Demystifying Enterprise Digitalization Powered by Intelligent Network

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A DAY IN A MANUFACTURING ENTERPRISE

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DIGITAL SUPPLY

5

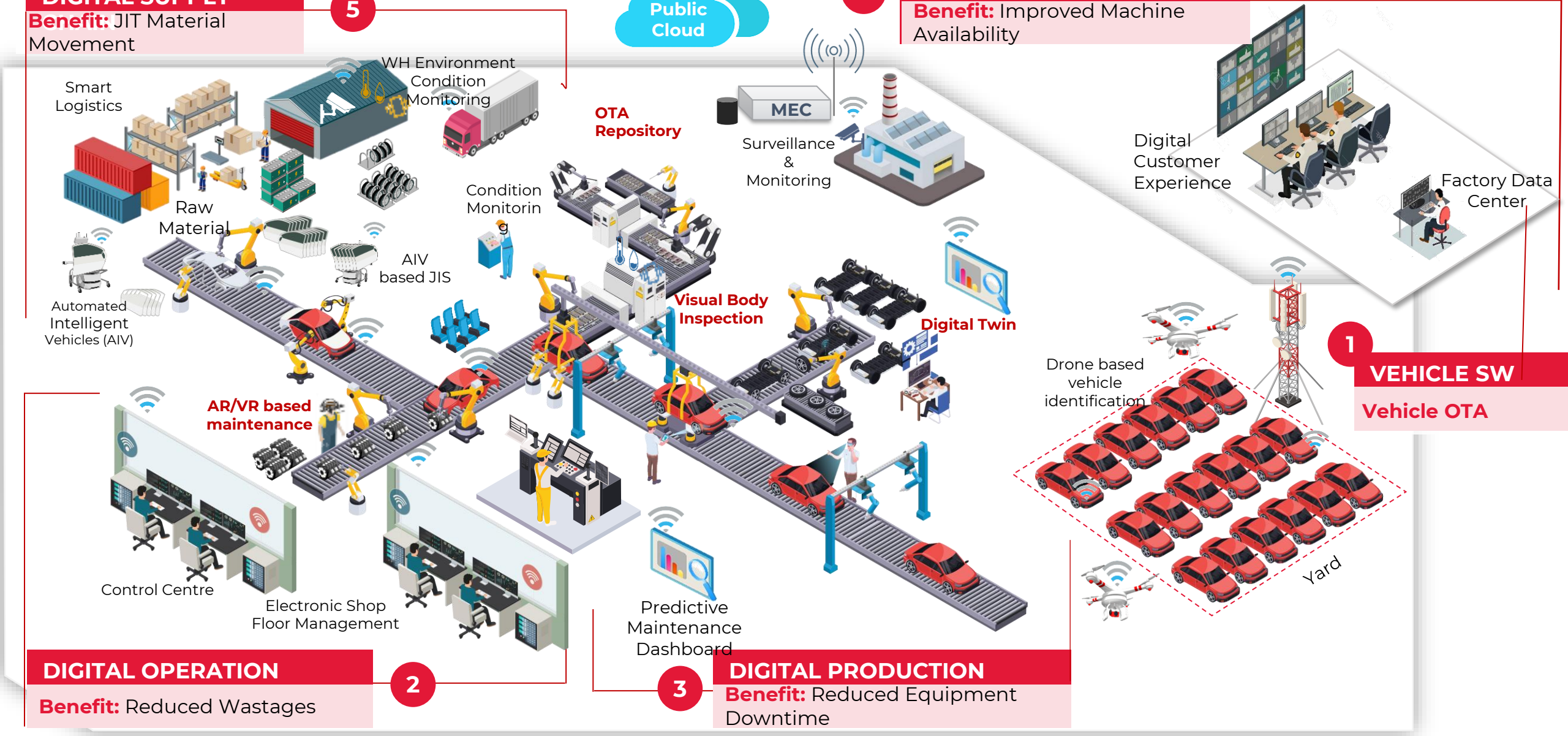
Benefit: JIT Material Movement

Public Cloud

4

DIGITAL SERVICES

Benefit: Improved Machine Availability



1

VEHICLE SW

Vehicle OTA

DIGITAL OPERATION

2

Benefit: Reduced Wastages

3

DIGITAL PRODUCTION

Benefit: Reduced Equipment Downtime

DIGITAL SOLUTIONS DRIVING NEED OF HIGH BANDWIDTH / LOW LATENCY

Variety, Velocity & Volume of data in Manufacturing landscape

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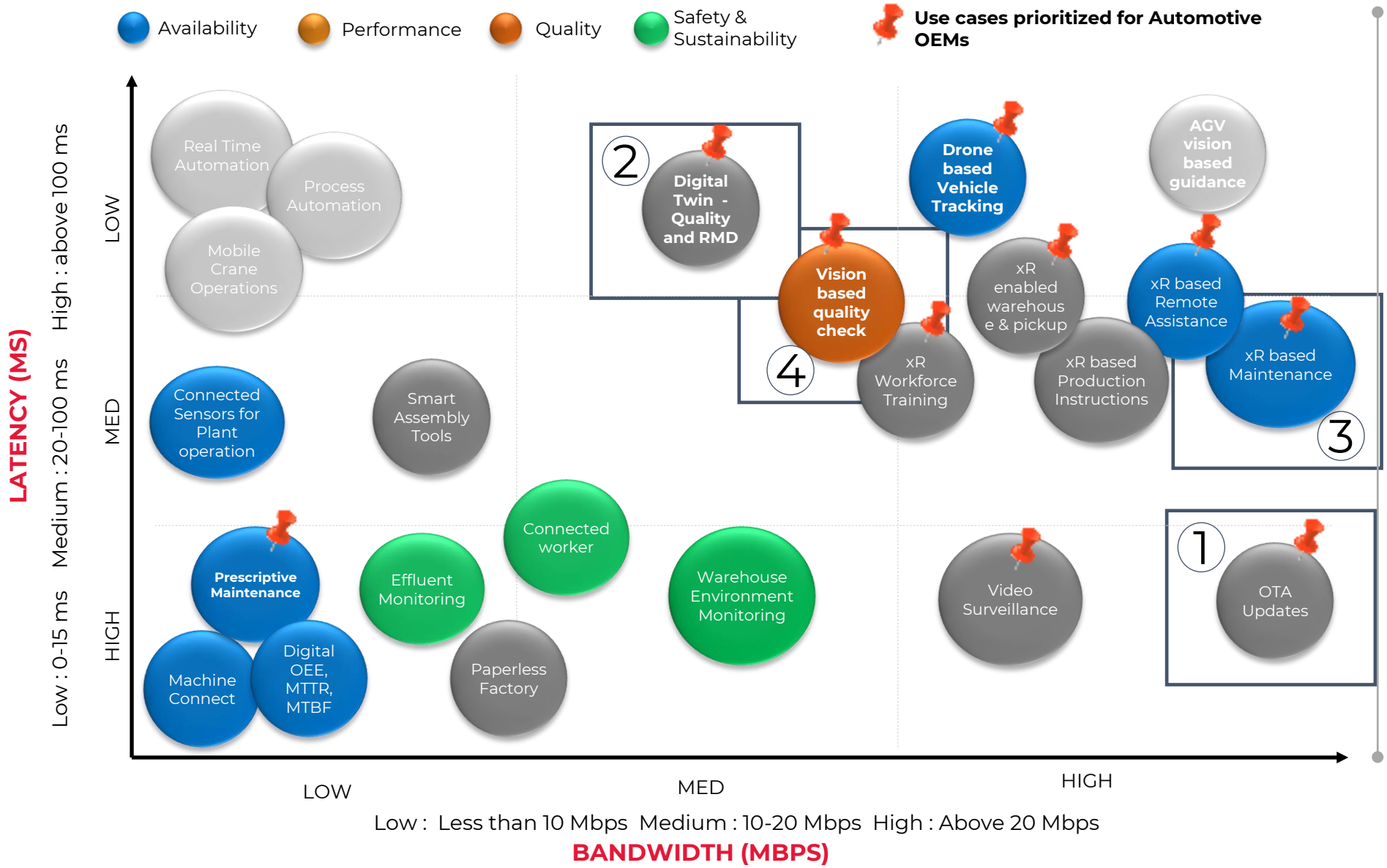

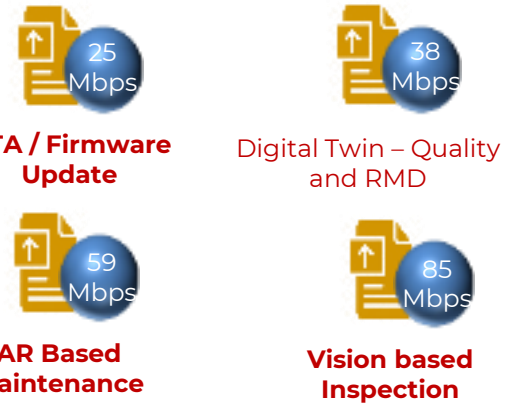

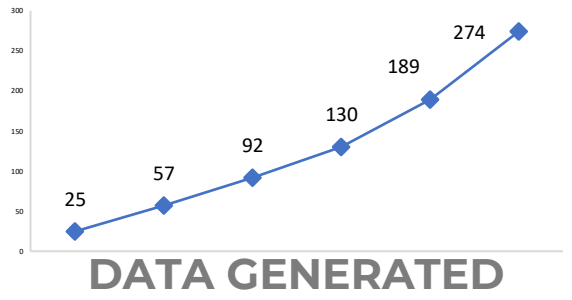

Compute, Transmission, Storage

~15 TB generated/day

These Use Cases will demand High bandwidth – Latency – Secure network for the M&M plant

ENTERPRISE DIGITIZATION SHIFT IN PARADIGM

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CURRENT STATE

IT Digitalization
Steadily Ongoing

IoT Investments
OT Digitalization PoCs

Unused Data
Data Silos
Unanalysed Data

Legacy Applications
Interoperability issues

CHALLENGES

Wireless Shift
Speed, Reliability, Mobility, Security

Application
Legacy to Transform

Cloud Shift
Latency, Privacy & security concerns

Discrete Assets
Heterogeneity

