
Telefónica
Outlook for operator adoption of 5G Private Networks
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Drivers for 5G Private Networks

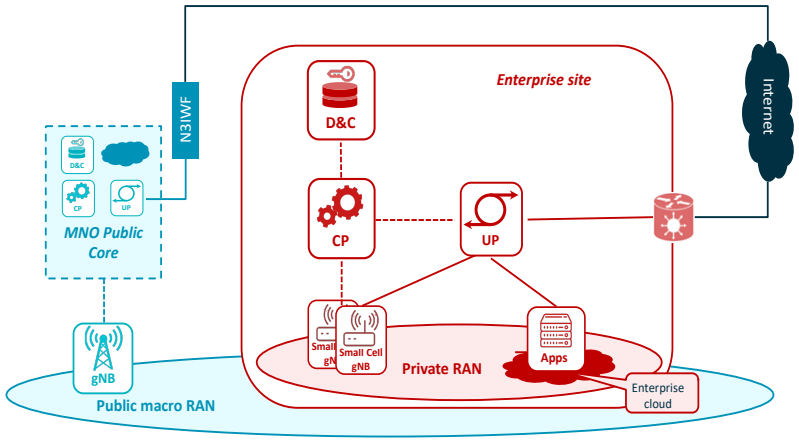
- Guaranteeing coverage
  - Often in locations with harsh radio frequency (RF) or operating conditions or where public network coverage is limited/nonexistent (e.g., remote areas).
- Gaining network control
  - For example, to apply configurations that are not supported in a public network.
  - Security and data privacy are also important. The ability to retain sensitive operational data on-premises is crucial to high tech industrial companies.
- Meeting a performance profile
  - Specifically, a profile that will support demanding applications. 5G has a clear performance advantage over LTE and Wi-Fi in cyber-physical industrial systems.

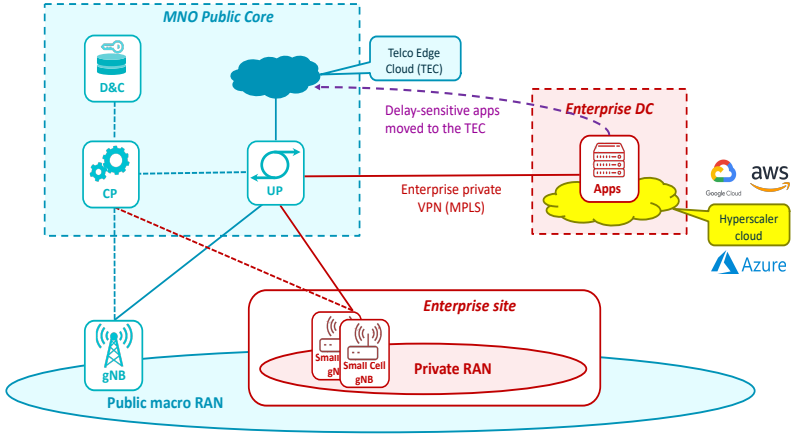
Two categories for 5G Private Networks, aka Non-Public Networks (NPNs)	
Standalone NPN (S-NPN)	Public Network Integrated NPN (PNI-NPN)

A wide variety of deployment scenarios

From single-site NPNs…

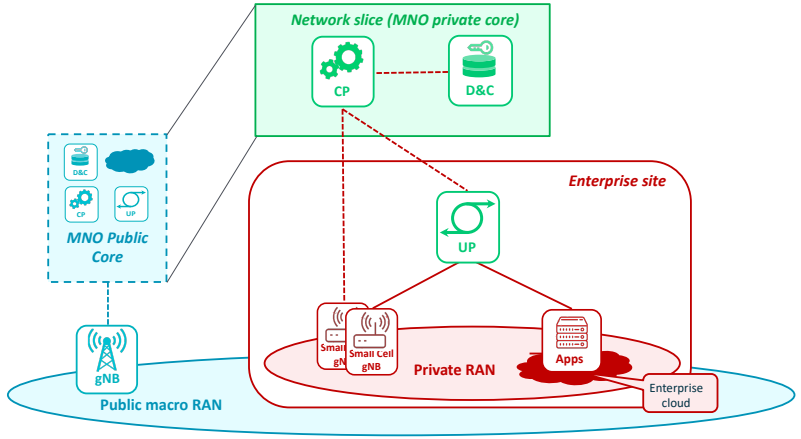
S-NPN with optional connection to the PLMN

