



# PRIVATE 5G STRENGTHENING THE INDUSTRIAL PILLAR

Shamik Mishra, CTO Connectivity, Capgemini



# THE INTELLIGENT, FLEXIBLE AND AUTONOMOUS FUTURE OF PRODUCTION IS DRIVEN BY DATA YET CENTERED AROUND THE HUMAN AS SHAPER

Hyper **convergence** of virtual and real world, hardware and software, digital, physical and biological world

Development, testing and simulation of product, process and factory **in the virtual world**

Prescriptive foresight for **all possible scenarios**

**Closed-loop operations** through intelligent data-driven self-steering and continuous improvement

Using **product's intelligence** already in the manufacturing process

**Autonomous** actions with the human as ultimate driver and decision maker

Value-based **simplicity** and **standardization** holistically along the network

**Resource efficiency** and **circularity** along the value chain

**Hyper intelligence** through data-driven operations, autonomous systems and high-performance computing

How to **choose** the right **Connectivity evolution?**  
(Fit-for-purpose & future-ready)

Do you see **your current Connectivity becoming a bottle neck** to your digital transformation ambition?



**Advanced Connectivity**

Scalability & Flexibility

High-Bandwidth, Low-Latency, High-Reliability

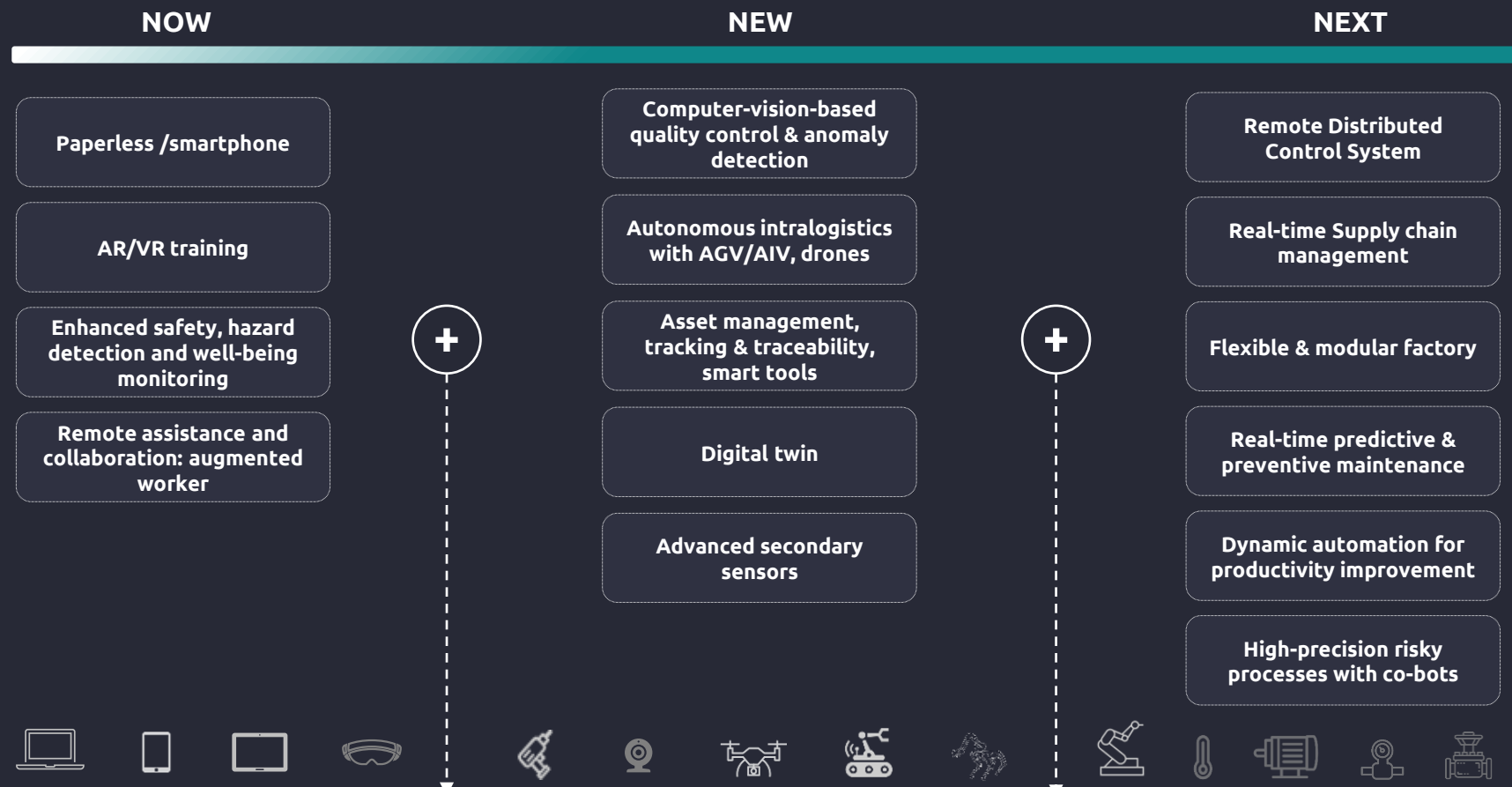
Convergence & Computing



# DIGITAL TRANSFORMATION JOURNEY AND WHAT IS THE IMPACT ON YOUR NETWORK?

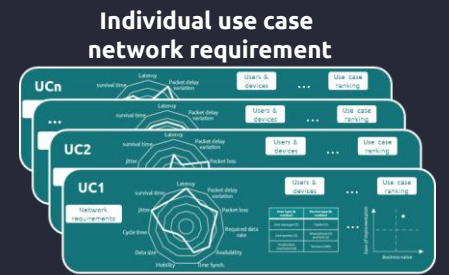
Digital Transformation Journey

Indicative & non-exhaustive

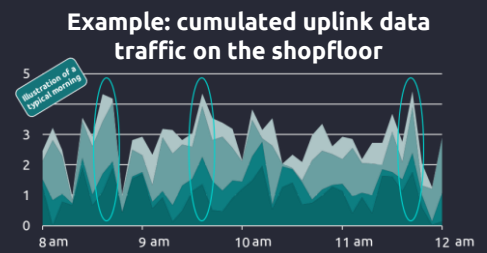
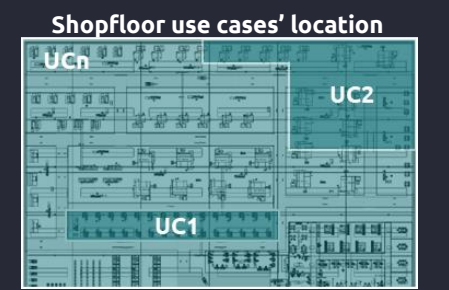


INCREMENTAL NUMBER OF CONNECTED DEVICES

GROWING STRESSES ON THE INDUSTRIAL NETWORK



+





# AN OPEN, MODULAR PLATFORM APPROACH IS ESSENTIAL TO ACCELERATE TRANSITION FROM COMPUTERIZATION TO ADAPTABILITY

Manufacturing  
Operations  
Platform

**OPEN**

Leveraging container, platform and interoperability technologies, to establish a platform which is designed for the seamless integration of assets and systems

**VALUE-DRIVEN**

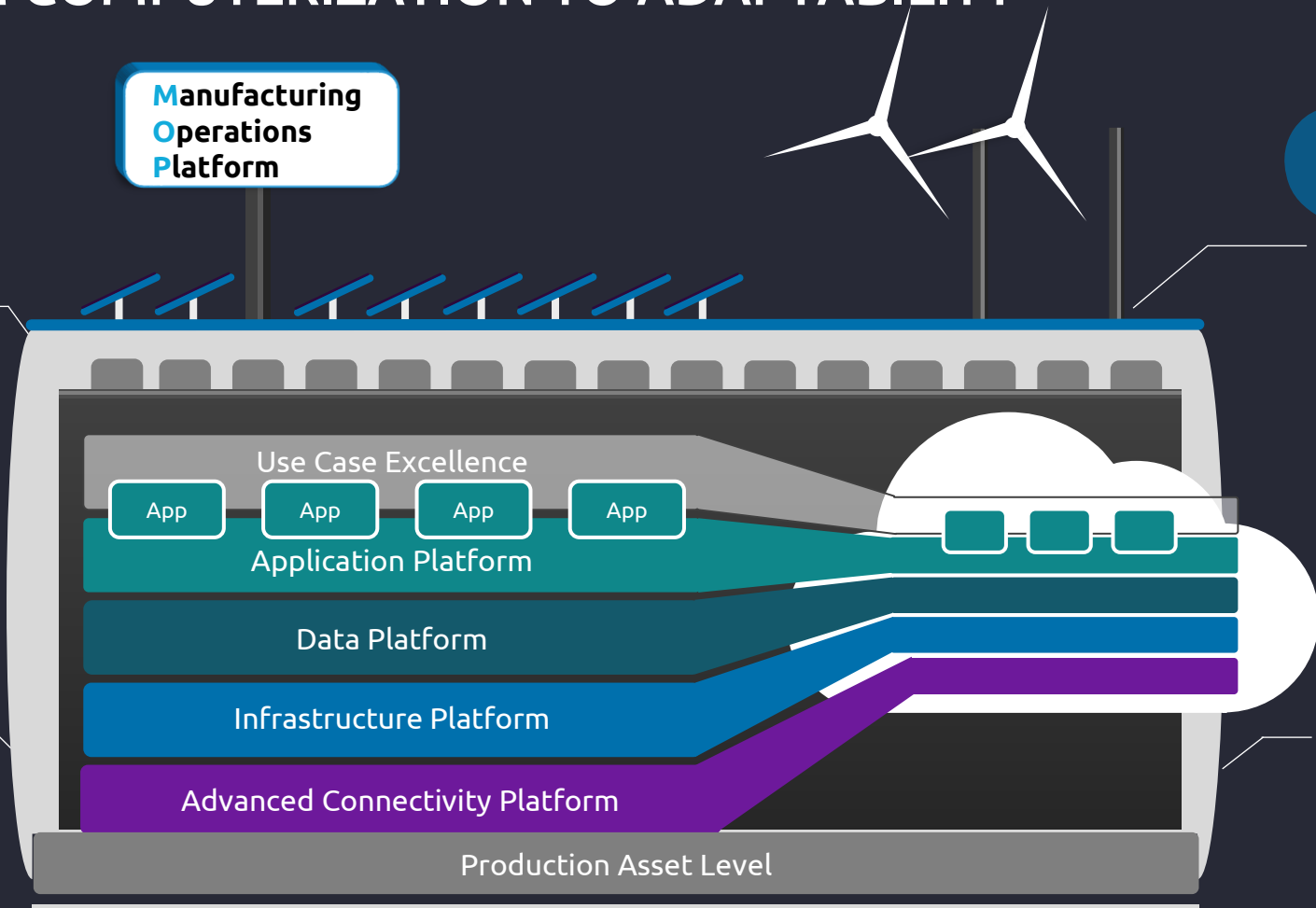
Based on standardized platform foundation focus on the business application to enable use case excellence layer and create immediate business impact

