Transport slicing – ongoing work at IETF with a personal view

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Network Slicing 2020 workshop
IFIP Networking 2020

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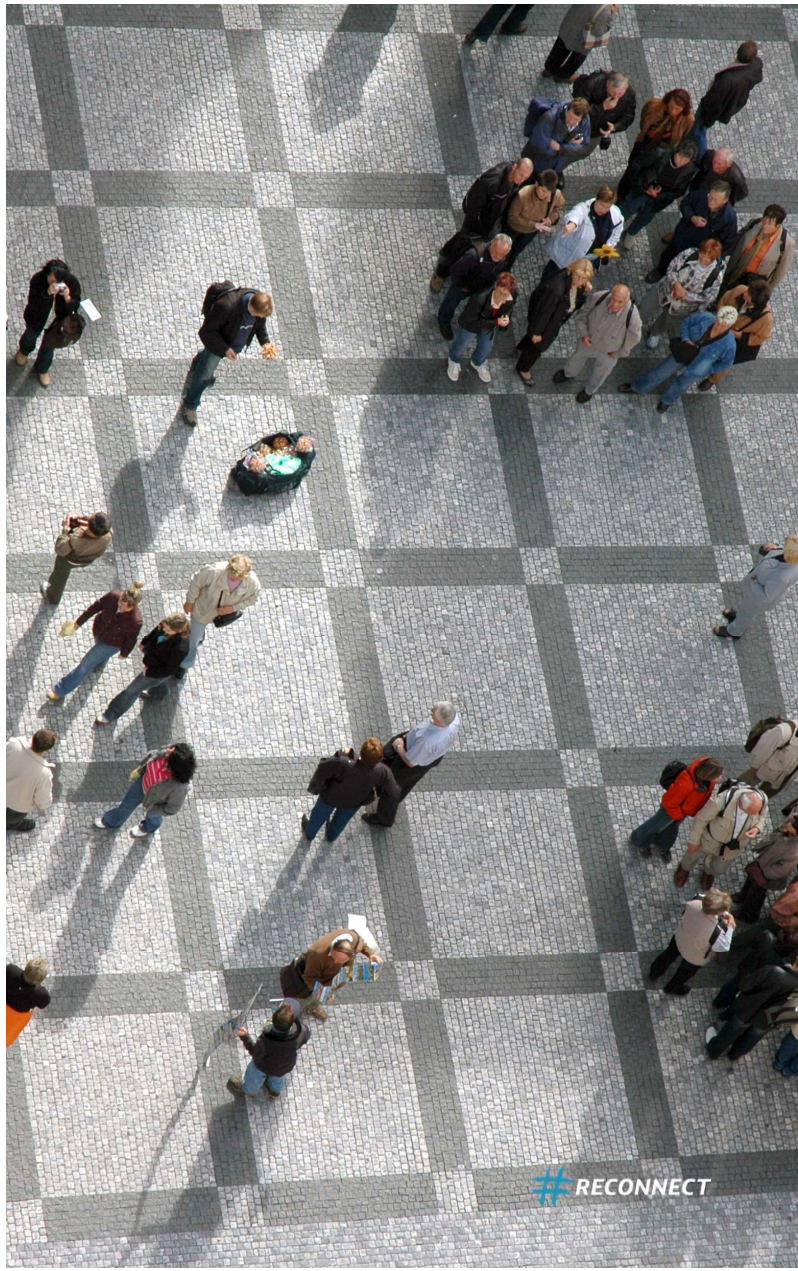


Agenda

- Network Slicing
- Transport Slicing

Work at the IETF

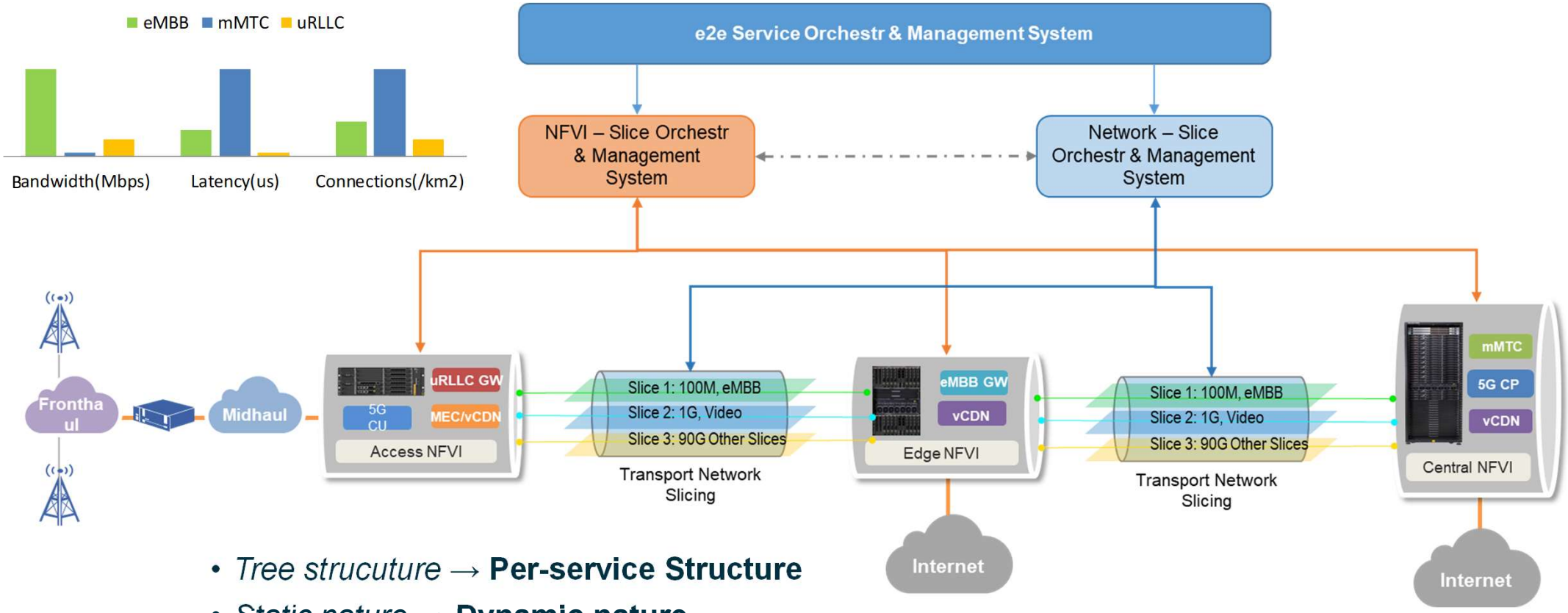
- How to integrate it on real architectures
- How to innovate on top of that

Personal view

- References

Network Slicing

Slicing – general overview



- *Tree structuture* → **Per-service Structure**
- *Static nature* → **Dynamic nature**
- *Separated management per segment* → **Unified orchestration**
- *Single domain* → **Multi-domain**

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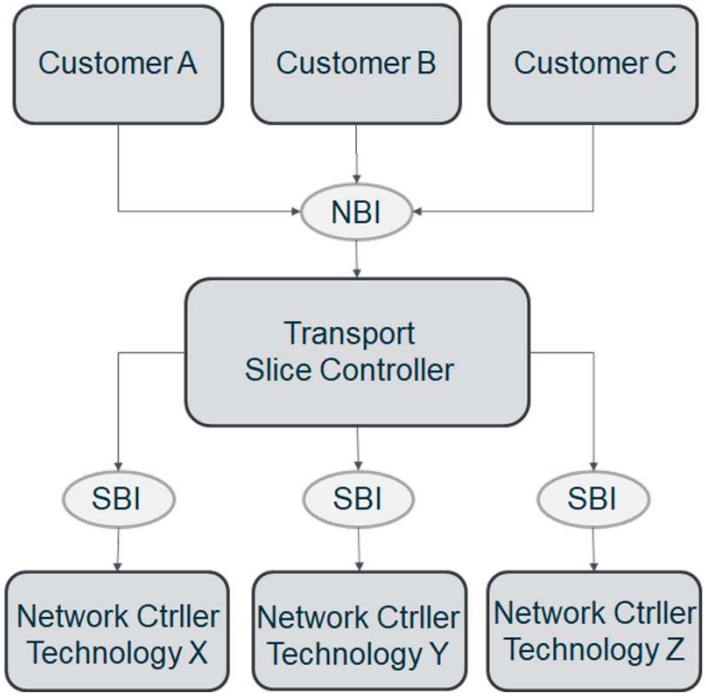
#RECONNECT