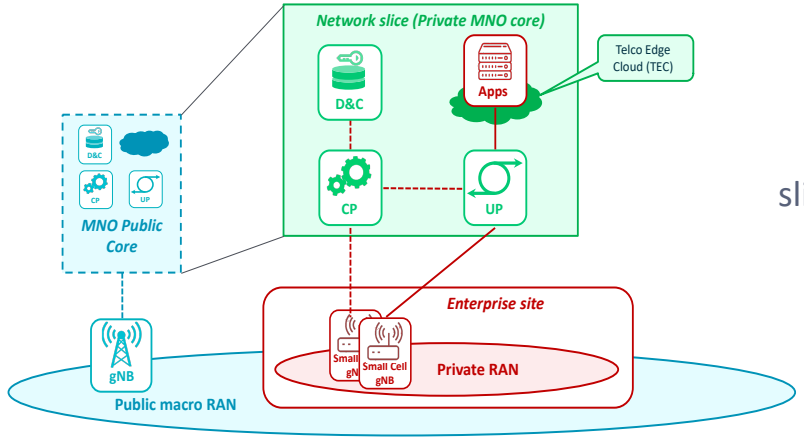




PNI-NPN: DNN provisioning

PNI-NPN: network slice provisioning (on-premise UPF)



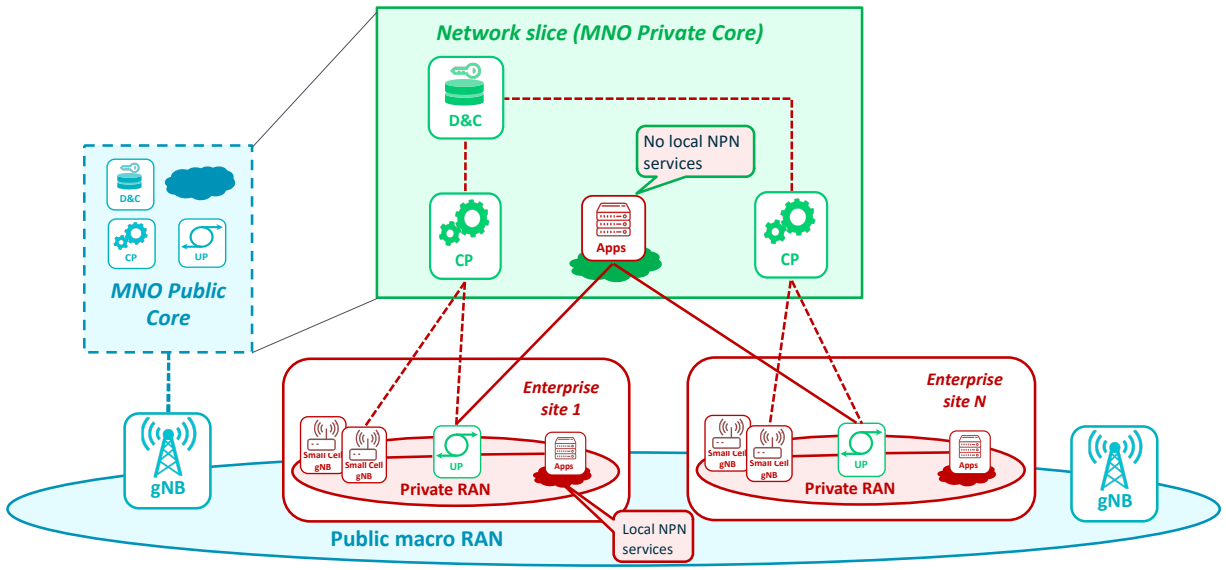


PNI-NPN: network slice provisioning (off-premise UPF)

