
Cognitive management of multi-service multi-tenant 5G mobile networks

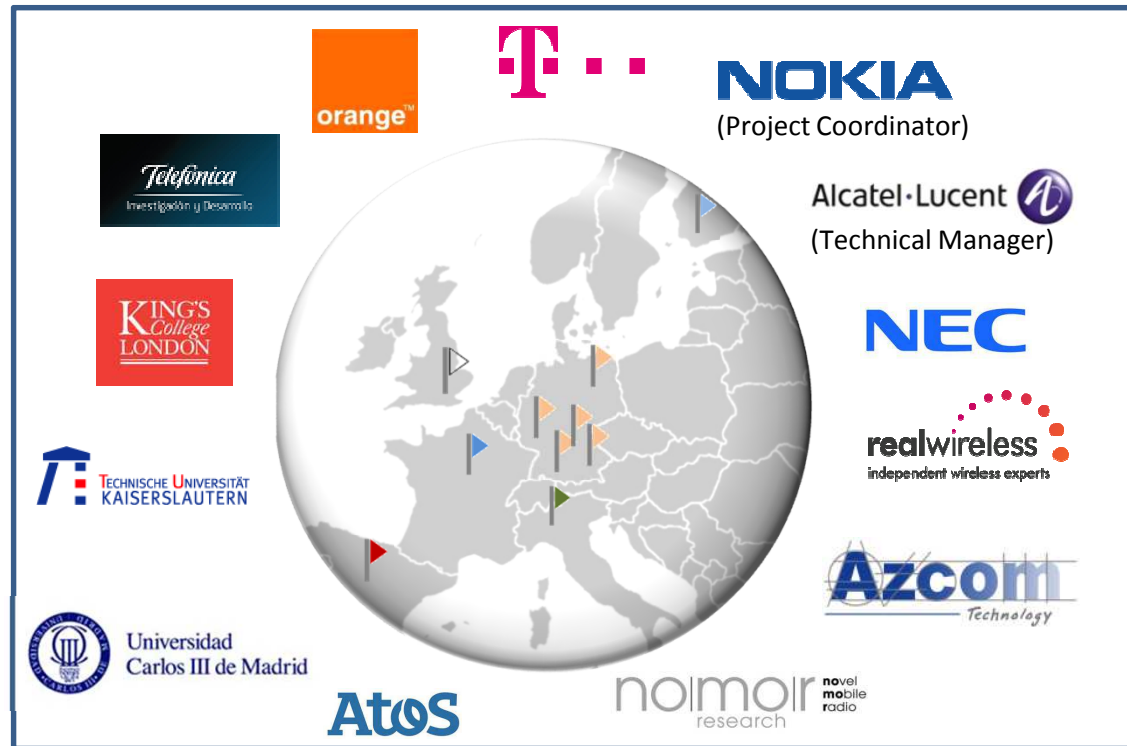
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5G NORMA – A NOvel Radio M ultiservice adaptive network A rchitecture for the 5G era



5G NORMA Consortium



5G NORMA in a nutshell

EU funded R&D project within 5GPPP Initiative, aiming on building consensus on E2E mobile network architecture and rapid implementation

Duration

July 1st, 2015 – Dec 31st, 2017 (30 months)

Project Coordinator

Peter Rost, Nokia

Connect to 5G NORMA

Webpage: <https://5gnorma.5g-ppp.eu/>

Twitter: 5G NORMA project @5G_NORMA

5GPPP: <https://5g-ppp.eu/>

Contact 5G NORMA

5G-NORMA-Contact@5g-ppp.eu

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Outline

- Motivation and Objectives
- Innovations / Key enablers
- The 5G NORMA Architecture
- Network Management, Orchestration and Control
- Conclusion

NGMN Vision



“5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation towards customers and partners, through existing and emerging use cases, delivered with consistent experience, and enabled by sustainable business models.”