Potential Use Cases

- Network slicing to become the new model of service provision in carrier networks
    - Important to create a provisioning model independent of the service and capable of handling multiple underlying technologies

- Potential use cases (~ *Customers*)
    - 5G services
    - Multi-PoP interconnection of SFs
    - Data Center interconnection
    - Network sharing
    - Evolution of wholesale service
    - …



Insight on a couple of exemplary Use Cases

- 5G Services
- Multi-PoP interconnection of SFs

Insight on a couple of exemplary Use Cases

- 5G Services

- Multi-PoP interconnection of SFs

Design and creation of slices – e.g. 5G

Design

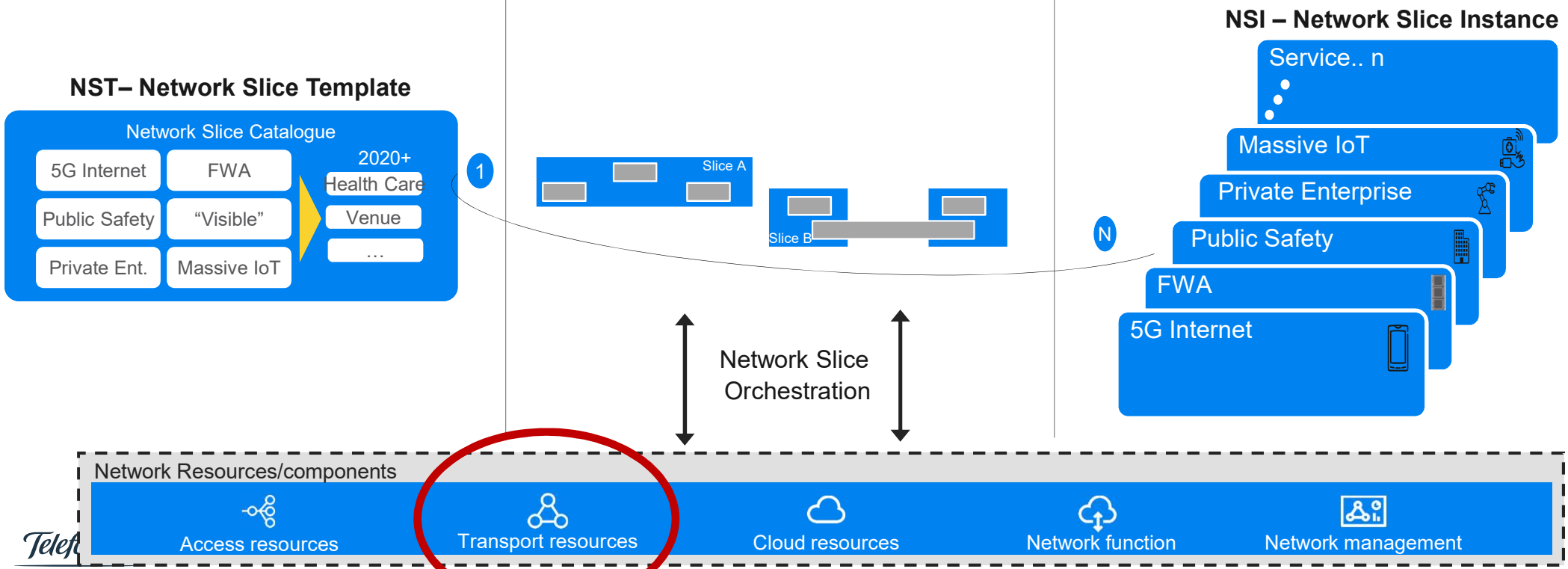
*A small number of blueprints (**NST**) for different logical network requirements (latency, bandwidth, security)*

Orchestrate

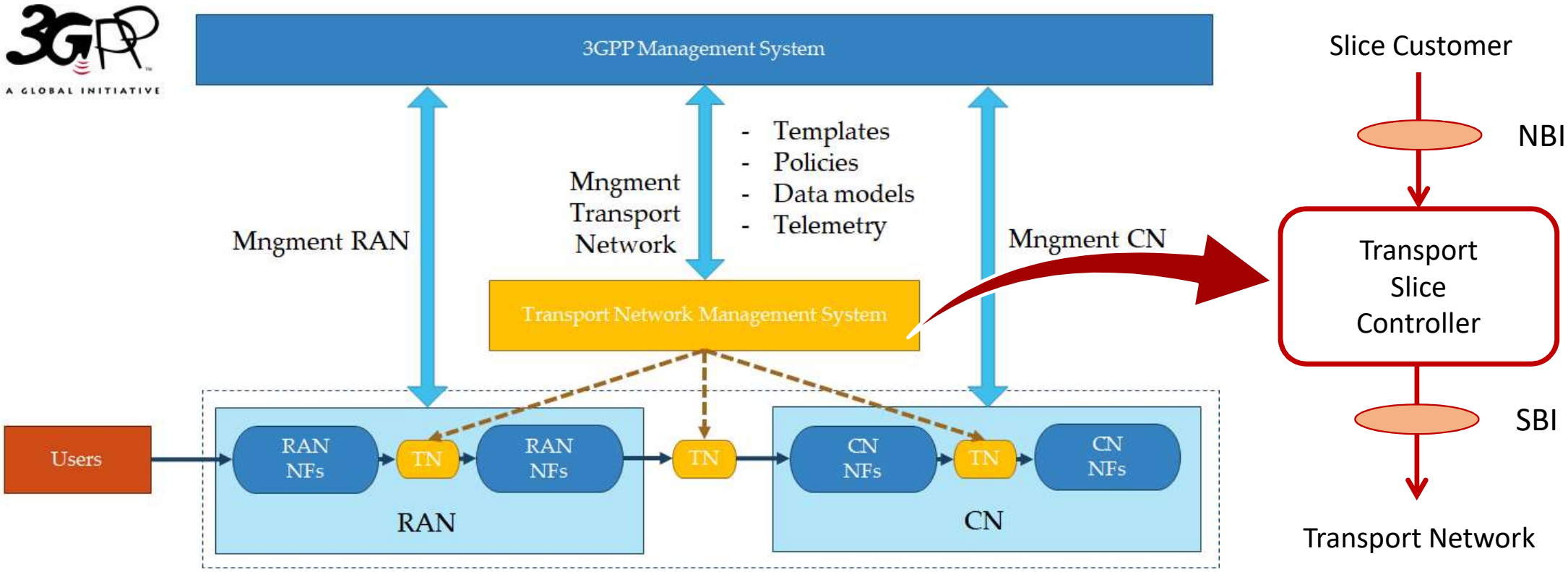
*Realize blueprint instances **(NSI)** in the network by configuring & instantiating RAN, transport, cloud resources and network functions*

Manage

Maintain and manage the inventory of instantiated slices and their associated resources (operate, heal, scale etc.)

