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Towards a standardized transport slicing architecture in operator networks

Luis M. Contreras

Telefónica GCTIO – Transport Technology and Planning

luismiguel.contrerasmurillo@telefonica.com

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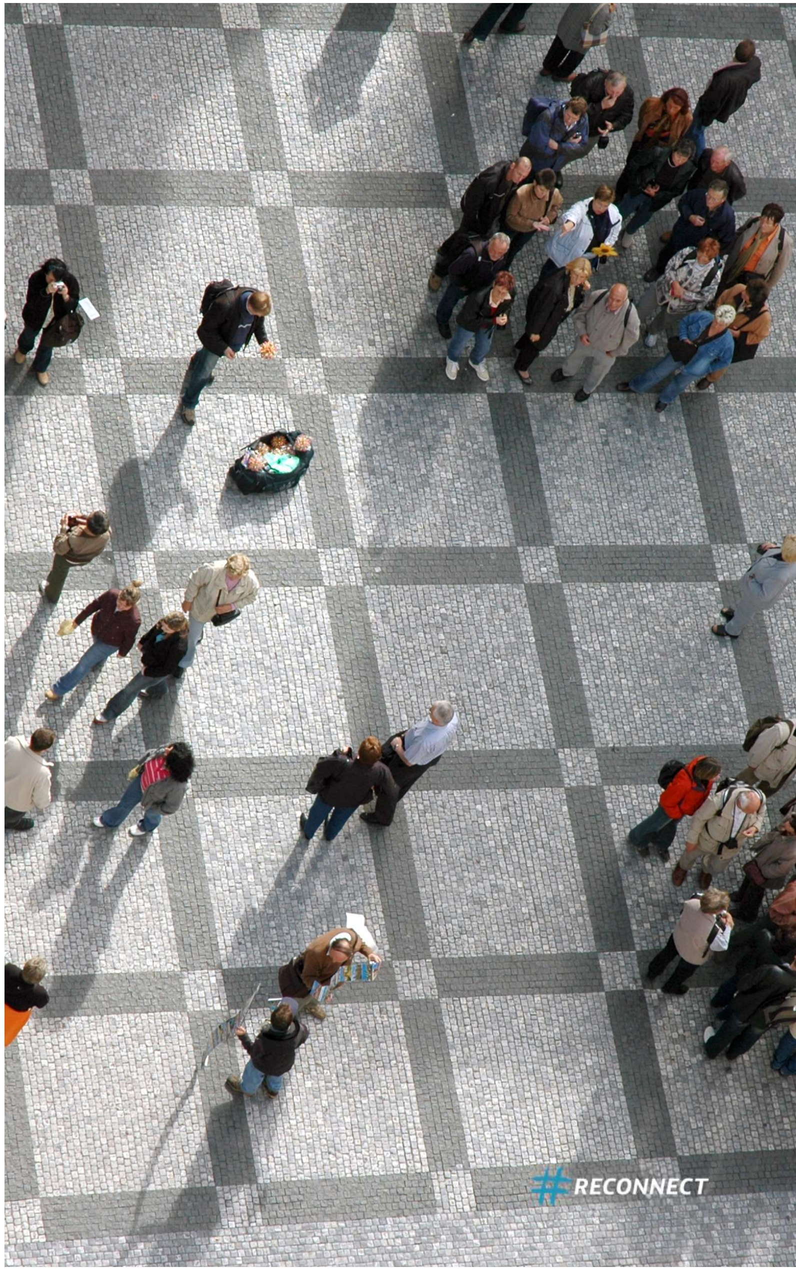
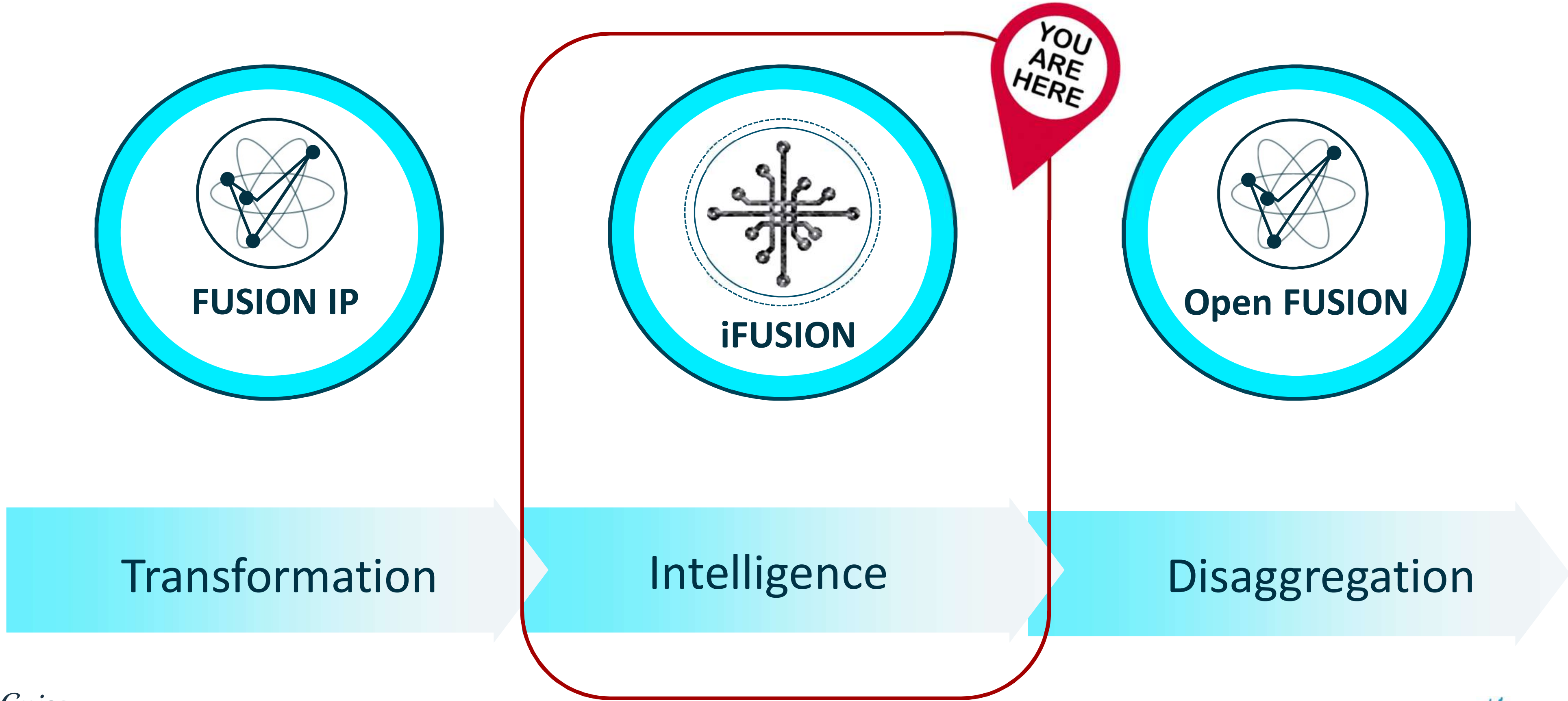
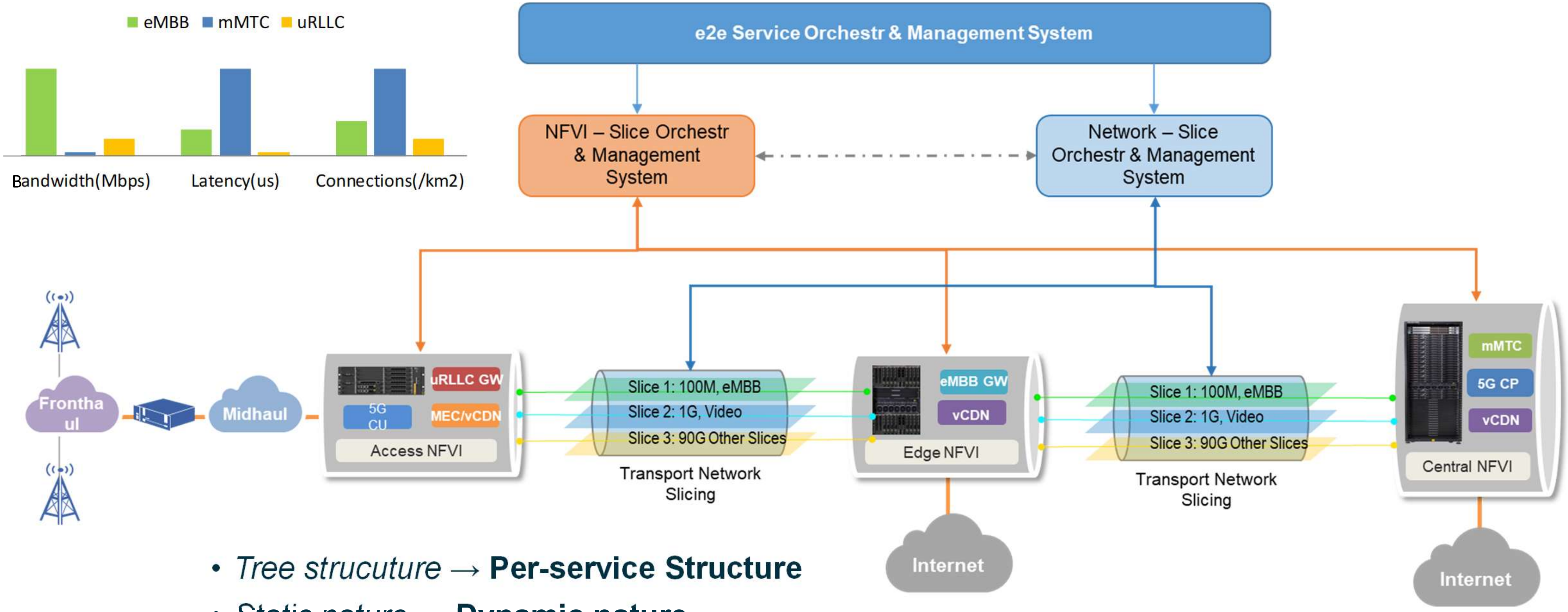


