Networking the Cloud, Cloudifying the Network

Luis M. Contreras
Telefónica GCTIO – Transport Technology and Planning

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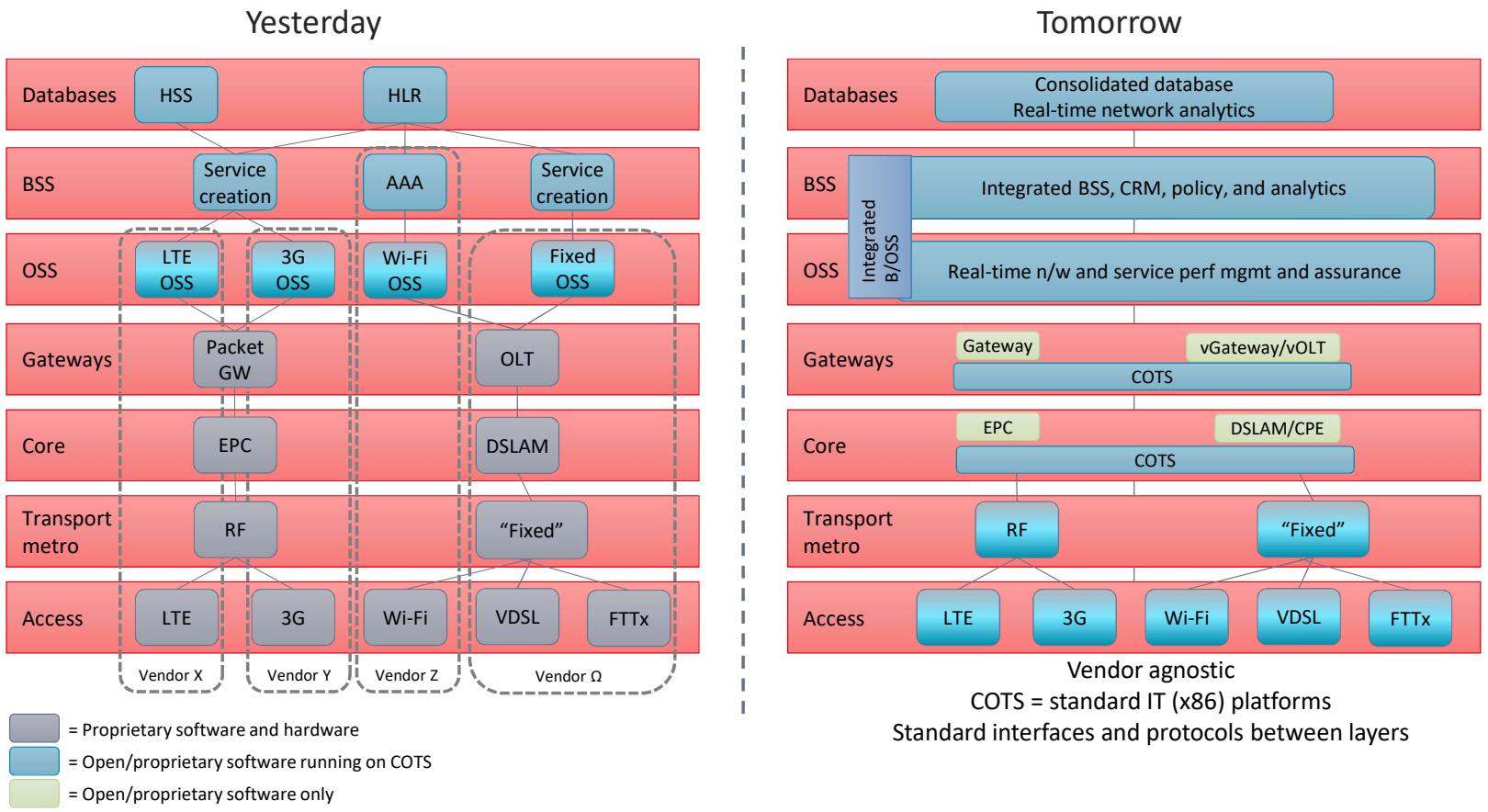
Agenda

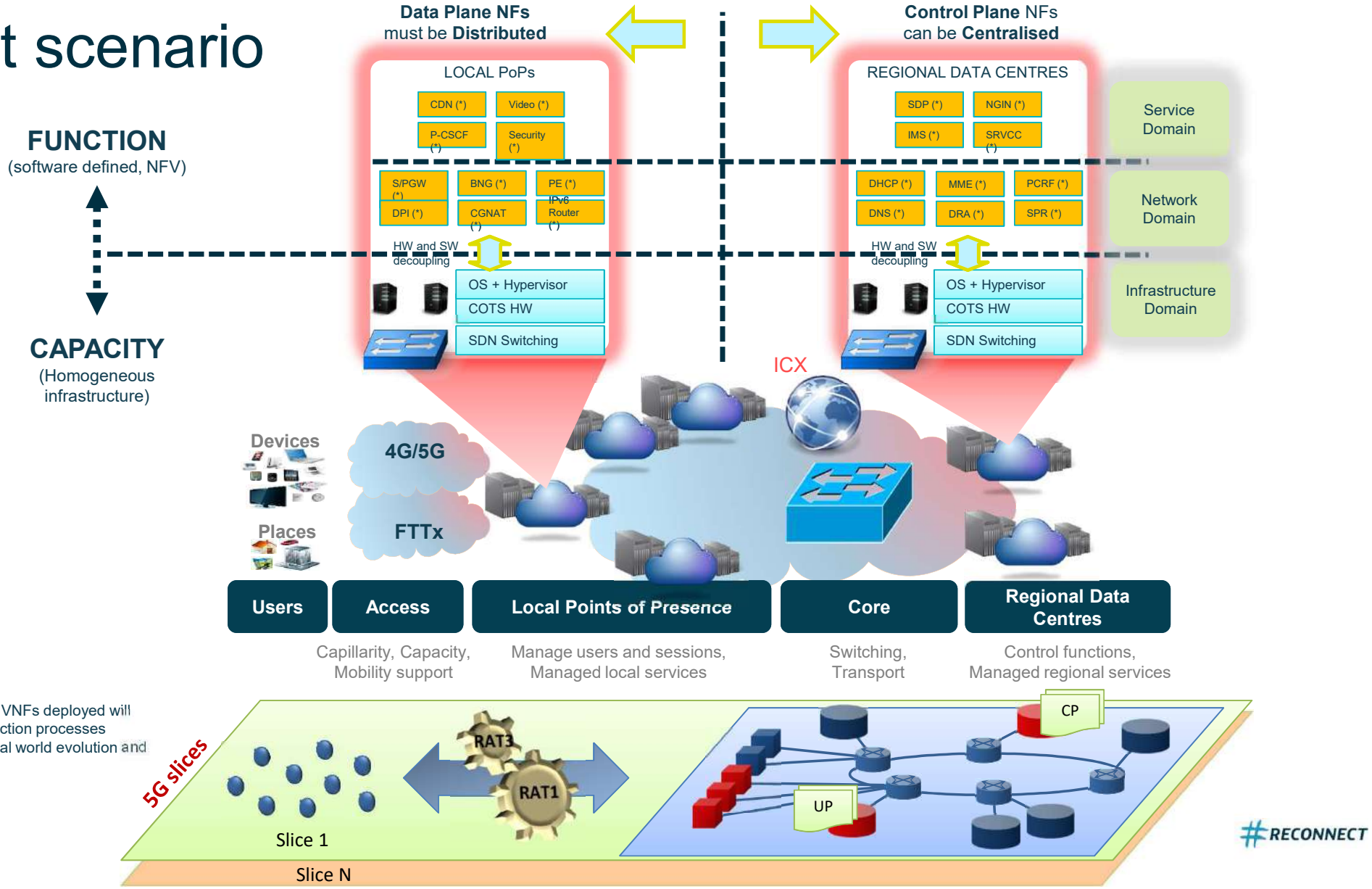
- Evolution of operator’s networks
- Networking the Cloud
- Cloudifying the Network
- Cloud-Network slicing
- Taking action
- Concluding remarks

Evolution of operator’s networks

Network evolution



Target scenario



(*) Illustrative, since final VNFs deployed will depend on a natural selection processes regarding traffic and digital world evolution and requirements.