**Modular**

Our approach helps to create a sustainable platform landscape where solutions can be up- and down-scaled locally, centrally or in the Cloud

**Adaptive**

Based on reusable capabilities and services, MOP helps to decrease time to market, and enables you to respond quickly to market needs



KPI impact

- +30% Efficiency
- 100% Scalability
- 40% Costs
- ~3x Speed of Innovation



# 5G IS THE FIRST CELLULAR CONNECTIVITY TO BE DEVELOPED FOR INDUSTRIAL OPERATIONS

## 5G TECHNOLOGY FEATURES

<b>* Bandwidth - Throughput</b> <i>x10-x100 vs 4G</i>	<b>10Gb/s</b>
<b>Devices density</b> <i>X100 vs 4G</i>	<b>1M devices /km2</b>
<b>Low Latency</b> <i>1/10<sup>th</sup> of 4G</i>	<b>1-10ms</b>
<b>High accuracy 3D positioning</b>	<b>&lt;3cm</b> Release17
<b>Versatility</b> <i>1 single infrastructure to support heterogeneous connected use cases</i>	
<b>Reliability</b> <i>Allowing support of safety critical use cases</i>	up to <b>99,999%</b>
<b>Network slicing</b> <i>Custom, guaranteed QoS per application, device...</i>	
<b>Mobile Edge Computing enabler</b> <i>For distributed applications</i>	
<b>Convergent core network</b> <i>Managing multiple access technologies (Wi-Fi, 4G, 5G NR...)</i>	

- **Accelerated 5G deployments now a reality**
- Preceding the deployment, an RF survey can **future-proof the deployment** by securing **ubiquitous coverage** of the shopfloor. Potential future requirements can be covered with remote SW upgrades
- 5G offers 99.999% availability and reliability, competing with wired **technologies without the physical obstacles for scalability**
- 5G is coming of age and **deployment cost is significantly reduced**, especially for deployments at scale (full factory floor)

### Key industrial features

- **Standardized QoS profiles** enable critical services to run unaffected in the required network performance
- Connectivity **convergence** ensures traffic from 4G, Wi-Fi & Wired networks can be integrated in one platform
- **Time-Sensitive-Networking** capability industrial automation & control-to-control communication
- Native capability to accommodate **massive machine-type-communications** making it ideal connectivity for IIoT

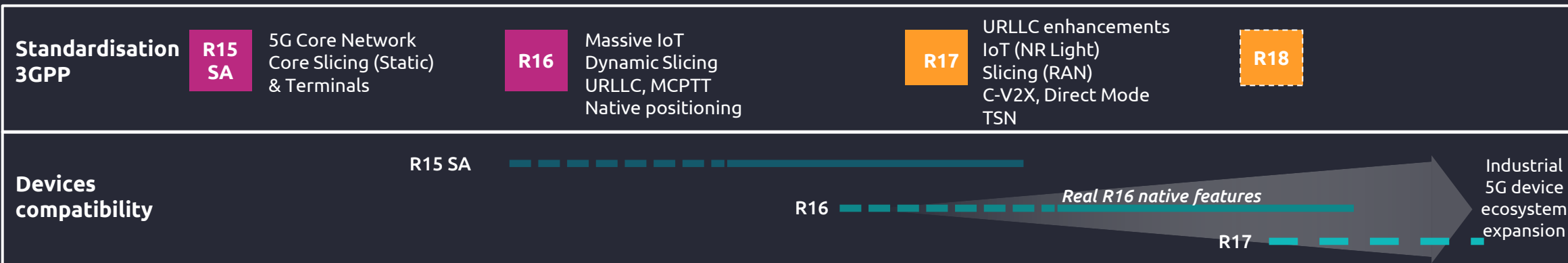
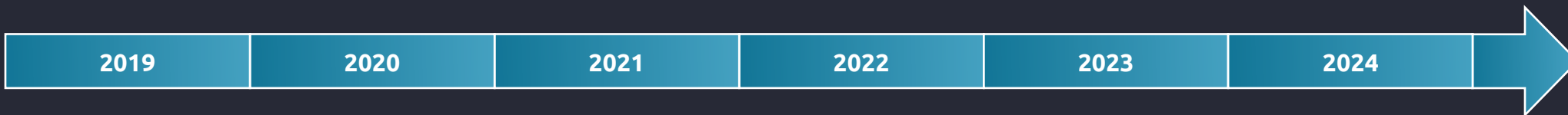
### Key security features

- Wi-Fi networks broadcast their identity (SSID), providing an avenue for attackers to compromise the network, whereas the **subscriber identity (SUPI/IMSI) is concealed in 5G**, offering better privacy protection
- The **Authentication and Key Exchange protocol in 5G** is superior to what is offered by the latest Wi-Fi standard (Wi-Fi 6)
- **\* Dedicated spectrum** is licenced to be the enterprise, unlike Wi-Fi which operates in unlicensed band
- 5G offers **seamless authentication** when moving from cellular to non cellular(Wi-Fi) networks



