infrastructure quickly becomes a decisive factor in how extensive and useful the solution can actually become.

This is where Private 5G can create better conditions.

Performance and Response Time

Machine Vision is increasingly used for real-time analysis and decisions. In these scenarios, delays, interruptions and variations in communication quickly become a practical limitation. If video and analytics data cannot be transmitted quickly enough, systems risk responding too late or with lower precision.

5G is designed for data communication with high bandwidth, but also with low and predictable latency, which can create better conditions for real-time video analysis and AI systems.

Private 5G is also often combined with Edge Computing, which means moving data processing to the edge of the network — closer to where the data is generated and used. The physically shorter route reduces latency further.

Security and Control

For obvious reasons, machine vision often involves large amounts of sensitive information, as it concerns production processes, security areas and critical workflows. In other words, data that the organization wants to retain full control over, both during recording and distribution.

5G technology has been developed with greater focus on identity management, authentication and control over connected devices than many older network technologies. This can create better conditions for limiting access to both the network and the information transported through it.

Because private mobile networks are dedicated to the organization's own operations, they also give the organization its own control over the design of the network and how data is transported and stored. In combination with local data processing, this reduces the need to continuously transmit sensitive information to external systems or data centers.

Miscellaneous

Machine Vision and Critical Video not only generate large amounts of data, but are also often dependent on mobile and geographically distributed equipment.

Today, cameras are used in, among other things:

- **Vehicles**
- **Drones**
- **Mobile machines**
- **Body-worn solutions**
- **Temporary installations**

This means that previously mentioned characteristics such as capacity and scalability, mobility, as well as availability and stability, are also central to Machine Vision. In many cases, Machine Vision actually reinforces the need for these characteristics even further.

Machine Vision VS Computer Vision

Computer vision is broader and also includes analysis and processing of already available video and image material, while Machine Vision specifically refers to the cameras and systems intended for real-time monitoring.


Hjälmkamera
Gassensor

CONNECTED WORKER

Connected Workers

A connected worker is an employee who has access to digital tools and relevant information at the right moment — regardless of where the work is carried out.

The information flow can also be two-way, where body-worn, handheld or mobile equipment shares information in real time about the employee's position, status or current conditions with a control center or another operational function.

The purpose is to improve situational awareness for the parties involved, make workflows more efficient and strengthen the working environment. The concept is useful in everything from industry and energy to logistics and critical societal operations — environments where access to the right information at the right time can affect both productivity and safety.

Why is Private 5G relevant for connected workers?

Like the previously described use cases, Connected Worker can require large amounts of information to be continuously shared between people, machines and systems across potentially large areas.

Examples of data sources

- Real-time video
- Drawings and instructions
- Real-time documentation and reporting
- Positions and sensor data
- Status information
- Communication between field personnel and operations management

Examples of demanding conditions

- personnel are continuously moving
- coverage areas change over time
- communication is business-critical
- large amounts of equipment need to be connected simultaneously
- video, sensor data and positioning are used as operational support

This means that the communication infrastructure quickly becomes decisive for how useful and reliable the solution can actually become.

This is where Private 5G can create better conditions.

Capacity and Scalability

- Developed for communication over large geographical areas
- Built to handle many simultaneous users and devices
- No direct link between the number of users and increased subscription costs

Mobility

- Developed to maintain connections even when users and equipment are moving
- Supports body-worn and mobile equipment
- Relevant when personnel, vehicles and equipment move between different parts of the operation

Availability and Stability

- Provides greater control over coverage, dimensioning and functionality
- Enables prioritization of business-critical communication
- Creates better conditions for stable information sharing even under high load

Performance and Response Time

- Support for high bandwidth and low latency
- Relevant for video, AR, remote support and real-time information
- Can be combined with local data processing for shorter transport paths

Security and Control

- Provides greater control over networks, users, devices and data flows
- Built on modern security mechanisms for authentication and access control
- Can reduce dependency on external networks and external data flows

REMOTE CONTROL

Remote Control

Remote control means enabling operators and drivers to control vehicles, machines or equipment from a distance. This can take place from a control room, a simulated cockpit or cab, another part of the facility or, in some cases, from a completely different geographical location.

The purpose is often to perform work in environments where it is impractical, risky or inefficient to have personnel physically present. This may include mining, port operations, industrial processes, hazardous work environments or locations where access to specialist expertise is limited.

Why is Private 5G relevant for remote control?

The operator needs to be able to see, assess and act in real time, and in that case it is not enough for communication to work well on average. It must work consistently and predictably, because even short delays, interruptions or variations can put safety at risk when working with heavy or sensitive equipment such as:

- **vehicles and work machines**
- **cranes and overhead cranes**
- **robots and drills**
- **drones for land, air or water**
- **equipment in hazardous or hard-to-reach environments**

In practice, remote control usually relies on several parallel information flows. The driver needs to receive video, audio, sensor data and status information while commands are sent back to the machine or equipment. If any of these flows fail, it affects more than safety. Precision and productivity also deteriorate quickly, which means the purpose of remote control risks being lost.

