NOKIA

5G Service Orchestration – Early Experience Sharing

IEEE 5G World Forum
9-11 July 2018, Santa Clara, CA
Ranny Haiby

The state of Network Service Orchestration

A quick reality check

"The traditional telecommunication industry is facing multiple challenges to keep competitive and improve the mode network services are designed, deployed and managed. Architectures and enabling technologies such as Cloud Computing, SDN and NFV, are providing new paths to overcome these challenges in a software-driven approach. Network Service Orchestration (NSO) is a strategic element in this process of evolution." – IEEE Network Service Orchestration Survey, March 2018

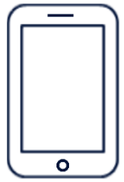
TABLE I
NSO STANDARDIZATION OUTCOMES

SDO	Working Group	Scope	Outcomes
ETSI	NFV ISG (Initial)	NFV	Service Quality Metrics for NFV Orchestration [68]
			Management and Orchestration Framework [33]
			Multiparty Administrative domains [69]
	NFV ISG (Release 2)		VNF Architecture and SDN in NFV Architecture [70]
			Orchestration of virtualized resources [71]
			Functional requirements for Orchestrator [71]
			Lifecycle management of Network Services [71]
			Network Service Templates Specification [72]
	NFV ISG (Release 3)		Policy management [73]
			Report on architecture options to support multiple administrative domains [56]
MEF	The Third Network	NFV, LSO	Lifecycle Service Orchestration Vision [49]
			LSO Reference Architecture and Framework [74]
ONF	Architecture and Framework	SDN	SDN Architecture [75]
			Mapping Orchestration Application to SDN [76]
			Definition of Orchestration [77]
IETF	SFC	SFC, NFV	SFC Architecture [32]
NGMN	Work Programme	5G Network	White Paper: Next Generation Networks [78]
			5G Network and Service Management and Orchestration [79]
TM Forum	Project	SDN, NFV	ZOOM (Zero-touch Orchestration, Operations and Management) [80]
3GPP	S5	5G Network (mobile)	Management and orchestration for next generation network [47]
OASIS	TOSCA	Resource and Service Modeling	TOSCA version 1.0 [81]
			TOSCA for NFV Version 1.0 [82]
			TOSCA in YAML Version 1.2 [83]
ITU	ITU-T SG 13	5G Network (IMT-2020) and network softwarization	Report on Standards Gap Analysis in 5G Network [84]
			Terms and definitions for 5G network [85]
			5G Network management and orchestration requirements [86]
			5G Network management and orchestration framework [87]
			Standardization and open source activities related to network softwarization [88]
	ITU-R	Mobile, radiodetermination, amateur and related satellite services	Framework and overall objectives of the 5G Network [89]

TABLE III
SUMMARY OF OPEN SOURCE NSO IMPLEMENTATIONS

Solution	Leader	VNF Definition	Resource Domain				MANO			Interface Management			Domain	
			Cloud	SDN	NFV	Legacy	NFVO	VNFM	VIM	CLI	API	GUI	Single	Multiple
ARIA TOSCA	Apache Foundation	TOSCA	✓							✓	✓		✓	
Cloudify	GigaSpace	TOSCA	✓		✓		✓	✓		✓	✓	✓	✓	
ESCAPE	FP7 UNIFY	Unify	✓	✓	✓		✓		✓	✓	✓		✓	✓
Gohan	NTT Data	Own	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
ONAP	Linux Foundation	HOT, TOSCA, YANG	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Open Baton	Fraunhofer / TU Berlin	TOSCA, Own	✓		✓		✓	✓		✓	✓	✓	✓	
OSM	ETSI	YANG	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Tacker	OpenStack Foundation	HOT, TOSCA	✓		✓		✓	✓		✓	✓	✓	✓	
TeNOR	FP7 T-NOVA	ETSI	✓	✓	✓		✓				✓	✓	✓	
X-MANO	H2020 VITAL	TOSCA			✓		✓				✓	✓		✓
XOS	ON.Lab	-	✓	✓	✓			✓			✓	✓	✓	✓

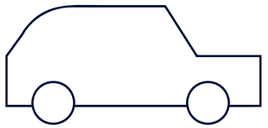
5G – One system of systems for a Diversity of Use Cases