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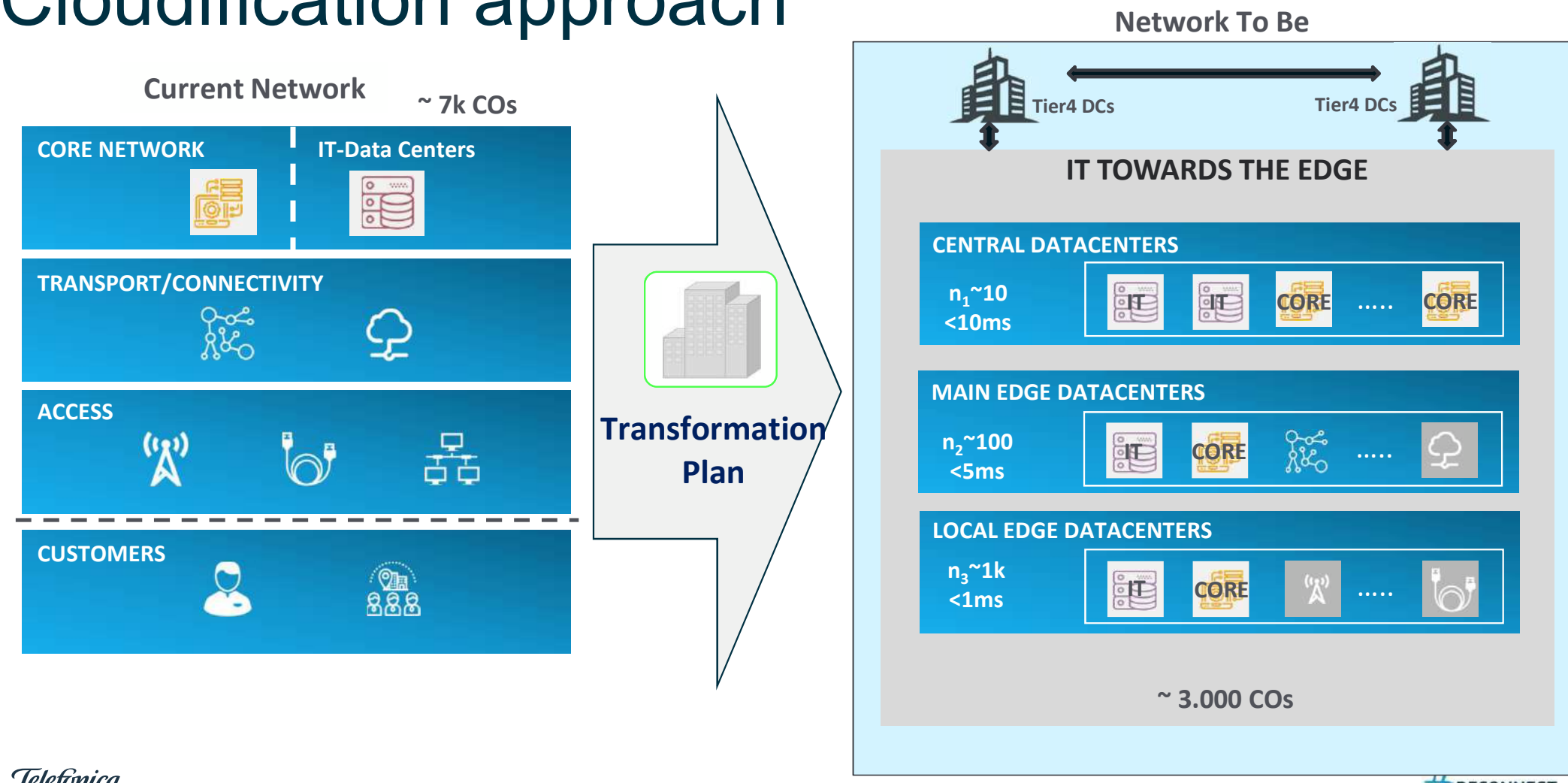
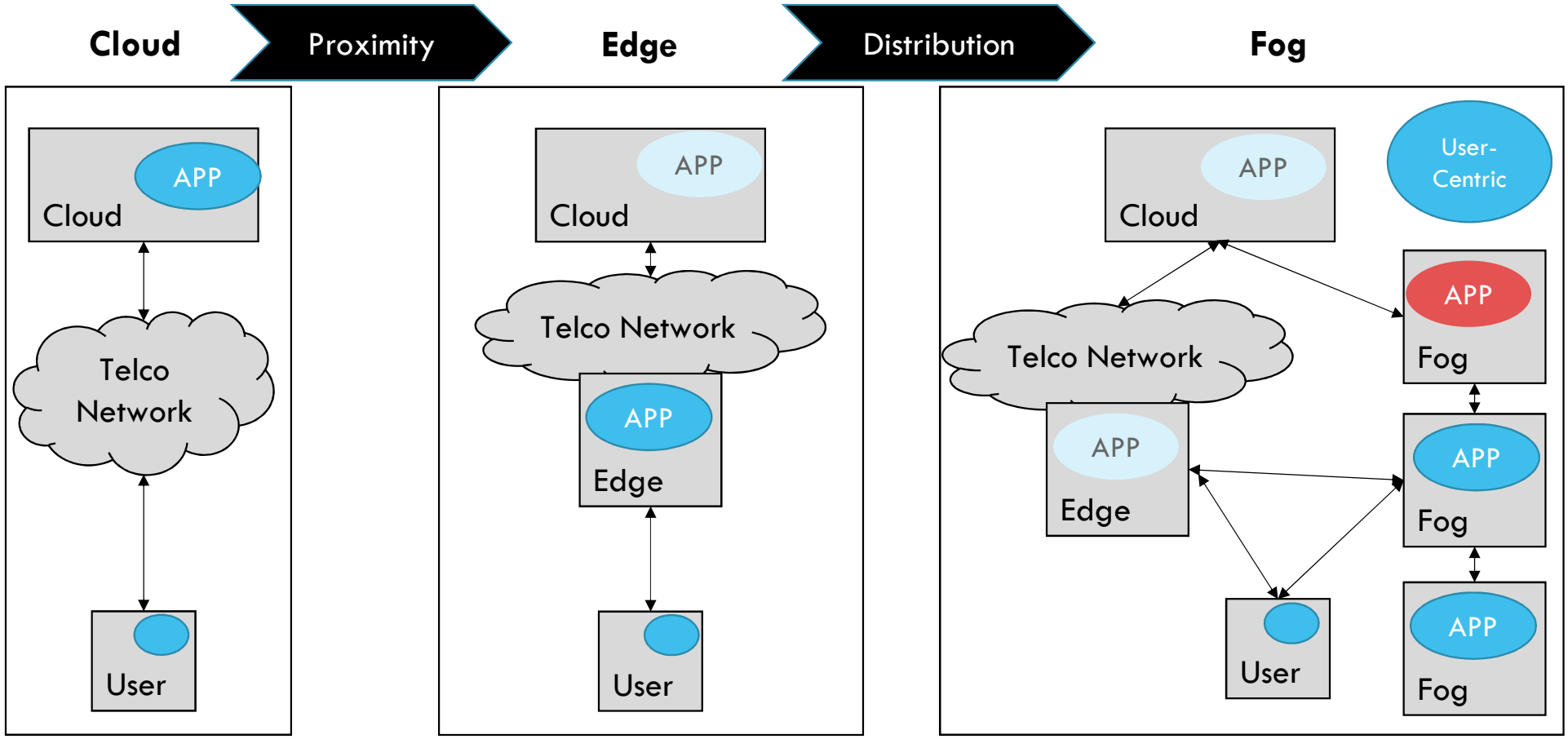
Cloudification approach



The Cloud, Edge and Fog

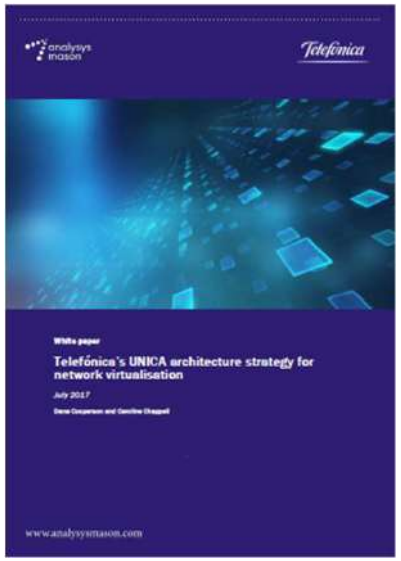


Networking the Cloud

UNICA: Telefonica Network Virtualization Program

Telefonica UNICA is **the foundation of our NFV strategy** and can be **described as a Telco Cloud** architecture allowing **hosting and deployment of network components in an automatized fashion**

- UNICA Architecture -



UNIC@ Telefonica

- **Open**: modular, multi-vendor, standard, evolvable
- **Cloud based**: Elastic, Multi site, Multi Vim, Multi Tenant
- **Telco Grade**: Secured, High availability, High performance
- **Efficient**: Automatized deployment and network connectivity through SDN

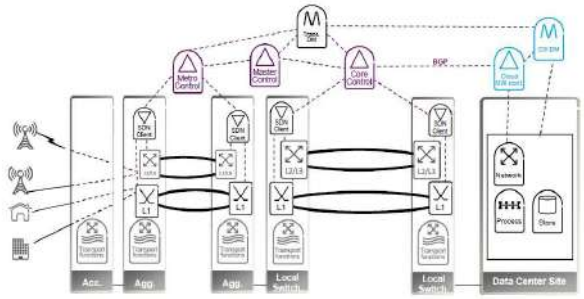
https://www.analysysmason.com/Research/Content/Reports/telefonica-UNICA-architecture-strategy-for-network-virtualisation-white-paper/

