5Growth Non-Public Networks (NPN) Deployment Solutions & Industry 4.0 Pilot Examples

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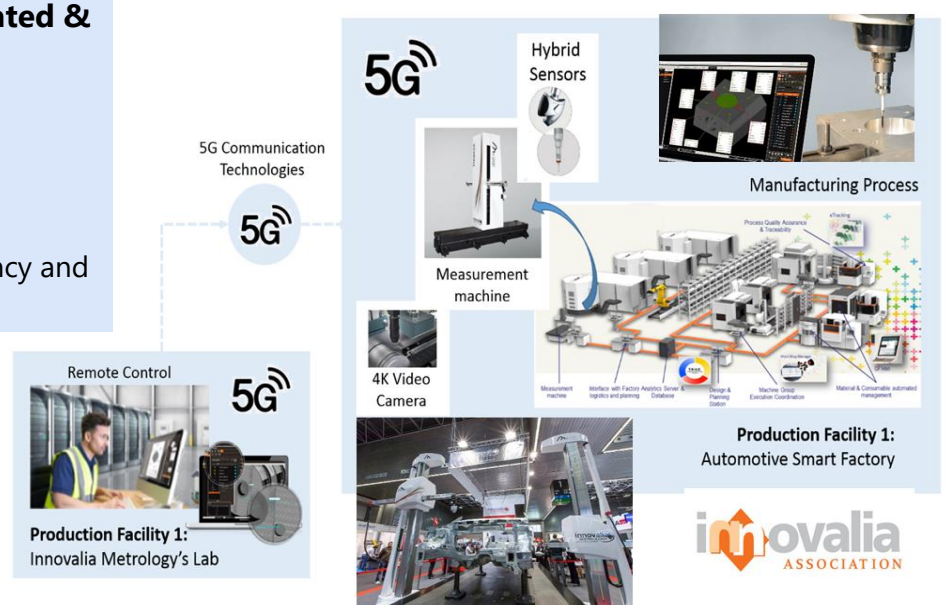
Outline

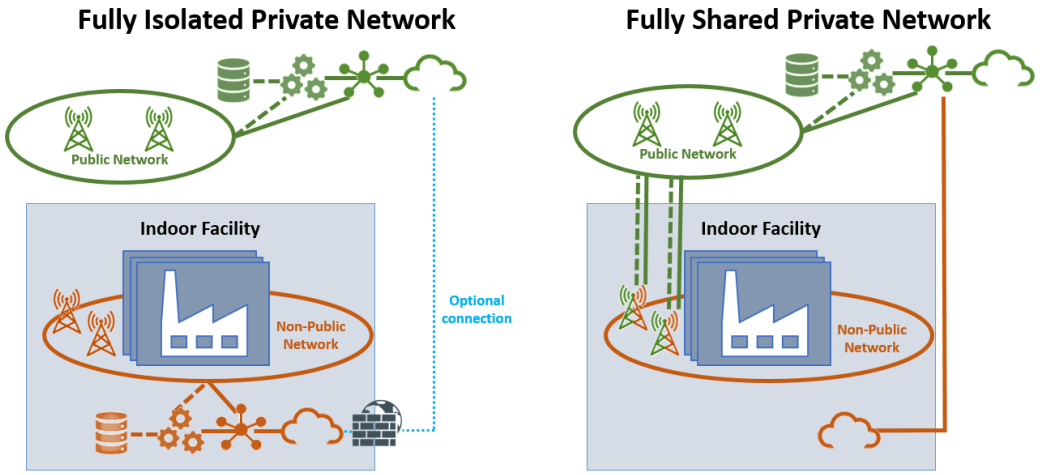
- Vertical Needs for 5G Private Networks
- 5Growth NPN Solutions
- Industry 4.0 Vertical Pilot Examples
  - INNOVALIA Pilot
  - COMAU Pilot
- Key Take-aways