# 5G PRIVATE NETWORKS CAPABILITY & FEATURES

## 5G IS COMING OF AGE IN 2023 FOR INDUSTRIAL APPLICATIONS & COMMERCIAL DEPLOYMENTS



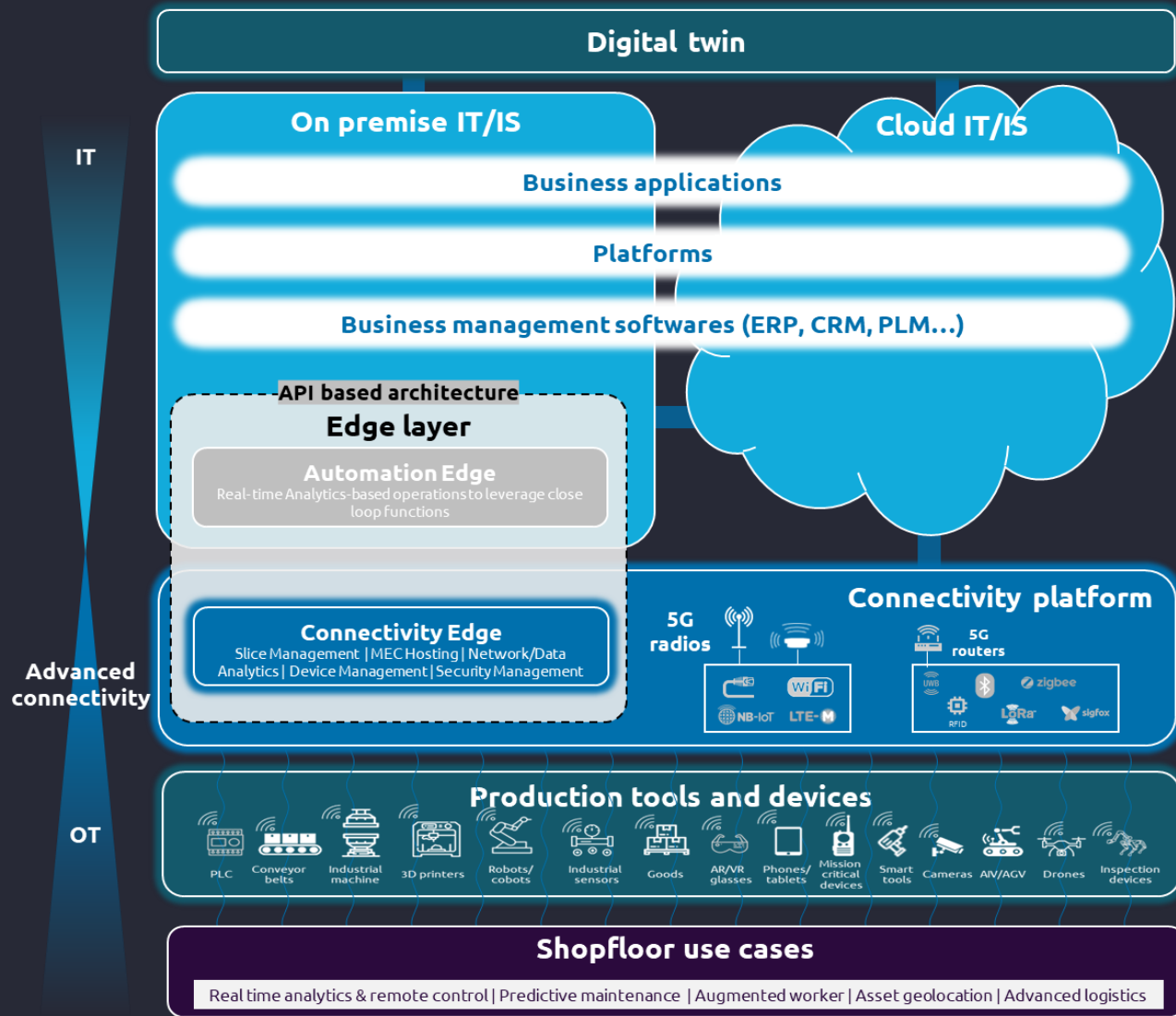
### 5G for I4.0, today

- eMBB (20Gbps+ UL/DL with carrier aggregation)
- Custom QoS profiles
- Dual support 4G+5G (Combo Core)
- 5G and Non-terrestrial Networks convergence
- RAN Energy Efficiency (vs 4G and Wi-Fi)
- Enhanced Security

### Industrial 5G, tomorrow

- Time critical communication (TSN) over 5G
- mMTC (massive IoT)
- Dual Support Wi-Fi + 5G (Combo Core)
- Accurate indoor location positioning (1m range)
- RedCap & low power
- Ultra reliable low latency
- Device-to-Device communications
- ORAN support

# 5G, COMBINED WITH EDGE COMPUTING, ENABLES FURTHER IT/OT CONVERGENCE AND ENSURE THE INTEROPERABILITY OF VARIOUS INDUSTRIAL CONNECTIVITY TECHNOLOGIES



## UNIFIED CONNECTIVITY PLATFORM

**Disruptive software-defined, multi-access edge & cloud-based architecture**

Deployable across sites and ensuring **abstraction of local specificities** (access to local spectrum, collaboration models with Telcos...) through **convergent layers**

