



PRIVATE 5G NETWORK-LED TRANSFORMATION

Sept. 2021



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THE NEED FOR INDUSTRY 4.0 AND INTELLIGENT CONNECTED INDUSTRY IS DRIVEN BY SIX KEY CHALLENGES



1. Customer demand for agility & flexibility

Customer expect more customization and faster delivery, which puts a strain on existing facilities which are hard to reconfigure and integrate complexity



Need for flexible production lines that can be adapted quickly



2. Fragmentation due to legacy

Prevalence of fixed, outdated equipment (high CapEx) presents difficulties when implementing new solutions and create data silos



Need for better integration of existing and new technology solutions



3. Securing data integrity

In 2019, over one in five manufacturers have experienced a cyberattack to their smart manufacturing initiatives ([Capgemini survey](#))



Need for secure, private or 'on-premise' network infrastructure



4. Navigating market uncertainty

COVID-19 and trade tensions have disrupted traditional supply chains, causing demand fluctuations and channel shifts (to local production)



Need to adapt to reduced human capacity and improve demand sensing capabilities

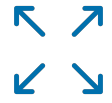


5. Need to upskill workforce

Demand for employees with data science, IT/OT/Network skills to help companies in the industrial sectors transition to smarter operating models



Need to drive cultural change in organization; upskill existing workforce and attract STEM talent



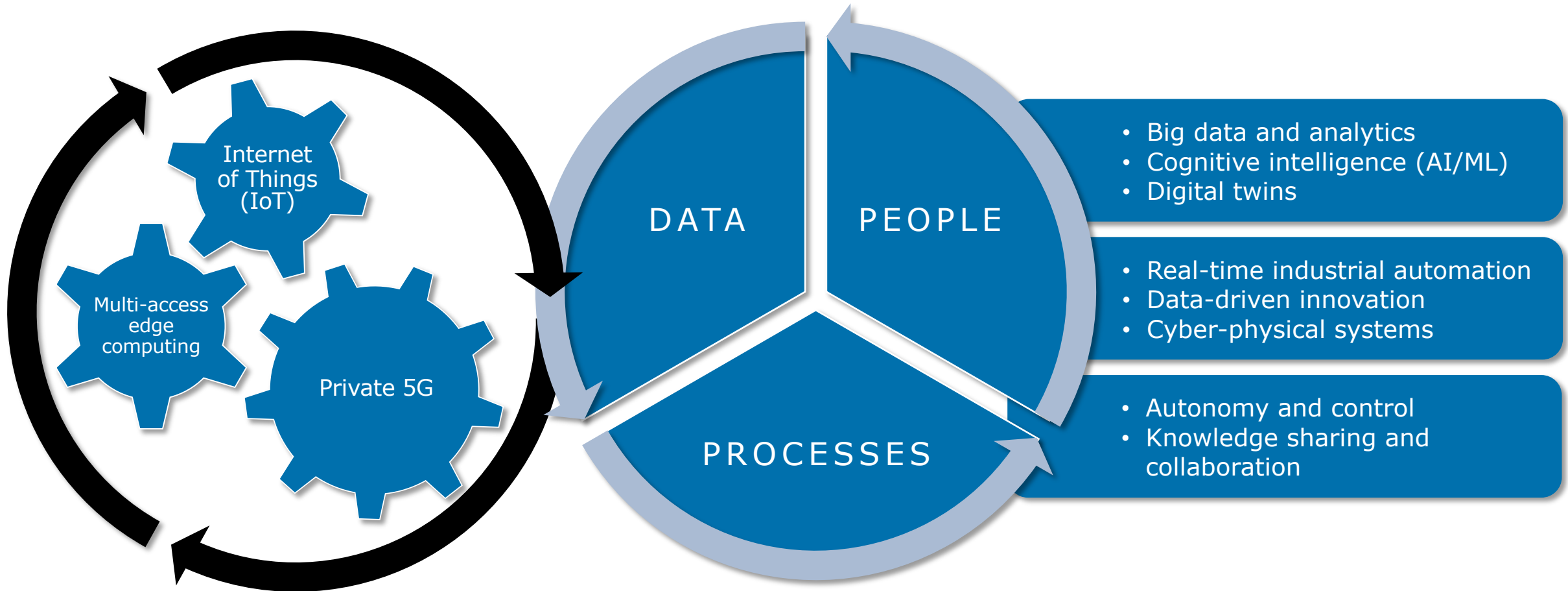
6. Need for scalability

The need to adjust production capacity and scale up sustainably and to support the growing number of devices that enable digital twins, AI/ML, analytics



Need to be able to support the exponentially increasing volume of devices and traffic