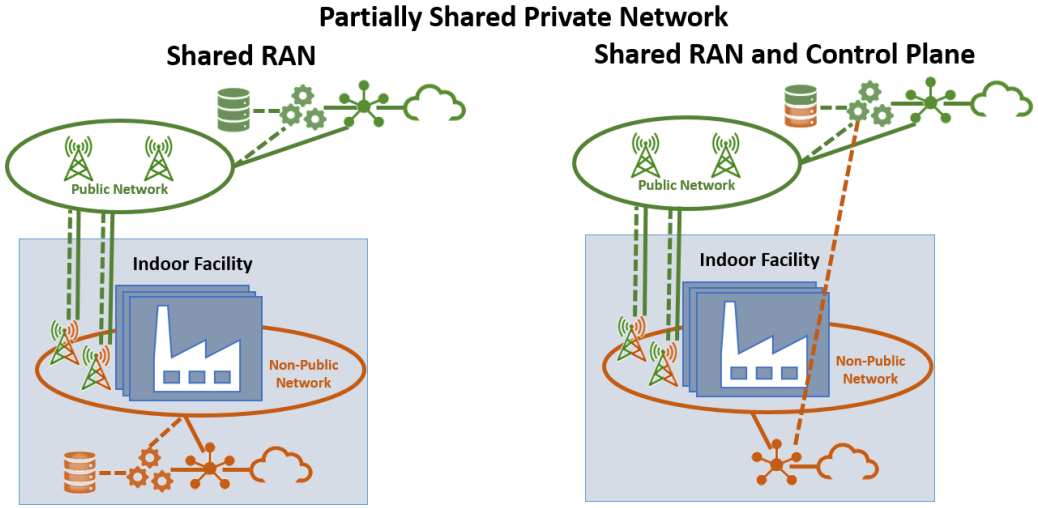
Vertical Needs for 5G Private Networks

Verticals need for dedicated & secure 5G networks

- Security
- Data privacy
- Separated O&M
- Dedicated and critical communication Req.
- Strict QoS Req. on latency and availability, etc.





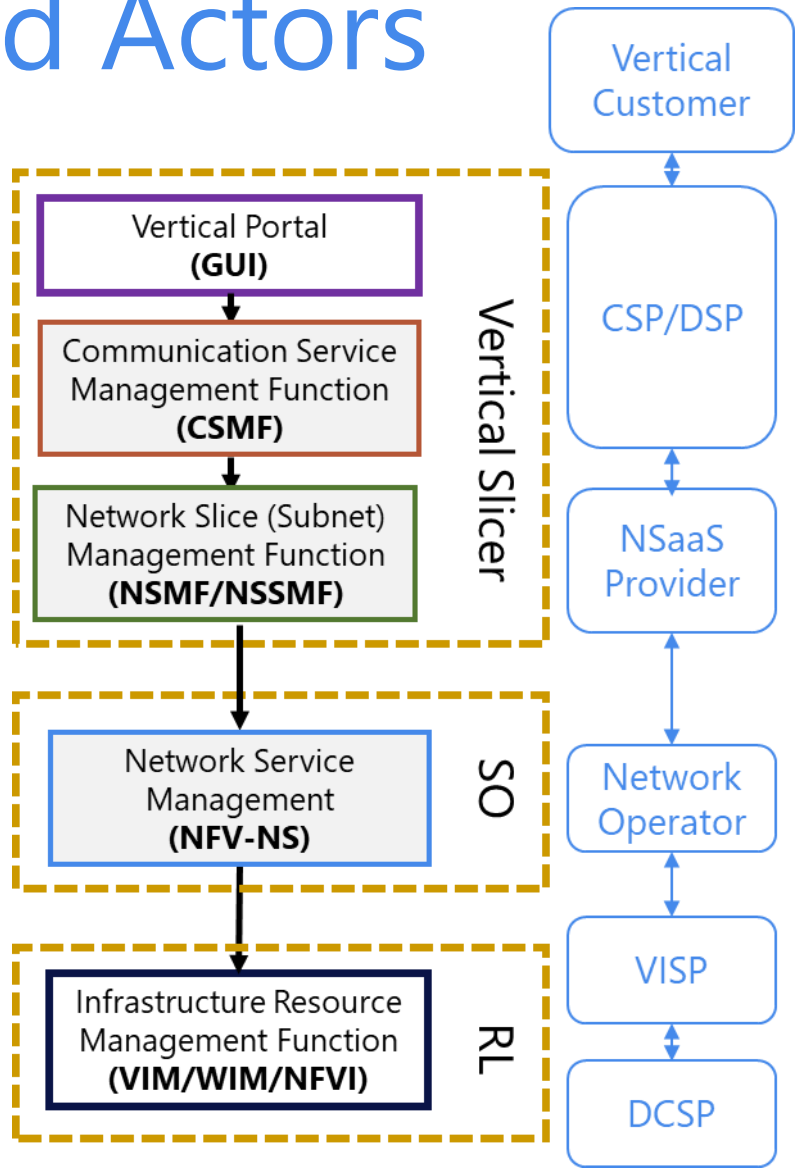


- The limited MNO's service footprint, together with the exclusive need of verticals of having dedicated and secure 5G network capabilities, make **Private 5G Networks (also referred to Non-Public Networks - NPN)** an attractive choice for the Industries.
- Different representative NPN deployment scenarios, taking guidance from operator roll-out strategies (GSMA), and recommendations from industry fora (5G-ACIA) and SDOs (3GPP)
- The NPN deployment is not to be standardized but use case dependent and vertical dependent, with different degree of compliance
- **Open Challenges in Public Network Integrated NPN (PNI-NPN) on how to connect NPN networks with Public Networks (PLMN - Public Land Mobile Network)**