Enabling fast digital use cases deployment & at lower cost, **bringing key business benefits :**

- ✓ Enhanced process monitoring and control capabilities
- ✓ Remote diagnosis/service capabilities
- ✓ Increased KPI visibility, analytics development and performance improvement
- ✓ Rationalized set of business applications
- ✓ Accelerated Industry 4.0 initiatives (eg. predictive maintenance, flow tracking..): existing APIs & connectivity

**Multiple connectivity technologies**



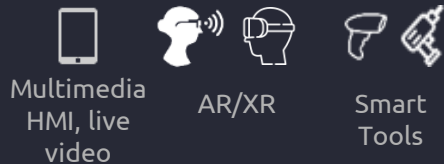
**Standardized and secure by design**

# 5G-ENABLED CAPABILITIES ACROSS PRODUCTION, SUPPLY CHAIN AND PRODUCTS FOR THE E2E OPERATIONAL LIFECYCLE



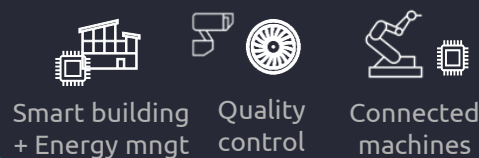
## CONNECTED WORKER

- AR / Remote expert & Guided procedure
- AR/VR training
- Paperless / smartphone
- Push-to-Talk
- HMI tablets
- Smart tools
- Safety & Wellbeing monitoring with AI-based camera system
- RTSP video streaming
- Handheld Scan and Track



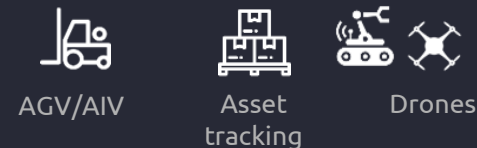
## CONNECTED PRODUCTION LINE & MACHINERY

- Massive sensor networks (environment, energy consumption, process control)
- Production process Digital twin
- Connected machines for monitoring & maintenance
- Quality control with computer vision
- Indoor asset tracking
- Automated Floor Maintenance
- Safety light curtain



## CONNECTED LOGISTICS

- AIV / AGV / AI Transfer Robots
- Remote Forklift Operations
- Co-bots
- Scan and Pick Robotic Arm
- Automated Pallet Mover
- Indoor asset tracking
- Precision motion control
- Inventory of assets by drones
- Autonomous wheel loader/trolley
- Stock management / replenishment



## CONNECTED PRODUCTS

- Spare parts track & trace
- Digital twin of car production process
- OTA updates on a parking lot

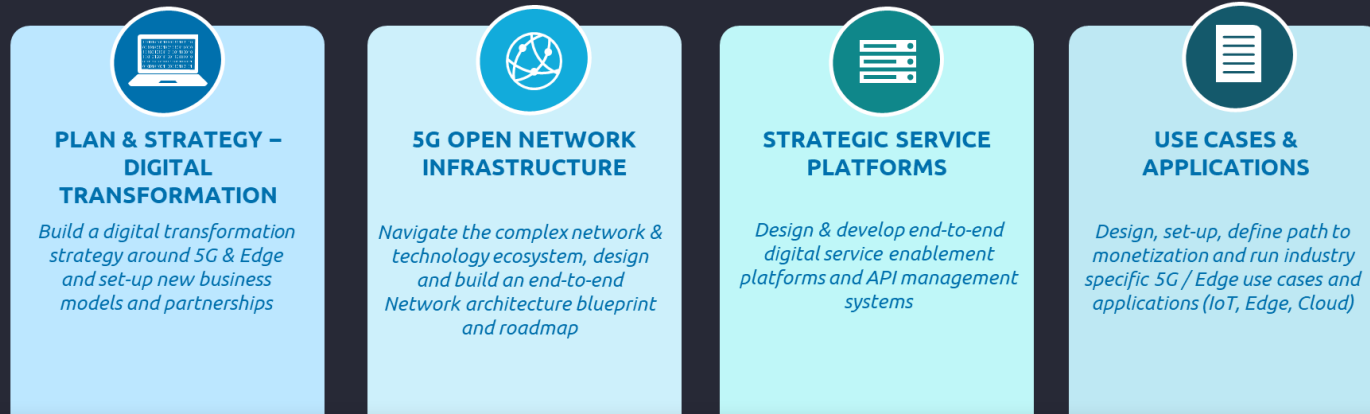






# CAPGEMINI OFFERS SERVICES AND ASSETS TO ACCELERATE AND DE-RISK 5G ADOPTION ACROSS THE E2E INDUSTRIAL OPERATIONS LIFECYCLE

## CAPGEMINI GROUP 5G SERVICE OFFERING



### ECOSYSTEM ORCHESTRATION & INTEGRATION

Assemble & integrate solutions to form a coherent, scalable, agile, software-driven and futureproof E2E technology stack:

- Integrate leading partners and open-source solutions
- Engineer complementary solutions where required



### 5G END-TO-END BUSINESS & OPERATIONAL SERVICES

Transform operating model, organization and OSS/BSS in line with new IT/NW infrastructure, new products and services, automating tasks & processes and providing managed services



## ASSETS & CAPABILITIES

Global network of 5G Labs	Portfolio of 5G/Edge Use cases & micro-services
5G PN offering (multiple variants)	Edge compute solution
Licensable 5G network software frameworks	Strong Partner ecosystem
Industry verticals expertise	Telecom / Connectivity expertise & engineering capabilities
Network   IT   OT system integration	Cross functional expertise across Industrial OT, Cloud, Analytics&AI...