PRIVATE 5G UNLOCKS WIDER TRANSFORMATION TO **MORE POLICY-DRIVEN OPERATIONS** AND **INTELLIGENT WAYS OF WORKING**



PRIVATE 5G IS ALSO ABOUT **ENABLING GREATER FLEXIBILITY** **AND FUTURE-PROOFING** BUSINESS

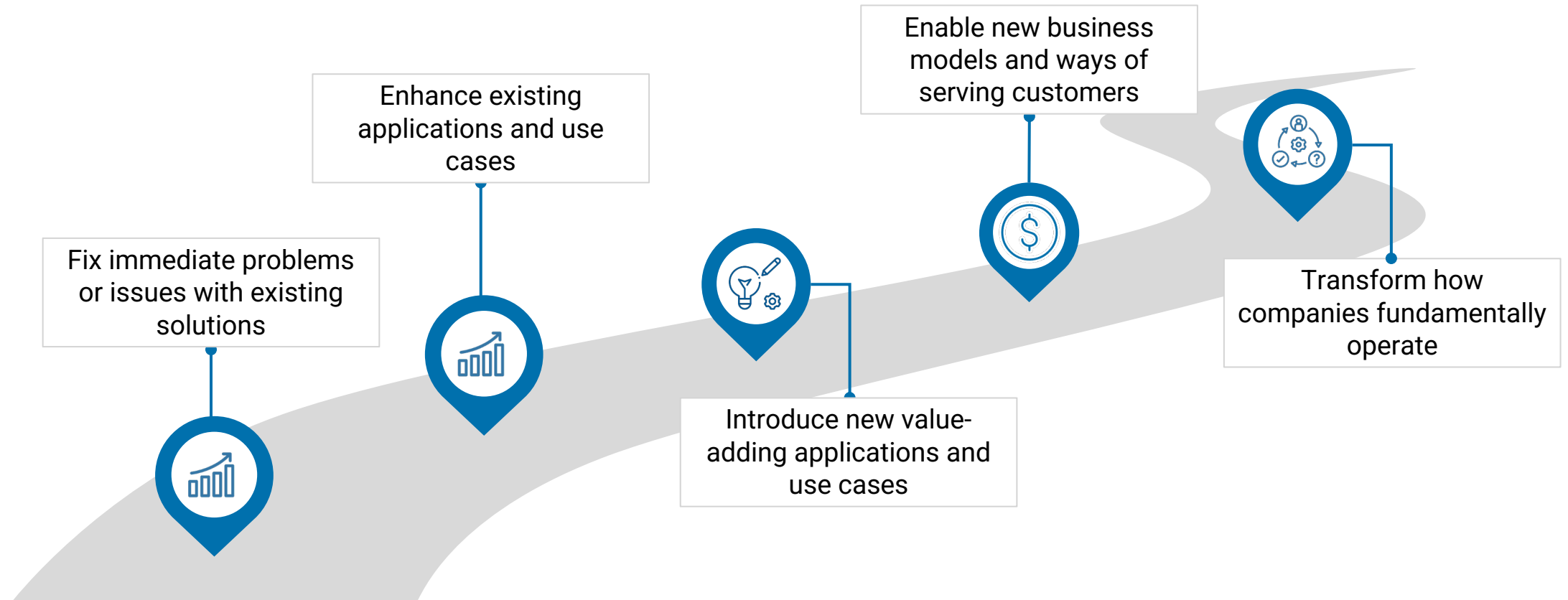


Greater flexibility

Ability to respond to changes in a much more agile way at a production or operational level

Digital transformation

Ability to enable all current and future use cases that drive efficiency and agility without the need for replacement, disaggregation





PRIVATE 5G DELIVERS KEY CAPABILITIES THAT CAN BRING ENHANCED OUTCOMES FOR YOUR BUSINESS



Security

Ability to protect network against cyber-attacks and ensure devices are properly authenticated

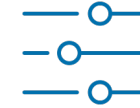
Keeps customers' infrastructure separate, serves specific security requirements e.g. for military purposes



Reliability

Guarantee network performance is maintained at a predetermined level throughout its operation

More reliable than Wi-Fi, where industrial materials e.g. metal parts can cause interference



Control

Isolates network as a customer-controlled, standalone 5G network/ private network slice

Guarantees service quality by allowing the industrial customer to fully control and manage their own network



Mobility on-site

Enable seamless handover between different cells without connection loss

Enables new innovative use cases to monitor and control moving assets and greater flexibility in operations



Resilience

Ability to maintain service dependability and recover from a fault or shock

Providing built-in ways of addressing potential faults and issues, enabling you to support mission critical applications



Coverage

Provision of high endpoint density and reliable connectivity both inside and outside buildings

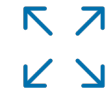
Reduces deployment cost to achieve coverage across large site (8 access points with 5G vs. 100s with Wi-Fi)



Speed of implementation

Ability to deploy and scale connectivity solutions quickly, easy to install more cells

Speed of deploying a solution makes the difference between winning and losing a customer contract



Bandwidth

Support use cases that require transmitting and receiving huge amounts of data

Provide the ability for enterprises to support new types of use cases that require large amounts of data to be sent

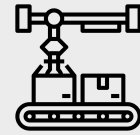


Tip: Click on these buttons to explore key industry-specific use cases



PRIVATE 5G USE CASES

Private 5G can enable value-adding use cases that can improve operational efficiency, reduce downtime, waste and damage, and drive greater agility for your business.