Different worlds requiring to work together

Tiered

Coverage

Dynamic Routing



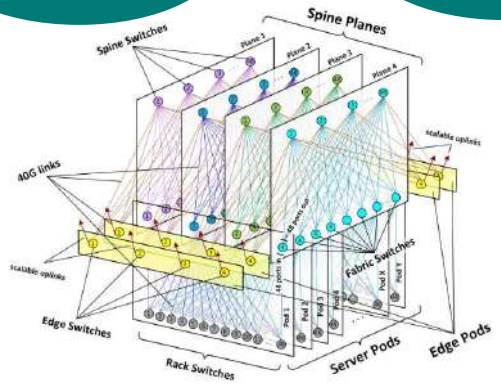
MPLS Services

HW termination

Orchestration

CLOS

Scale



Overlay

vSwitch

Wide Area Network

Data Center

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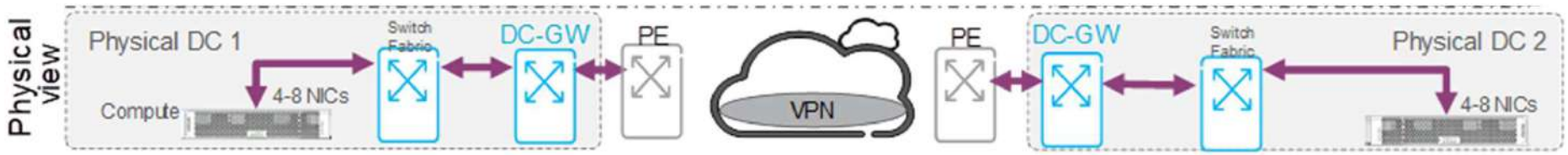
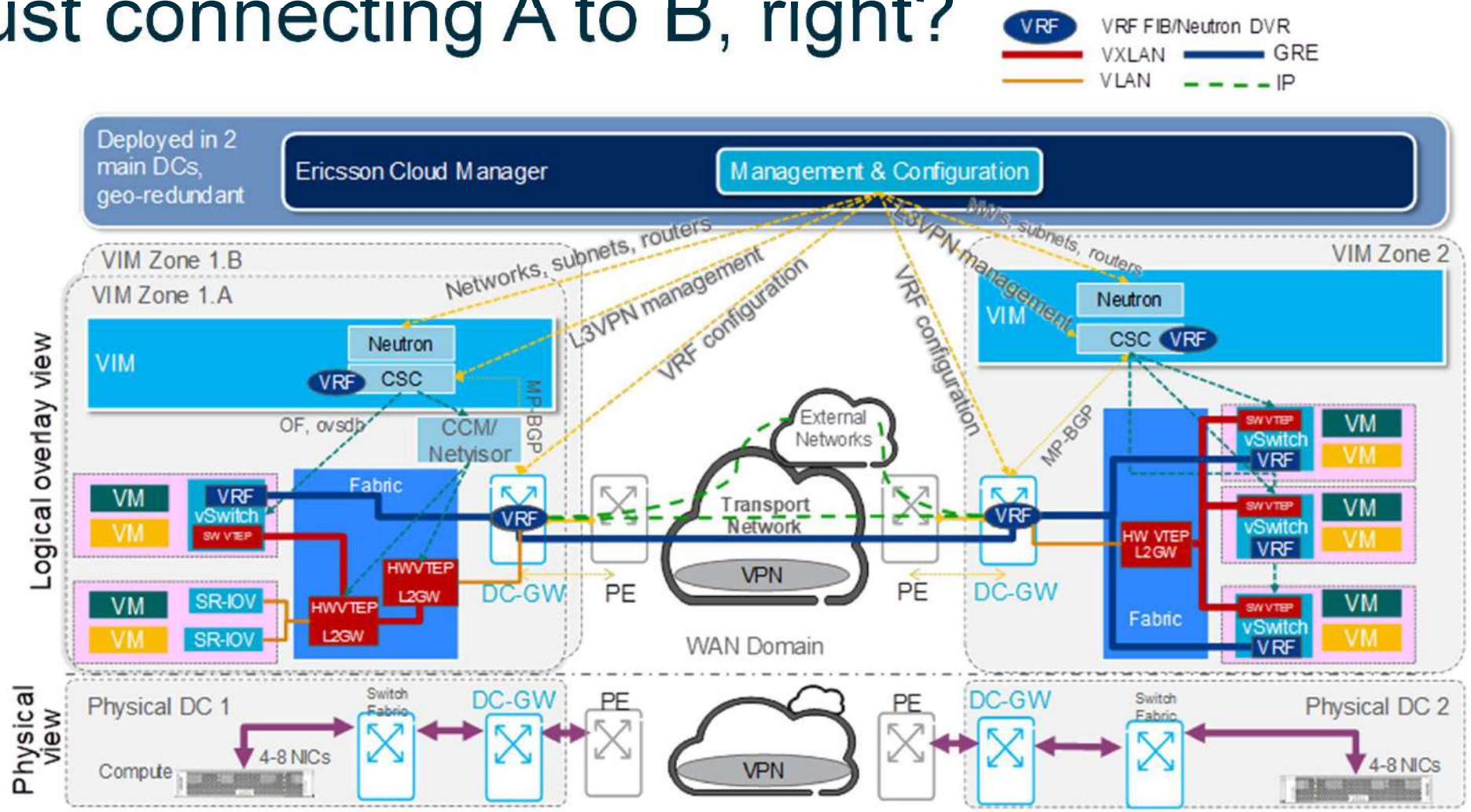
Just connecting A to B, right?



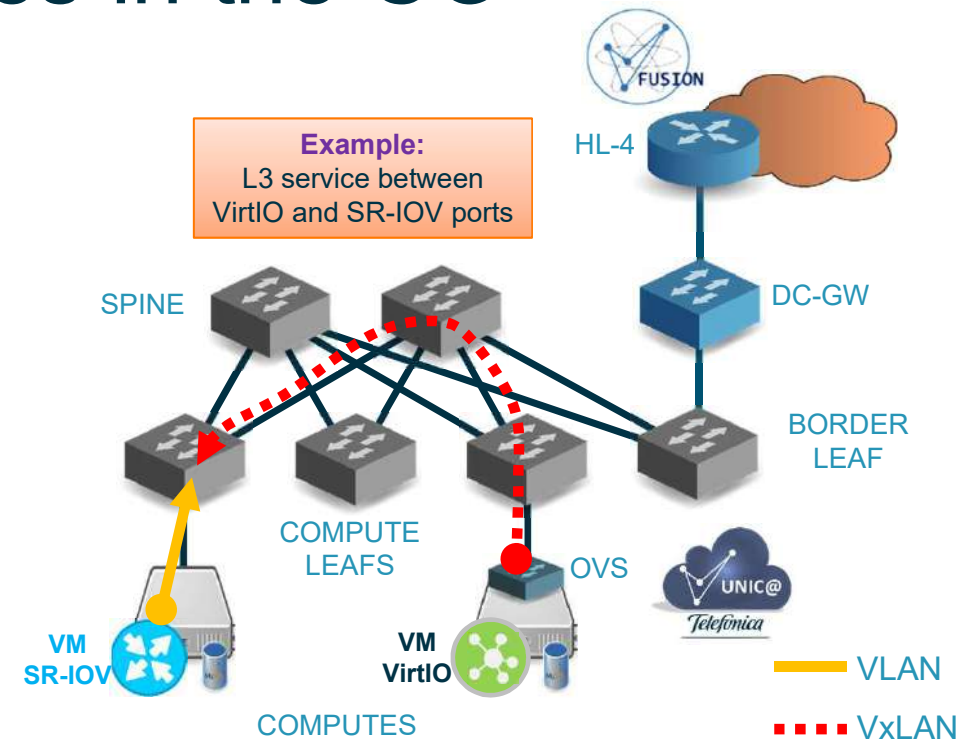
Just connecting A to B, right?



Intra-DC connectivity services in the CO

- VxLAN to transport any type of intra-DC traffic, removing the role of DC-GW and using Leaf Switches as the only end-points

	End-point 1	End-point 2	UNICA	Proposal for UNIC@CO
L2 services	VirtIO	VirtIO	VxLAN tunnel	VxLAN tunnel
	VirtIO	SR-IOV	Multi-segment	Multi-segment
	SR-IOV	SR-IOV	Multi-segment	Multi-segment
L3 services	VirtIO	VirtIO	VxLAN tunnel	VxLAN tunnel
	VirtIO	SR-IOV	Multi-segment via DC-GW	Multi-segment
	SR-IOV	SR-IOV	Multi-segment via DC-GW	Multi-segment



MAIN ADVANTAGES

- Harmonization the intra-DC connectivity services
- No E/W workload passing the DC-GW

MANAGEABLE

SCALABLE

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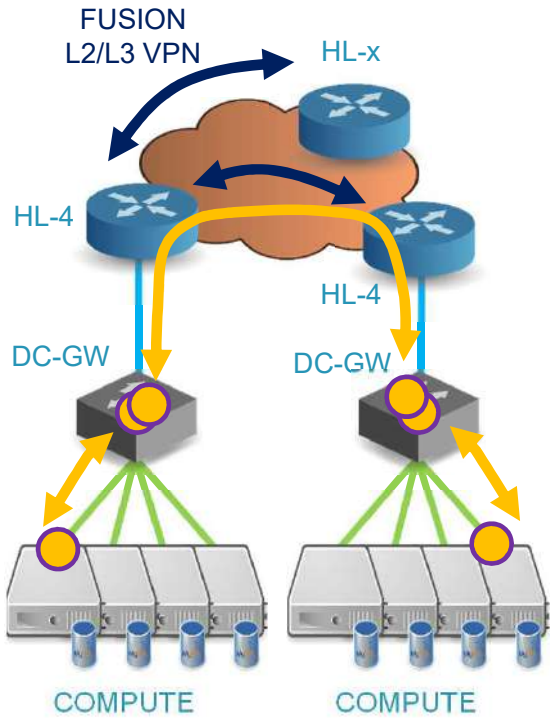
Inter-DC connectivity services* at the CO