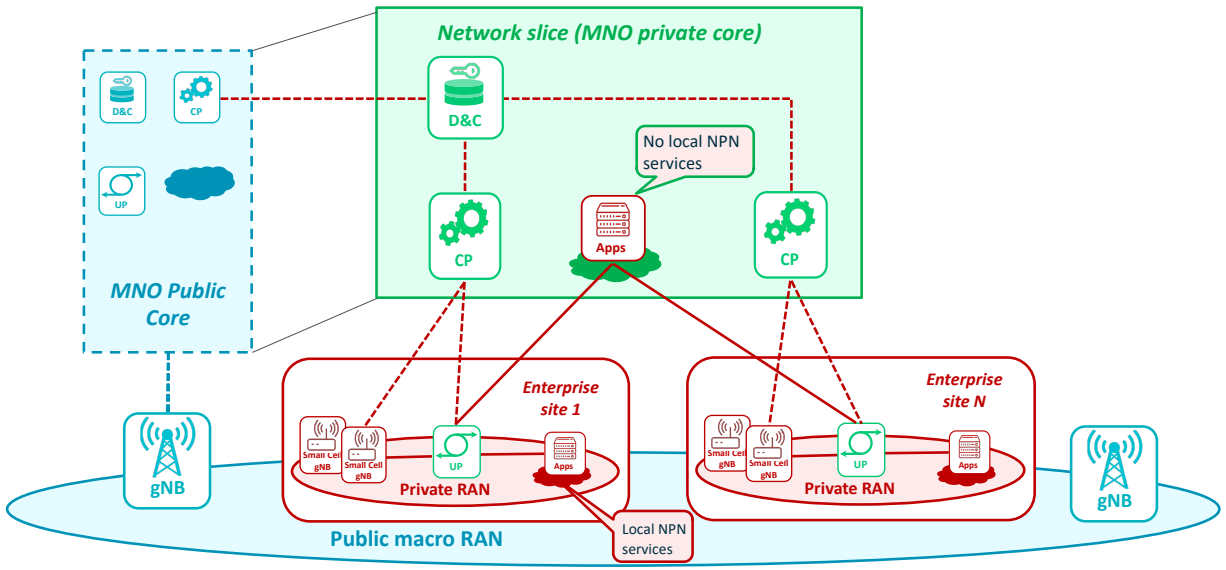
A wide variety of deployment scenarios

…to multi-site NPNs

PNI-NPN: network slice provisioning, no mobility support



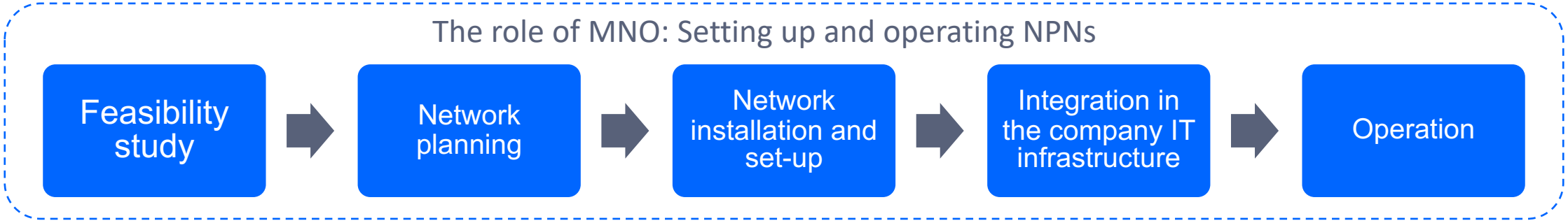
PNI-NPN: network slice provisioning, mobility support



- Mobility support allows the device to connect to the public mass-market radio when going out from private radio coverage. This requires…
  - The use of public IMSI range for private networks
  - The use of public PLMN ID for private networks configured in the SIM as preferred ID