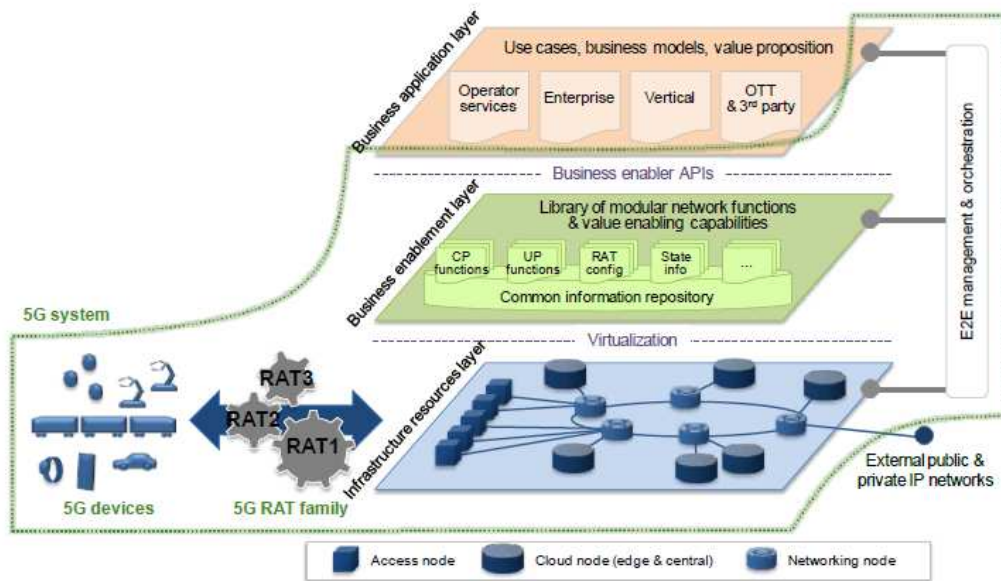


Figure 8: 5G Architecture

The NGMN White Paper has been endorsed by the following NGMN Board Members:

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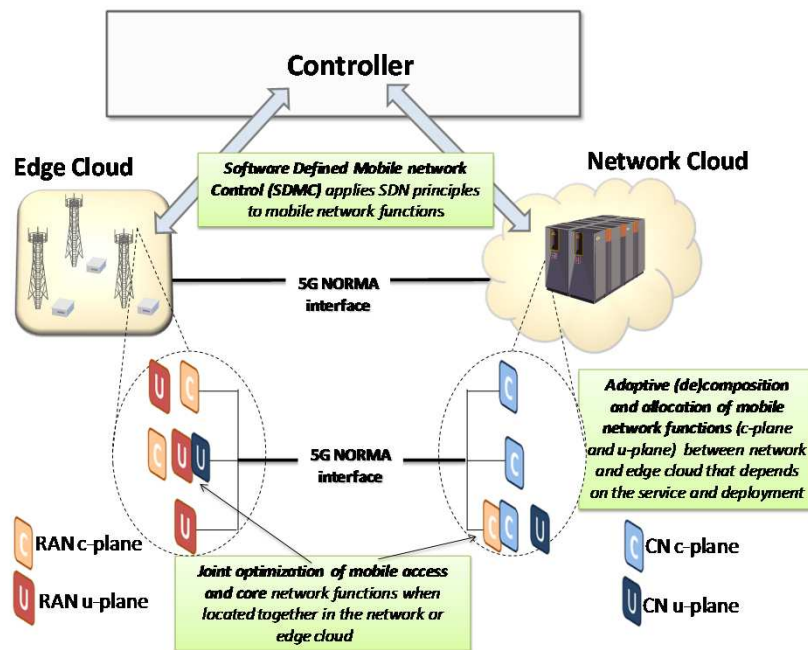
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NGMN 5G WHITE PAPER



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Three innovations enabling flexibility