* **Both options are valid**; it will up to OpCo's to deploy one or the other according to their specific needs

Overlay solution

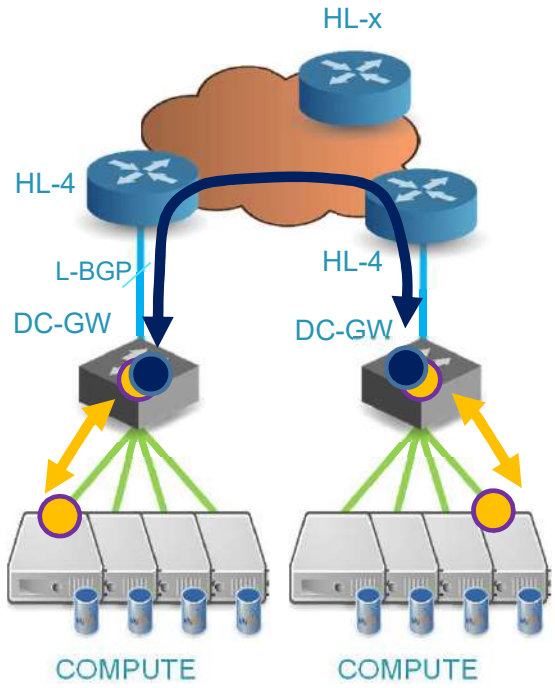
- **UNIC@CO DCI**: extend the connectivity services that are already implemented for intra-DC connectivity (**E-VPN over VxLAN**) → **VPN stitching at DC-GW**
- Internet connection:
  - E-VPN over VxLAN
- Overlay solutions supported on top of a few MPLS VPNs from the network



E-VPN over VxLAN end points

Non overlay solution

- Main non overlay solutions are based on **extending the MPLS towards the DC-GW**. This can be achieved using multiple protocols:
  - Inter-AS
  - L-BGP
  - …
- Apart from specific needs from some OpCo's, the extension of MPLS to the fabric might be of particular interest for VNFs like vBNG, vPE, etc.
  - Need for direct connectivity can be further studied
- **In the long-term, solutions like Segment Routing**



E-BGP signaled MPLS VPN end points

E-VPN over VxLAN end points

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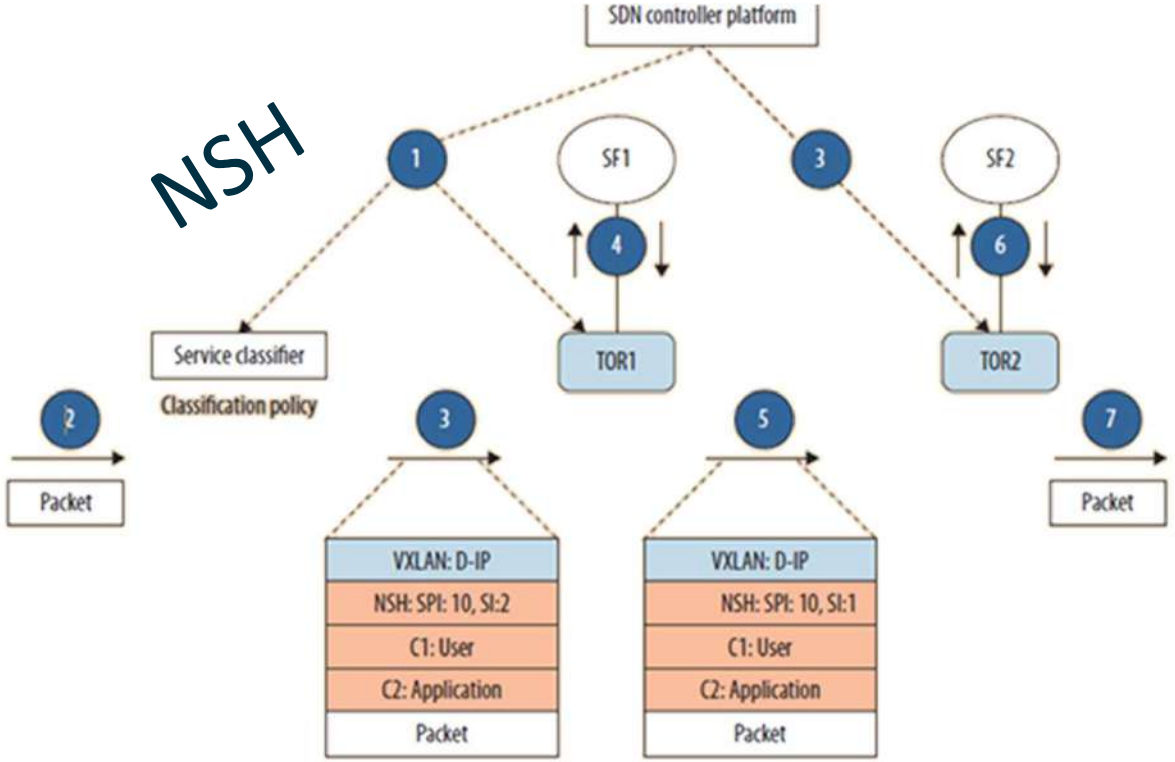
One step beyond

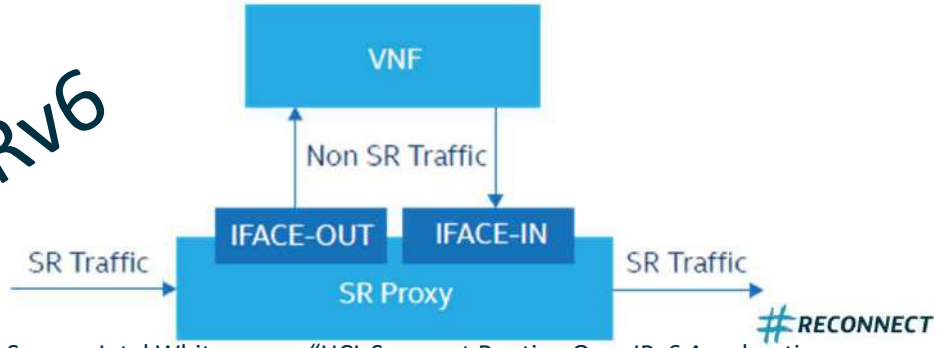
- Effective chaining is the very next step
- Alternatives: SFC based on NSH or SRv6
- Support in the DC devices

NSH



Source: T. Nadeau, K. Gray, "SDN: Software Defined Networks", O'Really 2013

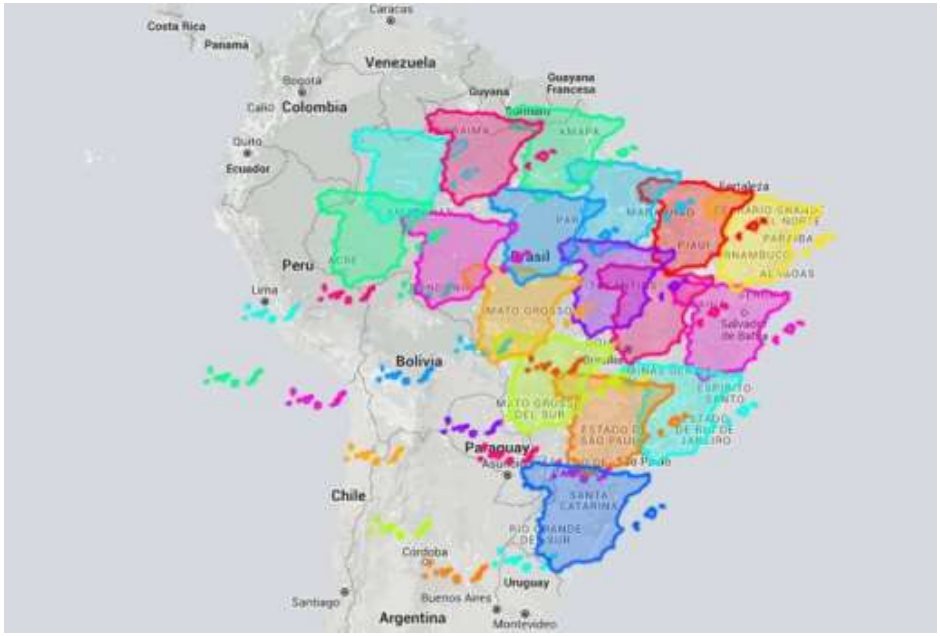
SRv6



Source: Intel White paper, "HCL Segment Routing Over IPv6 Acceleration Using Intel® FPGA Programmable Acceleration Card N3000", 2019