On-Prem
Capex intensive

People
Resistance to Change

SHIFT IN LANDSCAPE

4.4 ZB
Machine Generated Data by 2020

50x
Growth In Sensor Data By 2020

150K
COBOTS By 2020

34%
Data To Cloud Rest On-prem/Edge 2023

ENTERPRISES' SHIFT TO NETWORK TRANSFORMATION

5	INDUSTRY 4.0 ENTERPRISE	Integrating connected factories with smart supply chain, suppliers, customers, product design and aftermarket services
4	CONNECTED FACTORIES	Multiple digital factories are connected through the cloud and can be managed centrally
3	DIGITAL FACTORY	Smart manufacturing in a single factory premise with other digitized functions
2	SMART MACHINES	Intelligent machine in production with minimum human intervention
1	SMART COMPONENT	Intelligent machine components and subsystems

Data Bandwidth

Data Size

Mobility

Security

"Edgification" Edge & cloud	LAN/ Factory NW Transformation	WAN Transformation	Security	Application Transformation
▪ Latency requirements ▪ Edge datacenters ▪ Cloud (Private, Public, Hybrid) ▪ IT / OT integration	▪ Mobility requirements ▪ Private network ▪ Legacy devices integration ▪ Wired to wireless transformation	▪ Software defined (SD-WAN) ▪ Factory to cloud ▪ Factory to factory Connectivity	▪ Device onboarding & mgmt. ▪ Threat vectors & vulnerability ▪ IT & OT environment sanctity ▪ Security at device edge, enterprise Edge & cloud	▪ Edge Vs cloud resident applications ▪ Legacy application transformation