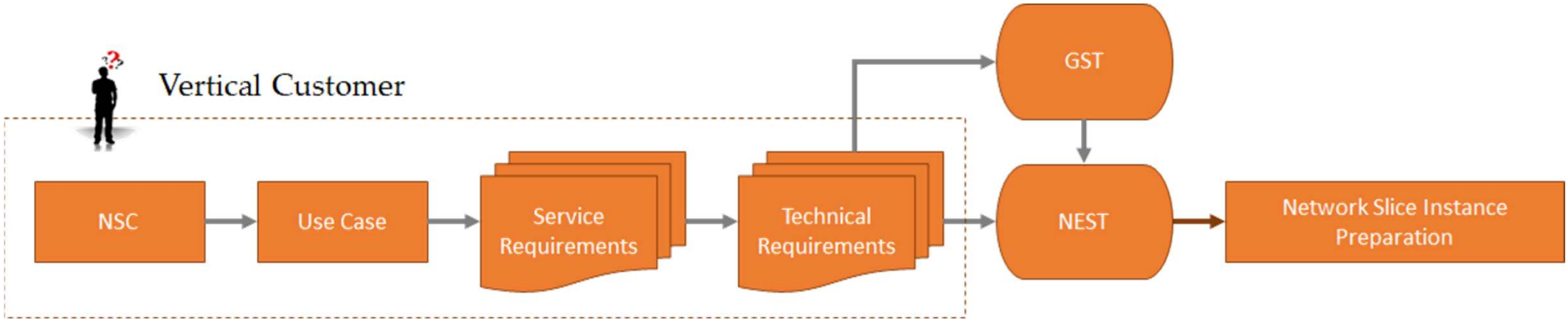


E2E slice management and control – e.g 5G



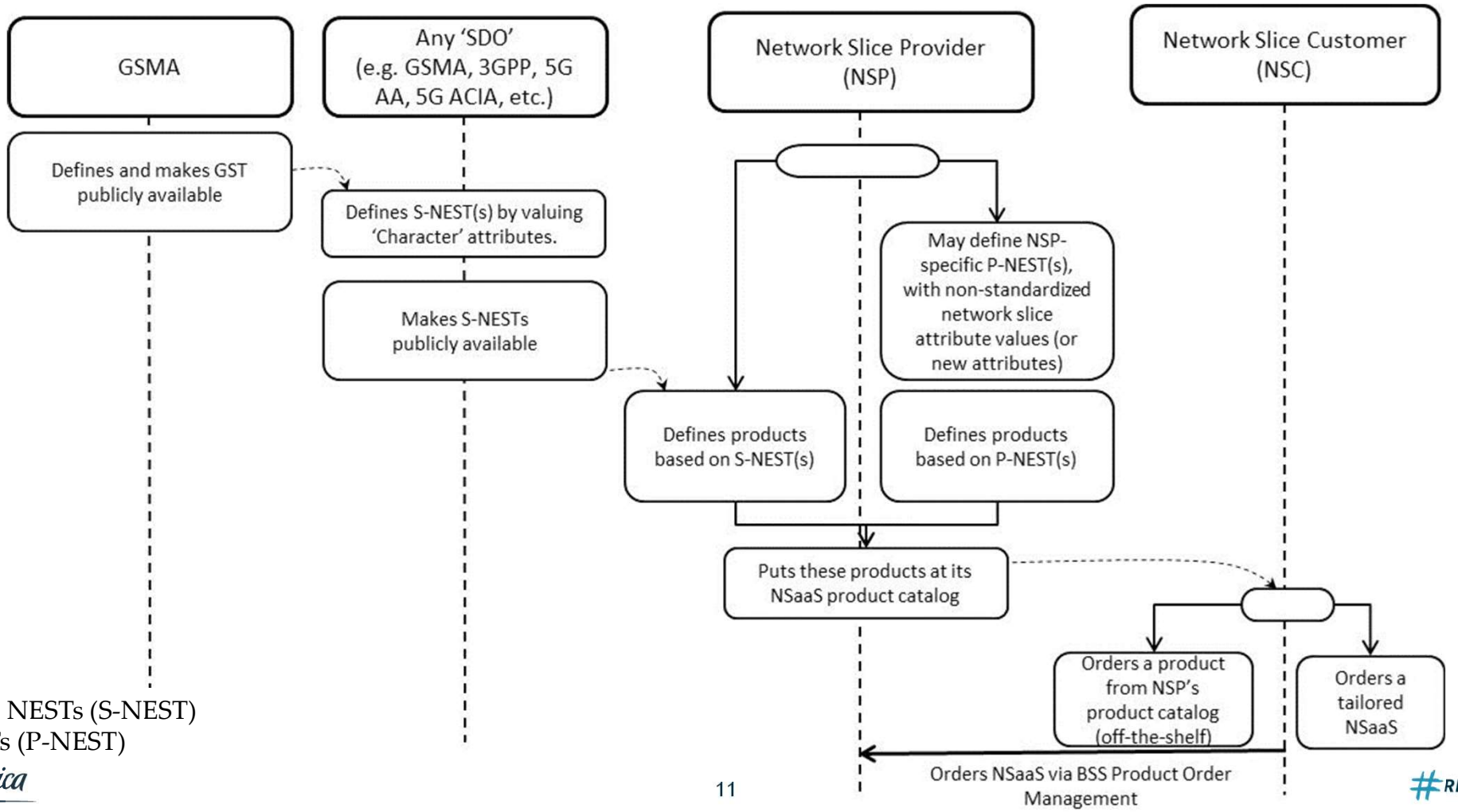
Understanding requirements for a transport slice

- Foundation for transport slices → GSMA Generic Slice Template [Ref2]
  - NG.116 (Generic network Slice Template (GST)): Version 3 Released on May 2020
  - The purpose of NG.116 is to assist network slice providers to map the use cases of network slice customers into generic attributes.
  - New attributes are still being defined and added.



3GPP TS 28.531

From GST to S-(/P-)NEST based product ordering



Standardized NESTs (S-NEST)
Private NESTs (P-NEST)

Transport slice attributes

[Ref3]

Generic Slice Template

#	Attribute	Description	Transport related
1	Availability	Not described in current version	Direct
2	Area of service	Area of access to a network slice	Indirect
3	Delay tolerance	Slice does not require low latency	Direct
4	Deterministic communication	Support of determinism for periodic traffic	Direct
5	Downlink throughput per network slice	Achievable DL data rate at slice level	Direct
6	Downlink throughput per UE	Achievable DL data rate at user level	Indirect
7	Energy efficiency	Bit / Joule for the slice	Indirect
8	Group communication	Support of multicast, broadcast, etc.	Direct
9	Isolation	Segregation level from other slices	Direct
10	Location-based message delivery	Indication of a particular geographic region	N/A
11	Maximum supported packet size	Maximum packet size in the network slice	Direct
12	Mission critical support	Priority respect to other slices	Indirect
…			
36	Latency from (last) UFP to Application Server	max or worst case one-way latency between UPF and application server	Indirect

Up to 37 attributes to consider (by now …)