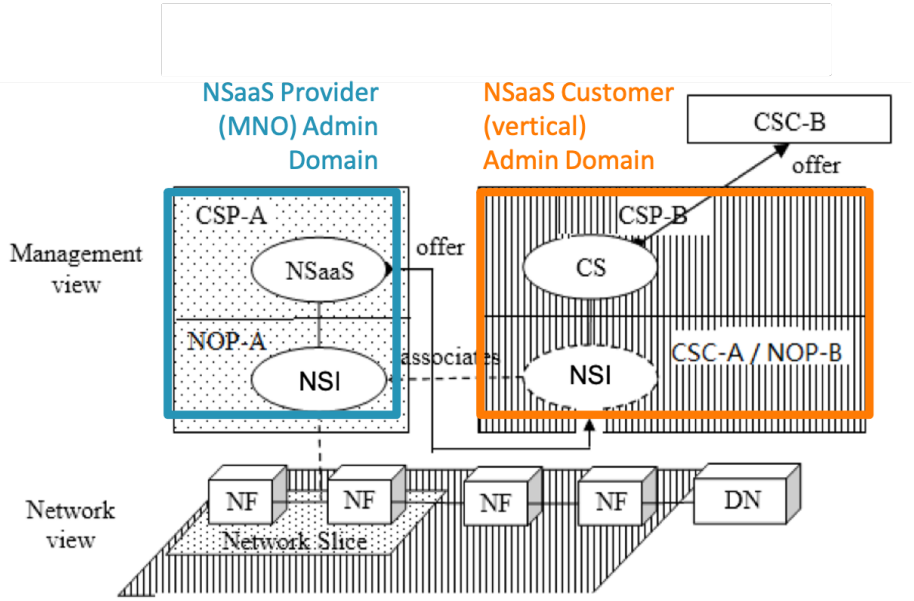
PNI-NPN as the medium-term goal

- S-NPN as a first step
  - Full 5G network in-house, with indoor coverage
  - No mobility support
  - CAPEX and OPEX extremely high – only affordable by large-sized enterprises
- PNI-NPN as the next natural step
  - Much more cost-efficient, facilitating the entry of new customers.
  - *Mind your business* principle: customer focusing on use case (service logic), while relying on MNO expertise for network related issues.



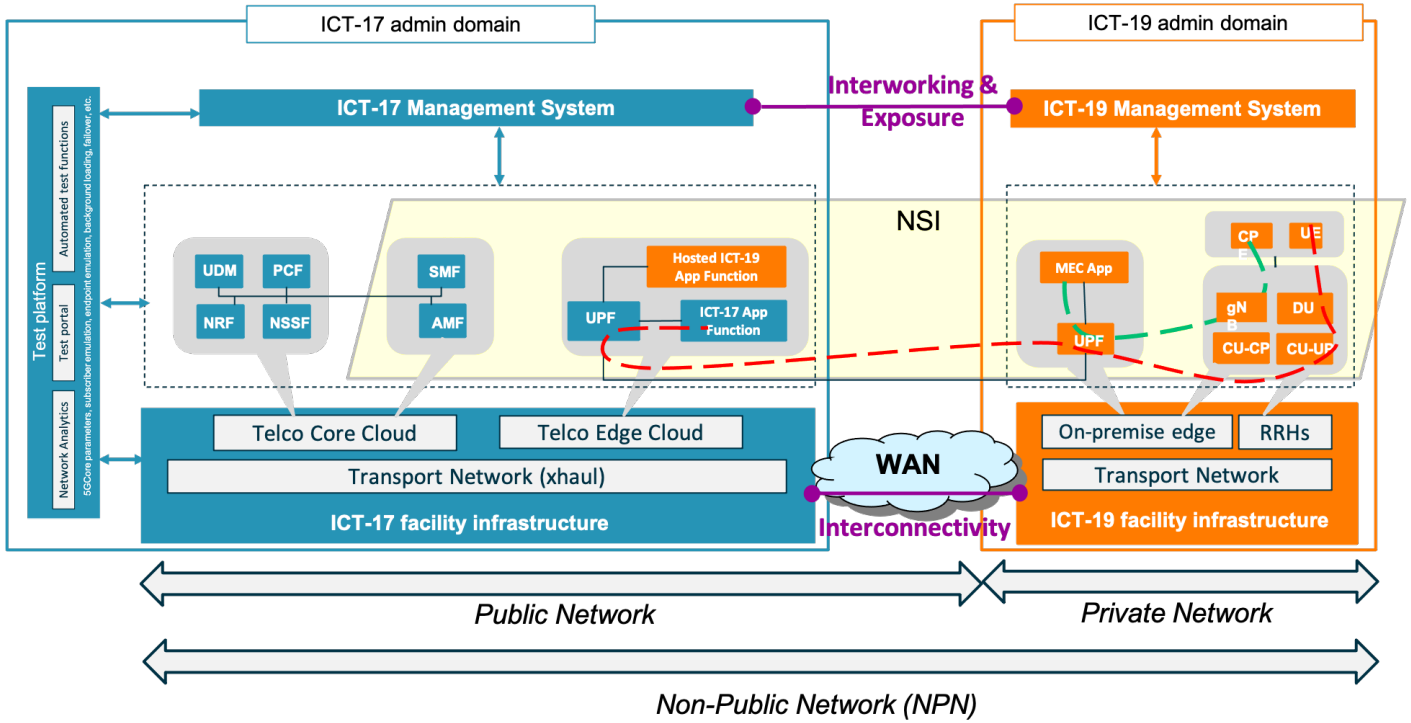
- Simplifying stages and reducing times in the pipeline with network slicing