Cloudifying the Network

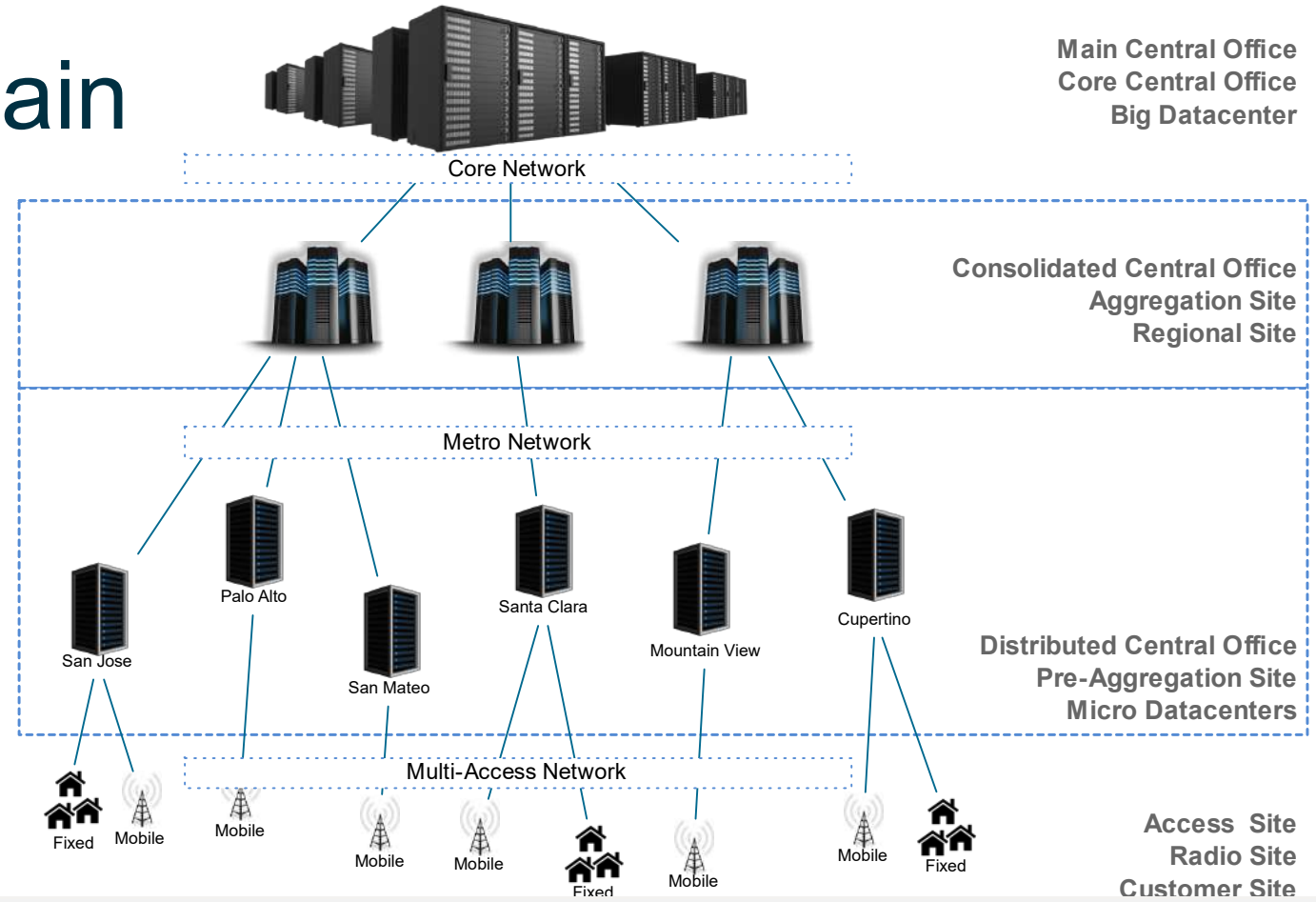
Deployments will depend on the country geography and context

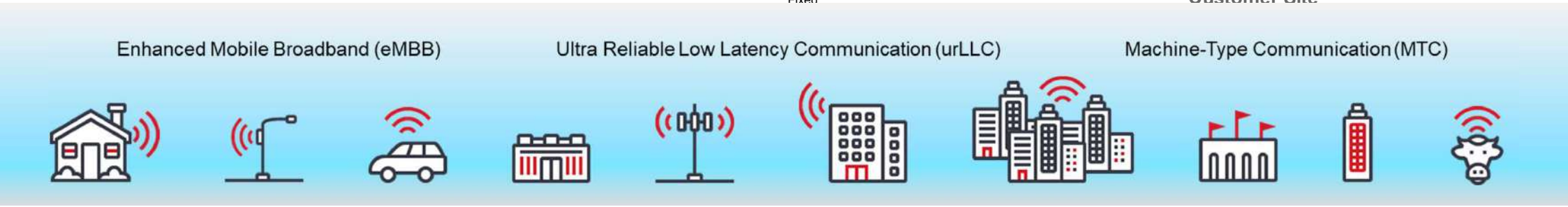


Need to leverage on third party infrastructures for e2e service

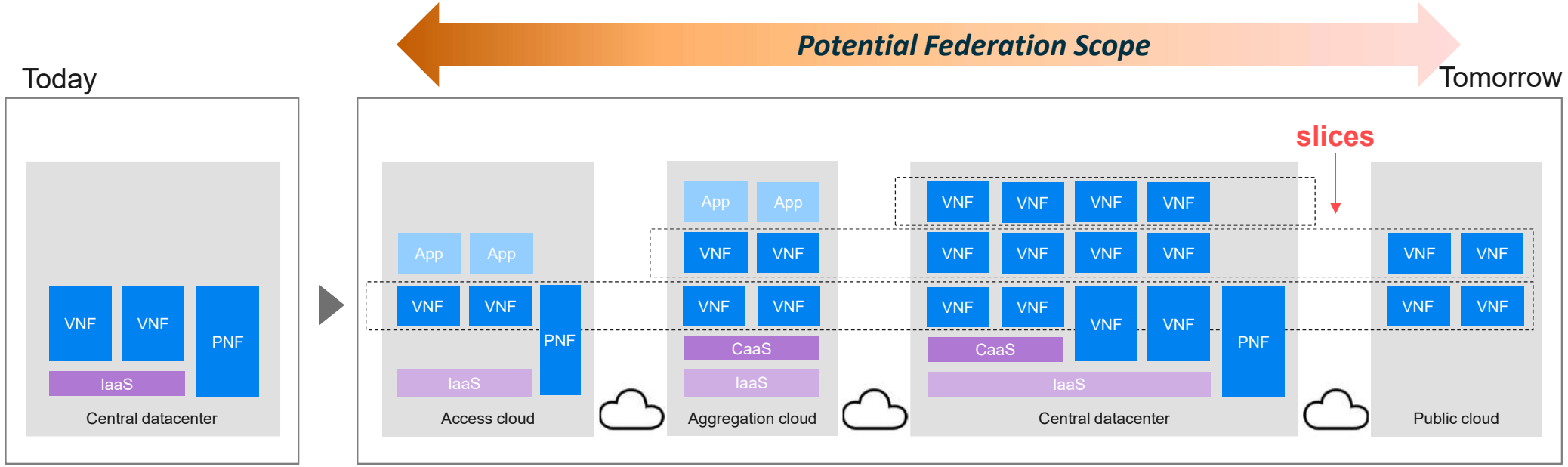
Multi-domain perimeter

- Telco operators
- MVNOs
- Cloud providers
- Municipalities
- Utilities
- etc





Extending the reach



Single data center with **semi-automated operations**

Automated and Optimized Workload placement across Distributed Data Centers in a **multi domain**, **multi technology** and **multi vendor** environment

Orchestration, Assurance & Analytics are essential to support a hybrid network that is increasingly becoming

Typical latencies in transport network

Avg device latency ~ 36 µs
one hop, no congestion

Transmission latency ~ 5 µs/km

Serialization delay < 12 µs
time in putting the packet on the line
1 Gbps line speed, 1500 bytes datagram = 12 µs

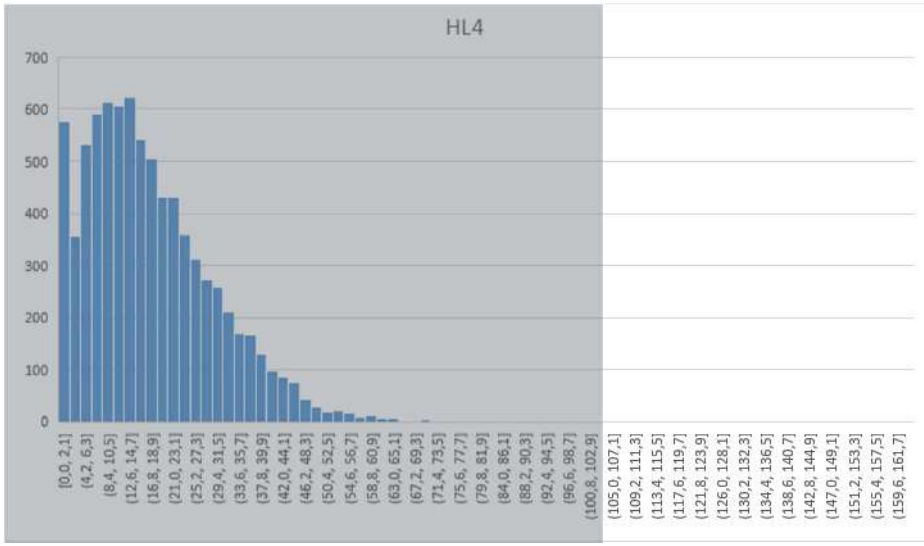
Typical **RTT latencies** for one hop between routers distant 50 /100 Km can be **bounded by 1 ms** per router