Telefónica transformation axes

Scalability and agility improvement in transport network



Slicing – general overview



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

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

Design

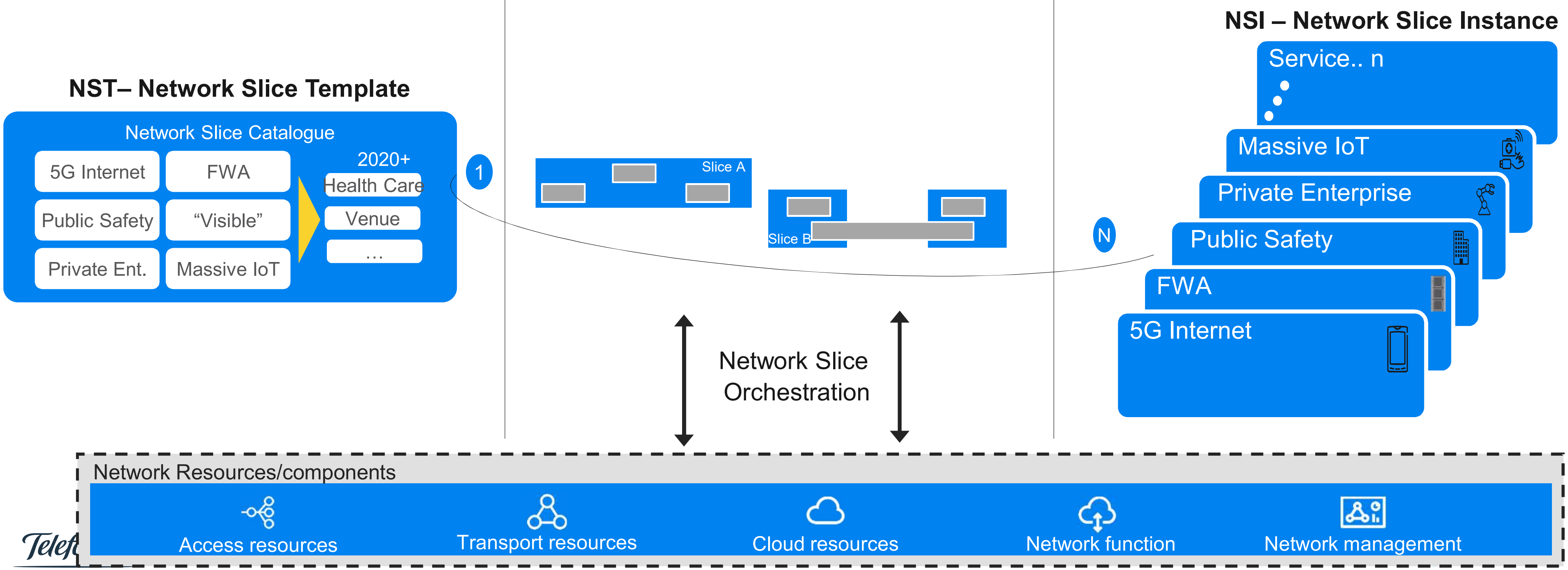
*A small number of blueprints (**NST**) for different logical network requirements (latency, bandwidth, security)*