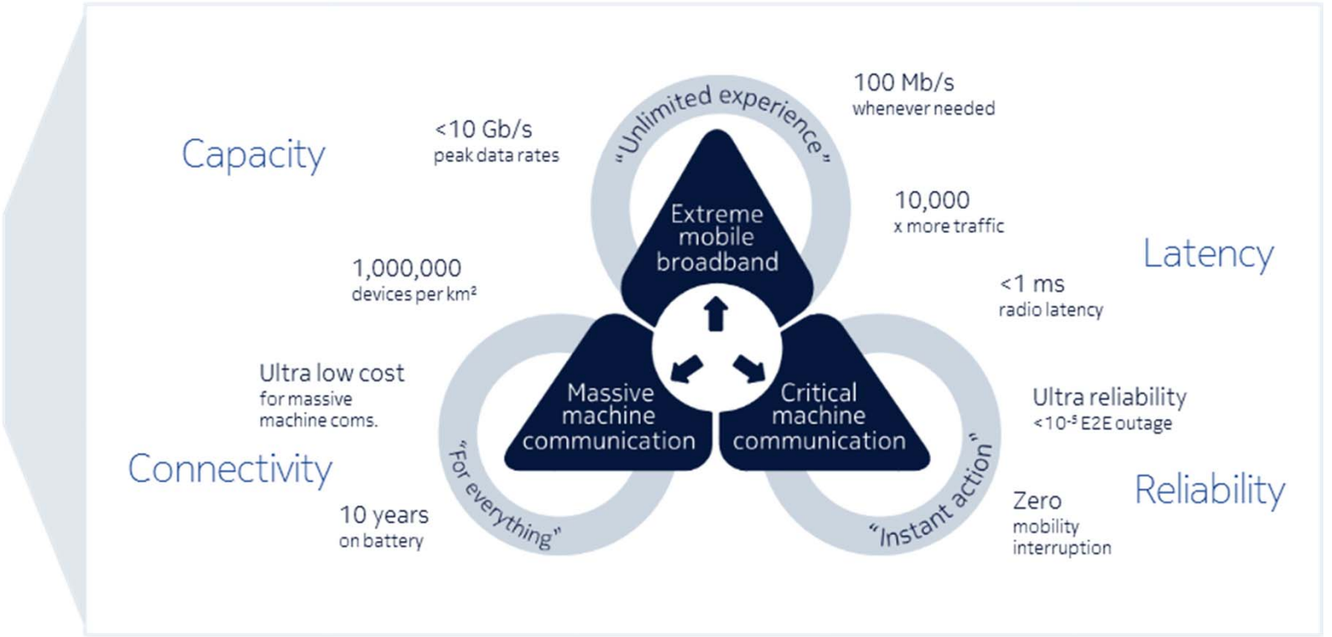
Devices
1.5 GB/day

Smart factories
1 PB/day

Billions of sensors
connected



Autonomous driving