1. Adaptive (de)composition and allocation of NFs
2. Joint optimization of RAN and CN
3. SW-defined Mobile Control

create the flexibility to

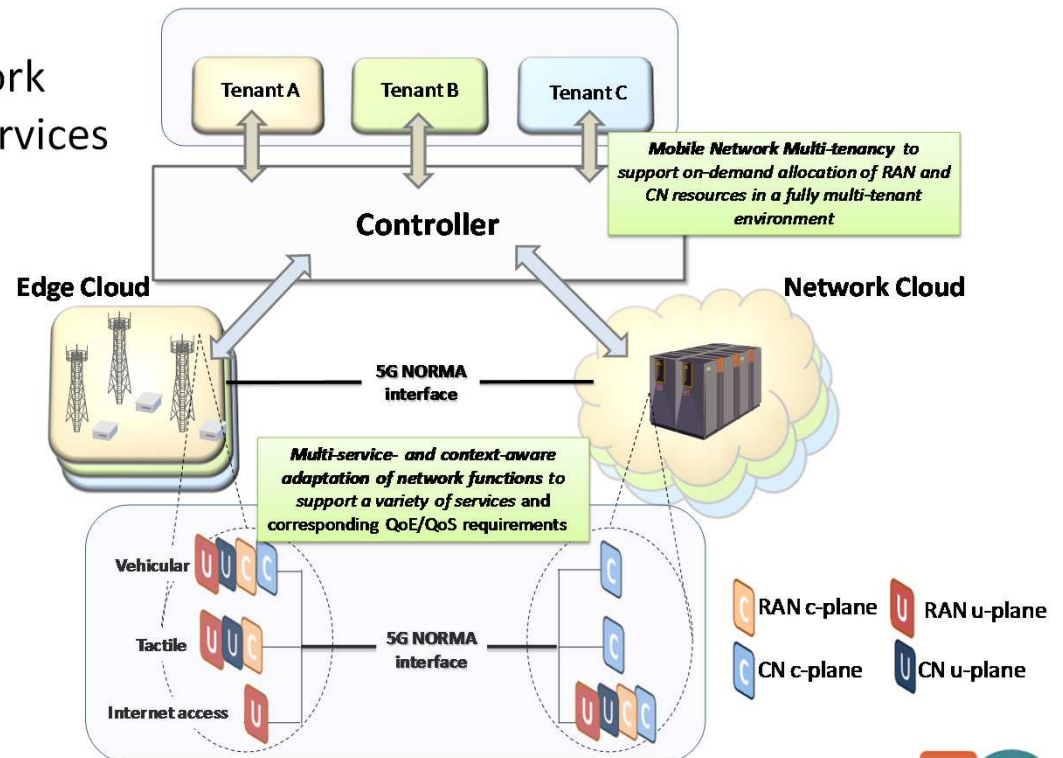
- adapt dynamically to daily fluctuations in traffic demand
- adapt to rapid load variations in small cells
- introduce new services and business models quickly

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Multi-service and multi-tenancy

Dedicated networks contained in network slices can meet the need of different services and tenants:

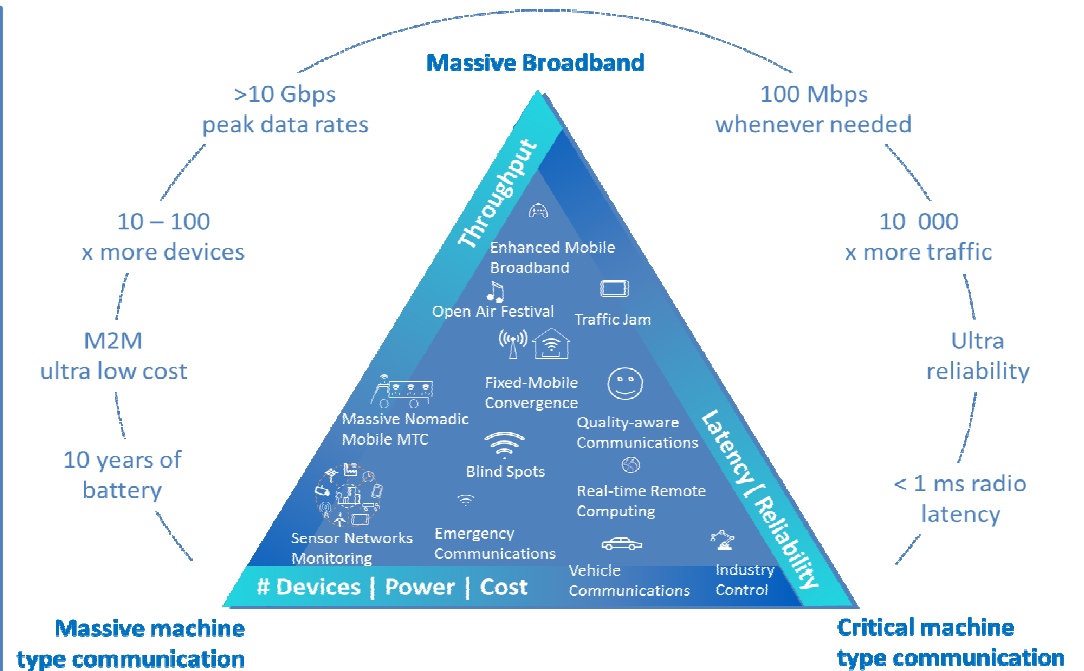
- Service quality and performance
- Service-specific functionality
- Customized security and isolation
- Adaptation to available infrastructure