DISCRETE MANUFACTURING



PROCESS MANUFACTURING



AUTOMOTIVE



OIL, GAS AND MINING



PRIVATE 5G ENABLES INNOVATIVE MISSION CRITICAL USE CASES IN DISCRETE MANUFACTURING



Advanced predictive maintenance

- Uses AI/ML to monitor performance data of machines and equipment using IoT sensors to flag pre-emptively if there is a need to repair equipment, eliminating need for scheduled maintenance
- Reduces the likelihood of failures and hence unplanned downtime, also increases return on assets during its lifetime, which is extended



Autonomous mobile robots (AMR)

- Improves efficiency, reliability and accuracy of transportation and haulage of automotive parts and materials; reduces labor costs, eliminates human error and increases workplace safety
- More flexible than AGVs, which follows planned routes



Wireless industrial machines

- Replacing previous (fixed) connection to the local area network to enable machines or robots to be moved around, and even controlled, allowing you to alter production processes in real-time
- Removes need for re-cabling and reconfiguration when changing site layout, in order to enable greater production flexibility



Precision monitoring and control

- Monitors manufacturing processes in real-time by analysing sensor data, detecting anomalies and actioning on machine performance, product conditions and quality
- Improves QA and customer satisfaction by increasing likelihood of defects being identified and mitigated than random quality checks



Real-time asset tracking and inventory management

- Track and monitor the position and usage of assets in real-time, increase visibility with greater accuracy in order to better manage assets over their lifecycle
- Automate inventory management to prevent any potential delays with parts or materials required for production



Private 5G capabilities leveraged:



Security & control



Reliability & resilience



Mobility



Coverage



Scalability & speed of deployment

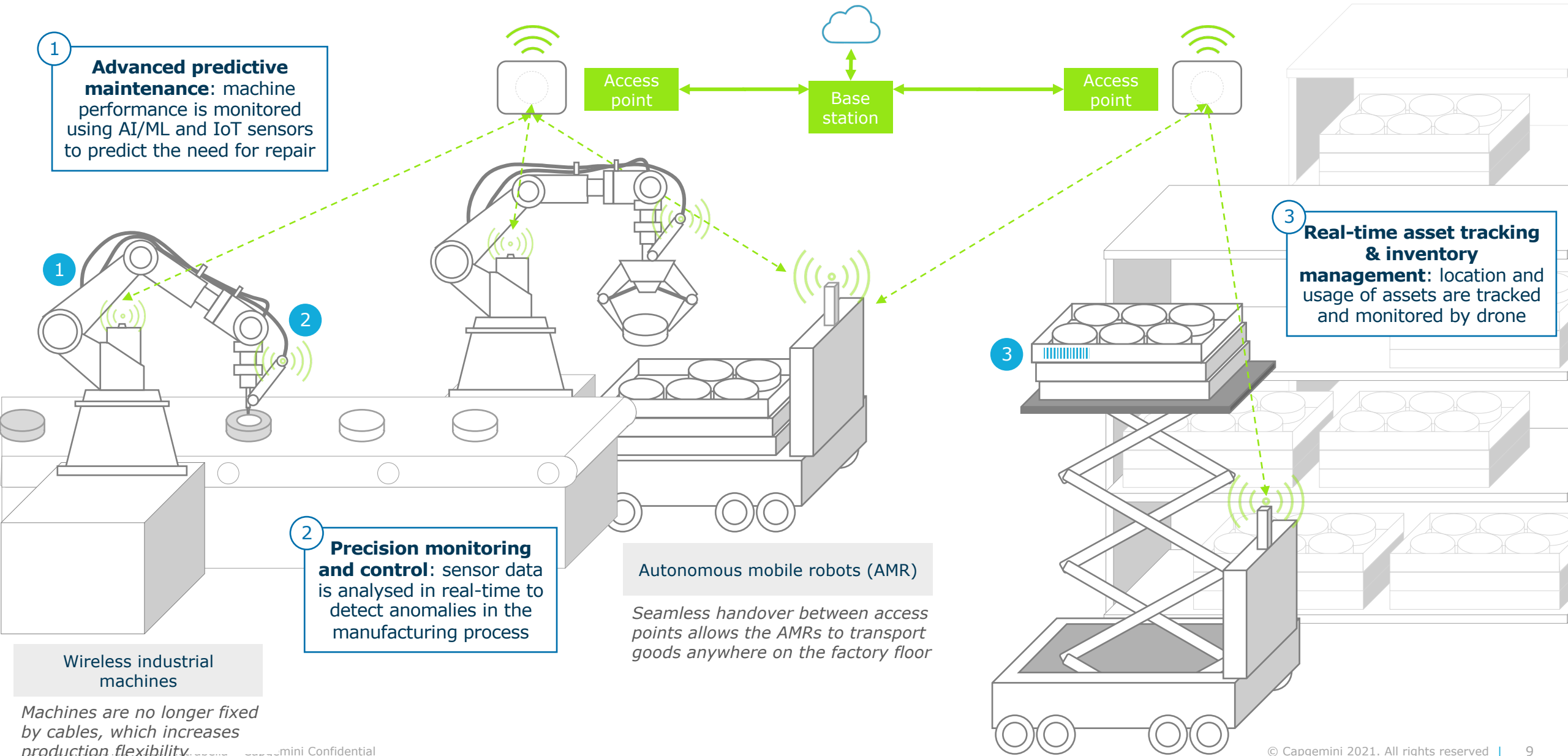


Low latency



High bandwidth

PRIVATE 5G CAN ENABLE INNOVATIVE MISSION CRITICAL USE CASES IN DISCRETE MANUFACTURING





PRIVATE 5G ENABLES INNOVATIVE MISSION CRITICAL USE CASES IN PROCESS MANUFACTURING



Collaborative robots

- Supports manned tasks in an intelligent and safe manner; guided by humans to perform exact movement patterns
- Capable of coexisting and collaborating with human workers in close proximity, unlike traditional robots that are programmed to stop when humans enter the facility