TELCO & ENTERPRISE CONVERGENCE INEVITABLE

COMMUNICATION

Revenue shift to OTT
Cost & Size decreasing

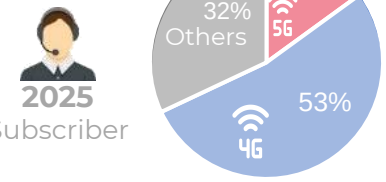
5G
- Speed
- Latency
- Reliability

4G
- Immersive experience *In 3 sec @20 mbps*
- Stream a movie *In 26 min @20 mbps*

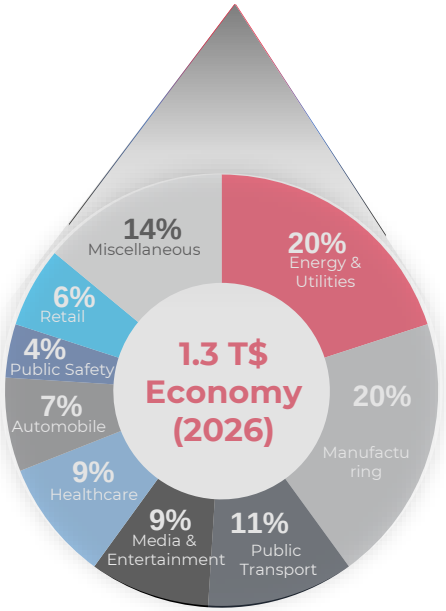
3G
- Download Pictures *In 25 hours @64 kbps*

2G
- Send text messages

Downloading 2 hour film on



Convergence of 5G and Enterprise



ENTERPRISE

Machine Data

- OPEX Optimization
- Revenue Augmentation
- Customer experience

42 Bn 80 Zb
Connected IoT devices by 2025

250Mn
Connected cars by 2020

200Mn
OTA enabled vehicles by 2022

4 TB
Data / Vehicle/day

3TB
Oil Field Data/day

50Mn+
remotely monitored patients by 2021

5G FOR ENTERPRISE : SHIFT INTELLIGENCE TO THE EDGE

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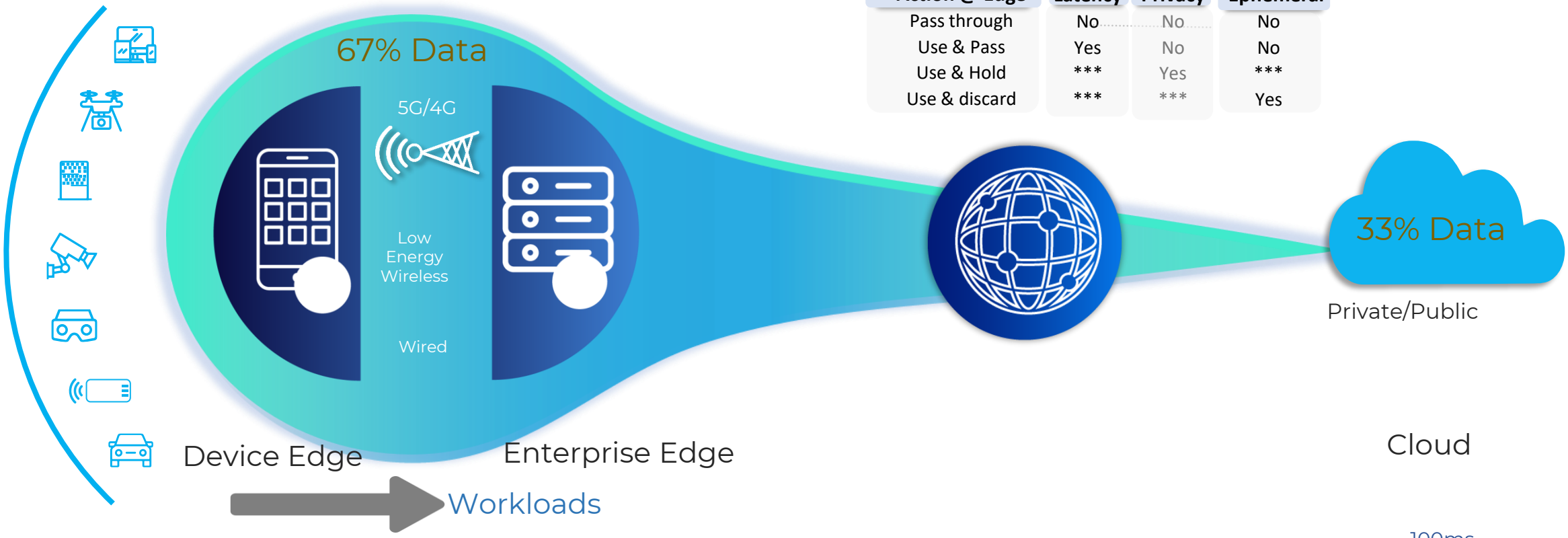
Data Processing function of
Latency, Privacy, Cost