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5G NORMA Use cases

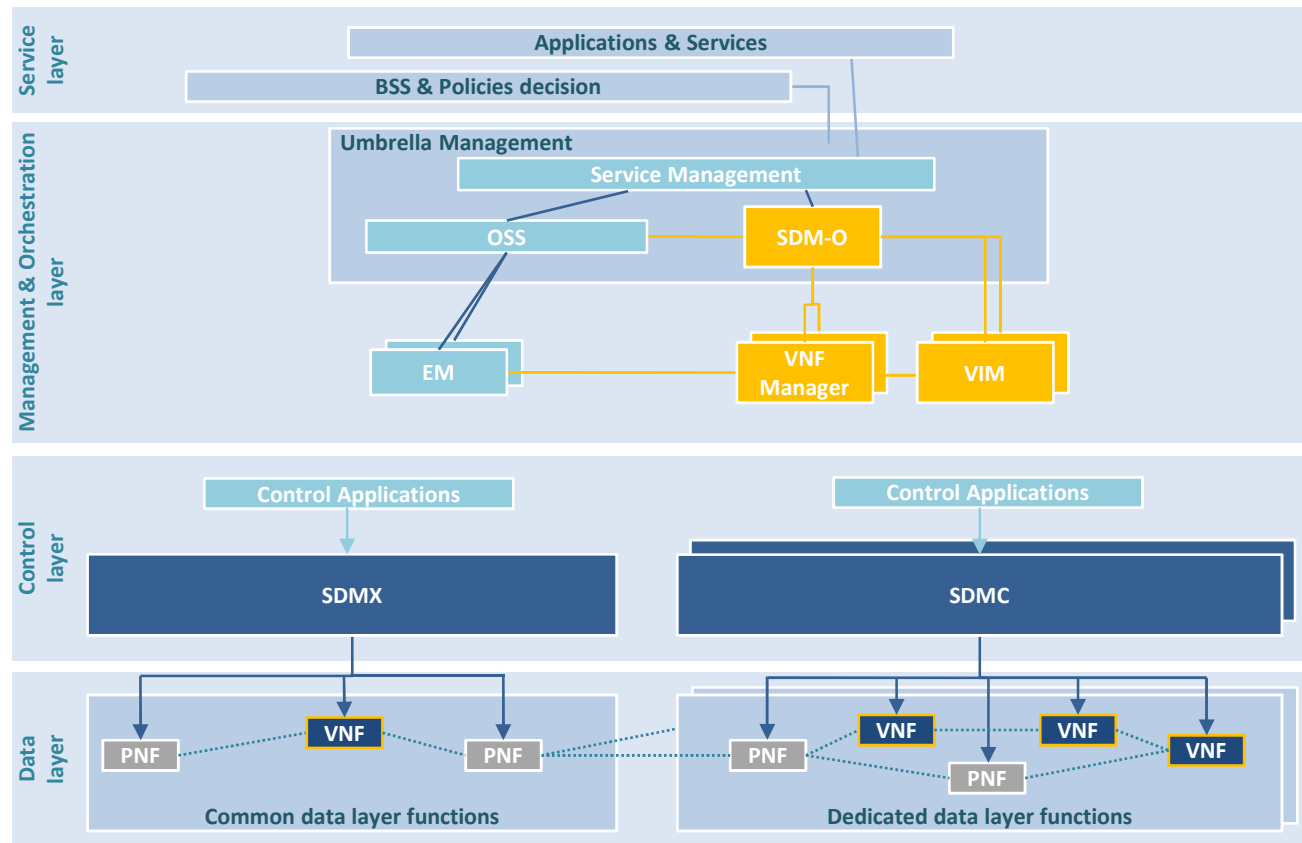
- Industry Control
- Enhanced Mobile Broadband
- Emergency Communications
- Vehicle Communications
- Sensor Networks Monitoring
- Traffic Jam
- Real-time Remote Computing
- Massive Nomadic Mobile Machine Type Communications
- Quality-aware Communications
- Fixed-Mobile Convergence
- Blind Spots
- Open Air Festival