AR/MR for lone worker and MRO

- Supports on-site workers to safely conduct maintenance, repair or and operations supplies (MRO), in place of or supervised by a remote specialist
- AR enables critical parameters, information and instant hazard warnings to be displayed as an overlay for real-time interactions



Environmental condition monitoring

- Monitors and analyses conditions of remote assets (temperature, pressure, vibration, etc.), where failures can be disastrous (e.g. oil pipeline explosions, water pipeline leakages)
- Reduces risk to critical operations and workers by proactively detecting anomalies and unexpected behavioural patterns



Video analytics for process monitoring and quality assurance

- Monitors manufacturing processes in real-time by using video ingest and analysis to detect anomalies and actioning on machine performance, product conditions and quality
- Improves QA and customer satisfaction by increasing likelihood of defects being identified and mitigated than random quality checks



AR/VR/MR for training

- Uses VR/AR to enhance field training with immersive experiences, with digital twin simulations
- Supports training of employees in health and safety procedures in hazardous industrial environments



Private 5G capabilities leveraged:



Security & control



Reliability & resilience



Mobility



Coverage



Scalability & speed of deployment



Low latency



High bandwidth



PRIVATE 5G ENABLES INNOVATIVE MISSION CRITICAL USE CASES IN OIL, GAS AND MINING



Unmanned (remote) operations

- Operating unmanned (or remotely controlled) vehicles such as autonomous haulage systems (AHS), mining dump trucks or other types of vehicles
- Improve the efficiency, safety and maintenance of oil, gas and mining operations by removing the need for manned machines



AR/MR for lone worker and MRO

- Supports on-site workers to safely conduct maintenance, repair or and operations supplies (MRO), in place of or supervised by a remote specialist
- AR enables critical parameters, information and instant hazard warnings to be displayed as an overlay for real-time interactions



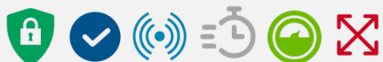
Real-time environmental condition monitoring

- Monitors and analyses conditions of remote assets (temperature, pressure, vibration, etc.), where failures can be disastrous (e.g. oil pipeline explosions, water pipeline leakages)
- Reduces risk to critical operations and workers by proactively detecting anomalies and unexpected behavioral patterns



Video analytics for process monitoring and control

- Monitors manufacturing processes in real-time by using video ingest and analysis to detect anomalies and actioning on them to mitigate any risks, for example with flare monitoring
- Improves QA and customer satisfaction by increasing likelihood of defects being identified and mitigated than random quality checks



UAV for site inspection and asset tracking

- Performs real-time industrial inspections via drones at remote, difficult environments or hard to reach locations such as pipelines, rigs, mines
- Improves safety, setup, operating time and cost compared to manual inspections. Drones or other UAVs can create a digital twin of existing assets (video, 3D visualization, accurate aerial data)



Private 5G capabilities leveraged:



Security & control



Reliability & resilience



Mobility



Coverage



Scalability & speed of deployment



Low latency



High bandwidth

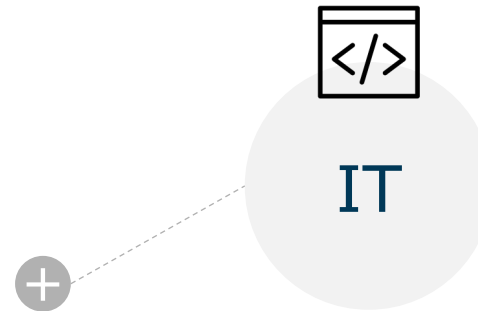


ENABLING 5G-ENABLED DIGITAL TRANSFORMATION

We drive **Intelligent Industry** across the business...