SENSITIVITY

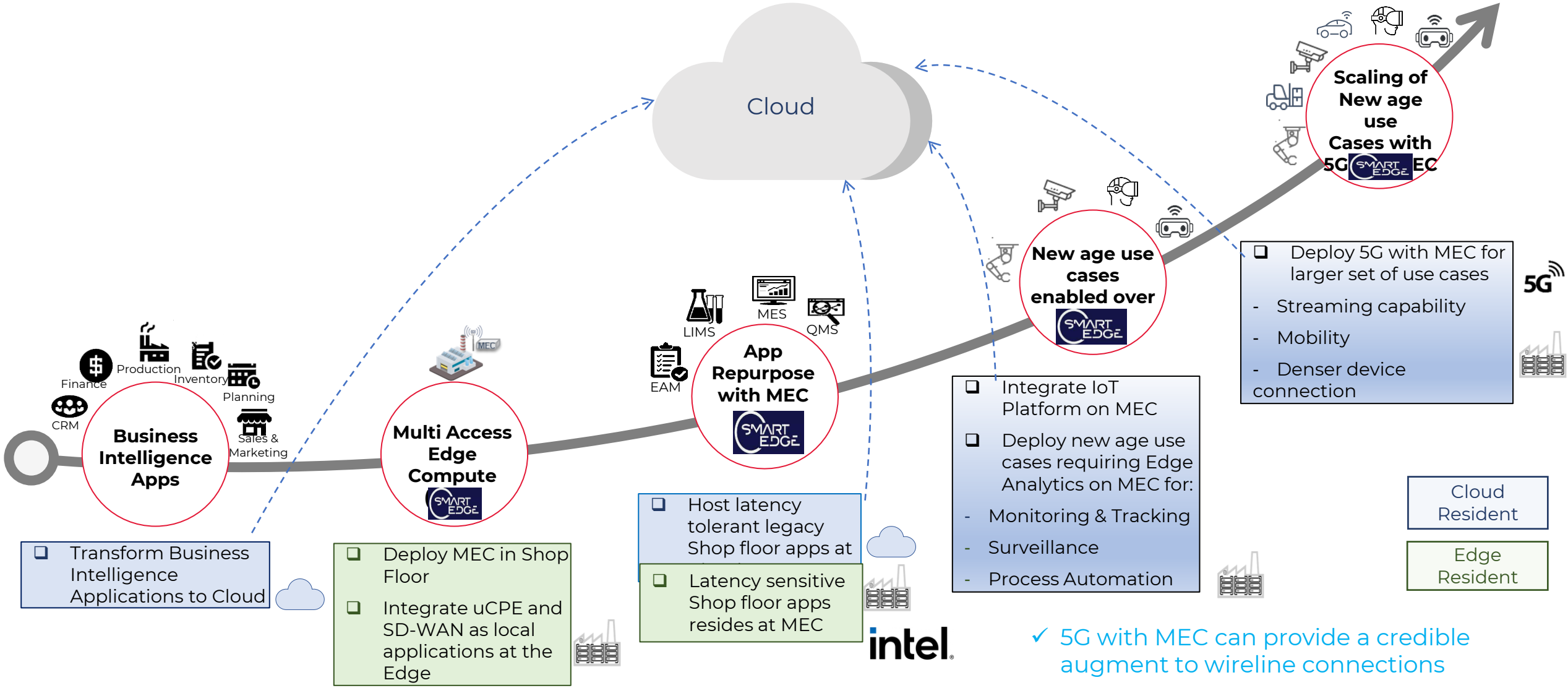
Action @ Edge	Latency	Privacy	Ephemeral
Pass through	No	No	No
Use & Pass	Yes	No	No
Use & Hold	***	Yes	***
Use & discard	***	***	Yes



	Device Edge	Enterprise Edge	Cloud
Latency	0 ms	20 ms	100ms
Cost Optimization	0%	20-30%	55%
Privacy Vulnerability	Low	Low - Medium	High

ENTERPRISE DIGITALIZATION ROADMAP

5G & MEC enablers in the road map



- Transform Business Intelligence Applications to Cloud
- Deploy MEC in Shop Floor
- Integrate uCPE and SD-WAN as local applications at the Edge
- Host latency tolerant legacy Shop floor apps at
- Latency sensitive Shop floor apps resides at MEC
- Integrate IoT Platform on MEC
- Deploy new age use cases requiring Edge Analytics on MEC for:
  - Monitoring & Tracking
  - Surveillance
  - Process Automation
- Deploy 5G with MEC for larger set of use cases
  - Streaming capability
  - Mobility
  - Denser device connection

- ✓ 5G with MEC can provide a credible augment to wireline connections
- ✓ LTE with MEC is starting point for many use cases