Orchestrate

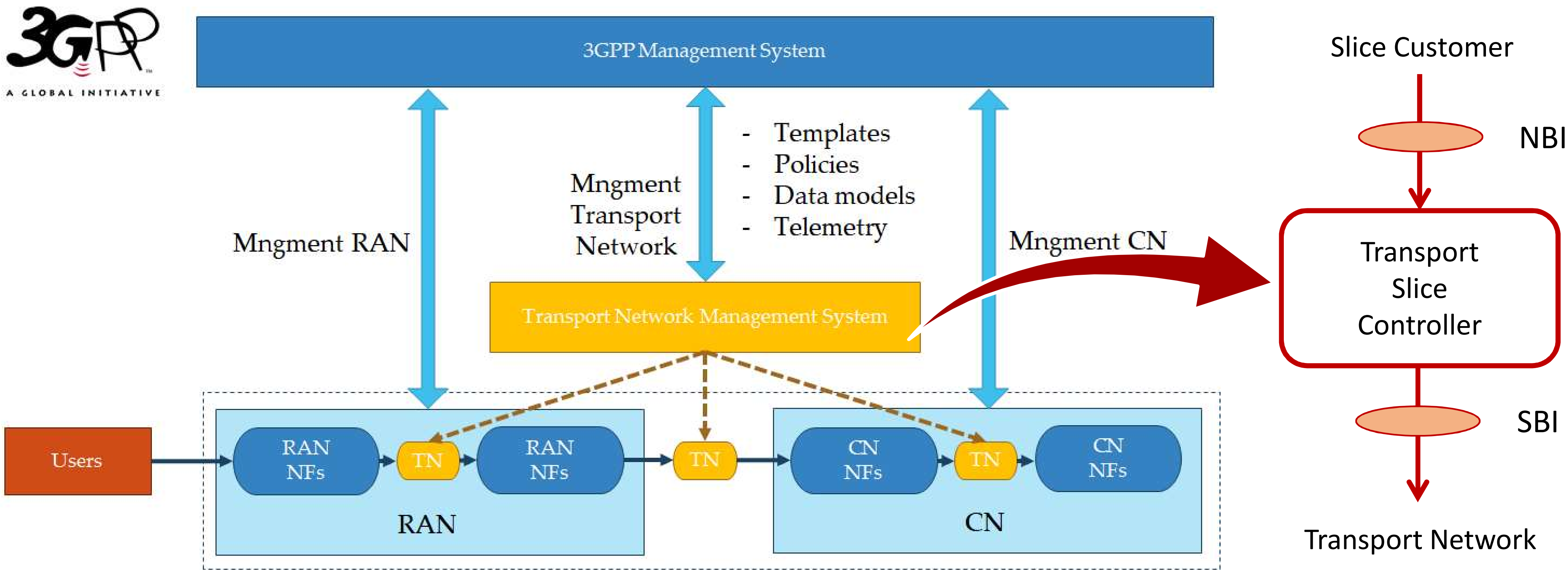
*Realize blueprint instances **(NSI)** in the network by configuring & instantiating RAN, transport, cloud resources and network functions*

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



Transport slice

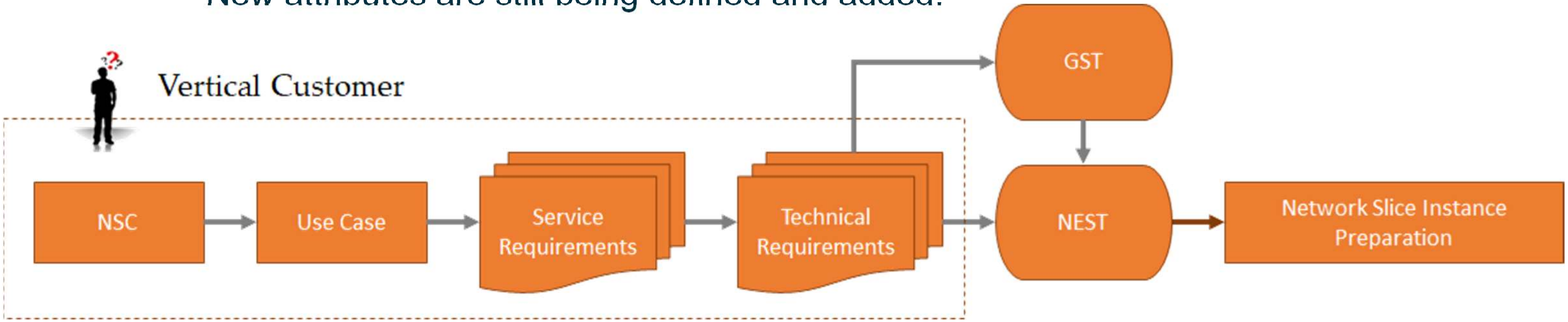
- Definition [Ref1]:

"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
  - ✓ Its Realization will be specific to underlying technology.
- Service level objectives
  - ✓ Concrete network resource and connection requirements
- Topology & end points
  - ✓ Connectivity centric, other related things are handled at a level above.

Understanding requirements for a transport slice

- Foundation for transport slice intents → GSMA Generic Slice Template [Ref2]
  - NG.116 (Generic network Slice Template (GST): Version 2 Released on October 2019.
  - The purpose of NG.116 is to assist network slice provides to map the use cases of network slice customers into generic attributes.
  - New attributes are still being defined and added.