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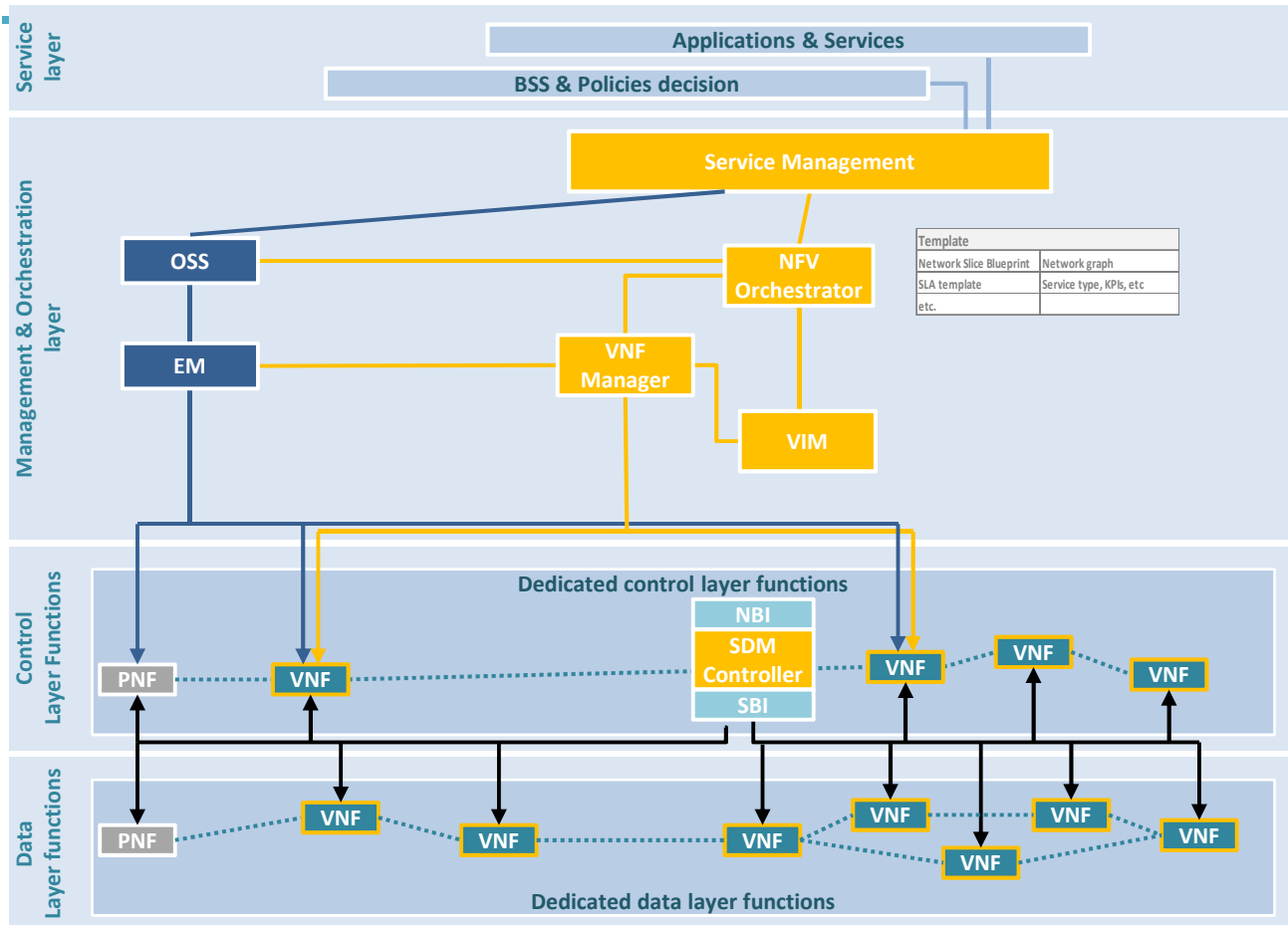
5G NORMA Architecture