# .....THERE ARE NEW GOALS FOR CONNECTED INDUSTRY AND NEW PROBLEMS TO SOLVE WHICH NEED A ROBUST SOLUTION...

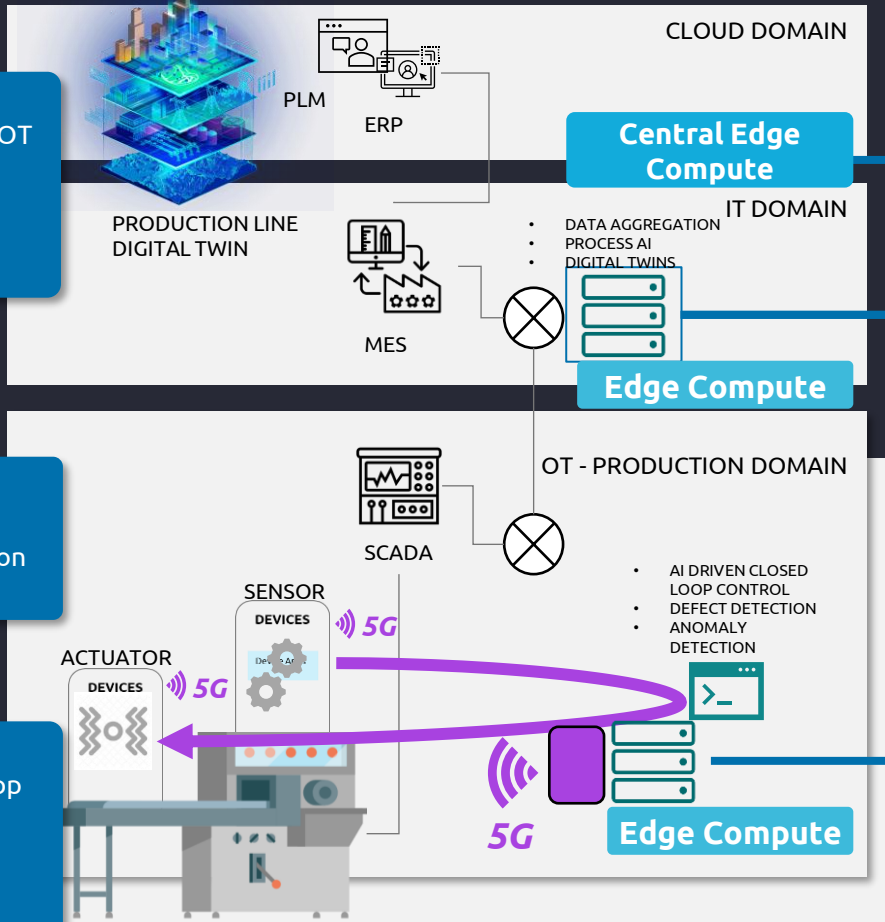


## NEW GOALS FOR GIGAFACTORIES

- 1
  - Aggregate Data from OT Cells and build Digital Twins of the entire production process
  - Get 360° observability

- 2
  - Add more sensors for better defect prediction and insight

- 3
  - Implement Closed Loop Control based on new sensors and AI aided Control Algorithms



## NEW PROBLEMS TO SOLVE

- 1
  - Getting Real-Time Data from disparate OT Domains
  - Unifying data from different vendor devices
  - Providing secure access to data and connectivity

- 2
  - Reducing the wire sprawl when adding new sensors and actuators
  - Provide connectivity in a denser deployment environment

- 3
  - Deploying new software for AI Aided Control Algorithms, with local OT domain access



## SOLUTIONS

- 1
  - Multi-Tier localized processing with Edge Computing, supported by a common Orchestration Platform
  - IoT Data pre-processing & normalization
  - Secure & Verified access to data