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
…			
…			

Up to 36 attributes to consider (by now …)

TSC Interfaces

[Ref1]

```
+---------------------------------------------+
|                  Customer                    |
+---------------------------------------------+
                       A
                       |
                       V
+---------------------------------------------+
|            A higher level system             |
|    (e.g e2e network slice orchestrator)      |
+---------------------------------------------+
                       A
                       | TSC NBI
                       V
+---------------------------------------------+
|          Transport Slice Controller          |
+---------------------------------------------+
                       A
                       | TSC SBI
                       V
+---------------------------------------------+
|            Network Controller(s)             |
+---------------------------------------------+
```

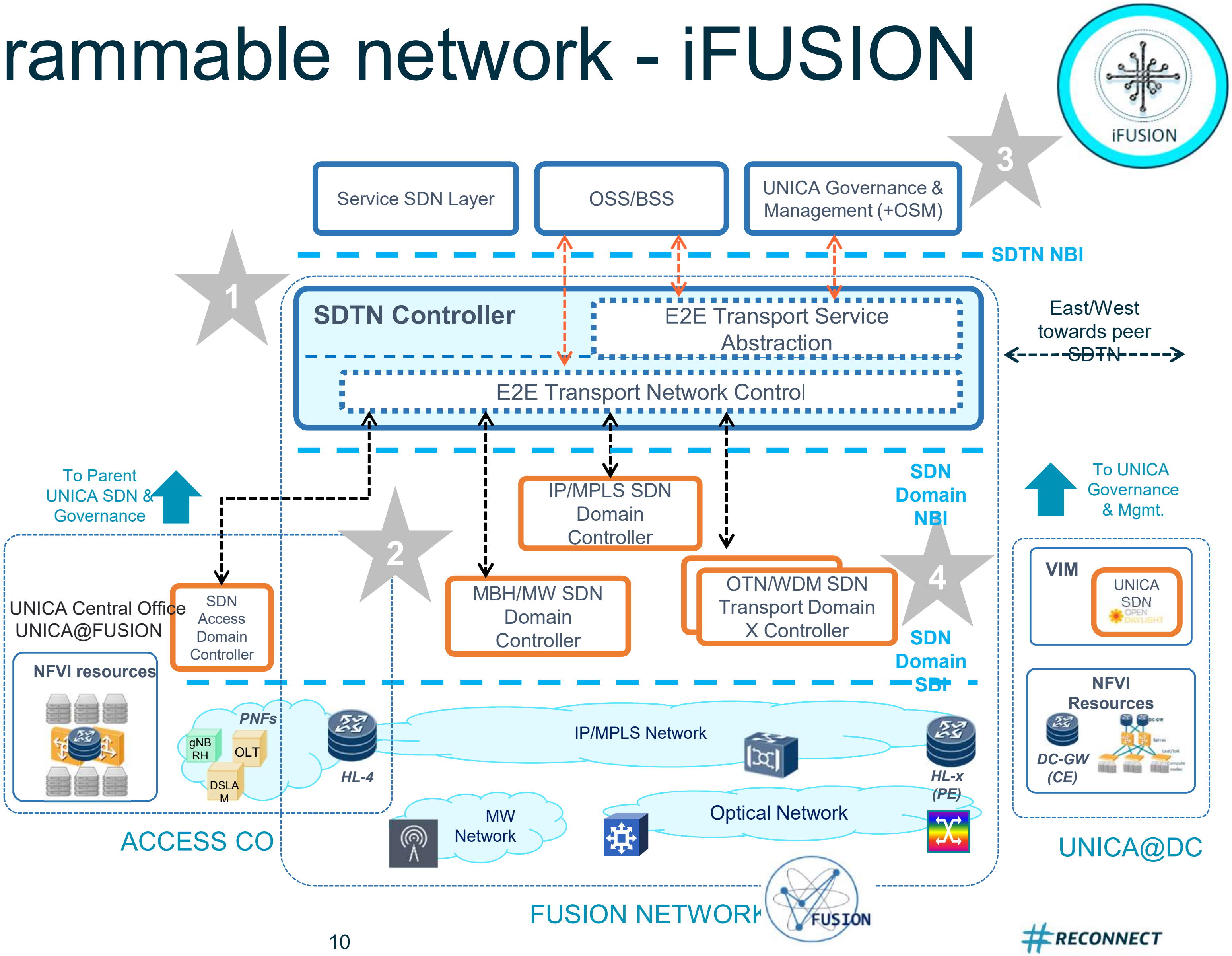
e 3: Interface of Transport Slice Controller

- Northbound Interface (NBI) — *Description*
  - ✓ SLOs and connectivity requirements
  - ✓ Translate requirements to lower layer entity and receive runtime state for monitoring
- Southbound Interface (SBI) — *Realization*
  - ✓ Above requirements are mapped into technology specific manner
  - ✓ May require particular extensions or enhancements.
  - ✓ May or may not be slice-aware (optional)

Intelligent programmable network - iFUSION

[Ref4]

1. Hierarchical approach with unique SDTN Controller, offering **service level abstraction**
2. Per network domain SDN controller, offering **network level abstraction** and implementing devices configuration
3. SDTN Controller may also **offer services to UNICA**, in combination with the UNICA SDN Domain Controller
4. **Common** SDN **Domain NBI and/or SBI**, for multivendor SDN interoperability



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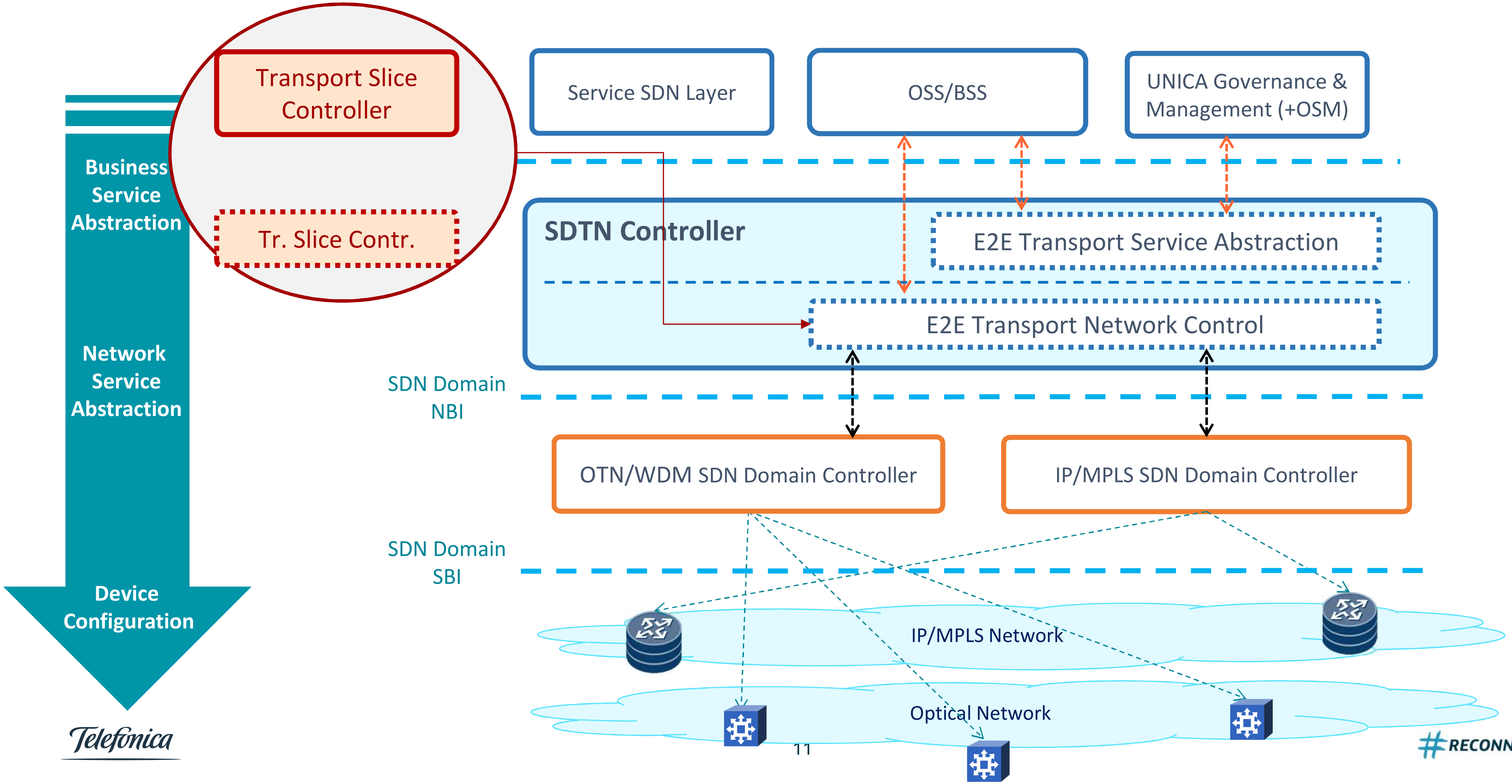
#RECONNECT