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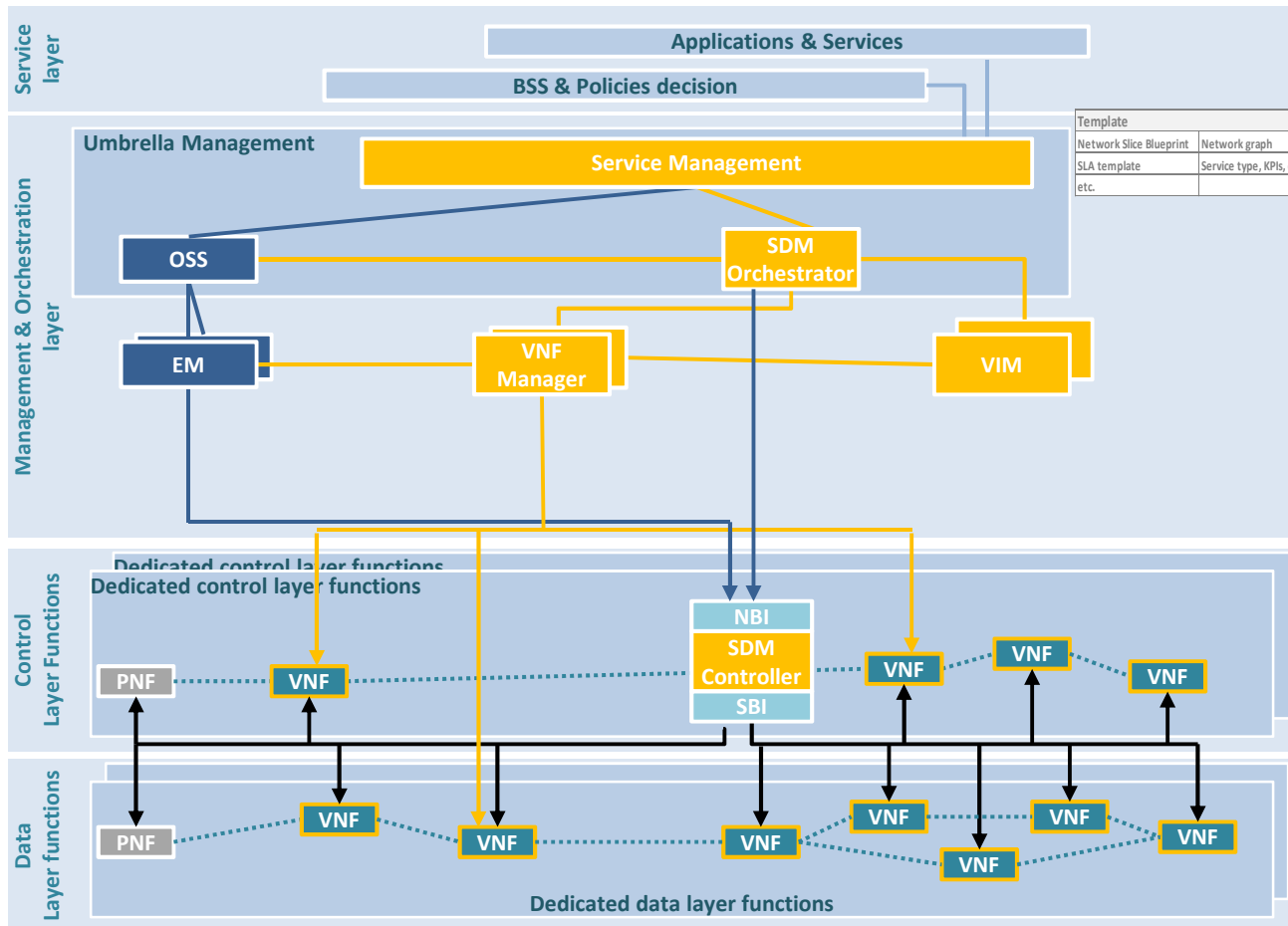
What should the 5G architecture look like?



- Major consideration: e2e perspective of a network slice
- **Service Management:** owned and operated by the tenant or the service provider, e2e 'umbrella' function
- **SDM Controller** is a key function in 5G NORMA. It controls the performances of PNFs and VNFs through its SBI. It exposes a NBI for 'inserting/ reconfigure' functions and resources assigned to the network slice. Time scale can be in the order of tens of milliseconds. In case that QoE/QoS targets cannot be met, the SDM-C may request re-orchestration SDN-C and NF are owned and operated by service provider
- ETSI- NFV MANO seems sufficient in this simple case
- What about Network Slicing?