1ms latency

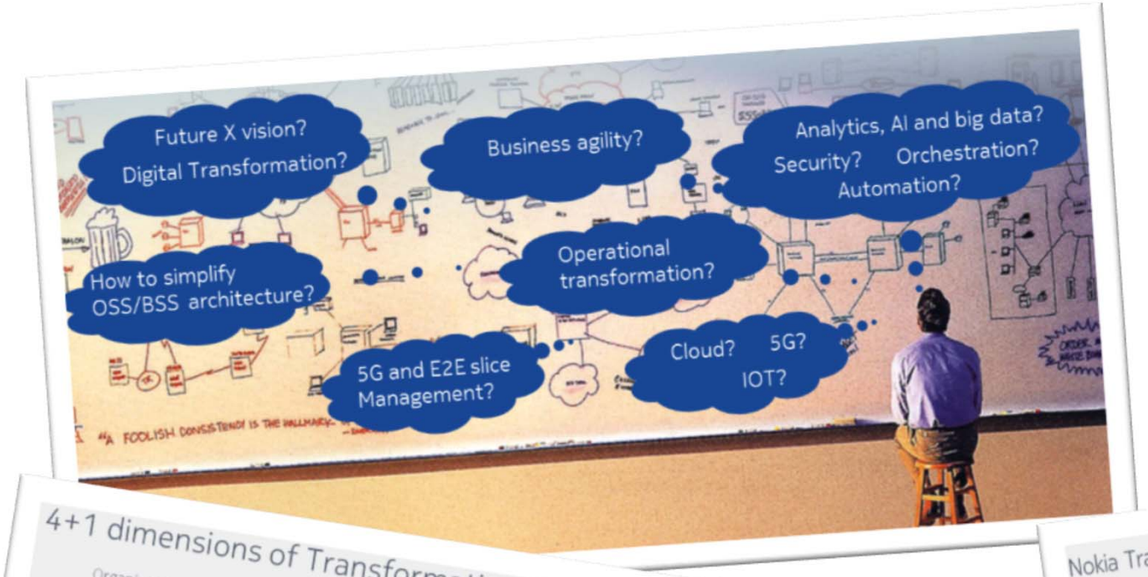


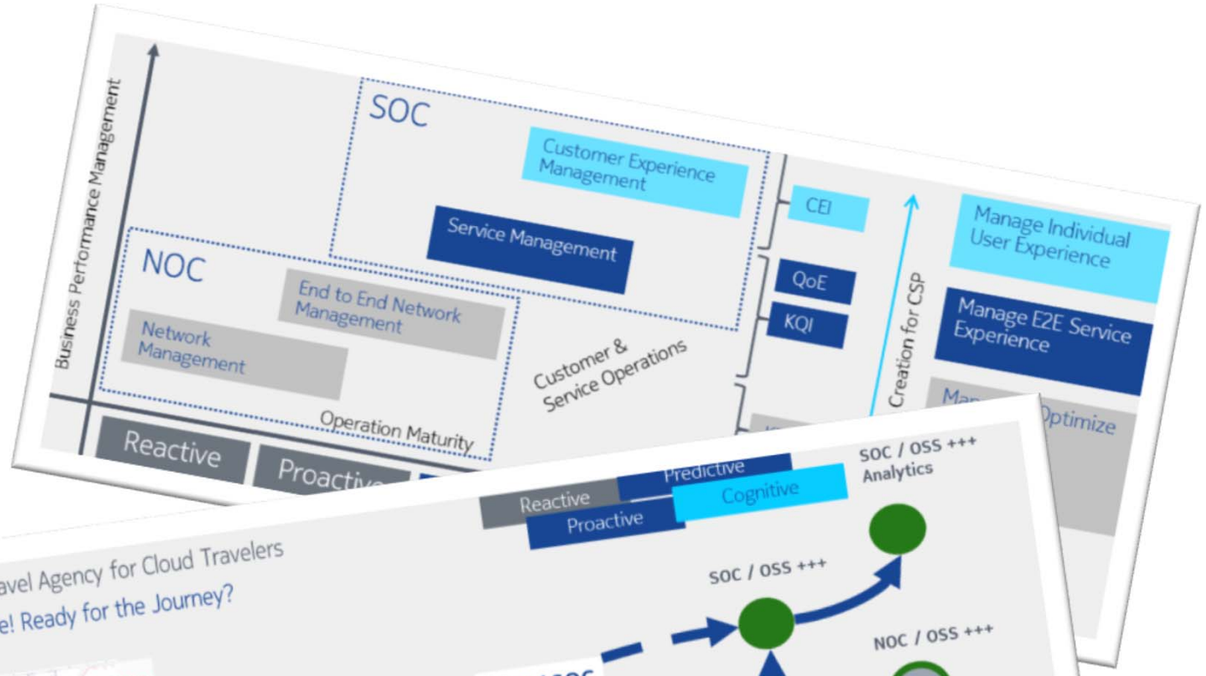
Design and architecture principles