5G slice procedures

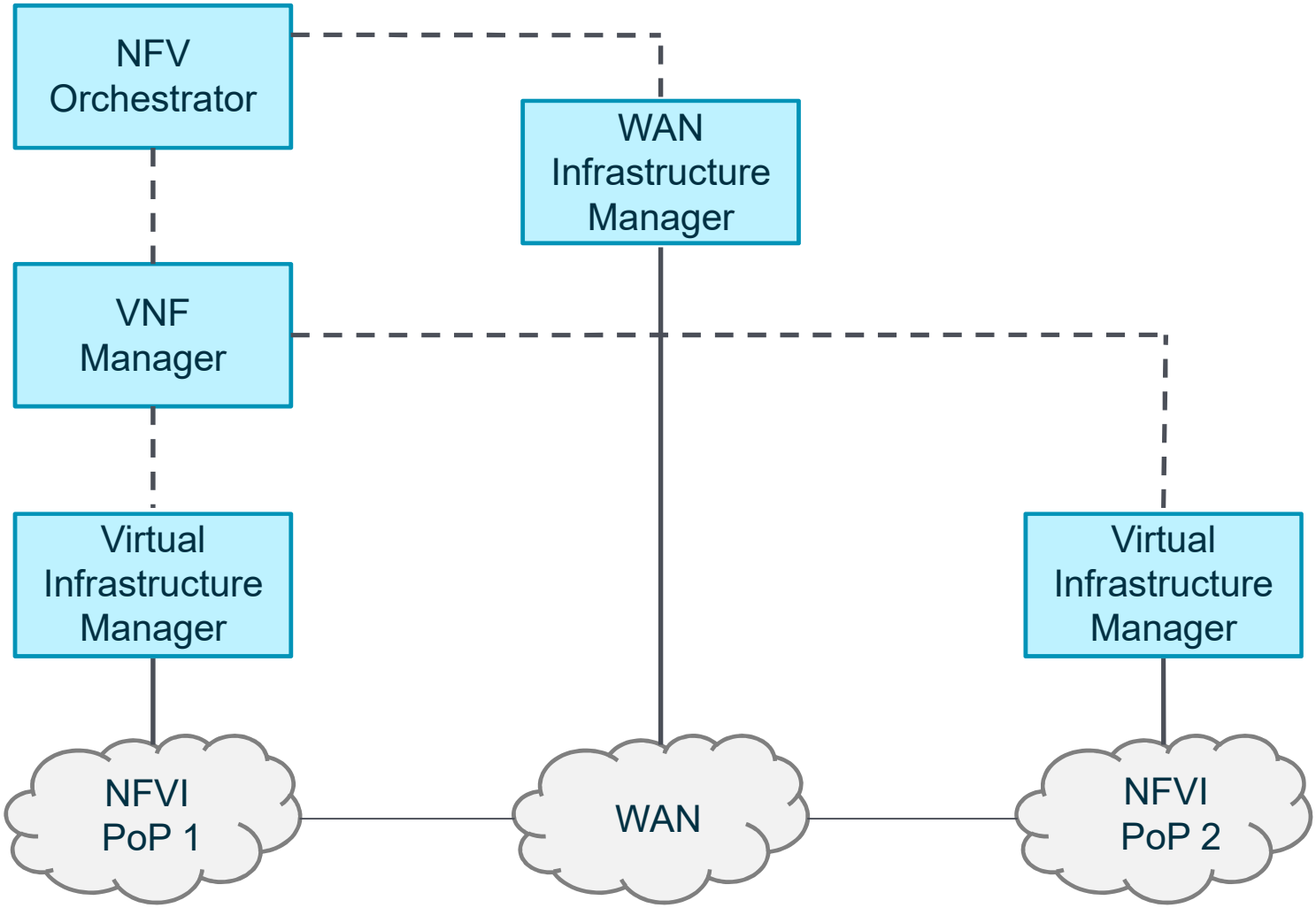
Procedure	Description
Allocate slice instance	Create a new slice instance (or reuse an existing one).
De-allocate slice instance	Terminate a deployed slice instance.
Modify slice instance	Modify a deployed slice instance. These modifications can be done at the resource layer (i.e. scaling in/out) and/or the application layer (i.e. semantics-related changes)
Get slice instance status	Retrieve run-time information on the status of a deployed slice instance (e.g. active/inactive, resources allocated, performance measurements, fault alarms). This information can be retrieved from the corresponding repository.
Get slice capabilities	Collect information on the supported capabilities of a deployed slice instance (e.g. maximum latency, maximum capacity, minimum availability). This information can be retrieved from the NEST.

Insight on a couple of exemplary Use Cases

- 5G Services

- Multi-PoP interconnection of SFs

ETSI MANO and WIM



Multi-site interconnection of SF

Attributes

Attribute	Description
Incoming and outgoing bandwidth	Bandwidth required for the connectivity services (in Mbps).
Qos metrics	Set of metrics (e.g., cost, latency and delay variation).
Directionality	Indication if the traffic is uni- or bi-directional.
MTU	Value of the largest PDU to be transmitted.
Connectivity mode	Point-to-point of point-to-multipoint.

Operations

Interface	Operations
Multi-Site Connectivity Service (MSCS) Management	Create, terminate, update and query of MSCS, including reservation. Also subscription for notifications and information retrieval.
Capacity Management	Query about the capacity (e.g. bandwidth), topology, and network edge points, as well as information of consumed and available capacity on the underlying network resources.
Fault Management	Provision of alarms related to the MSCSs.
Performance Management	Provision of performance information (measurement results collection and notifications) related to MSCSs.

Transport Network Slicing

(IETF's work in progress)

Transport Slicing initiative in IETF

- Design Team chartered after 2019 July meeting (IETF#105)
- TEAS Network Slicing Design Team charter (excerpts)
    - The TEAS Network Slicing Design Team (NSDT) is being formed **to develop a framework for delivering Network Slicing using existing IETF technologies**, and if and where needed, possible extensions to those technologies.
    - An **important early deliverable from the DT will be a proposed definition** of what is in-scope and what is out-of-scope for the WG on this topic.
    - It will present an update on their status and plans at IETF 106 (Singapore) - which will hopefully include an initial discussion on scope. For IETF 107 (Vancouver) the **goal for the DT is an initial DT framework**, and possibly draft, in time for discussion at the meeting. A stable Draft is targeted for discussion at IETF 108. Once the draft is accepted as a working group document, it will progress per TEAS working group normal process.
- 2020 July meeting (IETF#108) ->
    - Both definitions and framework drafts extensively discussed, close to be ready
    - Some initial work on transport slice YANG models have emerged
    - Additional work on NBI parameters is being developed

Transport slice

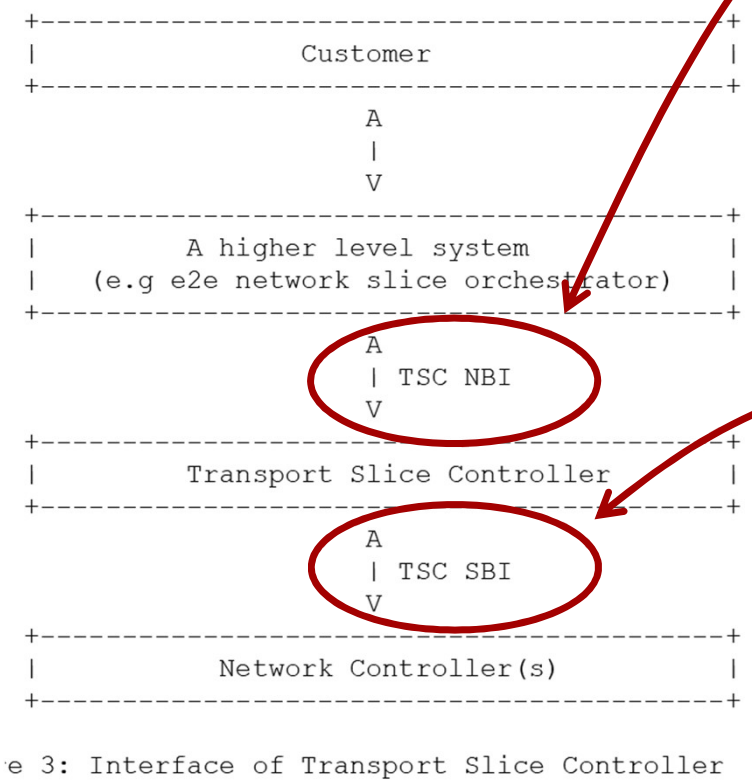
- Definition [Ref1]:

"A transport slice is a **logical network topology connecting a number of endpoints and a set of shared or dedicated network resources**, which are used to satisfy **specific Service Level Objectives (SLO)**".

- Logical Description
  - ✓ Technology agnostic or independent at the NBI
  - ✓ Its realization will be specific to underlying transport technology at the SBI
- Service level objectives
  - ✓ Concrete and measurable parameters imposing connection requirements (and implying network resources)
- Topology & end points
  - ✓ Transport Slice is connectivity centric, other related things are handled at a level above.