Software Defined Transport Network (SDTN) architecture



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#RECONNECT

Transport Slice Intent

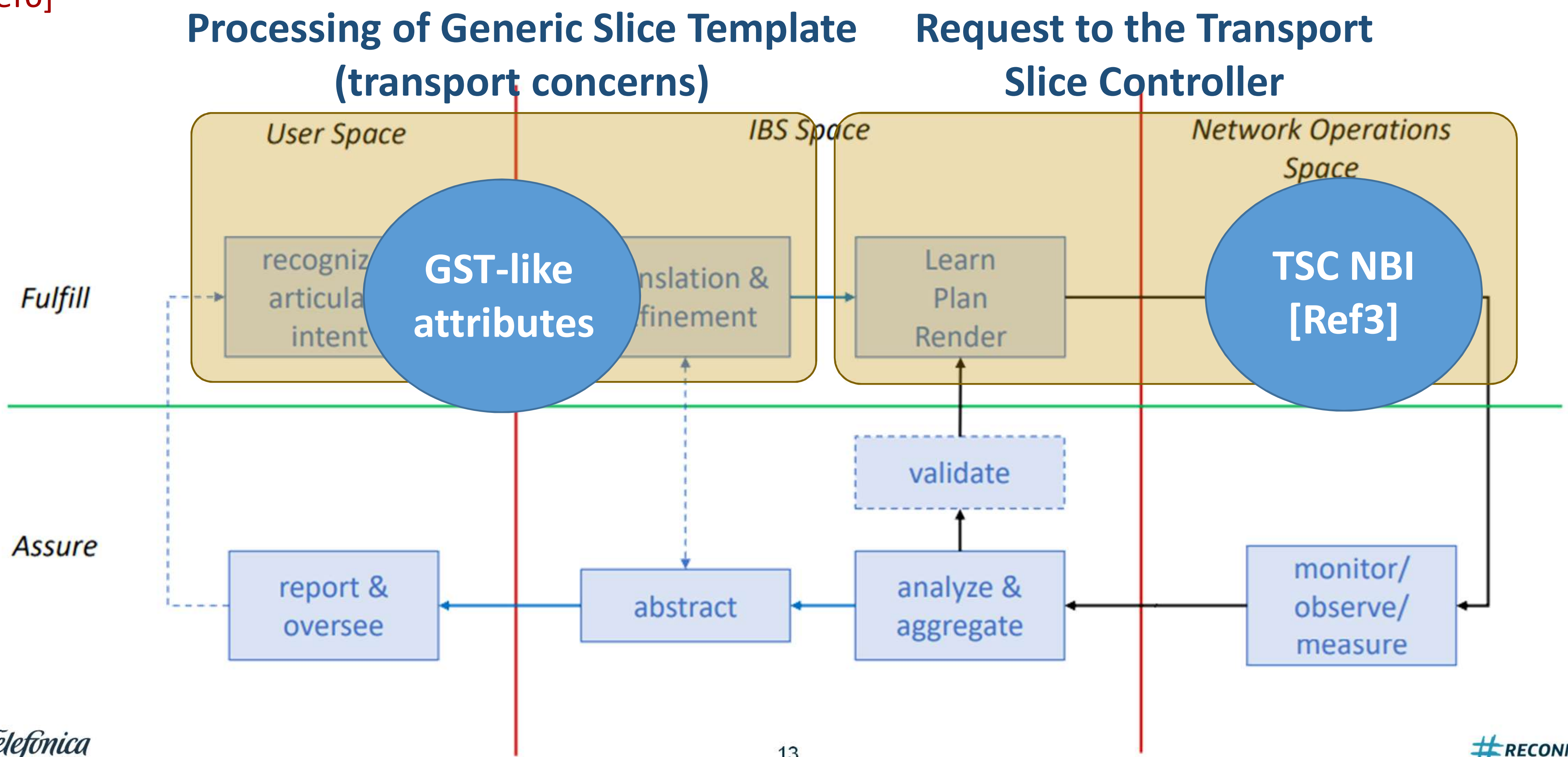
- [Ref1]: *"A transport slice is built based on a request from a higher operations system. The interface to higher operations systems should **express the needed connectivity in a technology-agnostic way**, and slice customers do **not need to recognize concrete configurations** based on the technologies (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