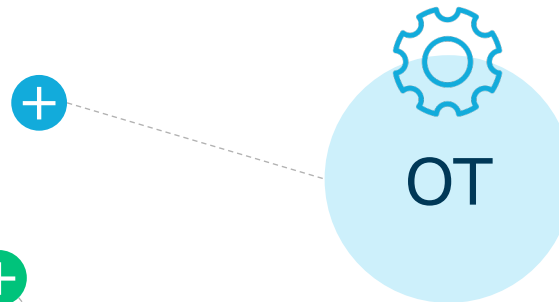


- Consultative services
- Systems integration & verification of network and applications
- Deployment services
- Maintenance & operations
- Monitor performance & adherence to KPIs



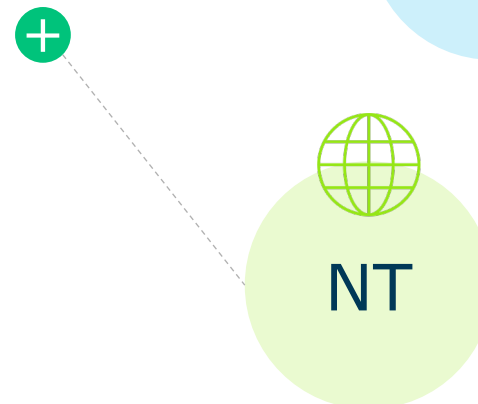
INFORMATION TECHNOLOGY **Enterprise IT services**

- Application development and integration
- Data architecture and rationalisation
- IT integration services
- Cloud and edge deployment services
- DevOps maintenance and updates
- Third party partner management



OPERATIONAL TECHNOLOGY **Industry business solutions**

- Business case and plan
- Operational req. definition
- Operational scenarios vetting and verification
- Operational design
- Enterprise app. modernisation



NETWORK TECHNOLOGY **Communications solutions, Comms ER&D**

- Network req. definition
- Functional, non-functional requirements verification
- Traditional NEP, CSP R&D
- Comms aware apps design
- Network & operations design
- Network operations services



DELIVERING 5G-ENABLED INDUSTRIAL TRANSFORMATION



VERTICAL EXPERTISE

- Manufacturing engineering and technology
- Advanced connectivity & 5G
- Data driven ER&D
- Industry 4.0 & Product Lifecycle Management



CONSULTATIVE SERVICES

- Problem and business goal definition
- Business and product requirements
- Services engagement plan, implementation timeline and ROI



ECOSYSTEM ENABLEMENT

- Private 5G ecosystem as a service, including solution integration and validation
- Reference architecture design services
- Application use case capabilities across 11 industries



APPLICATION ENABLEMENT

- Development of network-aware software applications that leverage 5G, SDN, AI/ML
- Device-aware, network-aware, service-aware and application-aware software capabilities
- 5G network and edge cloud frameworks



INTEGRATION SERVICES

- End-to-end IT & OT systems integration and verification, continuous delivery of software
- Deployment and integration of monitoring and management tools for infrastructure and apps

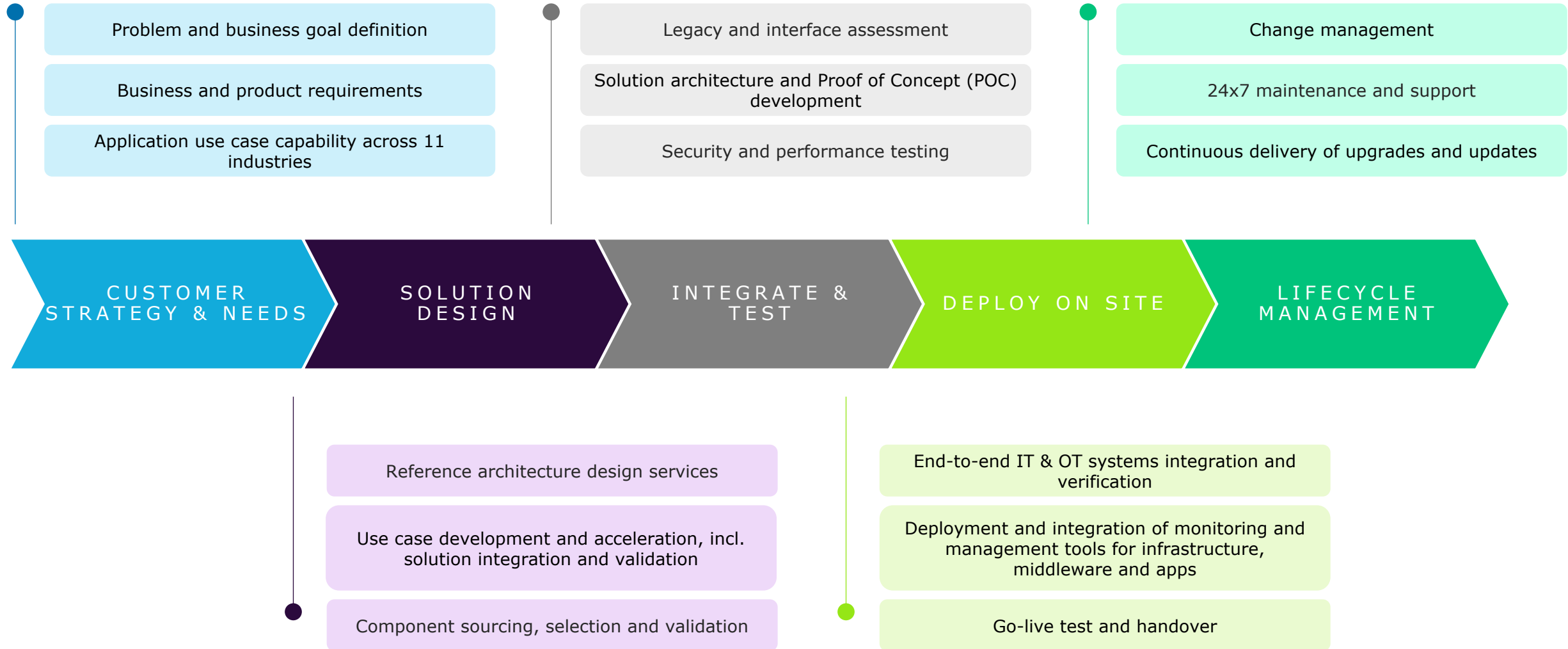


MANAGED SERVICES

- Multi-protocol, cross platform support 24x7, including remote monitoring and management
- Service design and operations, infrastructure maintenance and SLA management