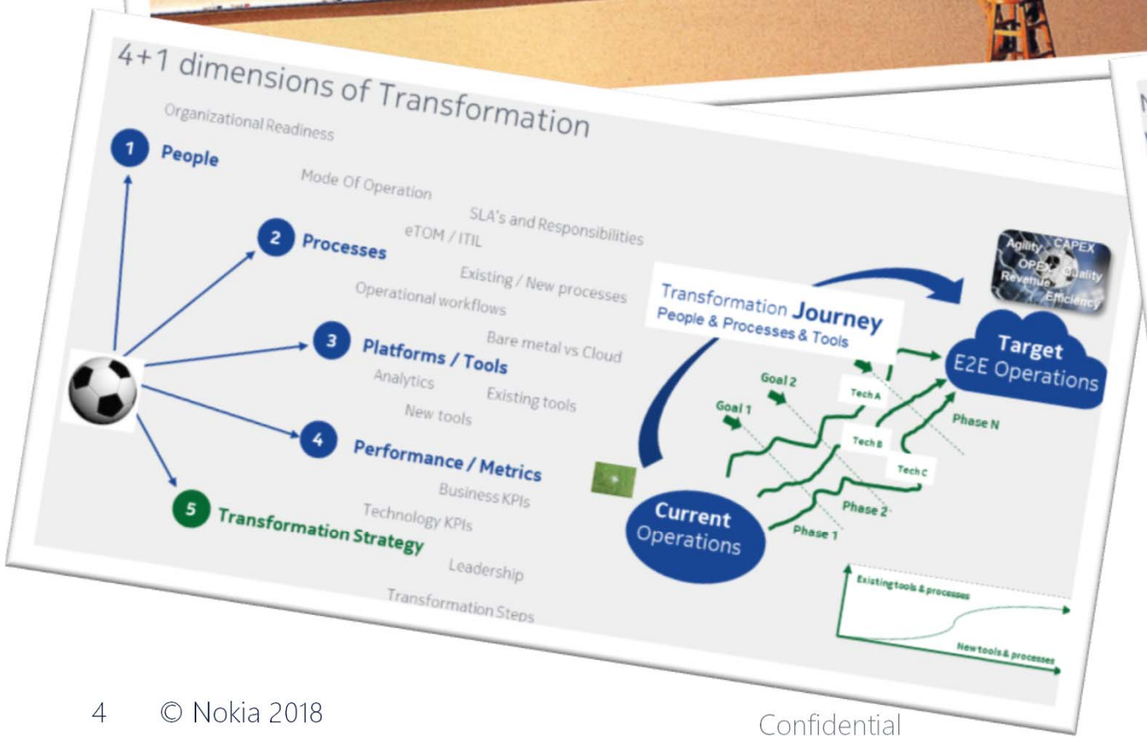
Flexible	Scalable	Automated
Cloud native	SW centric	Dynamic network slicing