Source: 5G ACIA white paper "5G Non-Public Networks for Industrial Scenarios"

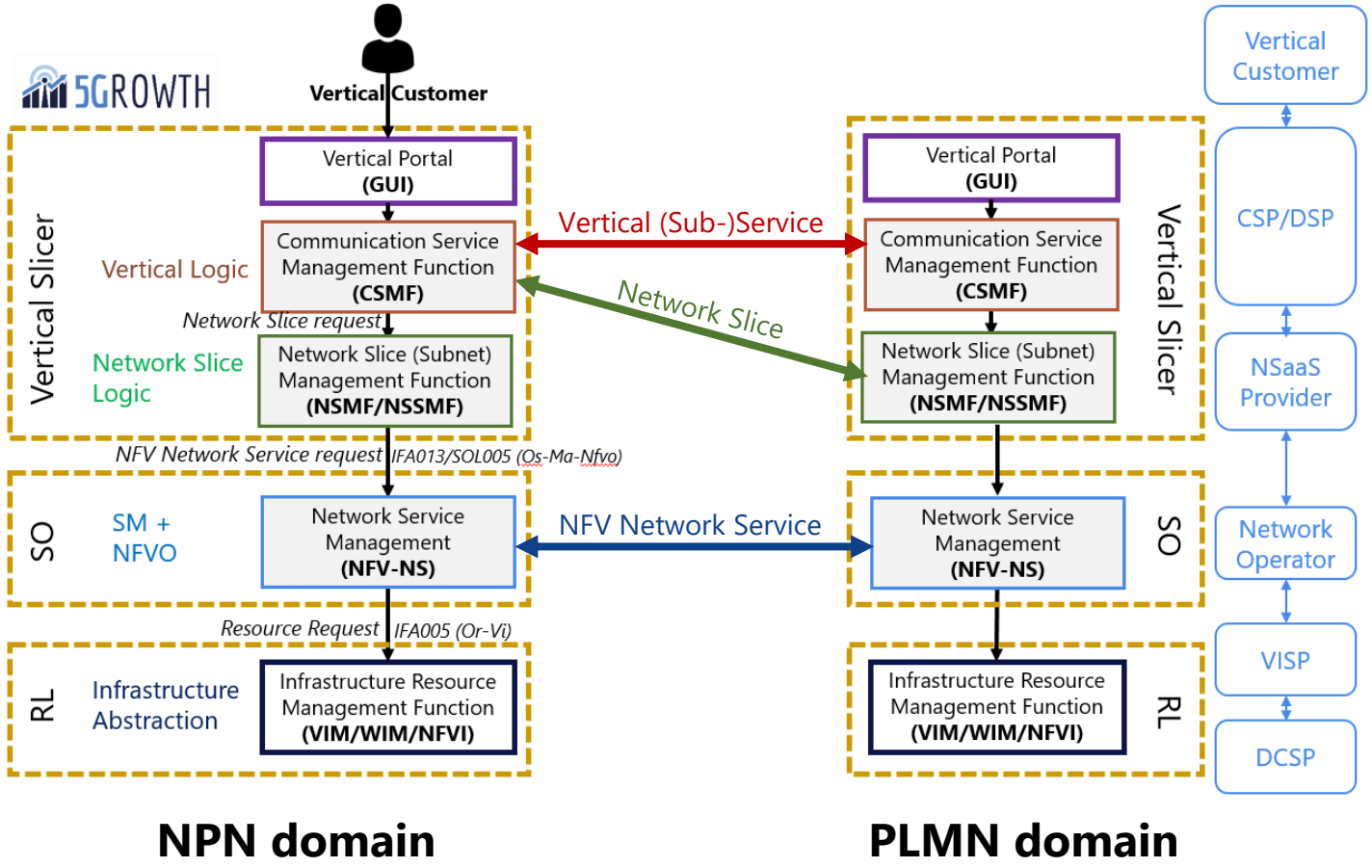
5Growth Architecture and Actors

- Customer
  - Vertical Service Customer
- Service Provider
  - Communication Service Provider or Digital Service Provider (CSP/DSP)
  - Provides Communication/Digital Services
  - Consumes Network Slices
- Network Slice (Subnet) Provider (NSP):
  - Network Operator (NOP)
  - Consume/Provide Network Slices
- Infrastructure Provider:
  - Network Operator (NOP)
  - Virtualisation Infrastructure Service Provider (VISP)
  - Data Centre Service Provider (DSCP)
  - Provide Infrastructure resources