5G-ENABLED DIGITAL TRANSFORMATION ENGAGEMENT





SERVICES AND SOLUTIONS ACROSS THE CAPGEMINI VALUE CHAIN: **CUSTOMER STRATEGY & NEEDS**

1

CUSTOMER
STRATEGY & NEEDS

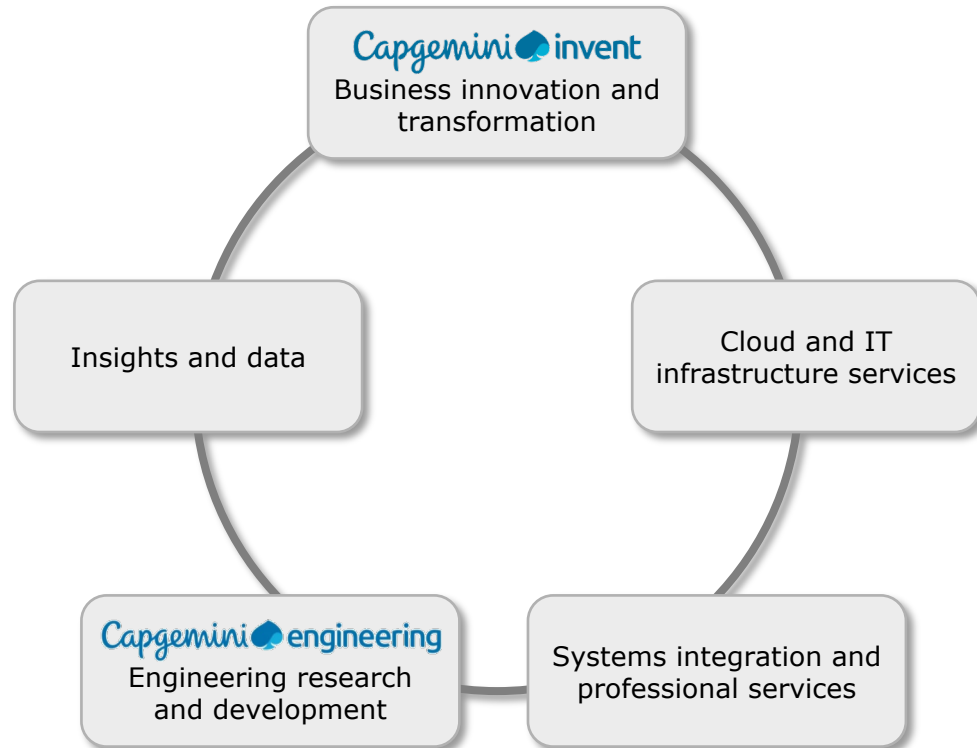
SOLUTION
DESIGN

INTEGRATE &
TEST

DEPLOY ON SITE

LIFECYCLE
MANAGEMENT

As a true partner, Capgemini provides rapid and agile consultative engagements with our clients to understand their needs, goals and “to be” state





Case Studies



CASE STUDY – Grocery Solutions Logistics & Automation



Capgemini helped our Client develop a custom wireless communication system to orchestrate thousands of fast-moving robots in real time.

Industrial IoT: Logistics

Private 4G LTE network deployed in unlicensed 5GHz Wi-Fi band (2016)

- 25000** devices/sq. km
World's most densely-packed mobile network
- 1000** Robots controlled per access point: 10x more than is usually possible
- 3.5M** Grocery items managed every week

“

Cambridge Consultants' world-class technical expertise has been key to developing the communication system that orchestrates our fleets of bots. We found the engineering teams to be responsive, dependable and highly professional throughout our collaboration.

Client CEO

Our involvement

- Cambridge Consultants (part of Capgemini Invent) worked closely with Our Client Technology's engineering team to develop a radio control system that manages the robots in their highly automated warehouses.
- Robots handling grocery items in Our Client's warehouses move across giant storage grids at speeds of up to four meters per second, which **makes them 18 times faster than a traditional warehouse** that uses extensive conveyor belt systems.
- Real-time control:** Our technology connects to Our Client's existing warehouse platform, **enabling the real-time control of thousands of crates**, all densely packed within the size of an Olympic swimming pool – maximizing warehouse efficiency. Each bot talks to the communication system ten times a second.
- Scalability:** The innovative wireless solution is also scalable and **can potentially handle 20 times the number of movements.**