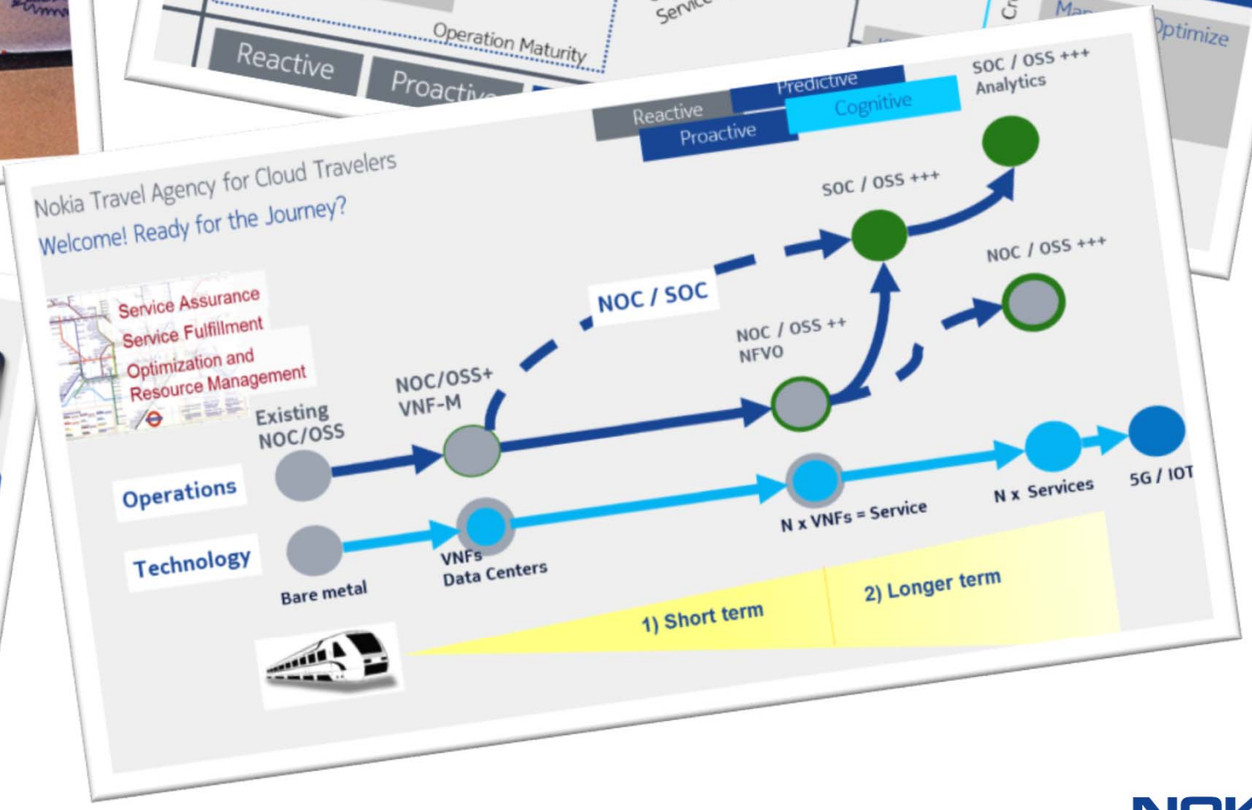
NOKIA

E2E Operations – one of the primary concerns









Unique challenges of orchestrating 5G network services
What is new? Why is 5G different?

- Deployment of hybrid 5G Radio Networks
  - A service is likely to be composed of both physical and virtual network functions
  - Some of the underlying functions are deployed as Edge Virtual Radio Network Functions (e.g. CU)