Stakeholder roles mapped to the 5Growth Architecture (aligned with 3GPP and 5GPPP)

5Growth Solutions for PNI-NPN



5Growth develops **three levels of Multi-domain Solutions:**

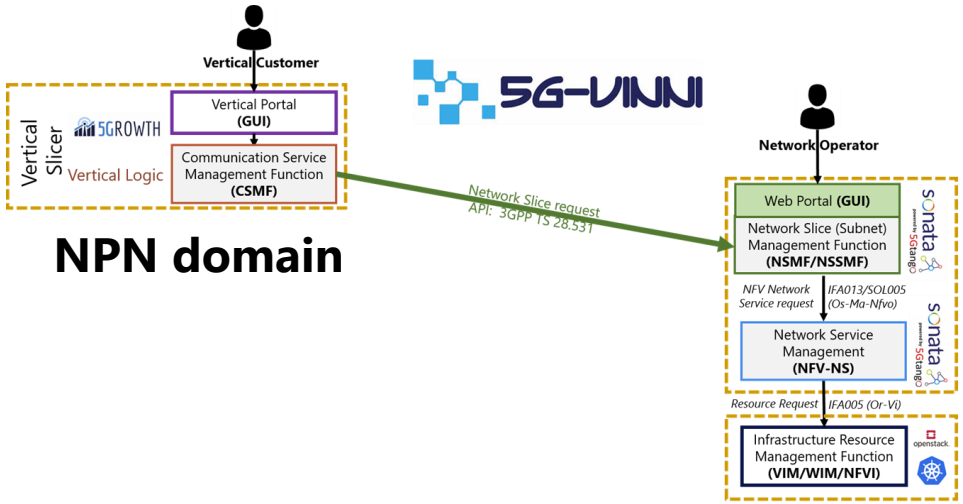
1. **Communication Service Level:**
   - CSMF-to-CSMF (federation among CSPs)
   - The CSP split the vertical service and delegates deployment to peer CSPs
2. **Network Slice Level:**
   - CSMF-to-NSMF (hierarchical multi-domain)
   - The CSP splits the vertical service into multiple network slices and delegates each to peer NSP
3. **Network Service Level:**
   - SO-to-SO (federation among NOPs)
   - The CSP is customer of multiple NSPs multi-domain @ NFV-NS level

Implementation & Proof-of-Concepts

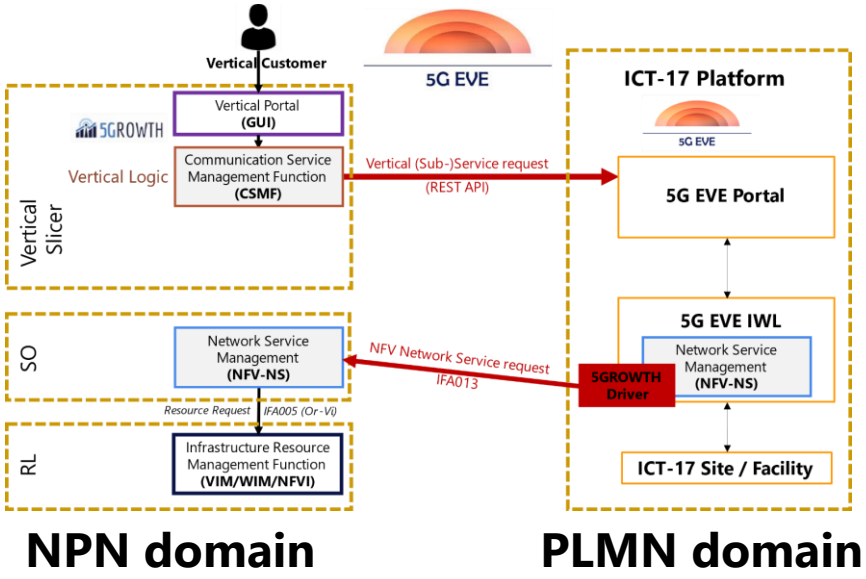
- **NPN managed by 5Growth platform**
  - 5Growth GitHub (*open source at public GitHub*)
    - https://github.com/5growth
- **PLMN provided by 5G E2E Platforms**
  - 5G EVE:
    - https://www.5g-eve.eu/
  - 5G-VINNI:
    - https://www.5g-vinni.eu/
- **Three multi-domain interactions supported**
  - Demo video: https://youtu.be/6CRYAwSlMZo
  - Drivers for 5G EVE and 5G-VINNI