PNI-NPN provisioning with network slicing



- Network Slice as-a-Service (NSaaS)
  - Slice *à la carte*, in terms of capacity and functionality
  - Provided by the MNO
  - Allowing tailored capability exposure to industry verticals

- Experimenting within 5G-PPP
  - ICT-17 facility operator as public network operator
  - ICT-19 facility operator as private network operator



PNI-NPN: WAN connectivity services

Allowing conveying the data, control and management traffic between the private site and PLMN nodes (telco edge node) hosting non-public VNFs/CNFs.

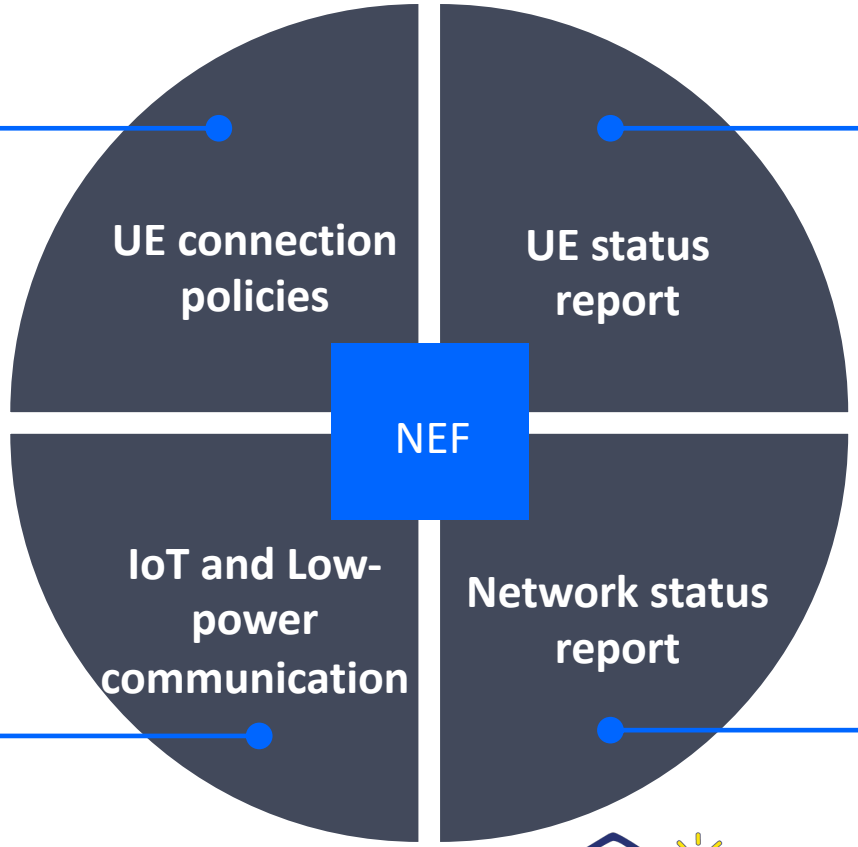
Solution	Topology	OSI	Technology	Underlay	QoS	Cost (per BW unit)
IPSec	PtP, MP, Mesh	Layer 3	IP	Shared	Low	Low
SD-WAN	PtP, MP, Mesh	Layer 3-7	SDN	Shared	Low-Mid	Low-Mid
Metro Ethernet	PtP	Layer 2	SONET	Dedicated	High	Low-Mid
EPL	PtP	Layer 2	SONET	Dedicated	High	High
MPLS VPN	PtP, MP, Mesh	Layer 2-3	MPLS	Shared	Low-Mid	Mid-High
EVPL	PtP, MP	Layer 2	MPLS	Shared	Low-High	Mid-High
VPLS	PtP, MP, Mesh	Layer 2	MPLS	Shared	Low-High	Mid-High
Wavelength	PtP	Layer 1	DWDM	Dedicated	High	Low