- Creation & Management of Radio Network Slice Subnet within the deployed network
  - Lifecycle management of Radio Network Slice Subnet Instances
  - Optimization of the deployed 5G network and the slices
- Near-real Time Data Collection (e.g. streaming)
  - Edge Analytics to Support 5G Network Optimization
  - Optimal placement of edge resources based on analytics

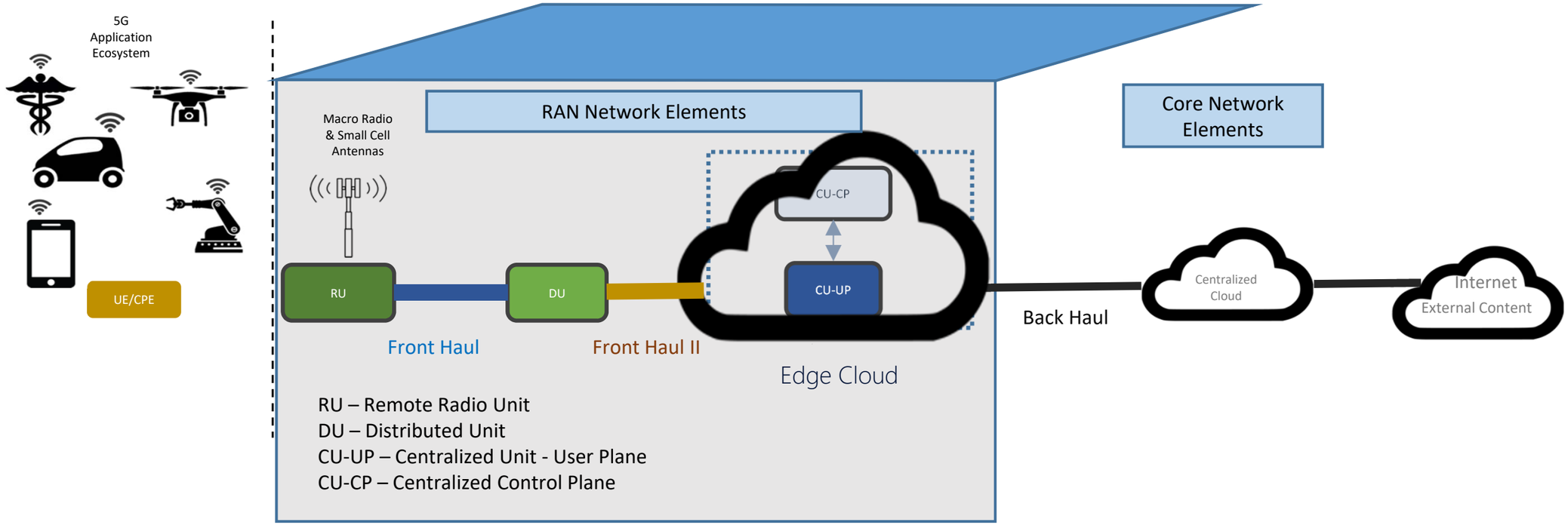
Hybrid Network Deployment
Physical and Virtual