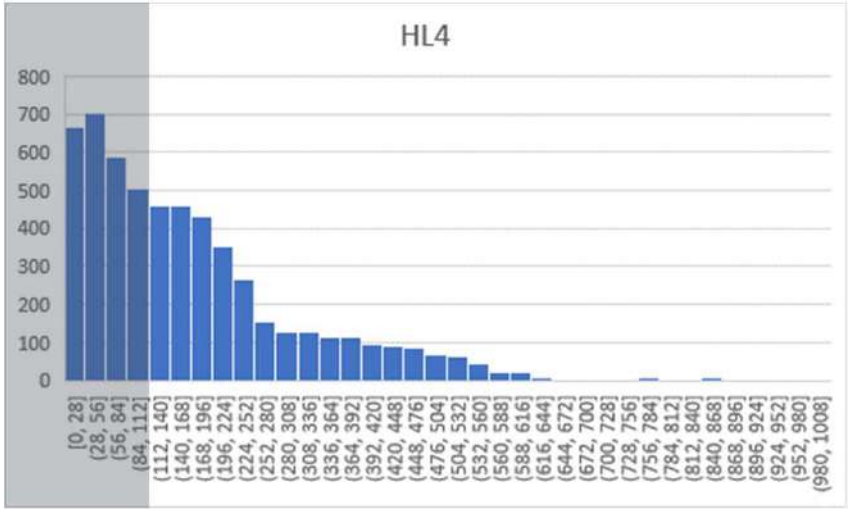
Additional latencies have to be considered for e2e service characterization

- Latency due to the access technology (interleaving, protection schemes, maximum bandwidth, etc)
- Latency due to data plane processing (PGW, coding, BRAS, etc)
- Latency due to service platforms (DNS lookup, etc)

Extract from 3GPP, “Service requirements for next generation new services and markets,” TS 22.261

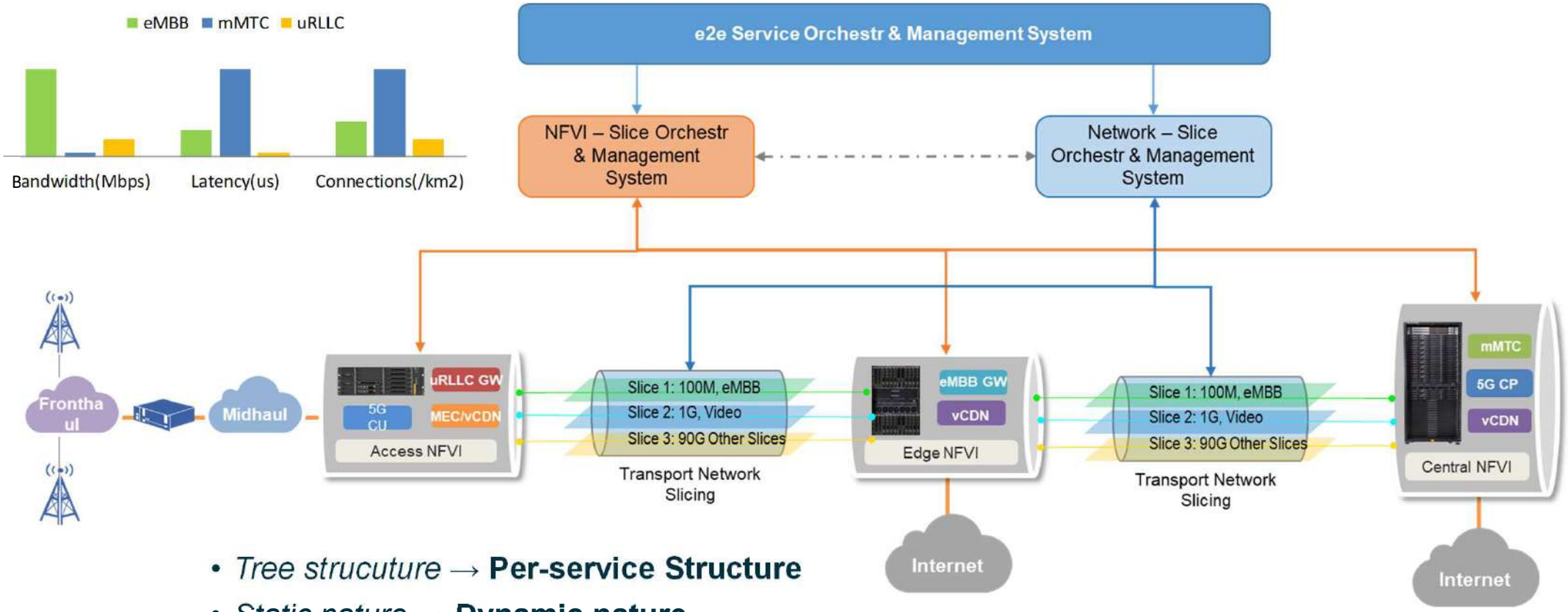
Scenario	End-to-end latency	Jitter	Traffic density
Discrete automation – motion control	1 ms	1 µs	1 Tbps/km^2
Discrete automation	10 ms	100 µs	1 Tbps/km^2
Process automation – remote control	50 ms	20 ms	100 Gbps/km^2
Process automation – monitoring	50 ms	20 ms	10 Gbps/km^2
Electricity distribution – medium voltage	25 ms	25 ms	10 Gbps/km^2
Electricity distribution – high voltage	5 ms	1 ms	100 Gbps/km^2
Intelligent transport systems/ infrastructure backhaul	10 ms	20 ms	10 Gbps/km^2
Tactile interaction	0,5 ms	TBC	[Low]
Remote control	[5 ms]	TBC	[Low]