PNI-NPN: Capability Exposure

Network Exposure Function (NEF)

- Network monitoring, network control & configuration, payload interfaces for customers
- Transforming NEF APIs to user-friendly APIs to hide complexity is a MUST

- Set QoS: ad-hoc per application flow with prioritized QoS profile list
- Traffic influence (UPF selection, routing decision)
- Enable/disable Ehanced Coverage Restriction per individual UE
- Change the chargeable party



- Loss of connectivity
- UE reachability
- Location report
- Communication failure
- No. of UEs present in an area
- Availability after DL data notification failure
- DL data delivery status
- Roaming status
- CN type change (EPC <-> 5GC)

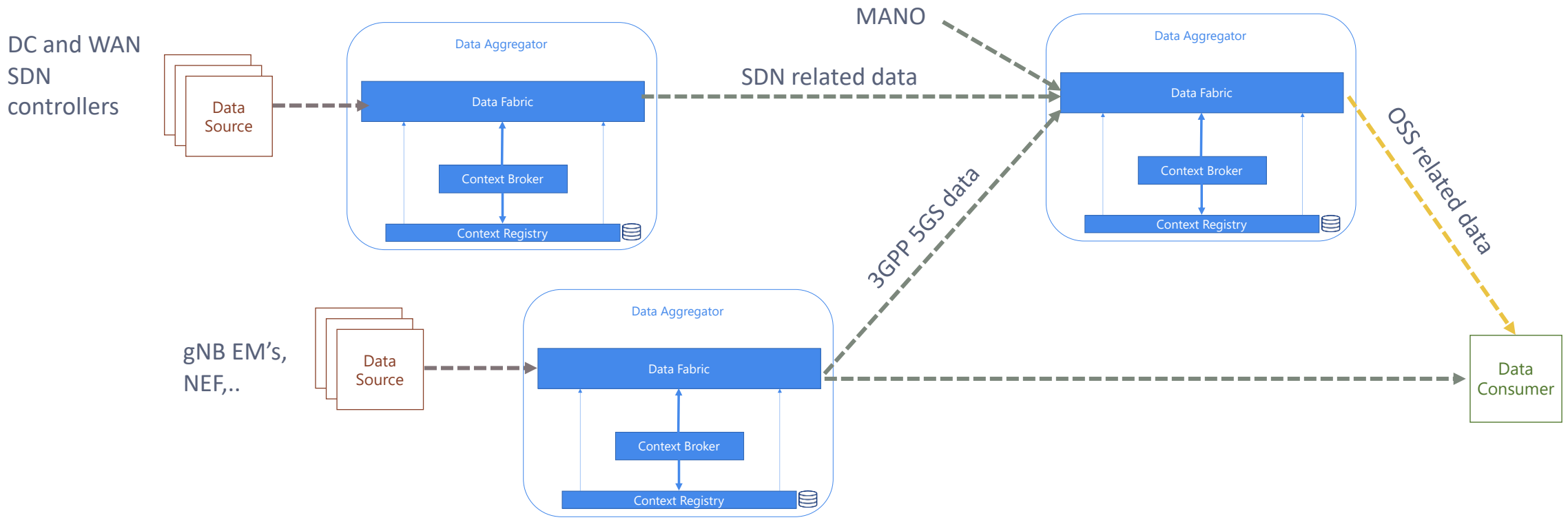
- Background Data Transfer Policy
- Device triggering
- Non-IP Data Dlivery (NIDD)