- Disaggregated 5G RAN consists of hybrid network elements (PNF and VNF)
  - Orchestration systems should be enhanced to support different lifecycle management aspects of PNF. That may include modeling, on-boarding, monitoring, inventory, etc.

- Some network functions will require a cloud infrastructure deployment at the edge (due to performance and latency constraints).
  - Orchestration systems will need to support such cloud topology, with distributed resources
  - The requirements to properly place the service components become more complicated

5G Network deployment architecture

High level view



Source: https://wiki.onap.org/download/attachments/29788530/5GucCasablanca-03222018v3.pptx?api=v2

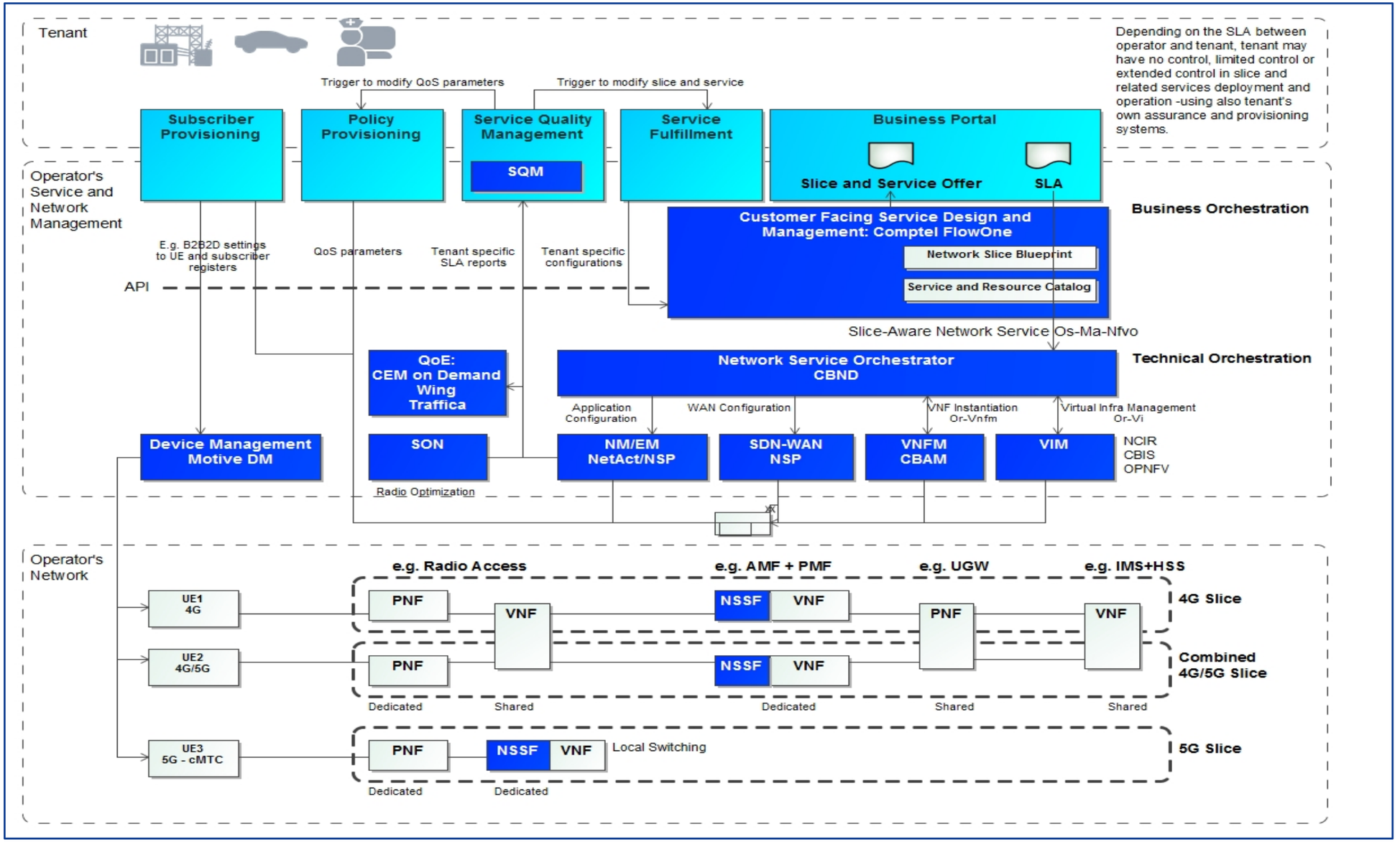
Network slicing

Current state-of-the-art

- Many service providers are interested in orchestrating slice management and extending the cloud notion of sharing network/compute/storage to sharing network functions and network slice subnet instances .
- 3GPP standards are still evolving and early versions just recently released (Rel. 15, June 14th)
- Some orchestration systems such as ONAP will soon be capable of demonstrating basic slicing using a simple slice definition, creation, and management for 5G Radio Network.
  - Radio Access Network slice subnet instances supported and demonstrated in ONAP Casablanca will be limited to simple examples such as eMBB (enhance Mobile Broad Band).
- Vendors and operators are performing trials and PoC
  - E.g. 360 Remote Presence