Drivers	Repository
5Gr-VS driver towards 5G EVE	https://github.com/5growth/5gr-vs
5G EVE IWL catalogue driver	https://github.com/nextworks-it/5g-catalogue
5G EVE IWL Lifecycle Manager driver	https://github.com/5growth/mso-lo
5Gr-VS driver towards 5G-VINNI	https://5growth.eu/redmine/projects/5growth/repository/5gr-vs
SONATA adaptor	https://github.com/5growth/sonata-drivers

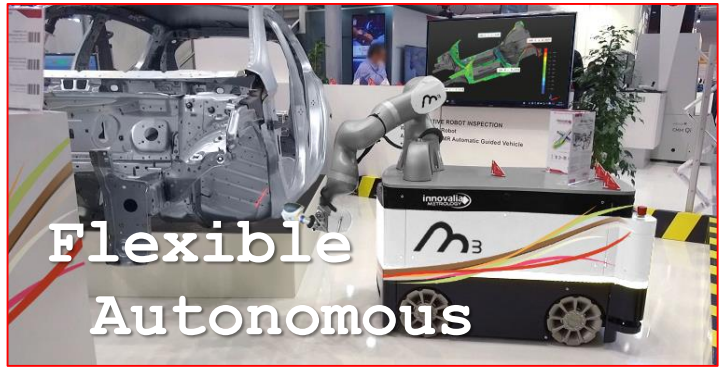
5Growth + 5G-VINNI



5Growth + 5G EVE



Industry 4.0 - 5G Smart Connected Quality 4.0 (Innovalia)