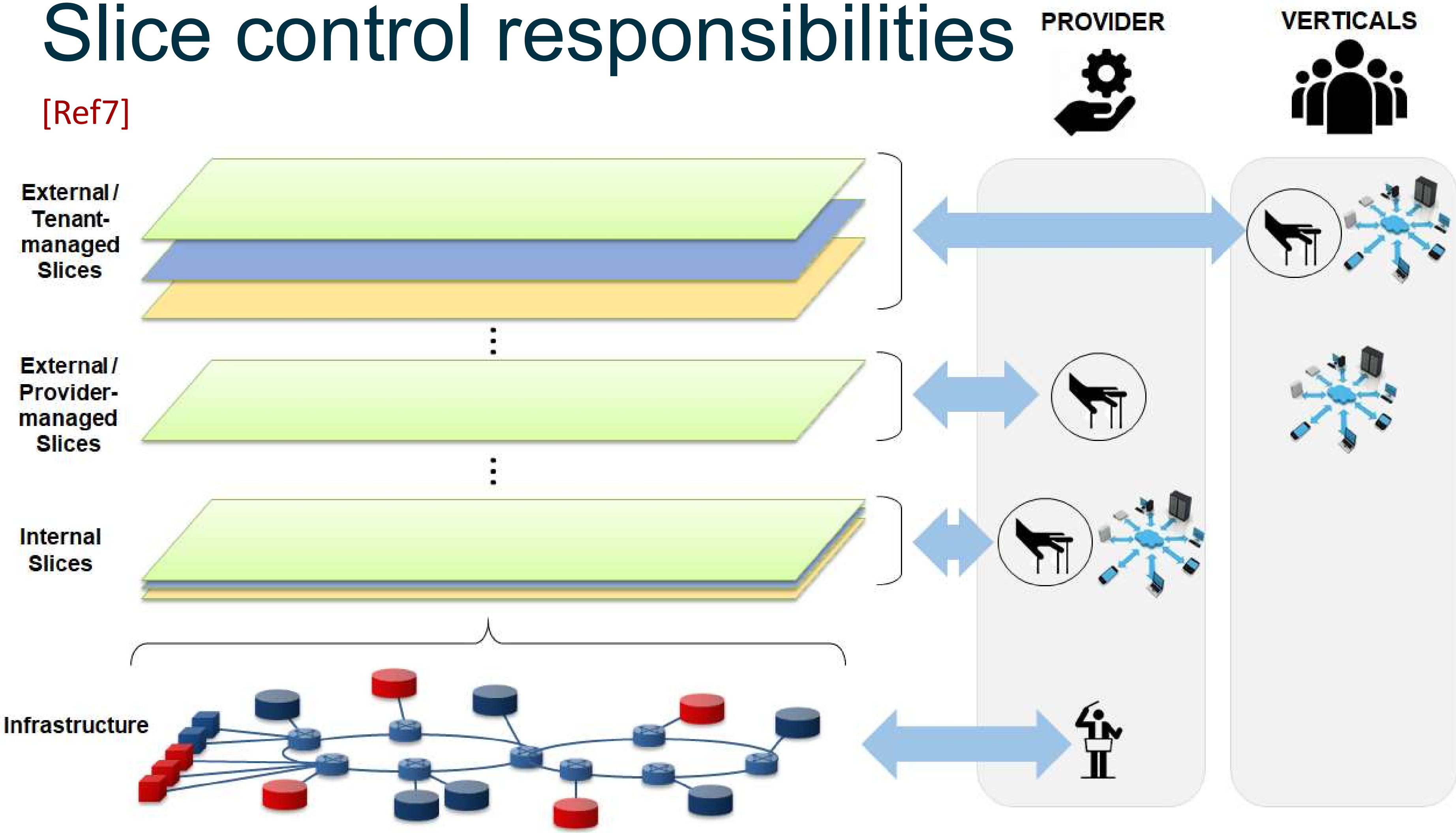
[Ref6]



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.

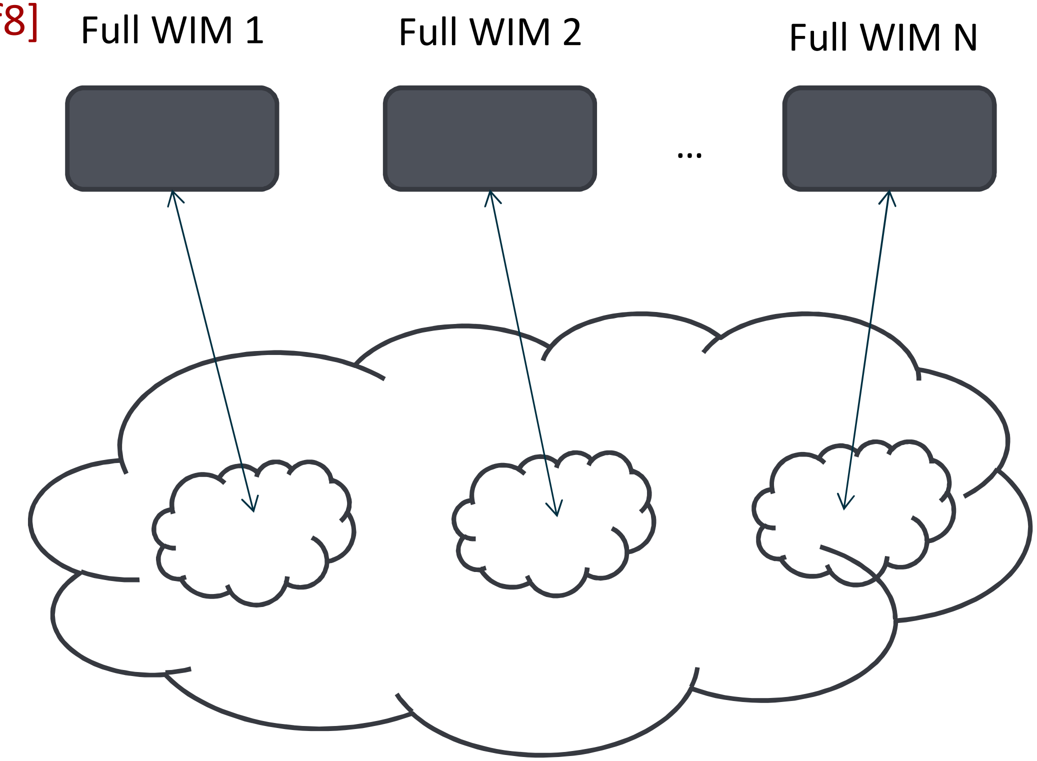
Multiple verticals per slice (adapted to a kind of service). The provider controls the slice, while the vertical controls its service.

