Integration of 5G NPN with TSN based industrial networks for Industry 4.0

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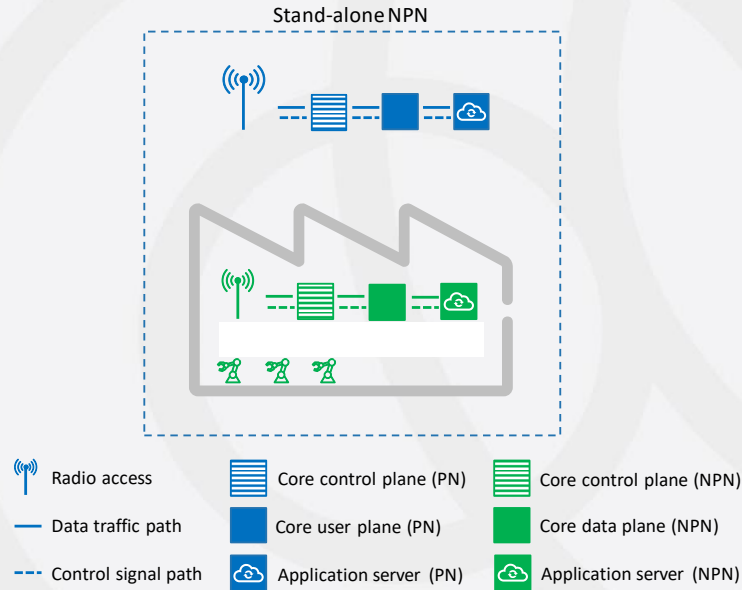EUCNC
8-11 June 2021

Agenda

- NPN Concepts

- NPN Business models

- NPN Technical enablers: 5GLAN

- NPN Technical enablers: TSN

Non Public Network

- To ease adoption of 5G for smart manufacturing and other verticals such as mining, construction, harbours, 3GPP has introduced NPN in release 16 specification.

- 3GPP distinguishes between two type of non-public network (NPN) deployments:
  - Stand-alone Non-Public Network (SNPN)
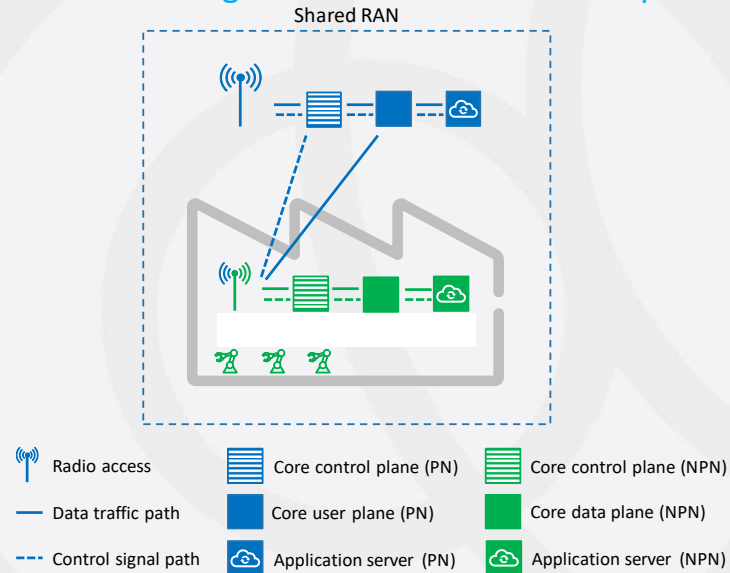 - Public network integrated NPN (PNI-NPN)

Standalone NPN

- The non-public network (NPN) can be deployed as an independent standalone network (SNPN).
- All network functions are located inside the logical perimeter of the defined premises and the non-public network is separate from the public network.

Stand-alone NPN

Radio access	Core control plane (PN)	Core control plane (NPN)	
— Data traffic path	Core user plane (PN)	Core data plane (NPN)	
--- Control signal path	Application server (PN)	Application server (NPN)	

PNI-NPN

- The private network can be integrated with public MNO (PI-NPN)

- RAN sharing can be realized with the help of a solution based on either a multi-operator core network (MOCN) or multi-operator RAN (MORAN).

- With MOCN, the MNO and the local network operator can share both the RAN (gNB) and the spectrum

- With MORAN the operators can share the gNB with own non-shared spectrum.

Shared RAN

Radio access   Core control plane (PN)   Core control plane (NPN)

Data traffic path   Core user plane (PN)   Core data plane (NPN)

Control signal path   Application server (PN)   Application server (NPN)

(REF: "5G-SMART Deliverable D5.2 First report on 5G network architecture options and assessments ")

NPN Shareholders*

- **MNO**: is the stakeholder who owns and manages a public land mobile network (PLMN).

- **Industrial Party**: is the stakeholder who requests NPN services for performing a (group of) industrial task.

- **3rd Party**: any stakeholder who cannot be categorized as MNO or industrial party. e.g., a network vendor or other third-party supplier, who can provide the NPN user with services such as network deployment and management.