innovalia METROLOGY · ASTI MOBILE ROBOTICS · Telefónica · ERICSSON

NEC · NOKIA · NEXTWORKS ENGINEERING FORWARD · Telcaria

MIRANTIS · interdigital. · CTTC

uc3m | Universidad Carlos III de Madrid

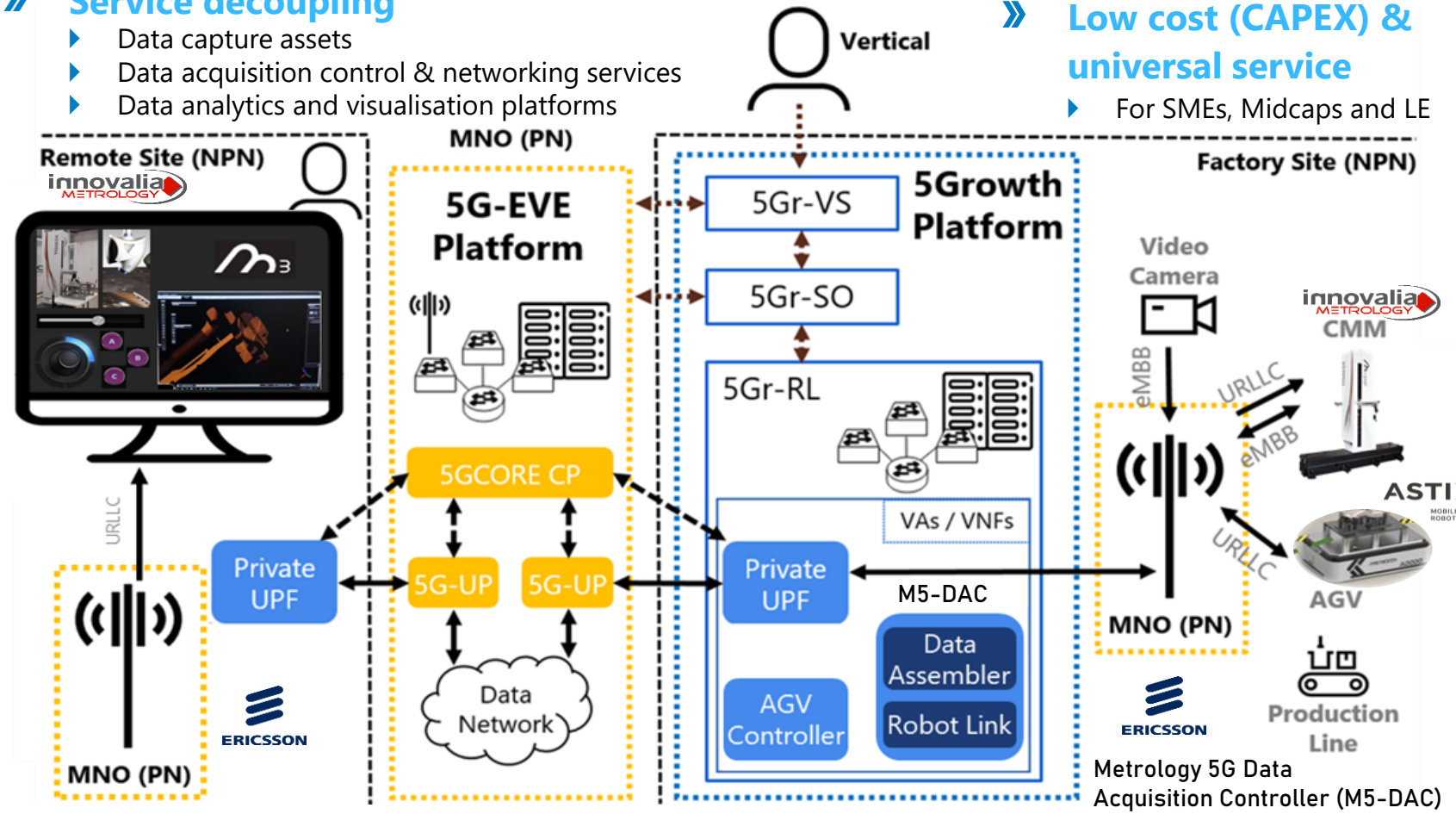
5GROWTH

NON PUBLIC NETWORK DEPLOYED IN PUBLIC NETWORK

- Remotely configure and perform high accuracy dimensional quality control (delay critical service)
- Global & secure service access
- Service decoupling