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

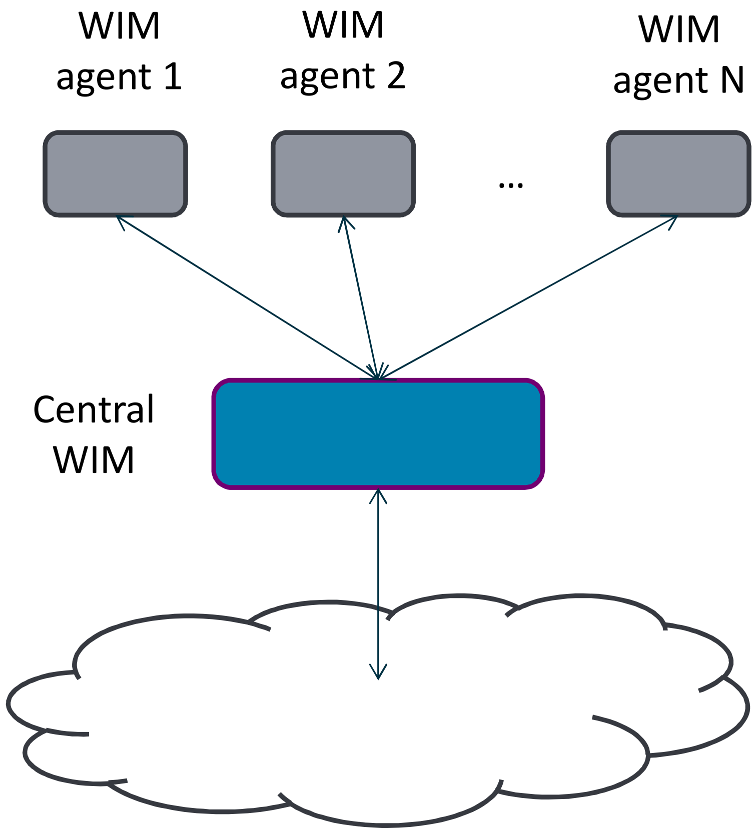
Orchestration performed by the provider

WIM-on-demand concept

[Ref8]



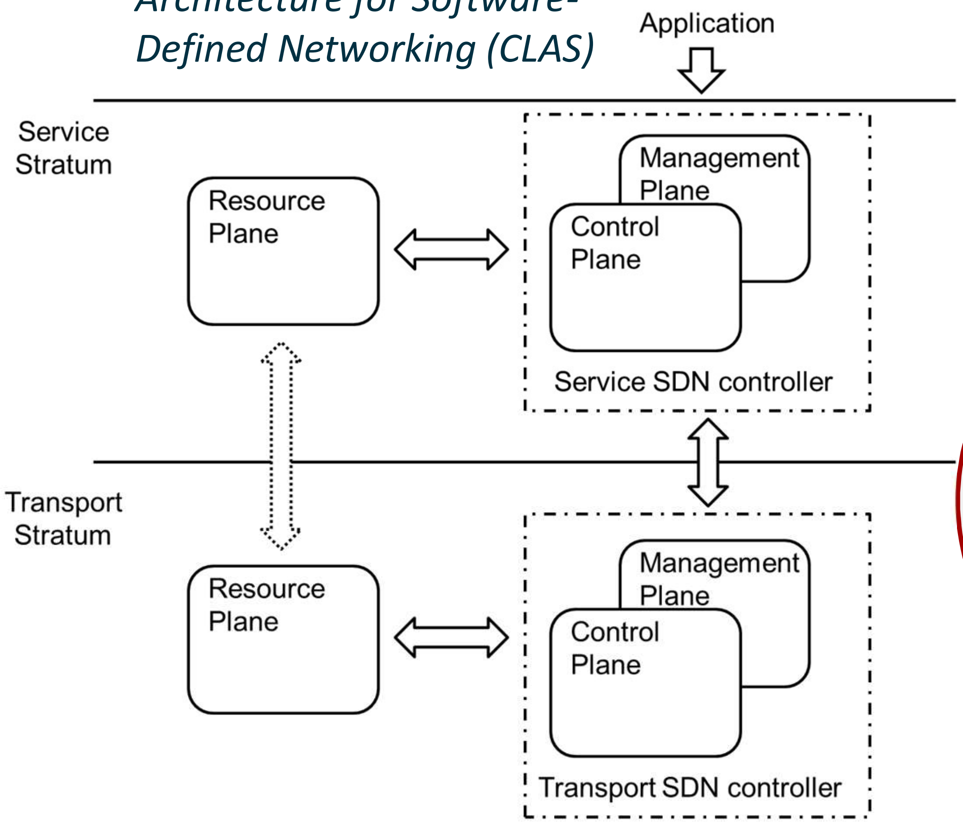
- Standard SBIs towards the Network infrastructure
- Mechanism / artifact for dedicated infrastructure allocation from the infrastructure provider