Transport Slice Controller

[Ref1]



e 3: Interface of Transport Slice Controller

- Northbound Interface (NBI)
  - ✓ SLOs and connectivity requirements
  - ✓ Translate requirements to lower layer entity and receive runtime state for monitoring

Description

- Southbound Interface (SBI)
  - ✓ Above requirements are mapped into technology specific manner
  - ✓ May require particular extensions or enhancements.
  - ✓ May or may not be slice-aware (optional)

Realization

SLOs

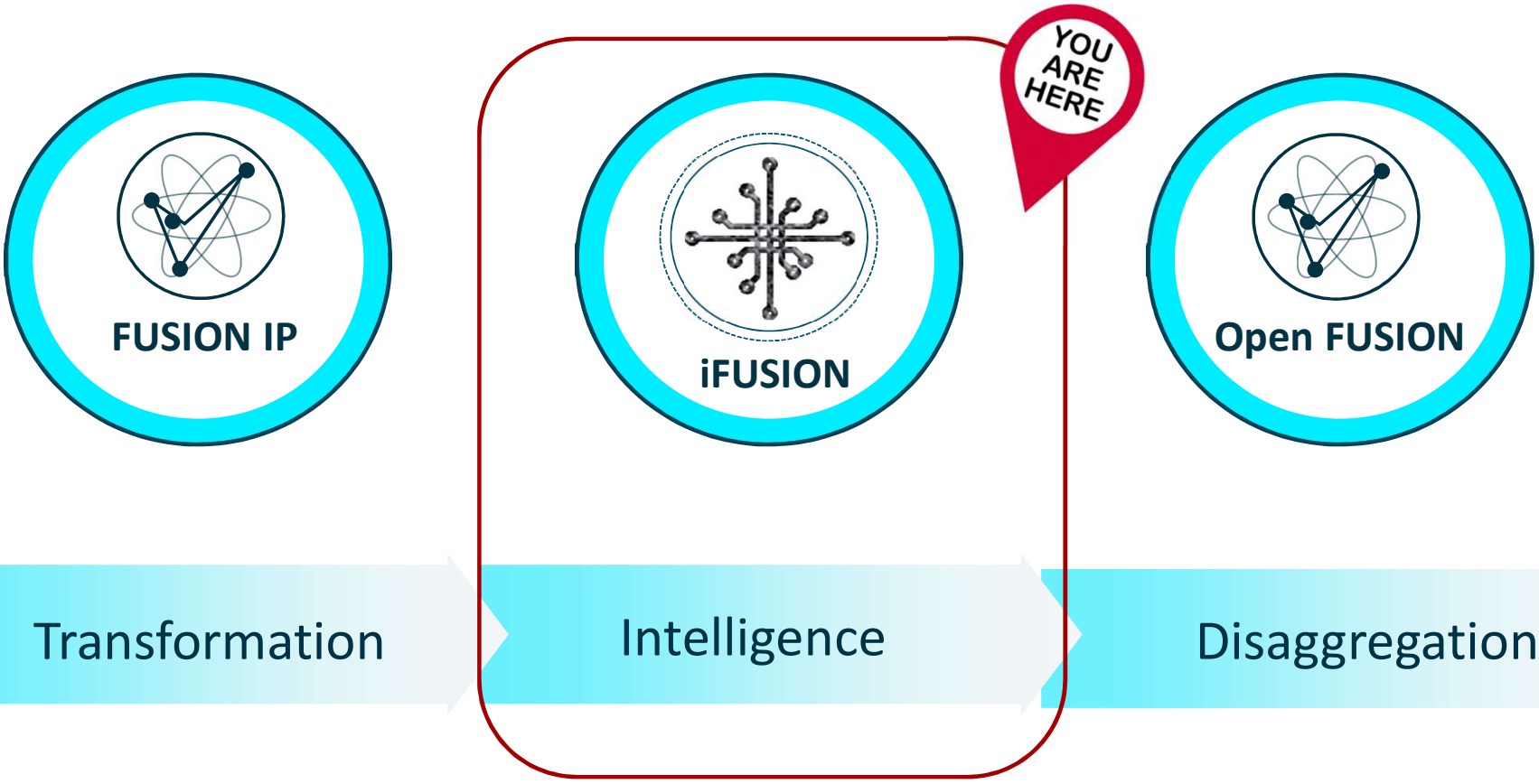
- Directly measurable objectives
    - Bandwidth, latency, jitter, packet loss, …
- Indirectly measurable objectives
    - Security, traffic type, …

- Other attributes can (/should) be taken into account
    - Geographical restrictions, Network functions, …
    - Great debate on **Isolation**
        - Mean of guaranteeing committed SLOs
        - Strict resource reservation and dedication

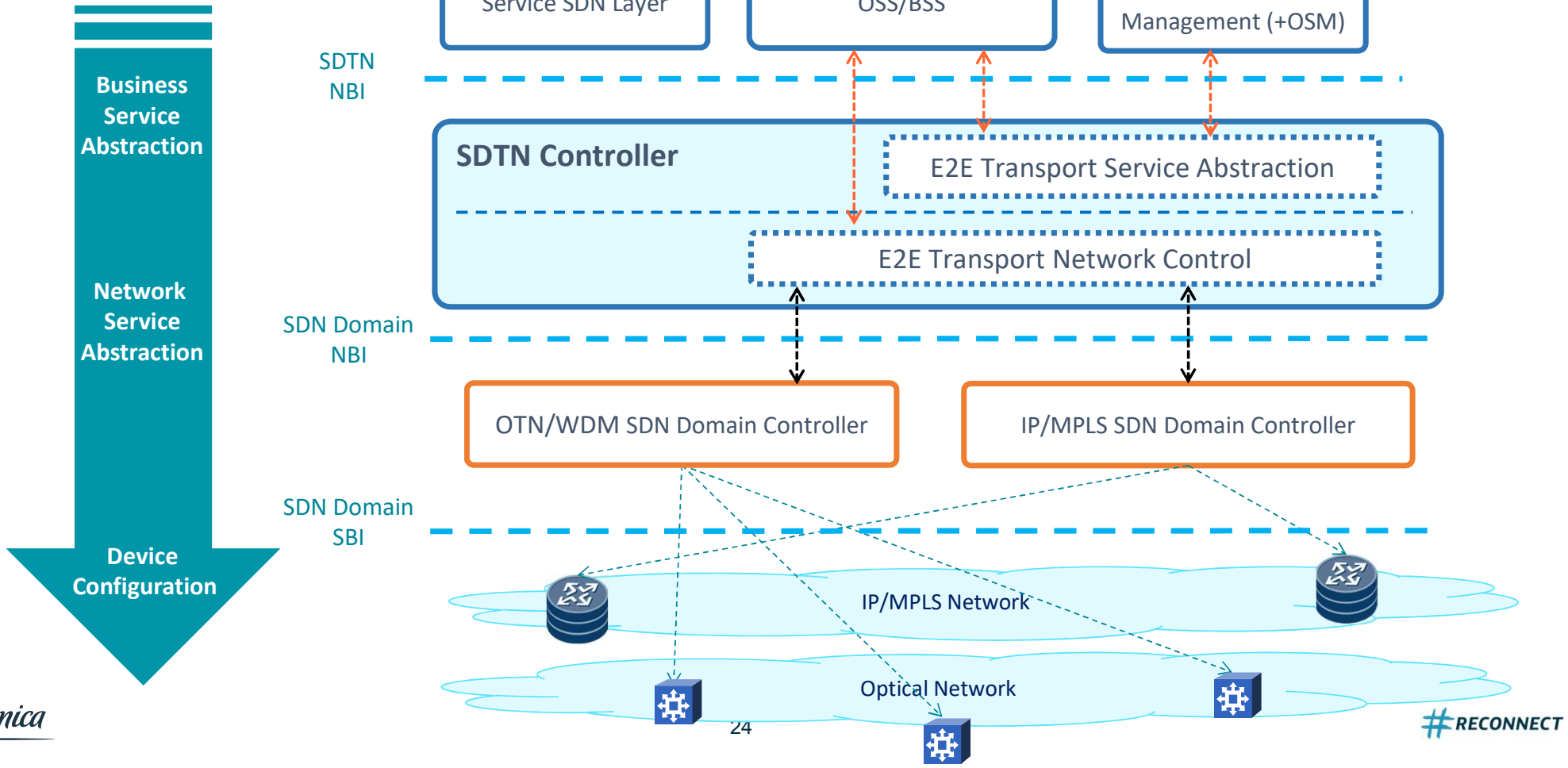
How to integrate it on real architectures