This is where Private 5G can create better conditions.

Performance and response time

- **Low and predictable latency**
- **Less variation in important commands, video and sensor data thanks to dedicated resources**

Availability and stability

- More stable connection thanks to increased control over coverage, dimensioning and functionality
- More reliable connection even under high load thanks to prioritization of resources

Mobility

- More stable connectivity because the technology is developed for mobile subscribers
- More reliable connection because the organization itself determines the coverage areas

Capacity and scalability

- Multiple simultaneous data streams thanks to high bandwidth
- Cost-effective scaling through the ability to add users without increased subscription costs
- Cost-effective scaling through the ability to expand coverage areas without extensive cabling

Security and control

- Increased control over which systems, users and devices are allowed to communicate in the network
- Greater control over sensitive control signals, video streams and operational information through local implementation and controlled access

The laws of physics cannot be developed or marketed away

Remote control over very long distances often sounds impressive, but signals are still affected by physical distances, network equipment and signal processing. For tasks that require very high precision, global distance is therefore rarely the most relevant factor — the ability to create low and predictable latency in a controlled environment is.


AUTONOMOUS EQUIPMENT
AS2
Packing Zone B

Autonomous Equipment

Autonomous equipment refers to vehicles, machines, robots or other systems that can perform tasks fully or partially without continuous human control. This may include anything from self-driving forklifts and mobile robots to autonomous inspection systems, drones or machines that automatically navigate and act based on their surroundings.

The purpose is usually to make recurring tasks more efficient, reduce risk exposure for personnel, improve precision or create better continuity in workflows where manual handling would otherwise be costly, slow or difficult to maintain.

Why is Private 5G relevant for autonomous equipment?

Autonomous equipment is rarely completely disconnected from surrounding systems. Even when decisions are made locally in the vehicle, robot or machine, continuous communication with other parts of the operation is often needed. This may involve updated routes, status information, safety zones, operations management or other autonomous units.

In practice, autonomy often relies on interaction between several information flows. The equipment needs to collect and interpret data from its own surroundings while also sharing information with other systems so that it can be coordinated, monitored and, when necessary, stopped or redirected.

This means that the communication infrastructure quickly becomes an important part of the overall solution. If communication is unstable, limited to certain areas or difficult to expand, it can limit where and how autonomous equipment can actually be used.

In these scenarios, Private 5G can create better conditions through the characteristics previously described in:

- **Capacity and scalability**
- **Mobility**
- **Availability and stability**
- **Performance and response time**
- **Security and control**

Conclusion

Private 5G as common infrastructure?!

As we stated at the beginning of the article, there is no intrinsic value in introducing Private 5G. As with all technological development, value only arises when the technology contributes to something more concrete, for example by enabling new ways of working, processes or production models that develop the operation and profitability.

At the same time, Private 5G is not just another wireless network technology. The technology has the ability to combine several characteristics, benefits and needs that have previously been distributed across different systems: wired networks for fixed and stationary installations, two-way radio for voice communication, CCTV for surveillance and Wi-Fi for laptops and guests. These have worked well and will continue to work well in many contexts.

Dedicated mobile networks can, however, in some operations function as a common communication platform for many needs and solutions. In this way, the technology does not become just another network, but a possible path toward a more unified digital infrastructure.

This does not mean that private mobile networks will always replace everything else, but when use cases begin to overlap, expectations on the infrastructure change — and that is where Private 5G becomes relevant. Private 5G is not just about better connectivity. It is about creating the conditions for ways of working that would otherwise be difficult, expensive or impractical to implement with sufficient precision, availability and control.

Private mobile networks should therefore not be seen as a universal solution. They are not always right, not always necessary and not always the most cost-effective. But in the right context, they can be all three — both today and in the future.

This ties back to the article's opening argument:

"Infrastructure develops when use cases drive the need. Use cases develop when infrastructure makes them possible."

Comment on AI, AR and VR

In this article, we have chosen not to treat artificial intelligence, Augmented Reality or Virtual Reality as separate use cases for Private 5G. The reason is that they are rarely the objective in themselves, but rather tools that strengthen other ways of working.

AI can, for example, be used within Machine Vision to analyze video streams, within digital twins for predictive analysis, or within autonomous equipment for object recognition and decision support.

In the same way, AR and VR can be used within Connected Worker for instructions, remote support, simulation, training and improved situational awareness.

This follows the same basic principle as the rest of the article: technology does not create value simply by existing. Value arises only when it solves a concrete problem or makes a way of working more efficient, safer or more feasible.

About Celab

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Celab Communications AB is a Swedish company within the Tången Group that, since its founding in 1978, has achieved significant success in mission- and business critical communications.

By this, we mean solutions for organizations where reliable communication is essential to operational success and/or employee safety.

The company's foundational concept is to provide communication systems based on world-leading equipment, which, through our unique expertise, are developed, refined, and optimized specifically for our customers and their unique operations.

Celab COMMUNICATIONS

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