  - Data capture assets
  - Data acquisition control & networking services
  - Data analytics and visualisation platforms

NPN Deployment: Shared RAN & Control Plane

- Flexible & simple deployment
- Service delivery optimisation
- Low cost (CAPEX) & universal service
  - For SMEs, Midcaps and LE



Metrology 5G Data Acquisition Controller (M5-DAC)

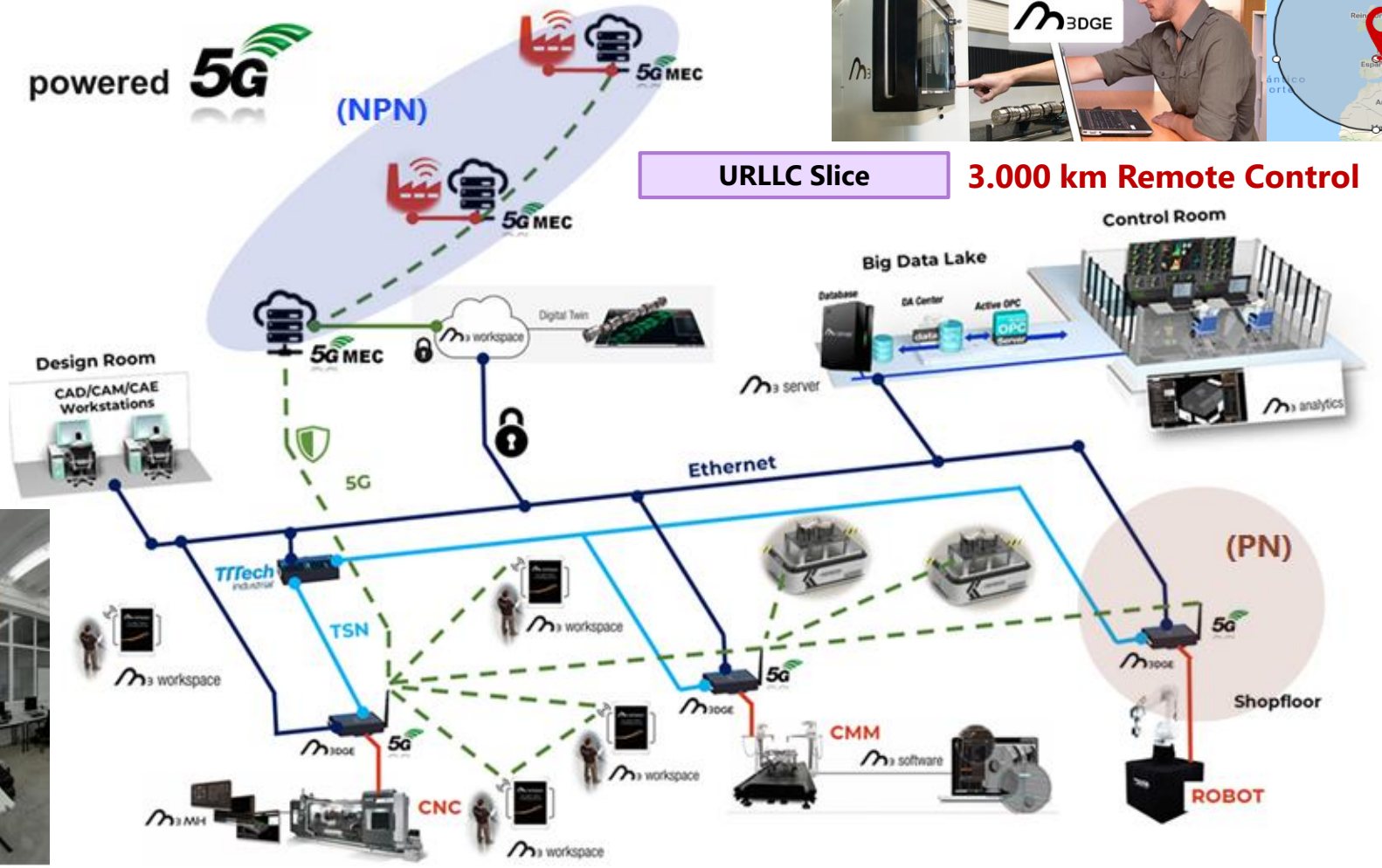
5G Smart Connected Quality 4.0 (Innovalia)