Telefónica transformation axes

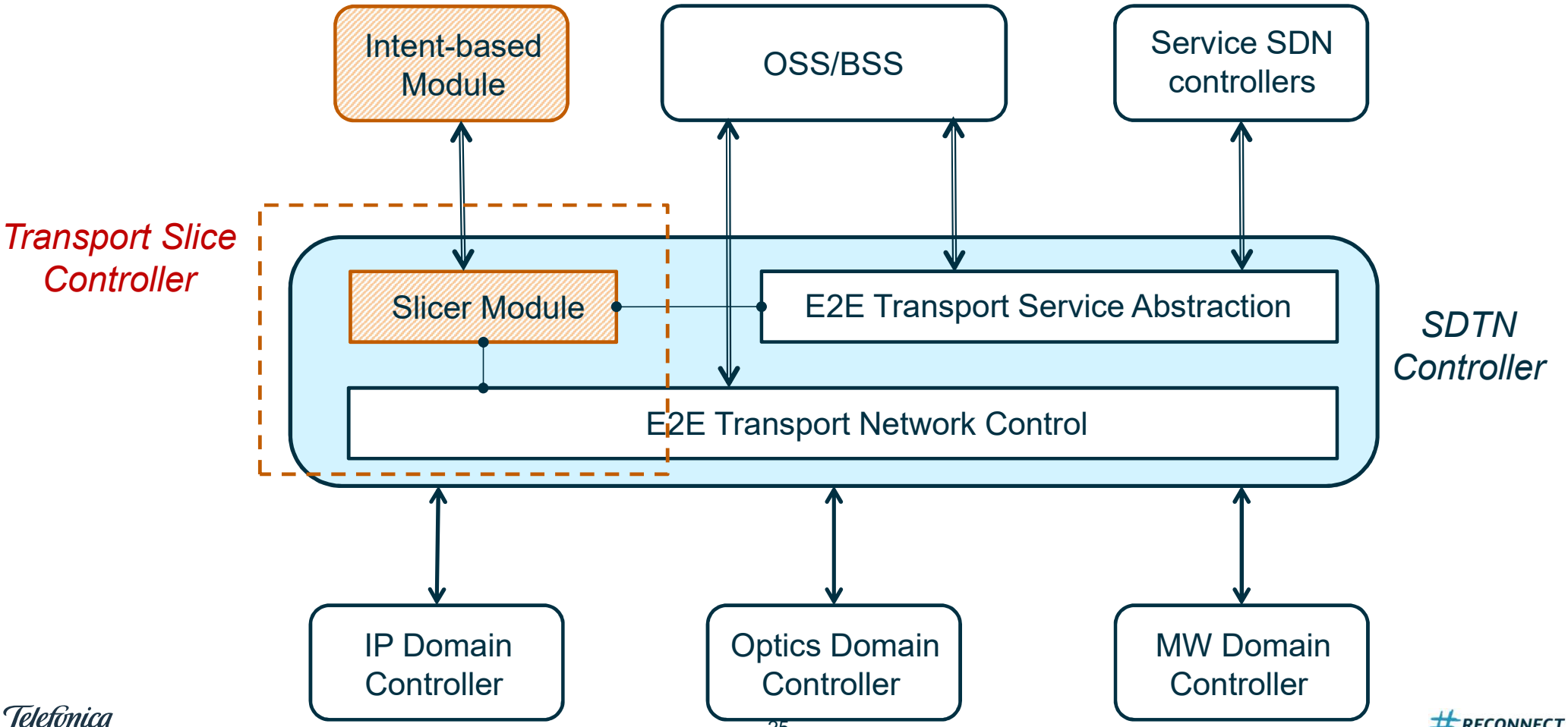
Scalability and agility improvement in transport network



Software Defined Transport Network (SDTN) architecture



Positioning TSC in SDTN



How to innovate on top of that

Transport Slice Intent

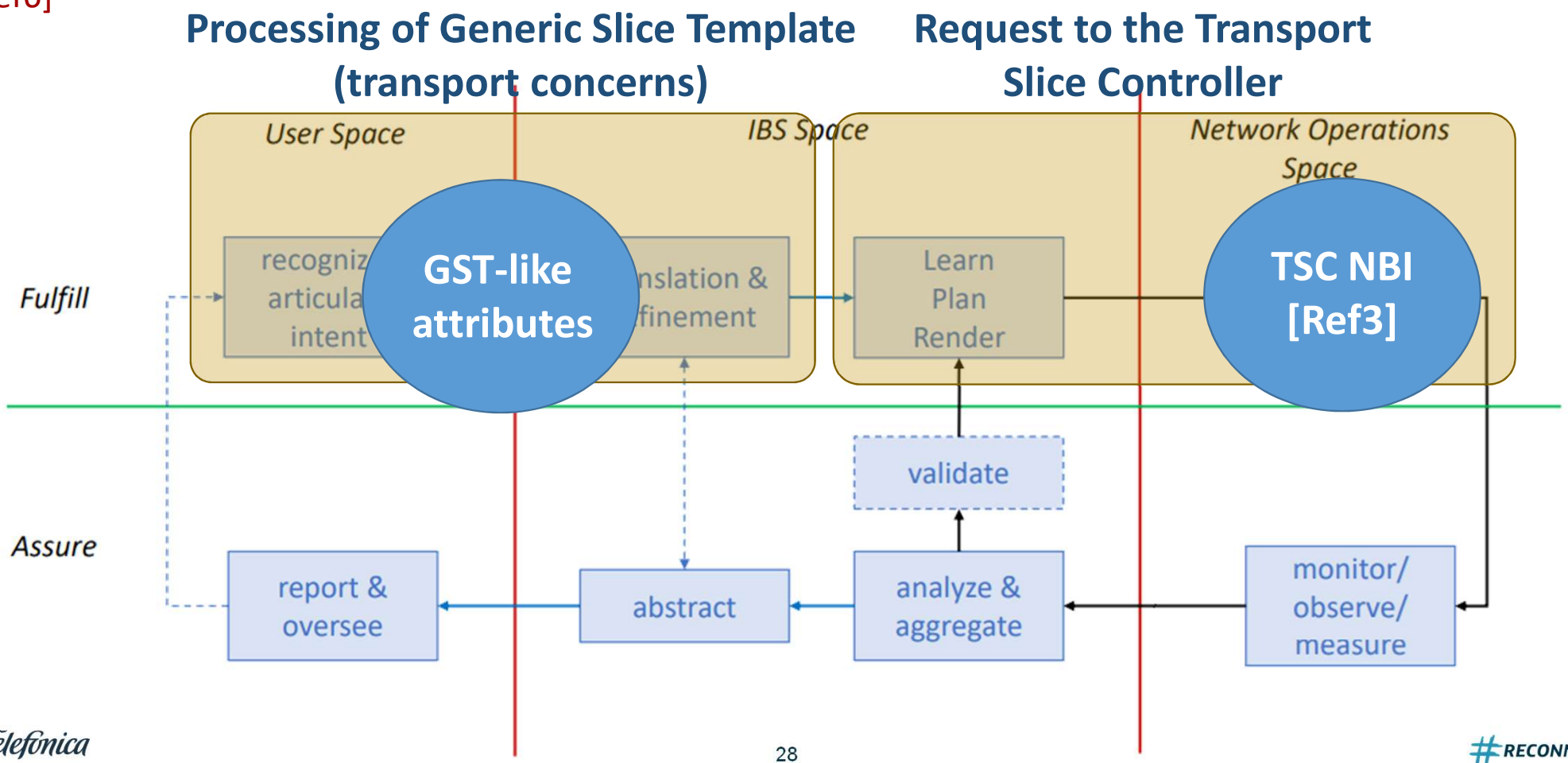
- [Ref1]: *"A transport slice is built based on a request from a higher operations system. The interface to higher operations systems should **express the needed connectivity in a technology-agnostic way**, and slice customers do **not need to recognize concrete configurations** based on the technologies (e.g being **more declarative than imperative**). The request to instantiate **a transport slice is represented with some indicators such as SLO, and technologies are selected and managed accordingly**."*