CAPGEMINI SUPPORTED OUR CLIENT END-TO-END TO DELIVER AN INNOVATIVE USE CASE WITH THOUSANDS OF FAST-MOVING ROBOTS

Existing mobile technologies could not fulfil Our Client's requirements

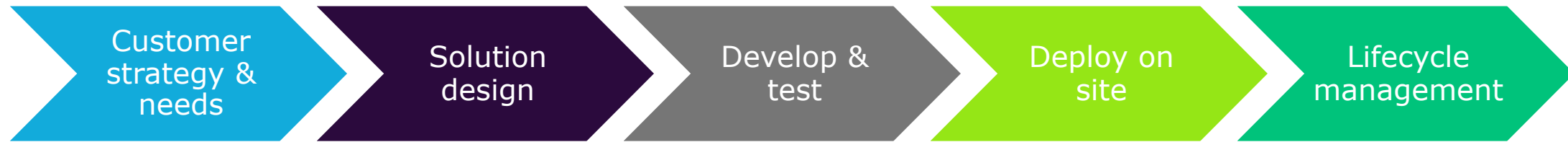
- Our Client's goal was to achieve real-time control of over 1000 fast-moving robots in its warehouses.
- They wanted a robust, scalable communication system between the robots and their central command system, Client's Smart Platform, while minimizing time and risk of deployment.

Design verification and de-risking

- We worked as an extension of Our Client Technology's team, guiding processes like manufacturing partner selection and functionality demonstrations
- As well as simulation models, we built warehouse test facilities to run and test robots, base stations and radios in a realistic setting to ensure that the robust performance requirements were achieved.

Supporting Our Client's team in integrating new technology

- Not only did we provide 24/7 support during the transition, and led technical seminars, training and knowledge transfer sessions; we also provide comprehensive support for the ongoing evolution and enhancement of the design throughout its lifecycle.



Customized radio solution

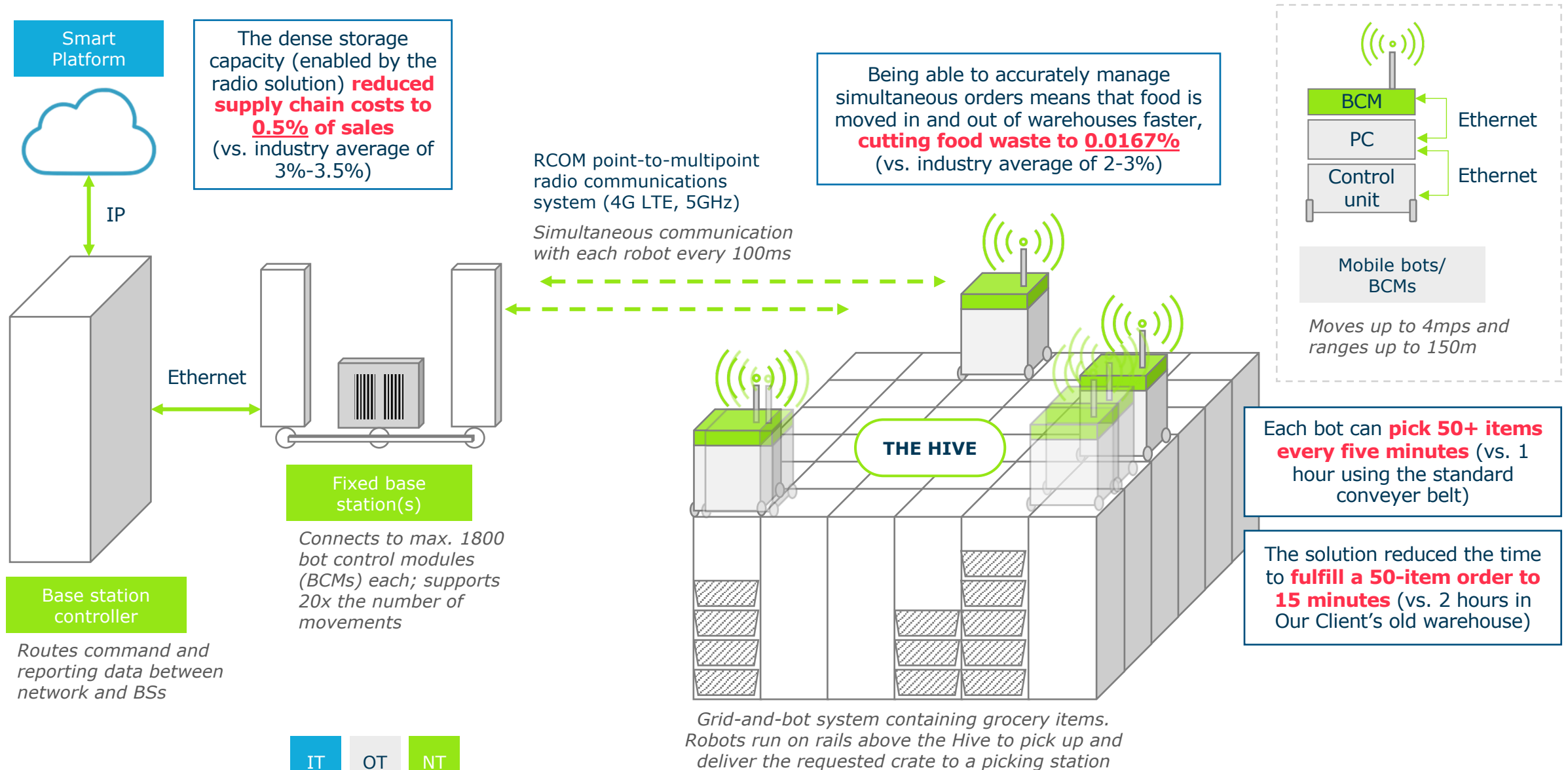
- To address Our Client's needs, Capgemini developed a completely bespoke radio control system from the ground up, based on 4G LTE technology.
- We custom-designed standards-based software, as well as hardware – the radio boards were made in our state-of-the-art manufacturing facility.
- An MVP was reached in under a year.