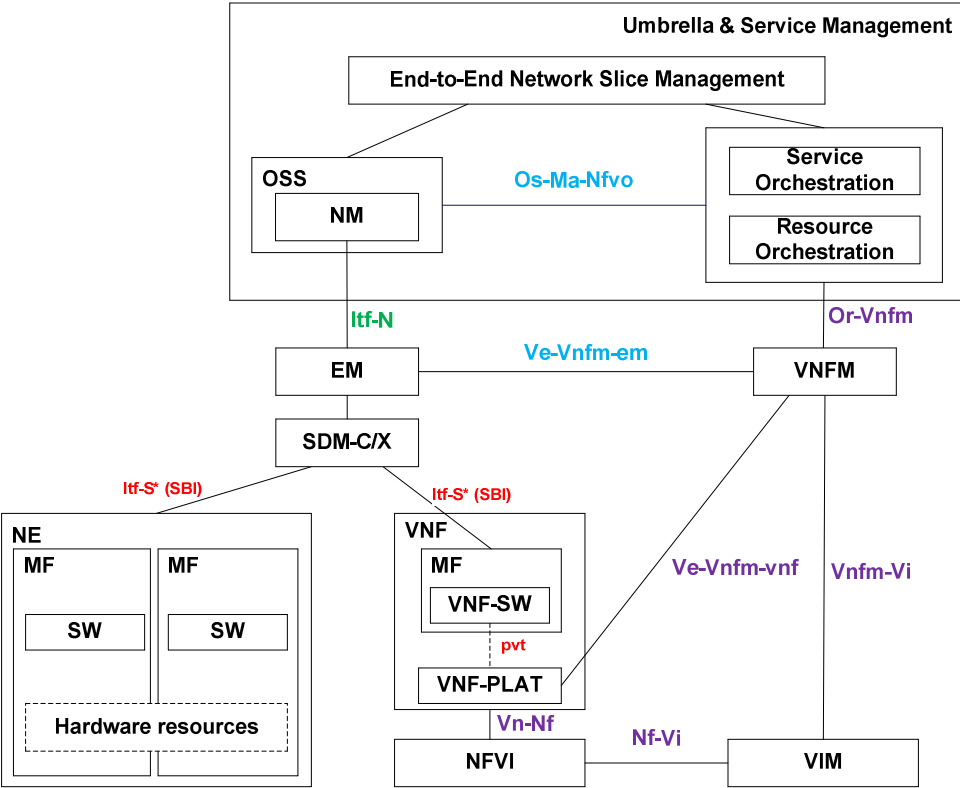


Architecture supporting network slicing



- **Service Management:** owned and operated by the tenant or the service provider
- **SDM Orchestrator:** owned and operated by the service provider that operates the slice for the tenant (tenant and service provider may be the same)
There is one instance per slice
- **The VNF Manager** is owned and operated by the service provider. There are multiple VNF-M instances per slice (typically per vendor)
- **The Virtual Infrastructure Manager (VIM)** is owned and operated by the infrastructure provider. one VIM per cloud (e.g. one for the edge and one for the central cloud)