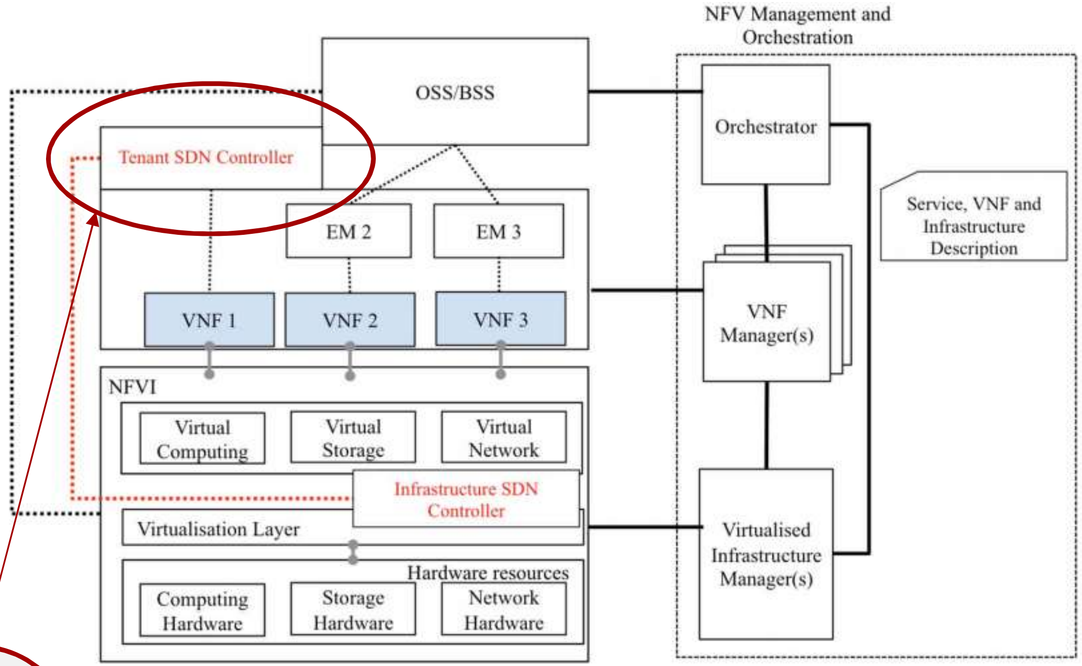


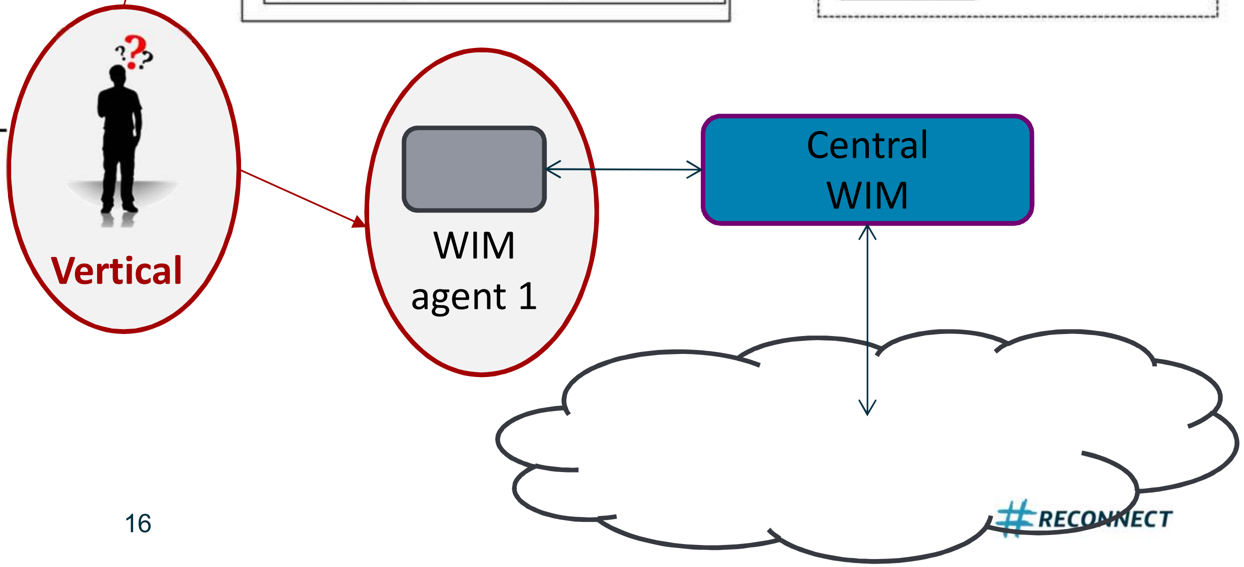
- Standard NBI from centralized WIM for allowing multiple agents running on top
- Isolation mechanisms to avoid affection from one tenant to another

Consuming the Network as an slice (work in progress)

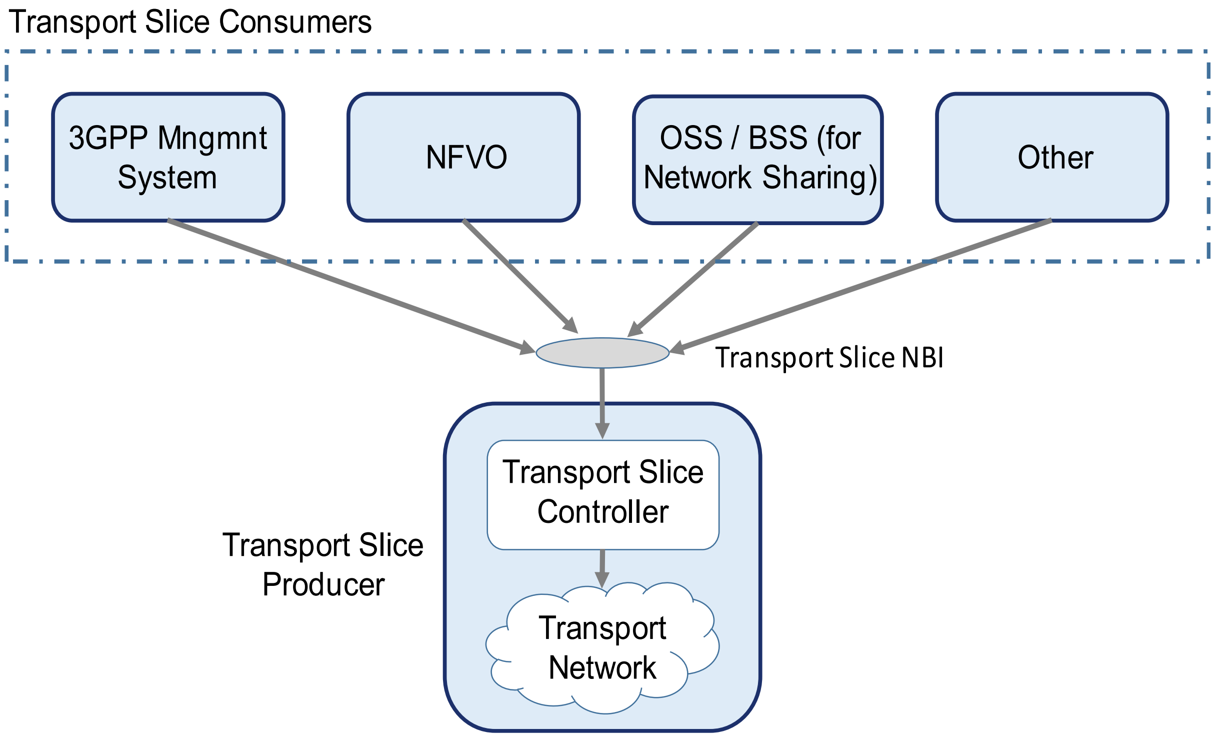
[Ref9] *Cooperating Layered Architecture for Software-Defined Networking (CLAS)*







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 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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Luis M. Contreras
Technology and Planning
Transport, IP and Interconnection Networks
Global CTIO Unit

Telefónica I+D
Telefónica, S.A.
Distrito Telefónica, Edificio Sur 3, Planta 3
Ronda de la Comunicación, s/n
28050 Madrid (Spain)
T +34 913 129 084
M +34 680 947 650
luismiguel.contrerasmurillo@telefonica.com

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