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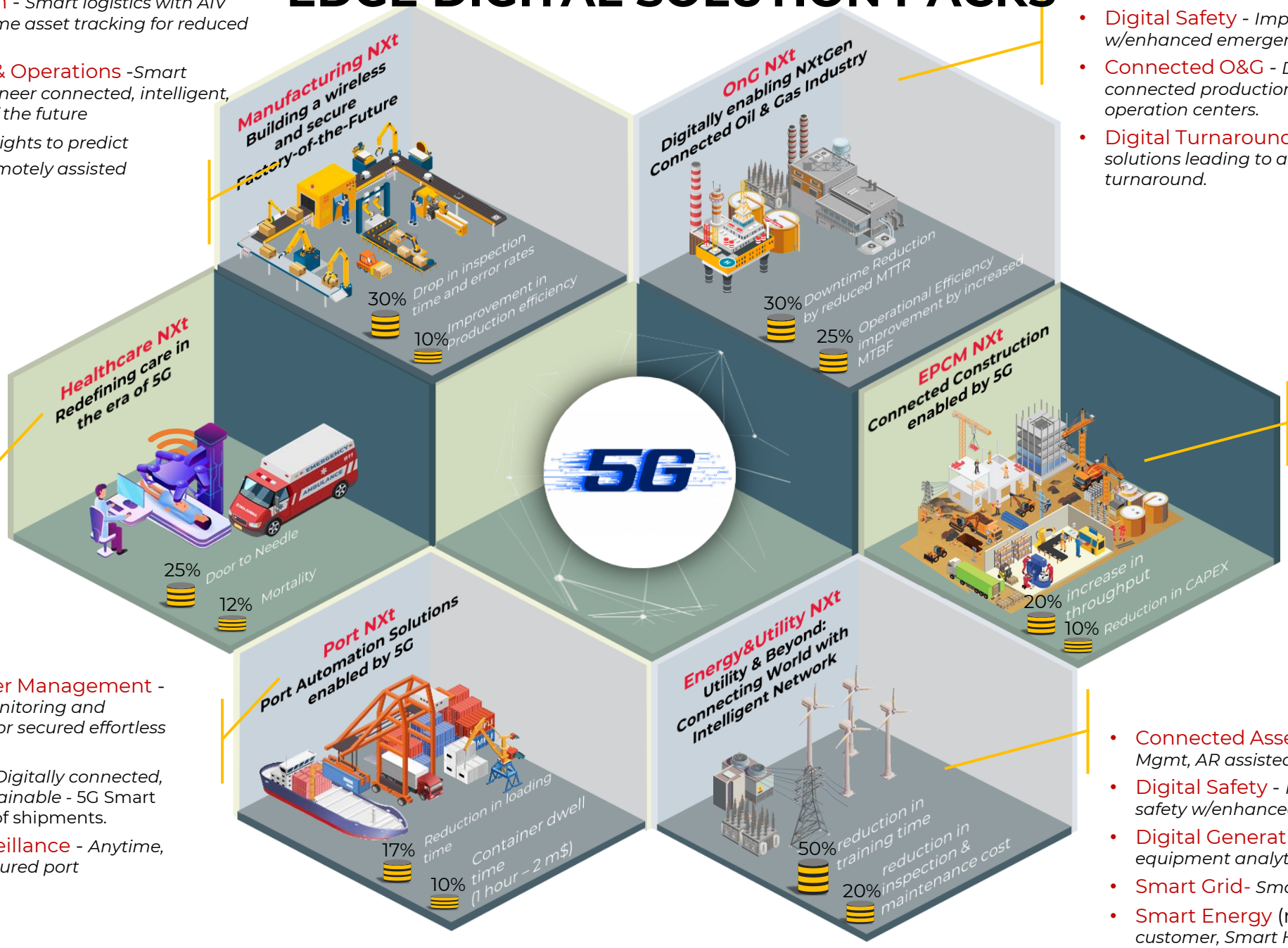
EDGE DIGITAL SOLUTION PACKS

- Digital Supply Chain - *Smart logistics with AIV technology and real time asset tracking for reduced response time.*
- Digital Production & Operations -*Smart Manufacturing to engineer connected, intelligent, and secure factories of the future*
- Digital Services - *Insights to predict machine needs and remotely assisted maintenance activities.*



- Connected Assets - *Real time Inferencing of data*
- Digital Safety - *Improved personnel safety w/enhanced emergency response*
- Connected O&G - *Digital transformation with connected production controlled via remote operation centers.*
- Digital Turnaround - *Pre-integrated digital solutions leading to a faster and cost-effective turnaround.*

- Real Time Diagnosis in Emergency Care
- Real Time Remote Monitoring & Consultation
- Tele Surgery
- Hospital Asset Mgmnt

- Connected EPCM (build right first time)- *Intelligent Design, Connected Procurement, Smart Construct, Connected Commissioning, Intelligent handover*
- Connected Assets - *Real time Inferencing of data*
- Digital Safety

- Automated Container Management - *Real time Container monitoring and automated inspection for secured effortless cargo movement.*
- Digital Operations - *Digitally connected, hyper-efficient and sustainable* - 5G Smart Ports for seamless flow of shipments.
- Digital Safety & Surveillance - *Anytime, anywhere visibility & secured port operations.*

- Connected Assets – *Real time Asset Mgmt, AR assisted remote maintenance*
- Digital Safety - *Improved personnel safety w/enhanced emergency response*
- Digital Generation – *Real time equipment analytics*
- Smart Grid- *Smart AMI, Smart T & D*
- Smart Energy (retail) – *Connected customer, Smart Home city, Renewables*

Technology & Architecture Behind 5G in Industrial / Enterprises

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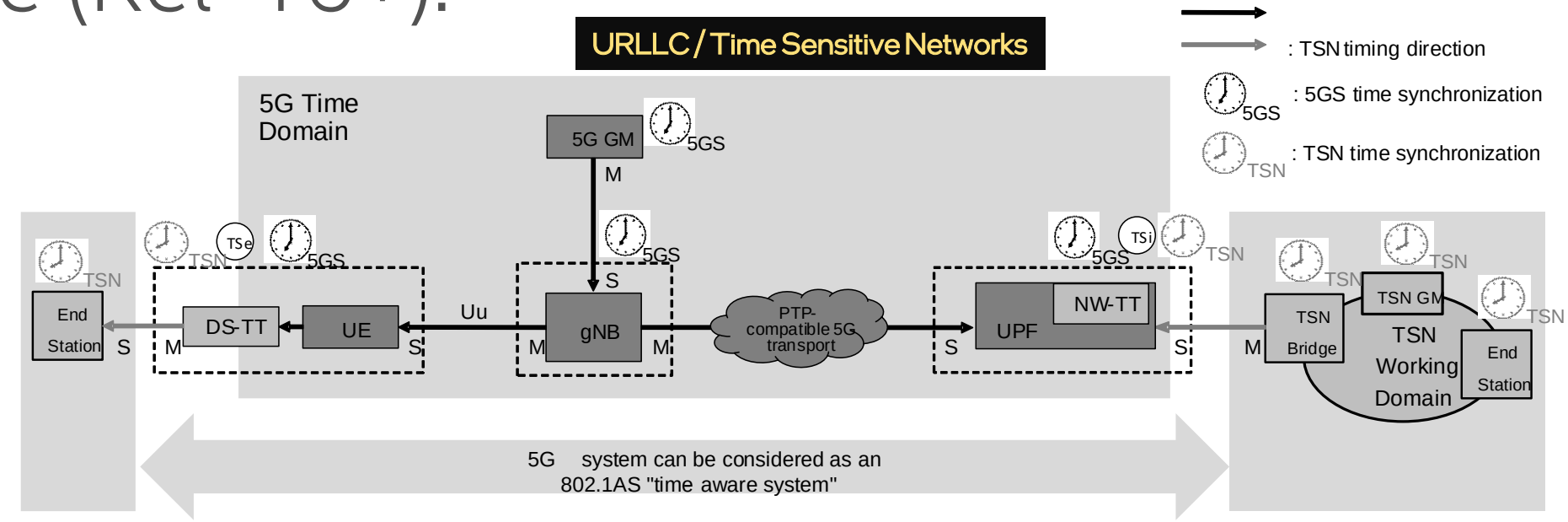
Outline