*(REF: "5G-SMART Deliverable D5.2 First report on 5G network architecture options and assessments ")

NPN Technology Enablers: 5GLAN

- Local Area Networks are the pillar of Private Networks, characterized by the high throughput, customization, low latency, and isolation against public networks.

- 5GLAN can support industrial LAN capabilities required for connecting 5G networks to fixed industrial infrastructure. (REF: "5G-SMART Deliverable D5.2 First report on 5G network architecture options and assessments ")
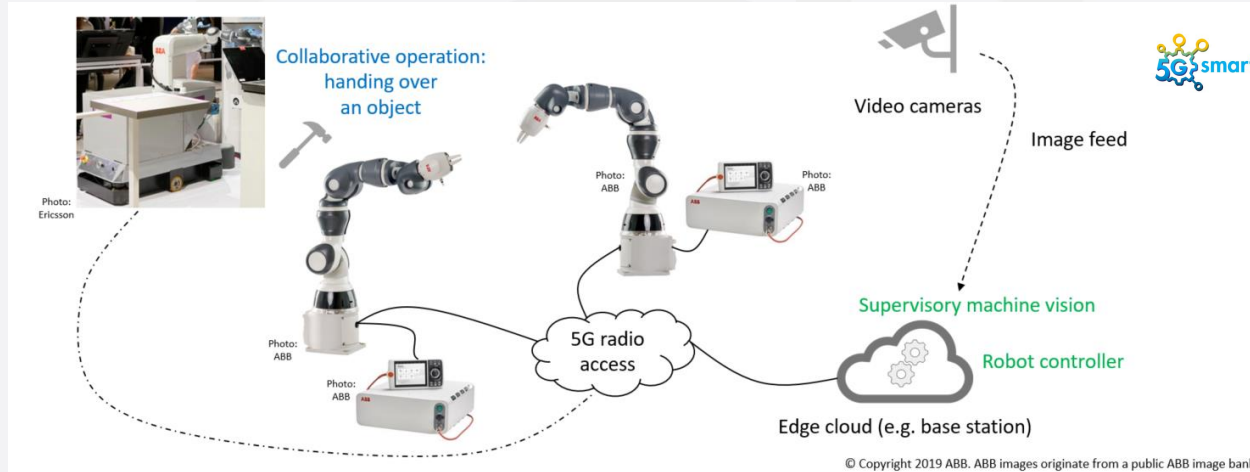
NPN Technology Enablers: 5G-Bridge

- TSN interaction with mobile devices through 5G system that from fixed infrastructure is considered as standard TSN/5G bridge.
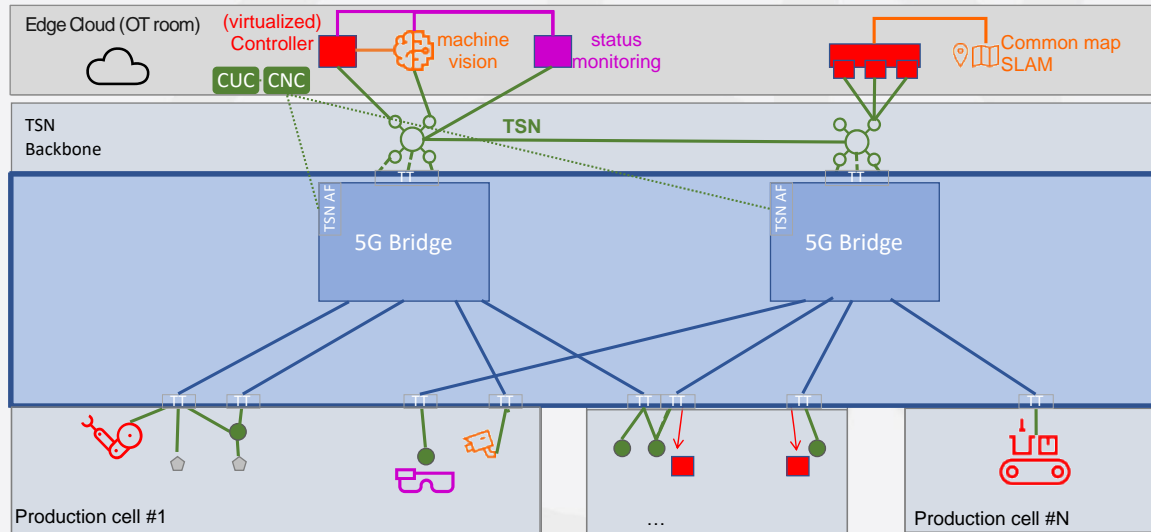
NPN Technology Enablers: 5G-TSN

- IEEE Time Sensitive Networking set of specifications enables deterministic and low-latency communication in the factories of the future.

- 5G Time Sensitive Communication is a service that supports deterministic and/or isochronous communication with high reliability and availability, enabling URLLC use cases in Industrial Networks.