Securing regulatory approval

- The technology works in license-free 5GHz Wi-Fi spectrum, so that it can be rapidly deployed and scaled.
- Capgemini worked closely with Ofcom (UK) and FCC (US) to create new test protocols, in order to secure regulatory approval for this unprecedented use of unlicensed spectrum.



TRANSFORMING OUR CLIENT'S OPERATIONS THROUGH WIRELESS COMMUNICATIONS AND WAREHOUSE AUTOMATION



Capgemini  engineering

Q&A



About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of 270,000 team members in nearly 50 countries. With its strong 50 year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fuelled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2020 global revenues of €16 billion.

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**Reference
Material**



CASE STUDY

Industrial Manufacturer



A technology company and one of the largest industrial manufacturer in Europe. Capgemini Engineering supported Client in developing a private 5G networking solution specifically for industrial automation use cases.

Industrial IoT: Manufacturing

Bespoke 5G gNB (RAN) and NGC (virtualized core) solution that runs the 5G software on industrial hardware compute platforms.

Our involvement

- Central to Client's Digital Enterprise portfolio are its industrial automation and controller solutions, which drive the digital transformation of manufacturing companies and help increase the productivity, speed and quality of industrial processes
- Client wanted to expand its capabilities into the Industrial 5G ecosystem to support its enterprise customers in adopting 5G-enabled IIoT and smart manufacturing use cases
- Therefore, Capgemini Engineering supported Client in developing a private 5G networking solution that can run on Client's industrial hardware platforms. This involved designing a custom 5G software solution specifically for industrial automation use cases.

Our capabilities

INDUSTRY EXPERTISE AND PARTNERSHIPS

- Established footprint and premier relationships across 11 vertical industries with its "Intelligent Industry" proposition.
- Partnerships with many Semiconductor providers bring proven functionality for industrial open hardware

ENGINEERING CAPABILITIES

- Capgemini's in-house software engineering capabilities allows clients to rapidly transform our software packages into custom, trial-ready solutions.
- Delivering a bespoke 5G gNB (RAN) and NGC (virtualized core) solution that enables Client to run the 5G software on industrial hardware compute platforms

5G INDUSTRY-FOCUS LAB

- Capgemini Engineering's 5G Industry-focus Lab-as-a-Service enables rapid testing, validation and customization to accelerate the deployment of Industrial 5G use cases.
- The 5G Lab helped Client create Industrial 5G demonstrators that can be used to engage their target end customers

Outcomes

- This project positioned Client as a driver of Industrial 5G development. With the support of Capgemini Engineering, Client launched in June 2021, its first 5G router that is designed to work in demanding industrial environments and be used in private 5G campus networks.
- Client has also set up a private Industrial 5G test network at its Automotive Showroom and Test Centre in Europe, showcasing its prototypes and testing the performance of Industrial 5G applications such as automated guided vehicles (AGVs)



CASE STUDY - Refinery



Augmented reality for MRO

This use case focuses on helping on-site workers at a customer's refinery to safely conduct maintenance, repair or and operations supplies (MRO), in place of or supervised by a remote specialist.

Augmented reality (AR) glasses enabled critical parameters, information and instant hazard warnings to be displayed as an overlay for real-time interactions

Overview of the use case

- Leveraging 5G to support operations personnel during on-site maintenance, repair and operations (MRO) tasks. Significant time (unplanned downtime) is often lost due to malfunctions or issues with maintenance
- Operator in the field often requires specialized support but there are challenges with sending an expert quickly to a remote refinery.
- Augmented reality connects the on-site workforce to a remote expert and enables a set of parameter values to be checked in real-time during operation and maintenance tasks

How the solution works

- Enabling **3D modelling of the elements** to be inspected on-site
- Created an application to **display AR dashboards, pop-ups and contextual data** once the operator has located himself in the area through a QR code
- Developed a connection module with the client's server at AWS to extract data in real-time
- Implemented a **video streaming application** for communication between field operator and remote expert

Key benefits for the client

- The client's on-site workforce is now able to address and complete any MRO needs more quickly and accurately - **operations and troubleshooting are improved with greater accuracy.**
- Faster response speed means that the client is able to **reduce planned and unplanned downtime.**
- Without the need to send an expert to the refinery, the client benefits from **reduced delays and associated financial losses.**