- What is changing in Enterprise Networking?
- An example Reference Architecture
- Discussion on Use cases and deployment

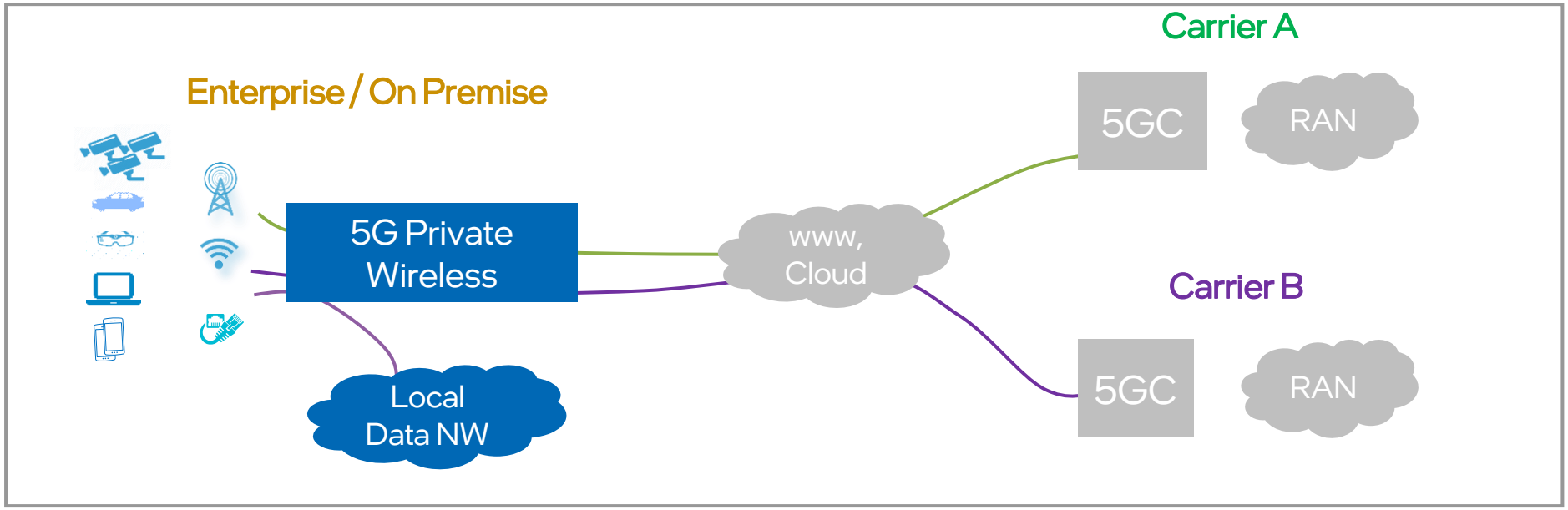
Beyond Mobile Broadband: Implications in RAN & Core (Rel-16+):



Platform for Low Latency & Reliability

- TSN / URLLC – implications to IO (QoS), TSN Translator for URLLC devices *(e.g. NIC enhancements for low latency traffic)*
- Stringent clock synchronization
- Accelerator offload overheads for low latency and jitter requirements
- Reliability KPI (Six 9s) using redundant paths, data duplication, multi-TRP connections, beamforming
- Optimization of transport for small packets