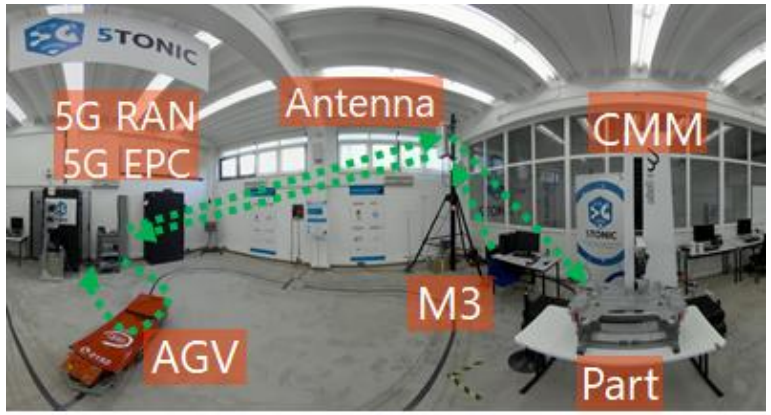
Radio segment
- RTT latency 10 ms
- 90 Mbps peak

Remote control (M3):
- RTT latency 30 ms
- 7 Mbps irregular peak

Video:
- 45 ms latency
- 20 Mbps constant

URLLC Slice **3.000 km Remote Control**

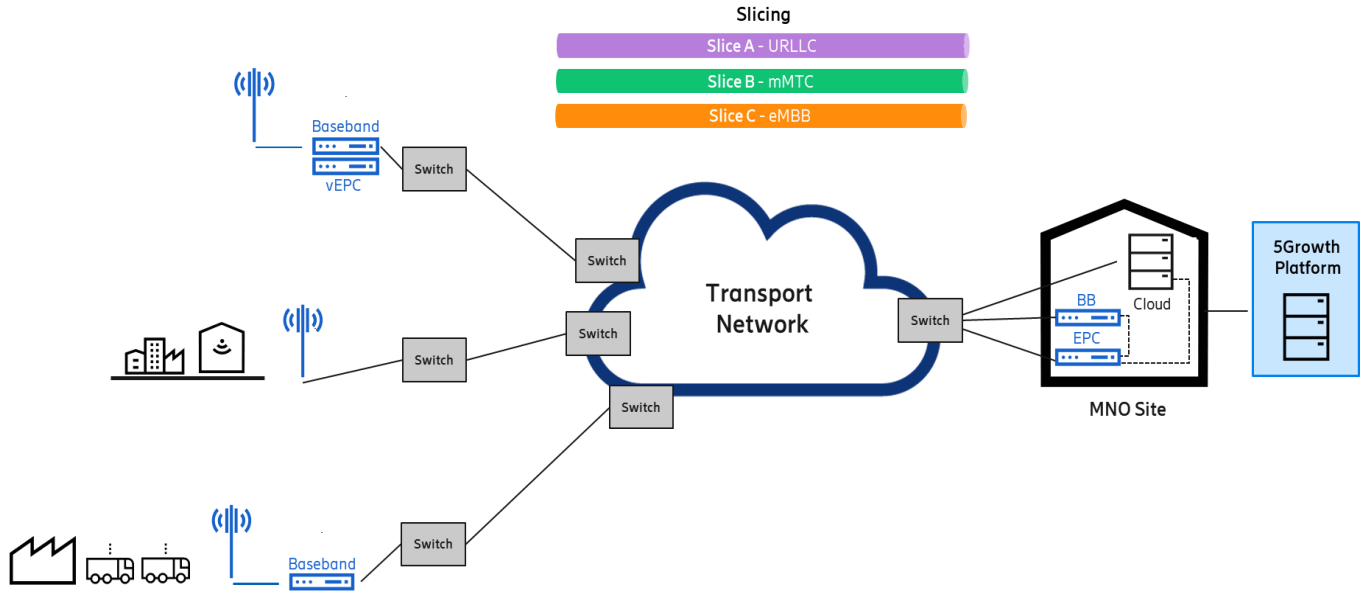




PILOT SITE	3GPP Rel.	3GPP Arch. Options	Spectrum	Operator & Vendor	Access Netwok	Core Network	End Devices	Monitored KPIs
Spain: 5TONIC	Rel 15	• Option 3 – NSA • Option 2 - SA	3.5 GHz (50 Mhz)	• Telefónica • Ericsson	• TDD 7:3 • MIMO 4x4 • 256QAM	vEPC & 5GC-Rel15 -Edge Deployment (5TONIC) -Central Office (5TONIC)	UE (Xiaomi) CPE (WNC)	• RTT Latency • UL/DL Data Rate • Reliability

Industry 4.0 (COMAU) Pilot

- To support critical use cases in industrial applications, like the ones demanding low latency in manufacturing, the current approach is to provide 5G coverage with **a standalone non-public network (NPN)**, entirely **installed at the vertical premises**.
- Small and Medium Enterprises (**SMEs**) could prefer leveraging on a **non-public network connected with an operator's network** which provides part of the radio infrastructure, like the core functionalities.



- The challenge is to define a solution to **serve even the critical use cases** over a **shared network** supported by an **appropriate transport layer to reduce the TCO** while preserving the required performances.

In the **COMAU pilot**, for practical implementation and validation constraints, the **transport network** (based on an optical WDM ring) has been deployed and tested inside the vertical premises, supporting eCPRI traffic flowing between the antenna site and the baseband (BB) node, both located on the COMAU shopfloor. The same network can be deployed in a geographical scenario, as in the picture above, subtended among different radio sites and the MNO site.

COMAU Shared Transport Solution

Digital Twin App
Low Latency for AR/Control -URLLC


AR


Digital Twin

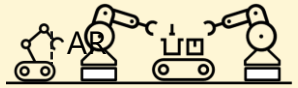
15 ms


Real Robot

Telemetry and Monitoring App
Massive Sensor Deployment - mMTC

Remote Support and Digital Tutorial
Broadband for Video Streaming - eMBB


AR


AR

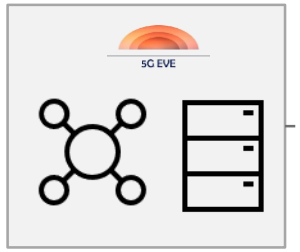
Slicing

Slice A - URLLC

Slice B - mMTC

Slice C - eMBB

5G EVE Site



Remote Support

PN

Comau IIoT Platform

MNO (NPN)

5Growth Platform

TIM

HSS

PN

10 km

MNO (NPN)

Transport infrastucture tested on-site

Baseband

vEPC

Vertical's Site

MNO's Site

Key Take-Aways

- In 5Growth, we have explored and developed **three levels** of multi-domain solutions, **the selection of options strongly depends on the actors and their roles**.
  - Communication Service Level
  - Network Slices Level
  - Network Services Level
- We have completed the implementation for 5Growth and ICT-17 integration with **5G EVE** and **5G-VINNI** platforms
  - Integration has been achieved and further improvements are ongoing
  - The code implementation is released as **open source** https://github.com/5growth
- Deployment of 5G for NPN and integration with PLMN (ICT-17 platforms) in the 5Growth pilots, **both INNOVALIA and COMAU pilots have been selected for the 5G Infrastructure PPP Trials and Pilots Brochure No3**
  - INNOVALIA video: https://youtu.be/EBLm0l32iTQ
  - COMAU video: https://youtu.be/rY6ZH75agOk

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