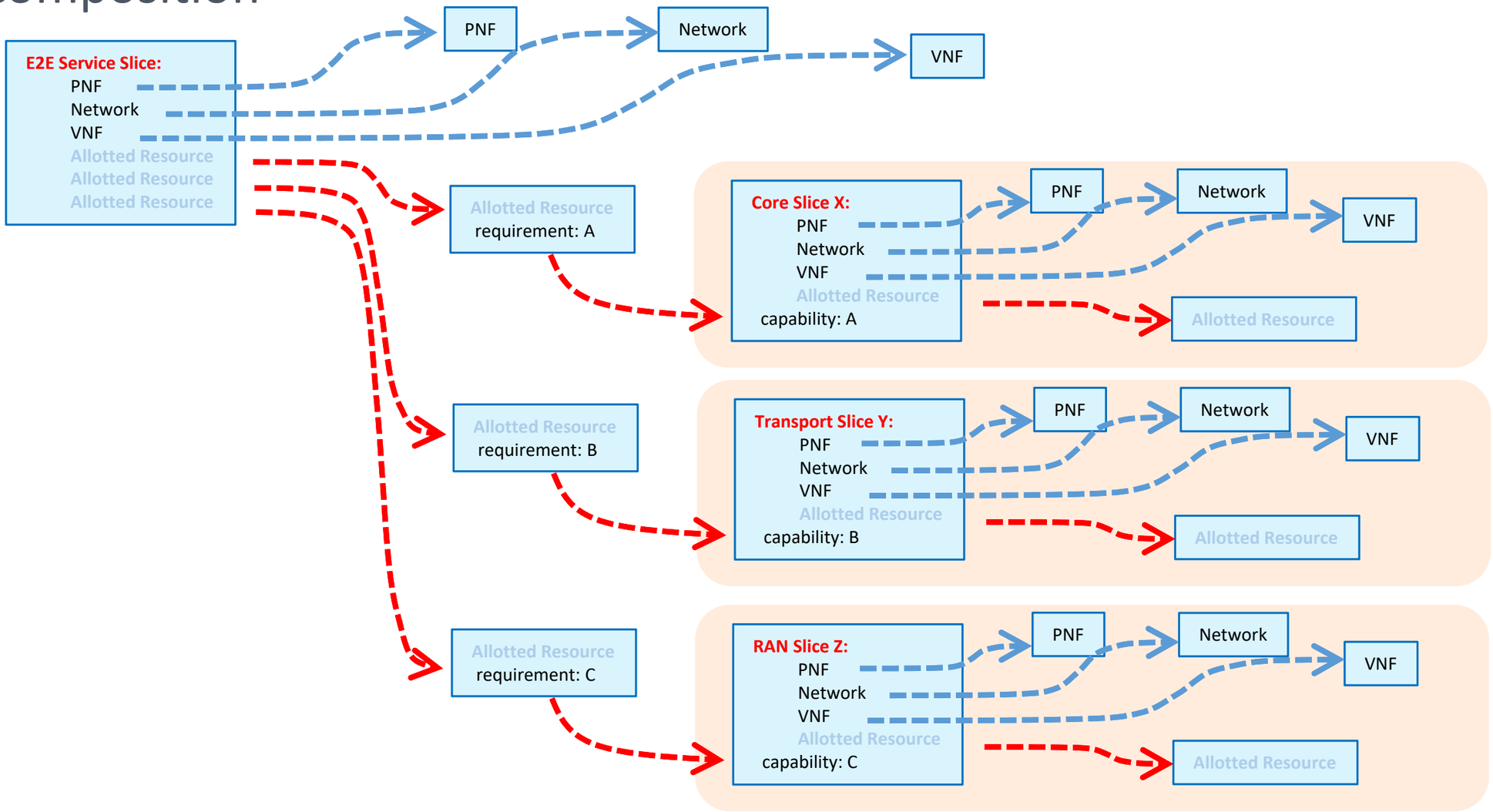
NOKIA

Network Slice – System View



Example – 5G mobility slice

Service composition



Source: https://wiki.onap.org/download/attachments/29788530/5G-Slicing_Casablanca-050318.pptx?api=v2

Real time analytics and network optimization

The need to operate on a larger scale

- Edge cloud infrastructure (ECI) analytics is required for near-real-time correlation between various
  - Events - E.g. Number of VM Power On/Off;
  - Alerts- E.g. Cloud region CPU usage exceeds threshold
  - Faults - E.g. loss of redundancy from a Host NIC perspective.
- Edge cloud near-real-time streaming infrastructure resource (CPU, Memory, Network etc.) utilization metrics are needed for inter-cloud resource optimization
- Optimization needs for typical carrier deployments will involve large, distributed data centers, and will involve complex rules and constraints governing how multiple network elements are instantiated and managed. Hence, these are critical functional requirements for a carrier-grade orchestrator. Specifically, within the 5G domain, efficient allocation of resources and dynamic, load- and cost-aware reconfigurations are valuable.
- This optimization may be effected via dynamic configuration of relevant 5G radio and backhaul network parameters. Such optimization is part of the so-called “Self-Organized Networking” or SON.

Optimization use cases

Some examples

- Optimization of E2E service level QoE (KQIs), with slicing awareness where relevant
- 5G White space/unlicensed spectrum management, where SON allocates bandwidth resources to users based on their traffic and mobility profiles, as well the availability of licensed bands in a given geographical location.
- 5G energy optimization: where a SON algorithm dynamically adapts the transmission power and/or tilt of 5G cells based on traffic conditions, in order to maximize the power efficiency of the network. This is especially important in dense networks. (This technique is widely used in 3G and 4G SON solutions, so not unique to 5G)
- Load balancing: where the allocation of user traffic to 4G and 5G cells in the region is based on a wide set of inputs including user load, traffic requirements/conditions, and environmental factors. (This technique is widely used in 3G and 4G SON solutions, so not unique to 5G)

Conclusions

Key takeaways

- 5G sets the bar higher for orchestration in terms of complexity and scale
- End to end orchestration is a key concern
- Standardization is still on-going. There is a need to react fast
- Open source initiatives are working on a solution. Still much work lays ahead
- Some vendors and operators are already having trials and PoC

NOKIA

Email: ranny.haiby@nokia.com

LinkedIn: https://www.linkedin.com/in/rannyhaiby

Q&A

NOKIA

Copyright and confidentiality

NOKIA