- QoS suistanability
- NF load information
- Network slice load information
- Expected network behaviour parameters (NWDAF-assisted)

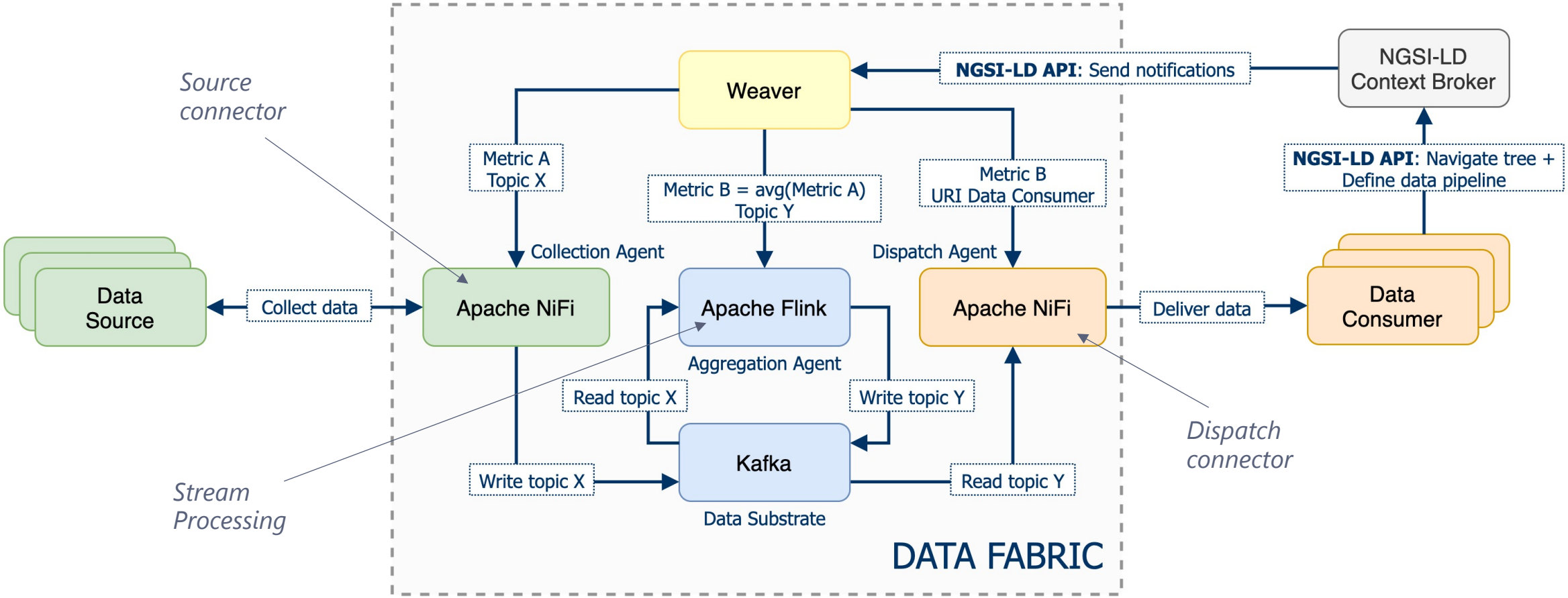
Building the data system for PNI-NPN scenarios

Beyond 3GPP scope

- Enriching NEF with data from other sources, including infrastructure nodes, SDN controllers, OSS (e.g., performance measurements, fault alarms) and even O-RAN defined RAN Intelligent Controller (RIC)



The Core Element: 5Growth Data Aggregator



5G-VINNI

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5GROWTH

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