Enterprise Private Wireless Network



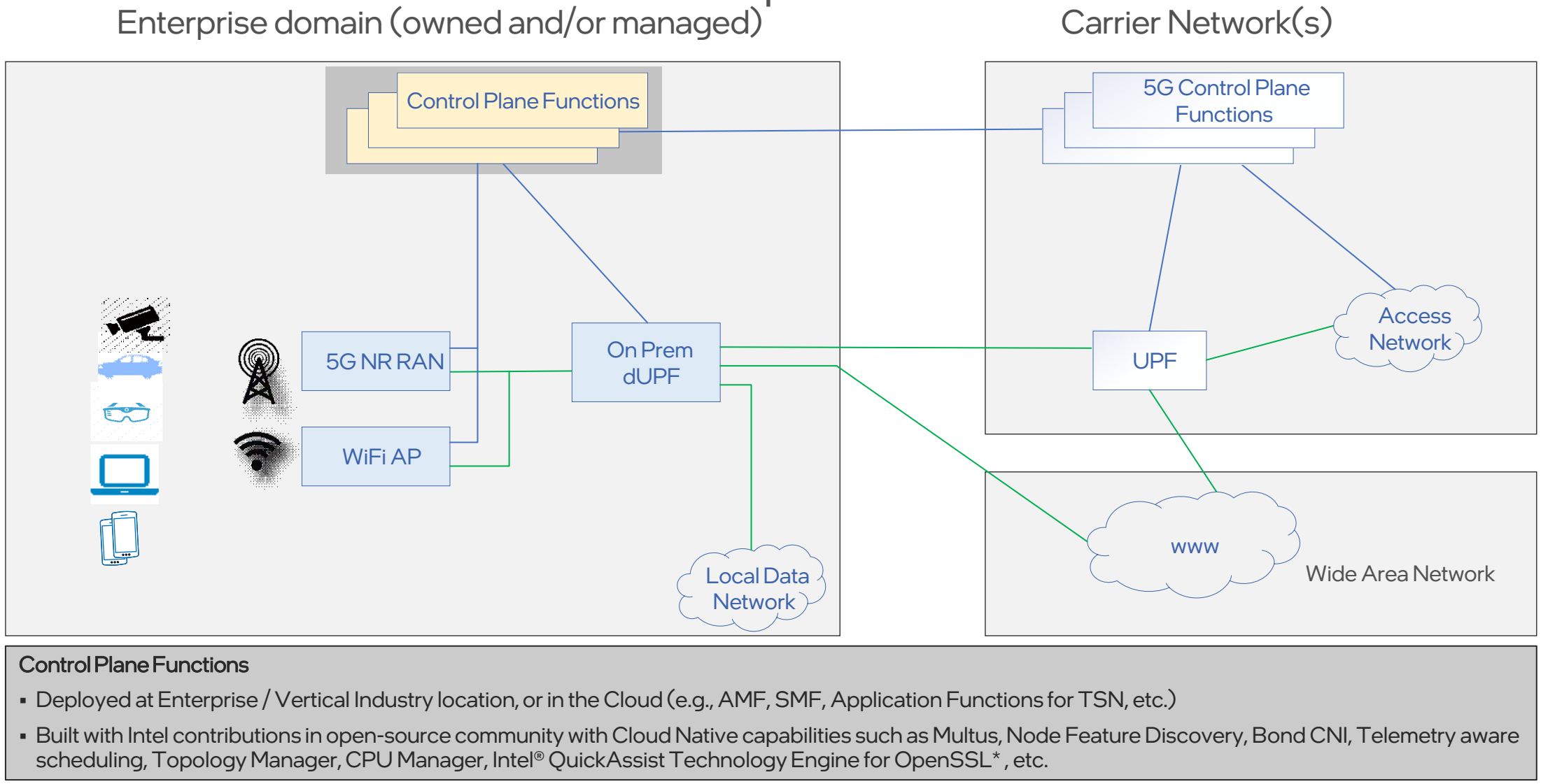
Digital Transformation in Enterprises

- Operational Efficiency & Automation (ex. AGV, Robots)
- Analytics & Insights (ex. Asset Tracking)
- Enhanced Collaboration & Productivity (ex. AR/VR)
- Security, Safety & Compliance (ex. Video Surv.)
- Experiences, Products, & Services (Context/Location)

Enterprise Networks Evolving with Multi-Access Capabilities

- Increased **complexity** of managing **multiple networks** (e.g., Wired, WiFi, LTE/5G, etc.)
- **Coverage** and quality demands growing, including types of devices on network
- **New network capabilities** (i.e., TSN / URLLC)
- Improved **reliability** and **mobility**
- Growing impact of **security threats**
- Requirement for **data sovereignty** and control on-premises