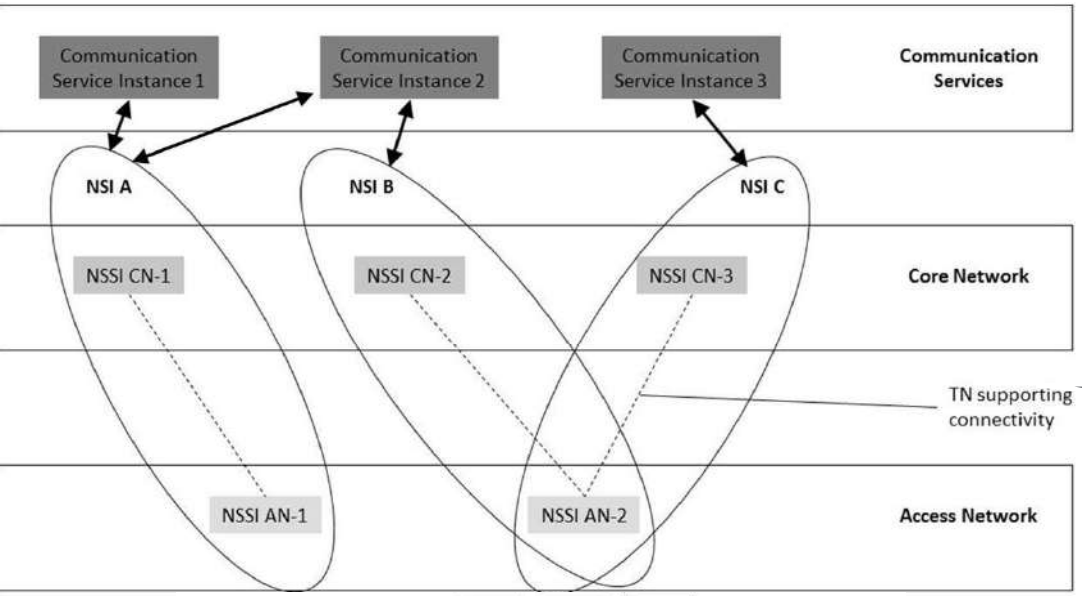
Cloud-Network slicing

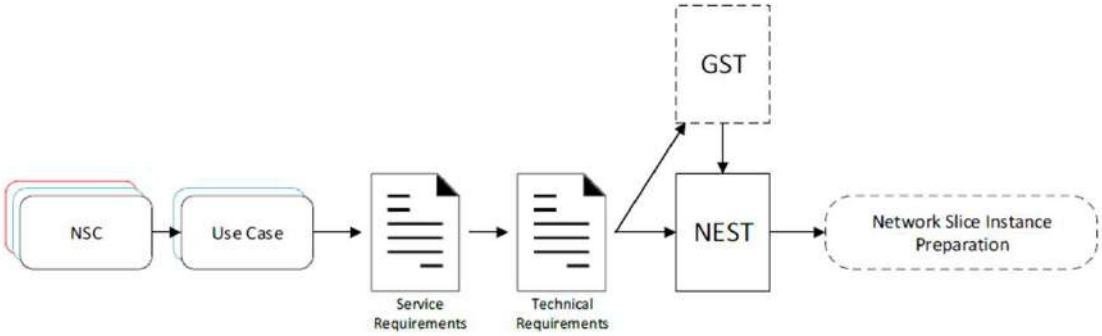
5G + Cloudification = Slicing

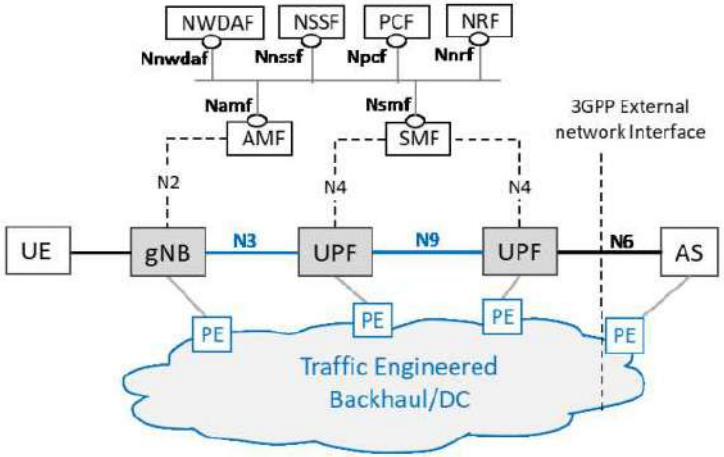


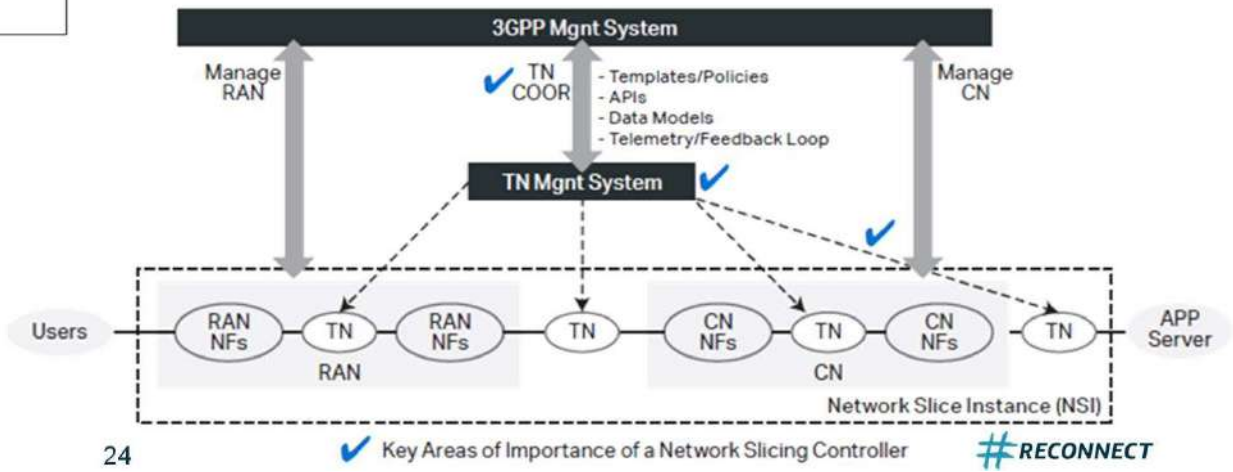
- *Tree structure* → **Per-service Structure**
- *Static nature* → **Dynamic nature**
- *Separated management per segment* → **Unified orchestration**
- *Single domain* → **Multi-domain**

Cloud-Network coordination: ex., 5G









✔ Key Areas of Importance of a Network Slicing Controller

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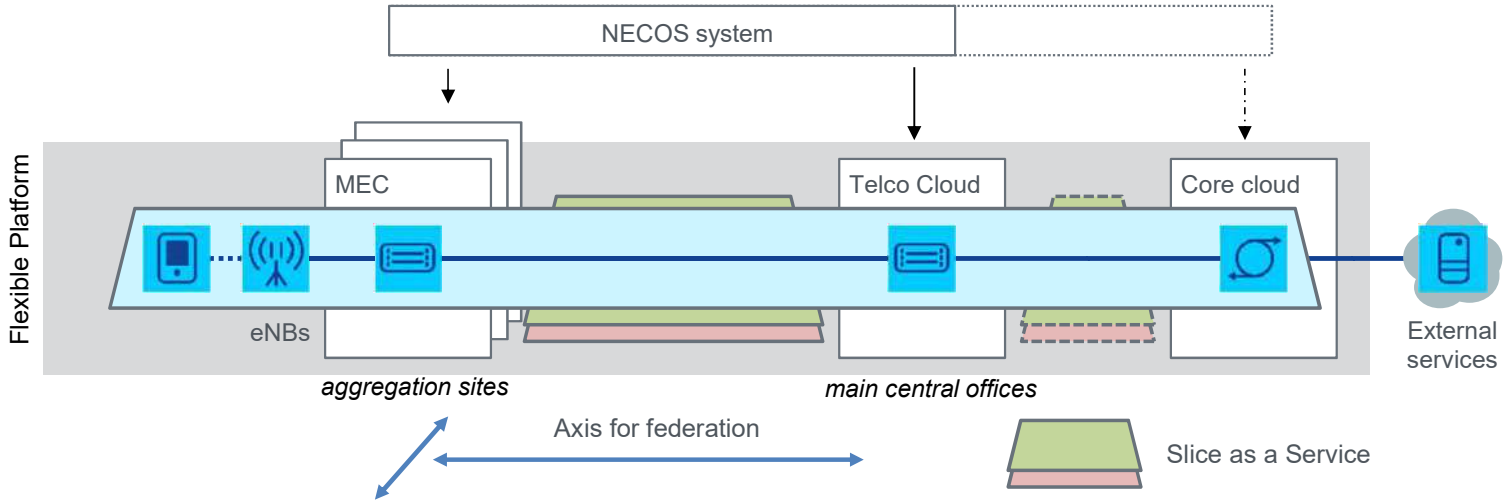
Taking action

Taking action – NECOS Project(*)



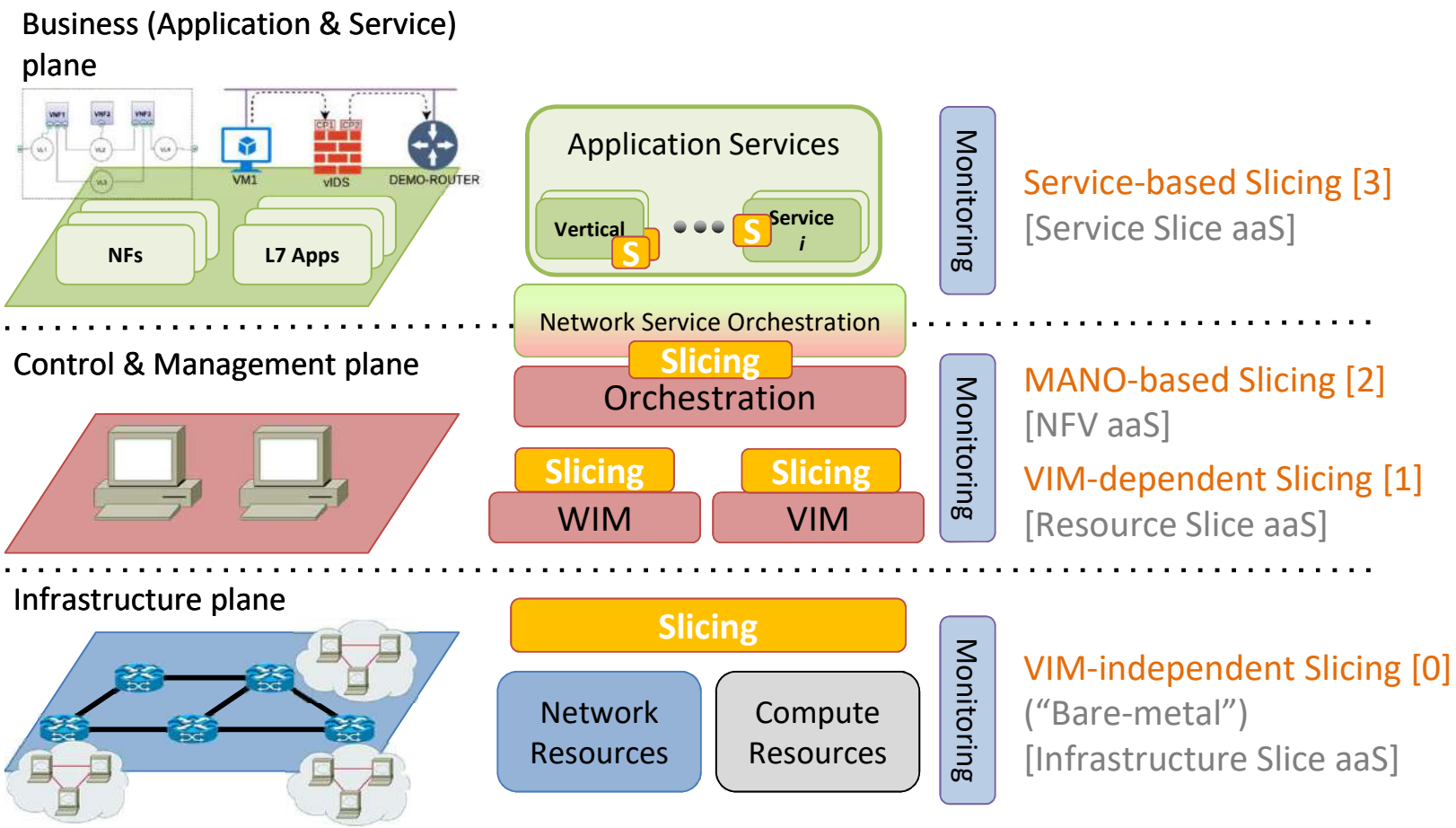
Slice as a Service as deployment model, grouping of resources managed as a whole, that can accommodate service components, independent of other slices.