System architecture view with 5GS appearing as a Time-Sensitive Networking bridge

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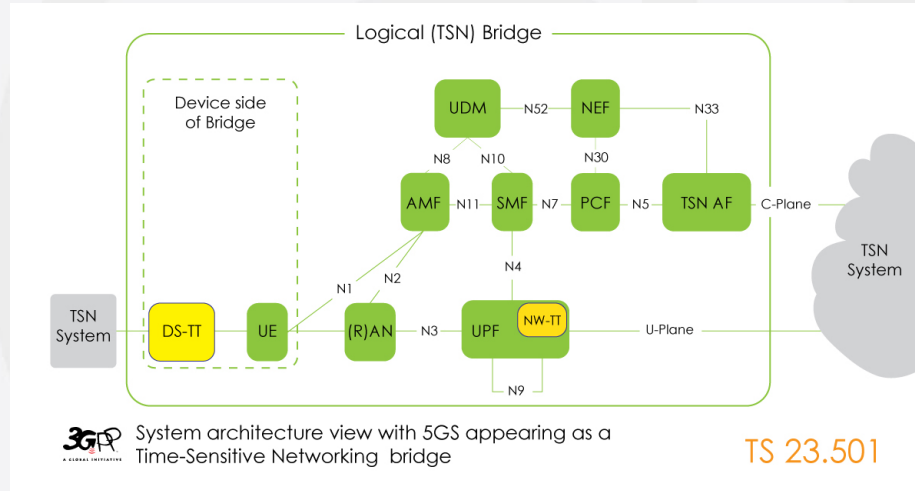
NPN Business Models

- The industrial party might become the NPN owner and operator of its network while MNO remains the spectrum owner (for some frequencies)

- The NPN integrator might become also operator and offer 5GaaS for those industry parties that need short-lived mobile infrastructure (e.g. constructions sites) or outsource the management of the network (e.g. mining, harbours)

  - REF: "5G-SMART Deliverable D1.2 5G Business Models" to be completed to be available: (https://5gsmart.eu/wp-content/uploads/)

Kuva: Vyhtinen Pekka, Helsingin Kaupunginmuseo

NPN Technology part of OT

- 5G system seamless integrated into the factory Information Technology (IT) and Operational Technology (OT).
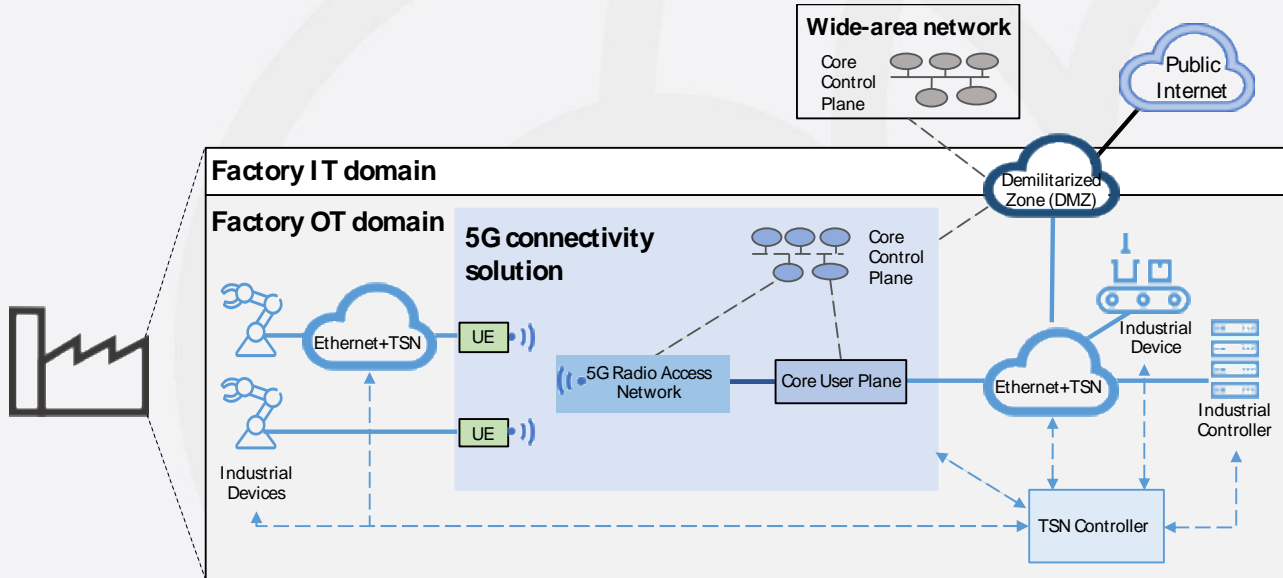
On-going Projects and Pilots

Ongoing Projects

Conclusions

- The integration of the 5G system into industrial systems requires additional network functions to fulfil requirements from industrial networks.

- This includes support for providing non-public networks for enterprise users.

- 5GLAN, TSN network translator functions are required to integrate 5G with industrial networks in a common system architecture.

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