- [Ref4]: *"Intent is a **higher-level declarative policy** that operates at the level of a network and services it provides, not individual devices. It is used **to define outcomes and high-level operational goals**, without the need to enumerate specific events, conditions, and actions"*

- IB approach seems adequate for the provision of transport network slices with appropriate level of abstraction towards the transport network control and management artifacts

Transport Slice Intents

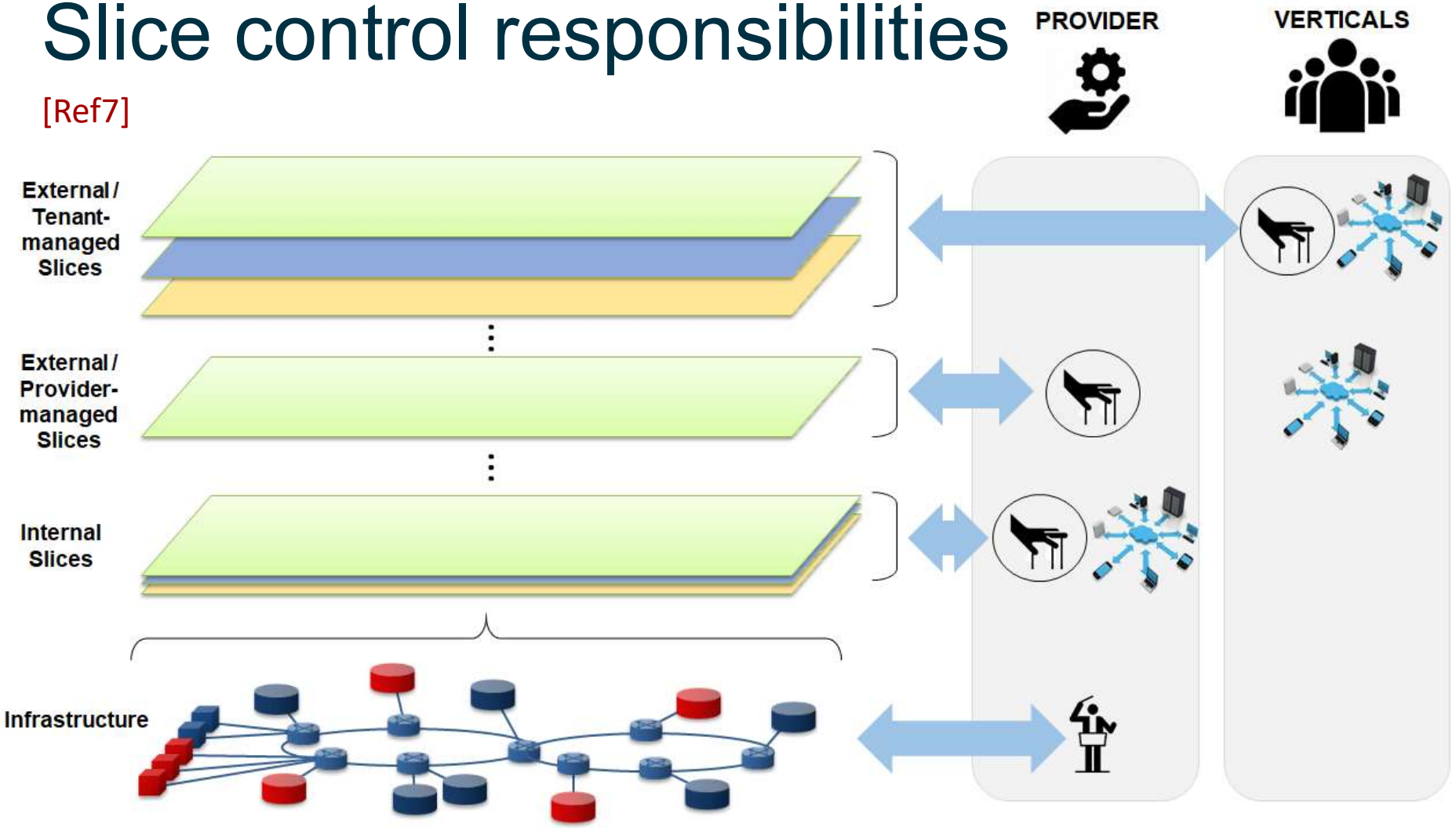
[Ref6]



Intent lifecycle according to [Ref5]

Slice control responsibilities

[Ref7]



One slice per vertical. The control of the slice and the service is on the vertical.

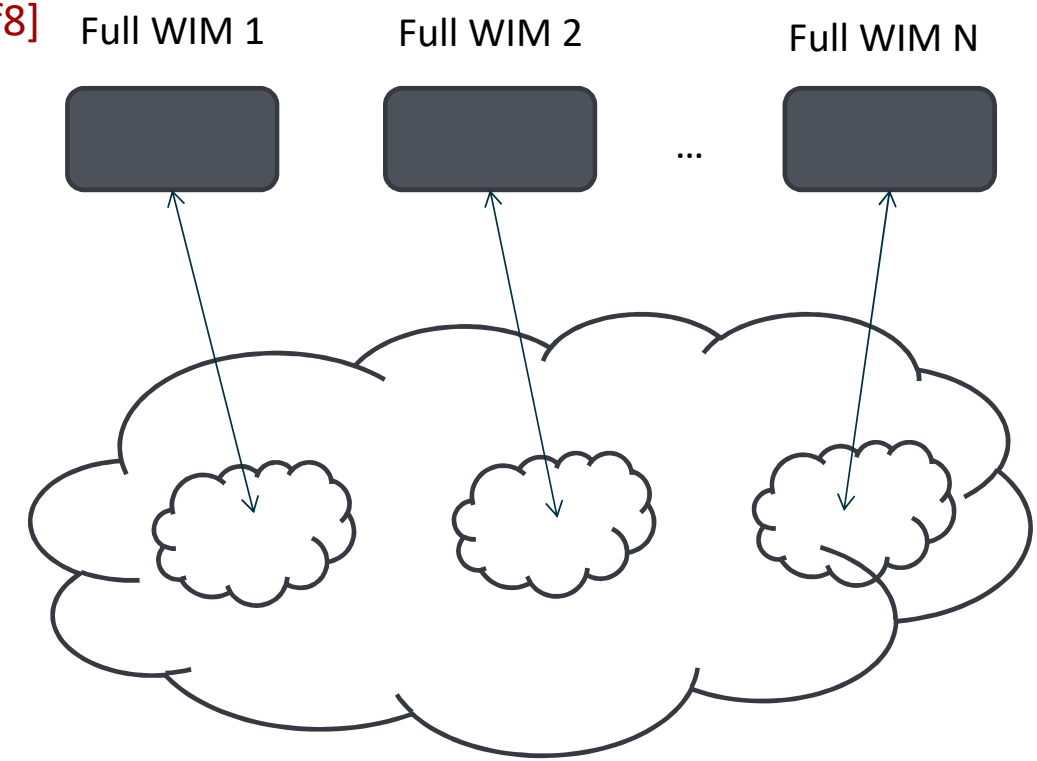
Multiple verticals per slice (adapted to a kind of service). The provider controls the slice, while the vertical controls its service.

Slices for internal services. The control of the slice and the internal service is on the provider.