### Edge Computing

- 2
  - 5G Mobile Private Networks with low-latency connection to Edge Nodes

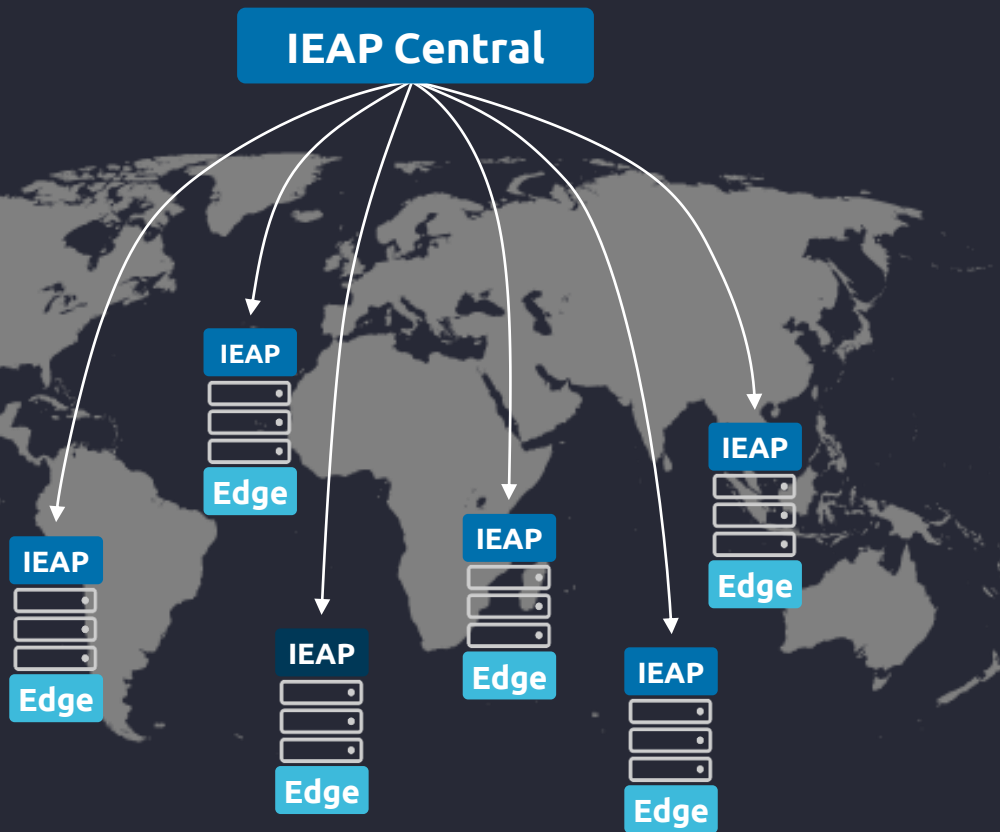
### 5G Mobile Private Networks

- 3
  - Multi-Tier Edge capable of running containerized AI / Control software with GPU and accelerated networking support
  - 5G Software frameworks and NEP partners to accelerate 5G adoption

## COLLECTING DATA & DEPLOYING INTELLIGENT FUNCTIONS WHERE NEEDED



# OUR INTELLIGENT 5G & EDGE APPLICATION PLATFORM



Capgemini & Partner applications leveraging Edge Computing in 4 key sectors:



## IEAP: an edge-to-cloud orchestration MEC platform

Leveraging existing assets, our solution offers a MEC platform

### ENSCONCE

Multi-Access Edge Computing (MEC) platform for developing & deploying applications at the network edge

### NETANTICIPATE

Communication network boost based on artificial intelligence and machine learning

### ADRENALINE

Computational boost for containerized applications at the network edge

### NUOS

Microservices for 5G and connected applications

### SMART FACTORY

Test bed and use cases for digital manufacturing

**Hardware and provider-agnostic:** allowing clients to leverage edge infrastructure of different types and in multiple locations (central cloud, far edge, near edge, devices, etc.)

**With unique, edge-specific, pre-packaged services** that accelerate edge use case development and deployment across priority industries

## Continuous commitment to open innovation and standardization



# WE BRING SCALABLE 5G INDUSTRIAL APPLICATIONS LEVERAGING MICROSERVICE-BASED ARCHITECTURE AND DELIVERY MODEL





**MICROSERVICES LIBRARY**  
INDEPENDENT SW FUNCTIONAL MODULES READY TO USE

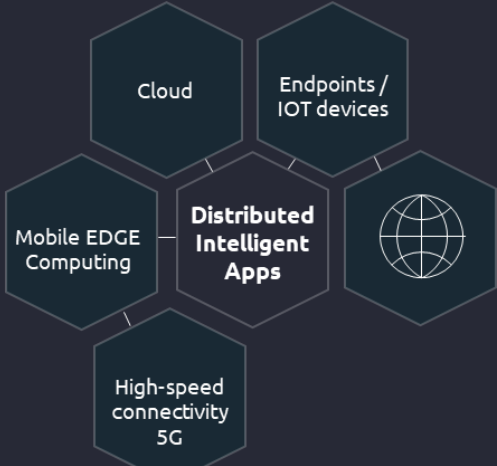
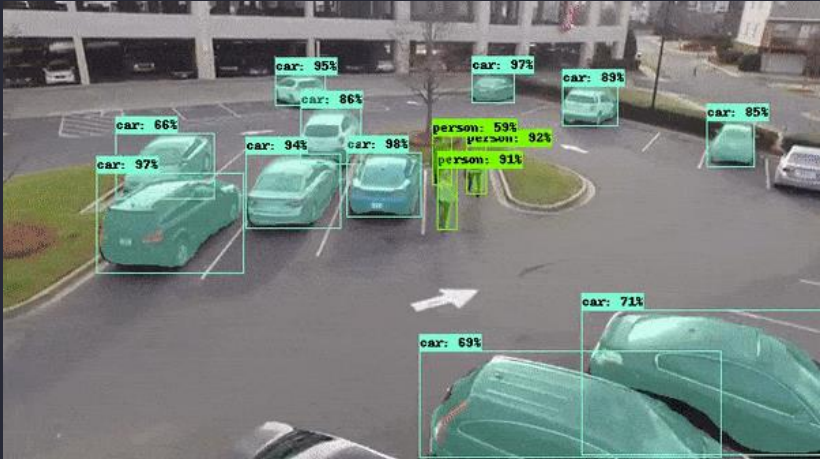