Embedded methods for an optimal allocation of resources to slices in the cloud and networking infrastructure, to respond to the dynamic changes of the various service demands.

Lightweight principle, in terms of small footprint components deployable on large number of small network and cloud devices at the edges of the network

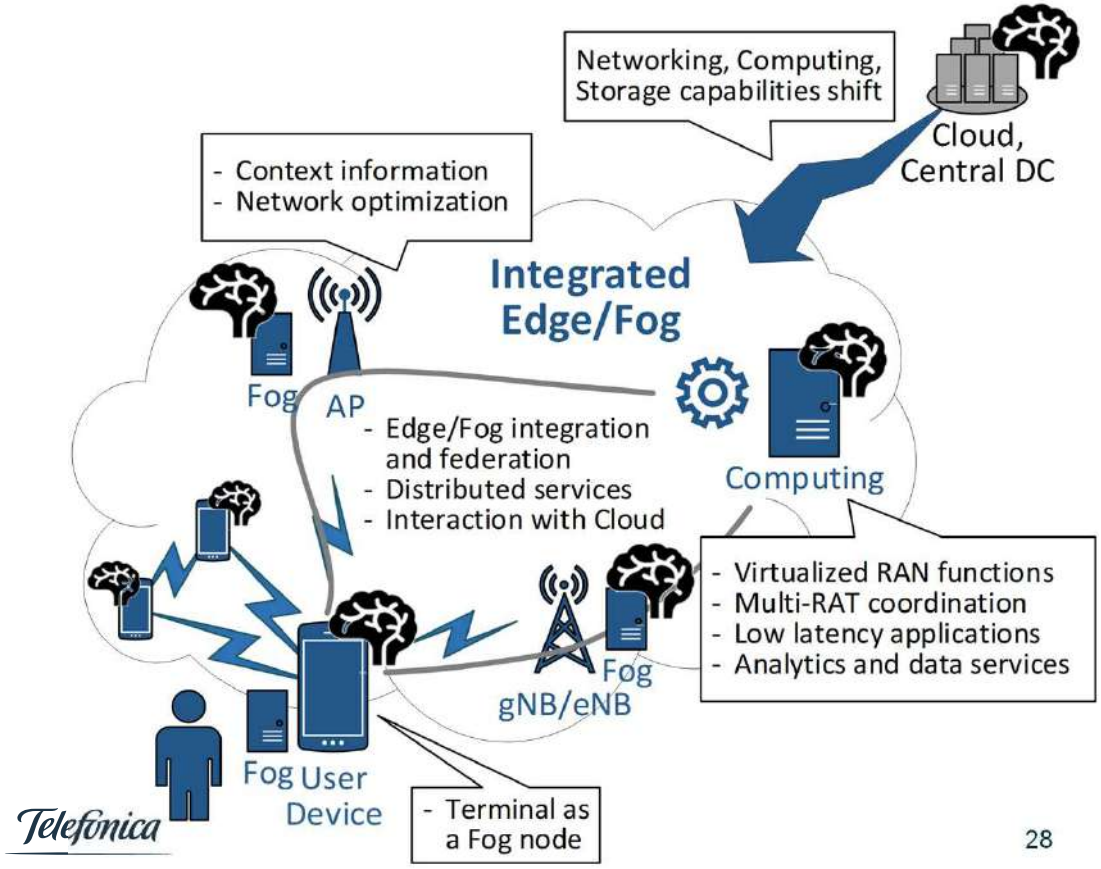
(*) http://www.h2020-necos.eu/

Slicing Models & Approaches



Project Mission

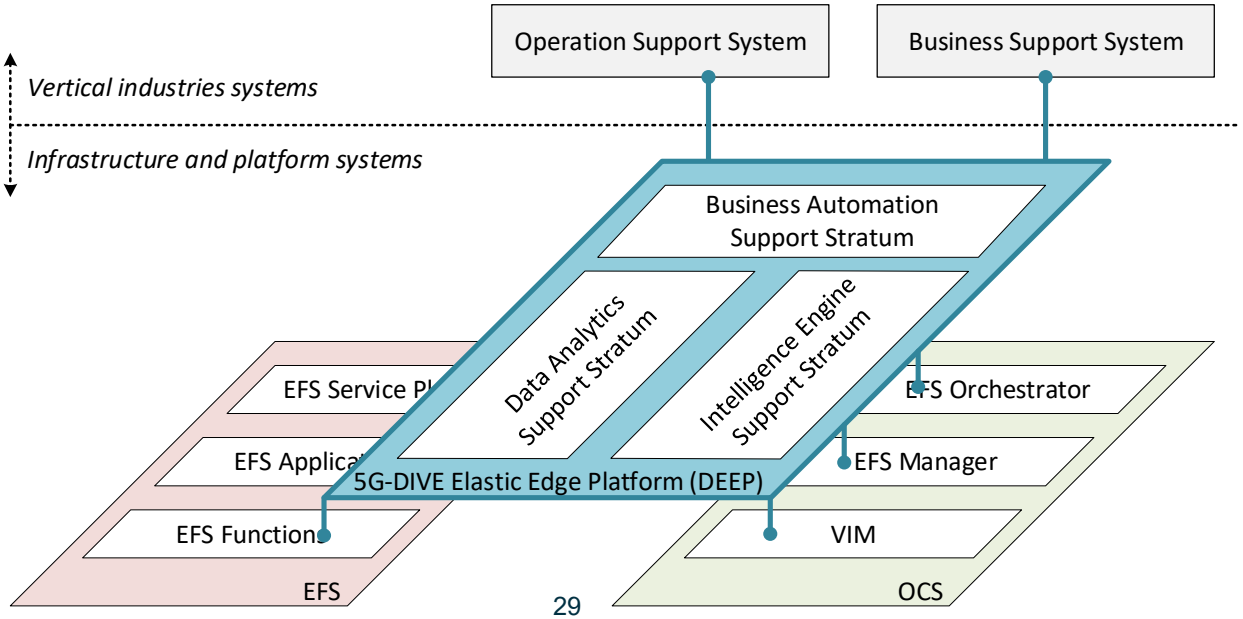
Targets end-to-end 5G trials aimed at proving the technical merits and business value proposition of 5G technologies



Mission: Design, validate and verify an intelligent 5G solution that integrates 5G connectivity with edge and fog computing (and intelligence residing on this new distributed edge)

Solution Building Blocks

(1) EFS:	hosting all proposed virtualized functions, services, and applications
(2) OCS:	managing and controlling the EFS, and its interworking with other domains
(3) DEEP:	supporting vertical industries in day-by-day operations, management, and automation of businesses processes on-top of an edge and fog infrastructure.



EFS: Edge and Fog computing System
OCS: Orchestration and Control System
DEEP: 5G-DIVE Elastic Edge Platform

Concluding remarks

Back to the future

FUNCTION
(software defined, NFV)

CAPACITY
(Homogeneous infrastructure)

(*) Illustrative, since final VNFs deployed will depend on a natural selection processes regarding traffic and digital world evolution and requirements.

Data Plane NFs must be **Distributed**

Control Plane NFs can be **Centralised**

LOCAL PoPs

CDN (*) | Video (*) | P-CSCF (*) | Security (*)

S/PGW (*) | BNG (*) | PE (*) | DPI (*) | CGNAT (*) | IPv6 Router (*)

HW and SW decoupling

OS + Hypervisor | COTS HW | SDN Switching

REGIONAL DATA CENTRES

SDP (*) | NGIN (*) | IMS (*) | SRVCC (*)

DHCP (*) | MME (*) | PCRF (*) | DNS (*) | DRA (*) | SPR (*)

HW and SW decoupling

OS + Hypervisor | COTS HW | SDN Switching

Service Domain | Network Domain | Infrastructure Domain

ICX

Devices | Places

4G/5G | FTTx

Users	Access	Local Points of Presence	Core	Regional Data Centres
	Capillarity, Capacity, Mobility support	Manage users and sessions, Managed local services	Switching, Transport	Control functions, Managed regional services

5G slices

Slice 1

Slice N

RAT3

RAT1

CP

UP

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

Telefónica

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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