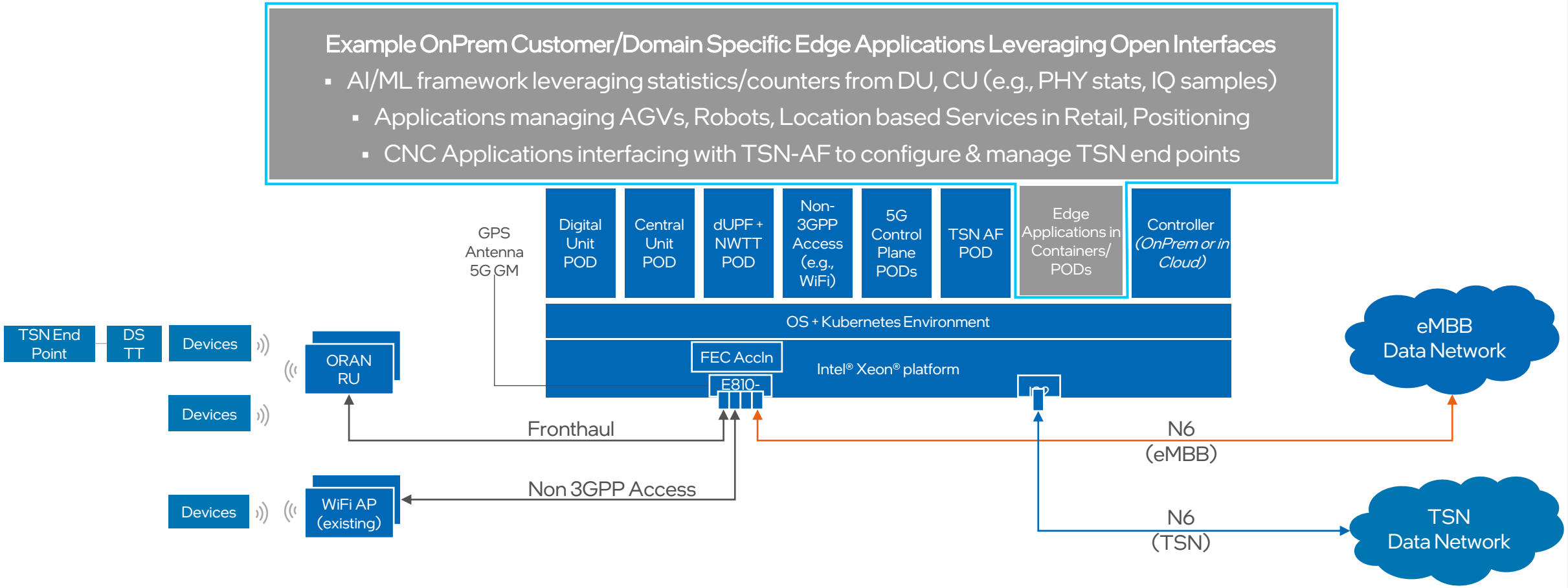
5G Network for Private Enterprises



Control Plane Functions

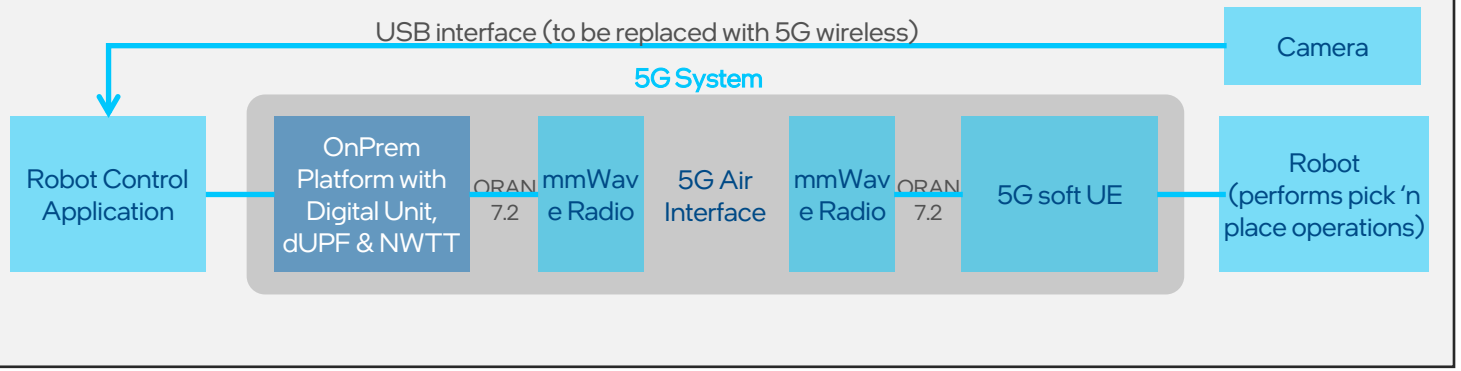
- Deployed at Enterprise / Vertical Industry location, or in the Cloud (e.g., AMF, SMF, Application Functions for TSN, etc.)
- Built with Intel contributions in open-source community with Cloud Native capabilities such as Multus, Node Feature Discovery, Bond CNI, Telemetry aware scheduling, Topology Manager, CPU Manager, Intel® QuickAssist Technology Engine for OpenSSL* , etc.

5G Private Wireless Platform with Containerized NW Functions

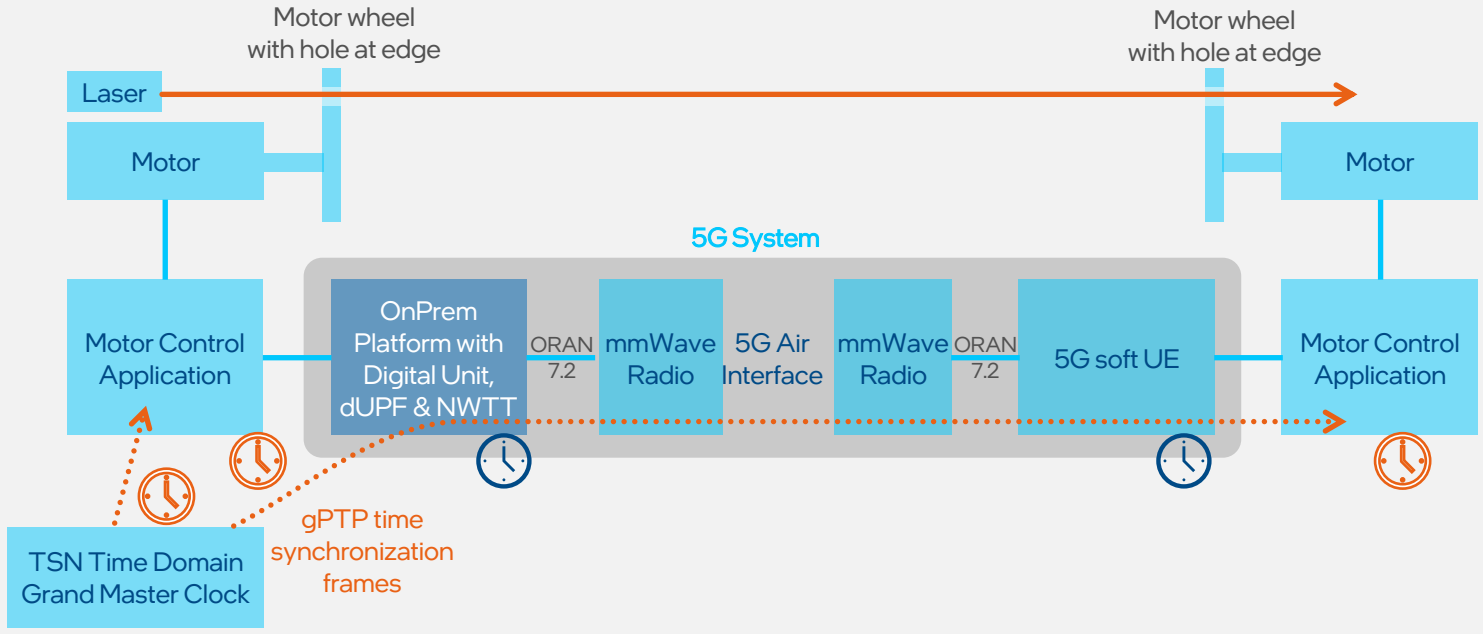


Demonstration of 5G in Industrial Application

Low Latency Characteristics of 5G



Time Synchronization Characteristics of 5G



Summary

- Enterprise Networks evolving with Multi-Access Capabilities with main focus on reliability, security and data sovereignty
- Intel as well as ecosystems are investing in 5G private wireless and deploying on-prem edge nodes at enterprise/vertical industry locations
- Industrial is one of the key initial vertical for 5G private network deployments
- Multiple real-life enterprise use cases are making the 5G private network a reality

Thank you

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