**MICROSERVICES PLATFORM**  
COMPATIBILITY WITH THE MOST COMMON K8S FRAMEWORKS

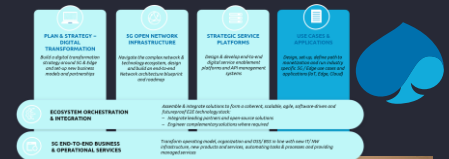


**SOLUTION DEPLOYMENT**  
IN EC NODES, PRIVATE NETWORKS, CLOUD PARTNERSHIPS ...

-   
Authentication
  -   
Recognition
  -   
Behavior Analysis
  -   
AR/XR
  -   
Video calls
  -   
Ultra Low Latency
- Ex: Object recognition microservice*



# ... WITH AN EXISTING PORTFOLIO OF 40+ USE-CASES THAT CAN BE TAILORED TO ADDRESS INDUSTRIAL NEEDS



## Manufacturing

## Energy/ Extraction

## Automotive/ Transportation

## Healthcare/ Life Sciences

## Public Safety/ Smart Cities

## Entertainment & Learning

## Retail

- Immersive Remote Assistance & guided procedure
  - Training in AR with Instructional Overlay
  - Enhanced maintenance with AR
- Autonomous Intra-Logistics with AIV / AGV
  - Smart Safety & Surveillance
  - Predictive Performance
- Robotic arm for intelligent operations (QA, pick & sort)
- Asset tracking
- Real time monitoring of drilling robots
- Integrated Autonomous Crane System (IACS)
- Smart Mining: Remote control & operations
- Smart Windfarm service monitoring & maintenance
- AR Powered operations for refineries
- Virtual training for offshore operations
- Real time monitoring of drilling robots
- Drones for inspection & surveillance
- Asset tracking
- Connected cars, ADAS systems
- V2X services with MEC roaming
- V2V Assisted Driving in condition of vehicle's queues and overtaking
- V2I Intelligent Speed Adaptation and Control
- 5G Open Road with connected & automatized mobility / V2X

- Smart Health - Real-time tele-transmission of ultrasound for remote consultation and guidance
- Connected ambulance
- Augmented vigilance Covid 19 robot
- Search & Rescue with drones with the Red Cross
- Emotional Support Avatar

- Crowd management
- Post-Covid: No-mask detection, Social Distance Detection, Temperature measurement
- Stolen license plate tracking\*
- Isolated operator protection\*
- Livestream bodycam\*
- Face Recognition
- Augmented vigilance Covid 19 robot
- 5G powered drones for Search & Rescue
- 5G Open Road with connected & automatized mobility
- 5G Services at Harbour
- Drones for port activities

- Interactive live holographic performance via 5G connectivity
- Gaming: bet in real time during sport events
- Streaming of live news / journalistic contents
- AR City Driver / Smart city-oriented indications
- Tourist in VR, enhanced experience for museums, monuments

- Augmented Retail experience with holographic view of items & chroma system
- Shopping Assistance with AR

*Indicative, non exhaustive*

# GET THE FUTURE YOU WANT



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RUGBY  
WORLD CUP  
FRANCE 2023

Capgemini 

WORLDWIDE PARTNER



# HOW TO CHOOSE THE RIGHT CONNECTIVITY TECHNOLOGY?

## DECISION MAKING IN-LINE WITH DIGITAL TRANSFORMATION MATURITY / ROADMAP

### 1 Do you know the limitations of connectivity solutions?

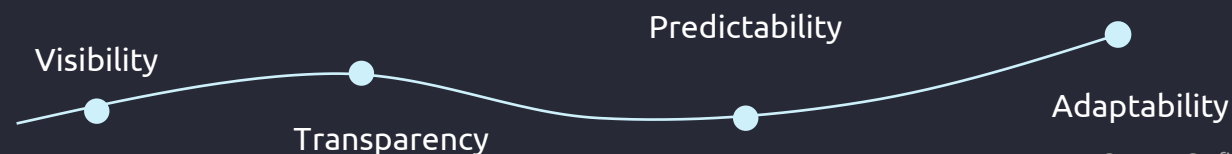
Range	< 100m	< 100km	< 20cm	< 10m	1m – 150m	50 – 100m	10m – 1km	100m -20km	< 5000km
Latency	< 10µs/m	< 10µs/m	< 100µs	~ 10ms	< 10µs	> 5ms	> 2ms	1-5s	500ms – 10s
Bandwidth	< 400 Gbps	< 1 Tbps	400 kbps	2 Mbps	600 kbps	5.5 Mbps - 2 Gbps	< 20 Gbps	50 kbps	Kbps – Gbps
Power Consumption	Moderate	Low	Very Low	Low	Very Low	High	Low – Very Low	Very Low	High
Deployment Costs	Moderate - High	Moderate – High	Low	Low	Low	Moderate	Moderate - High*	Low	Very High
Operational Costs	Moderate - High	Moderate - High	Low	Low	Low	Moderate	Moderate	Very Low	Very High
Reliability	High	High	Low	Low	Moderate	Low	High	Low	Moderate
Security	High	High	Low	Low	Moderate	Low	High	Low	Moderate

### 2 What is your critical need(s)?

- Legacy, low performing infrastructure
- Flexibility & Scalability in redesigning the shopfloor
- Investment for Industrial Automation
- Investment for location positioning
- MOP vision transformation
- Renew infrastructure for high-volume data
- Investment for worker safety
- On-prem Servers reaching EoL

### 3 Connectivity transformation in-line with digital transformation

\*Costs are decreasing QoQ as 5G technology matures and scales





# WHERE ARE YOU IN THE DIGITAL TRANSFORMATION JOURNEY?