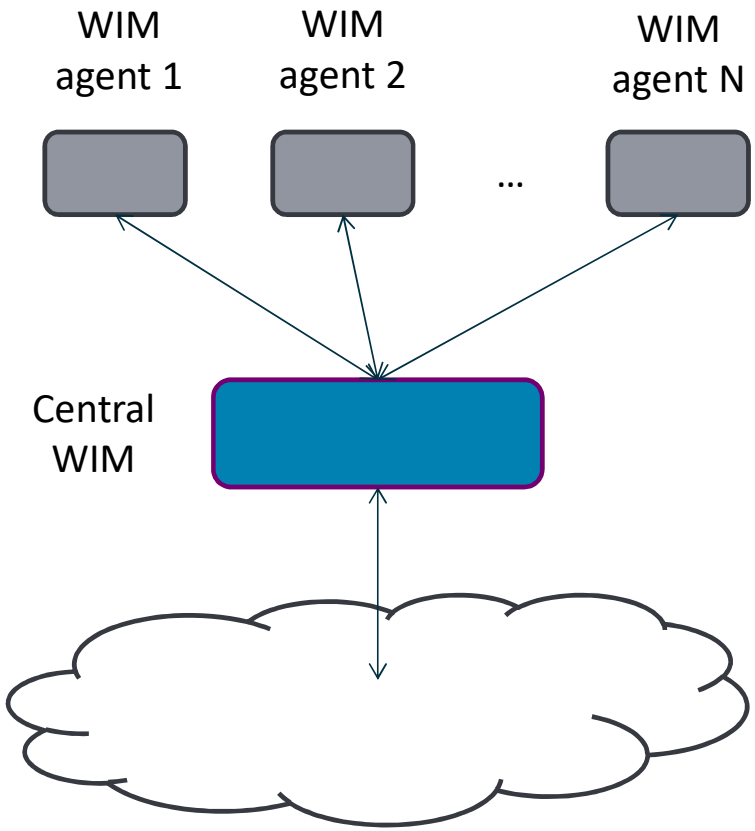
Orchestration performed by the provider

WIM-on-demand concept

[Ref8]

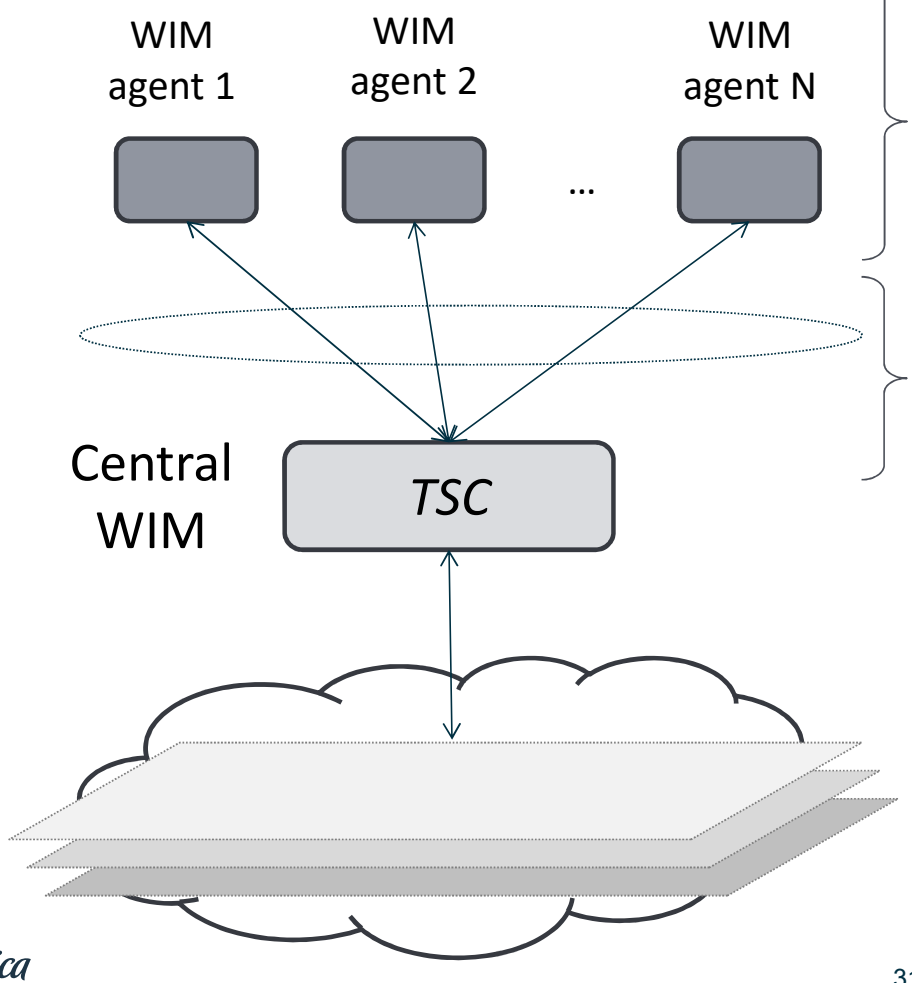


- Standard SBIs towards the Network infrastructure
- Mechanism / artifact for dedicated infrastructure allocation from the infrastructure provider



- Standard NBI from centralized WIM for allowing multiple agents running on top
- Isolation mechanisms to avoid affection from one tenant to another

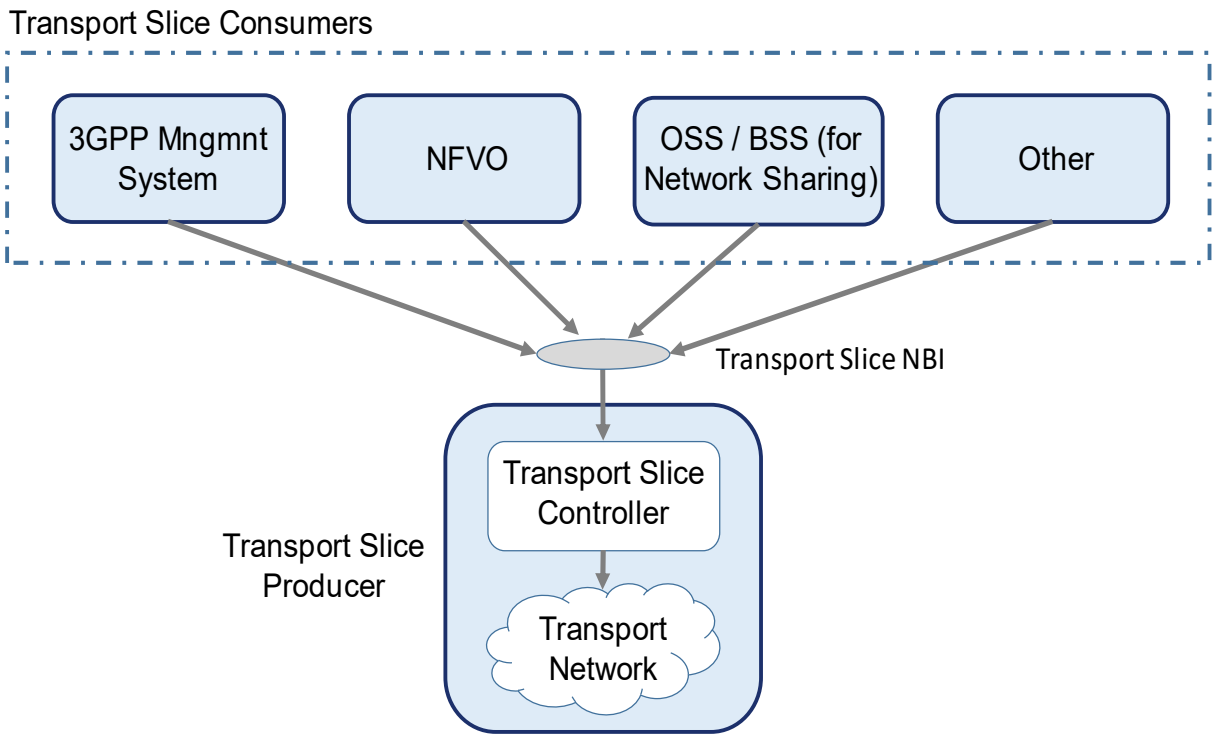
TSC in relation with WIM-on-demand



Each customer could be provided with an instance of a customer agent able to interact with the TSC for controlling and managing its transport slice

TSC NBI could be customized to the type of customer in terms of attributes and procedures that could manage

Conclusions and further work



- Standardization is needed to ensure proper integration from external systems
- 5G is the main case but not the only use case
- The integration with operational SDN architectures should be smooth
- Technology agnostic ways of requesting slices can leverage also on IBN mechanisms assisting slice customers on their requests
- Transport Slice Controller as a piece for enabling consuming the Network in a more advanced manner

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