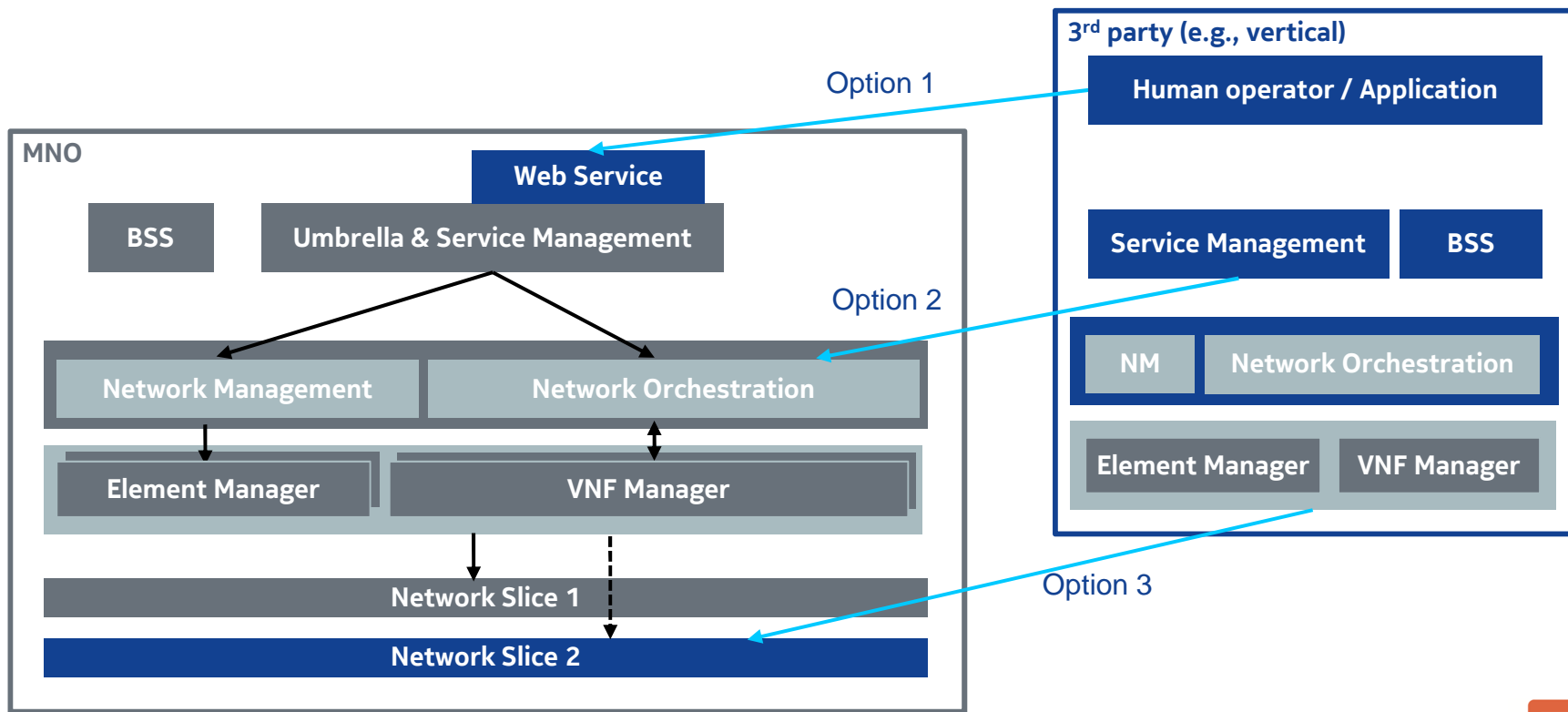
SDM-C – Management control continuum



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Depth of control and entry levels for 3rd parties

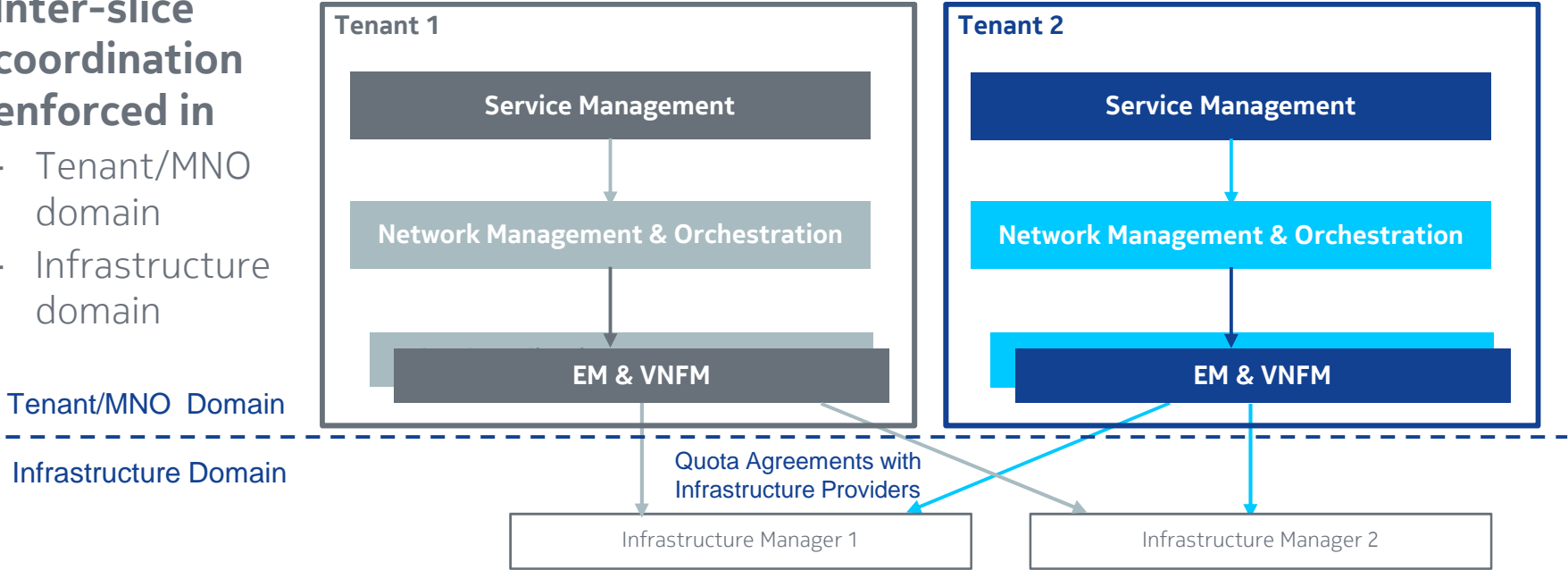


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Inter-slice coordination – SLAs and quotas

- **Inter-slice coordination enforced in**
 - Tenant/MNO domain
 - Infrastructure domain



Network slice isolation

Performance isolation	Security isolation
<ul style="list-style-type: none">• Mutually independent network slice operation• Performance variations in one slice should not peril SLA in other slices<ul style="list-style-type: none">• Underprovisioning• Concurrent access to shared functions• Multiplexing gains and limitations	<ul style="list-style-type: none">• Isolation of data and metadata<ul style="list-style-type: none">• Application data• User data• Isolation of network traffic• Isolation of network functions and services• Isolation vs duplication of management & orchestration functions

Criteria for isolation

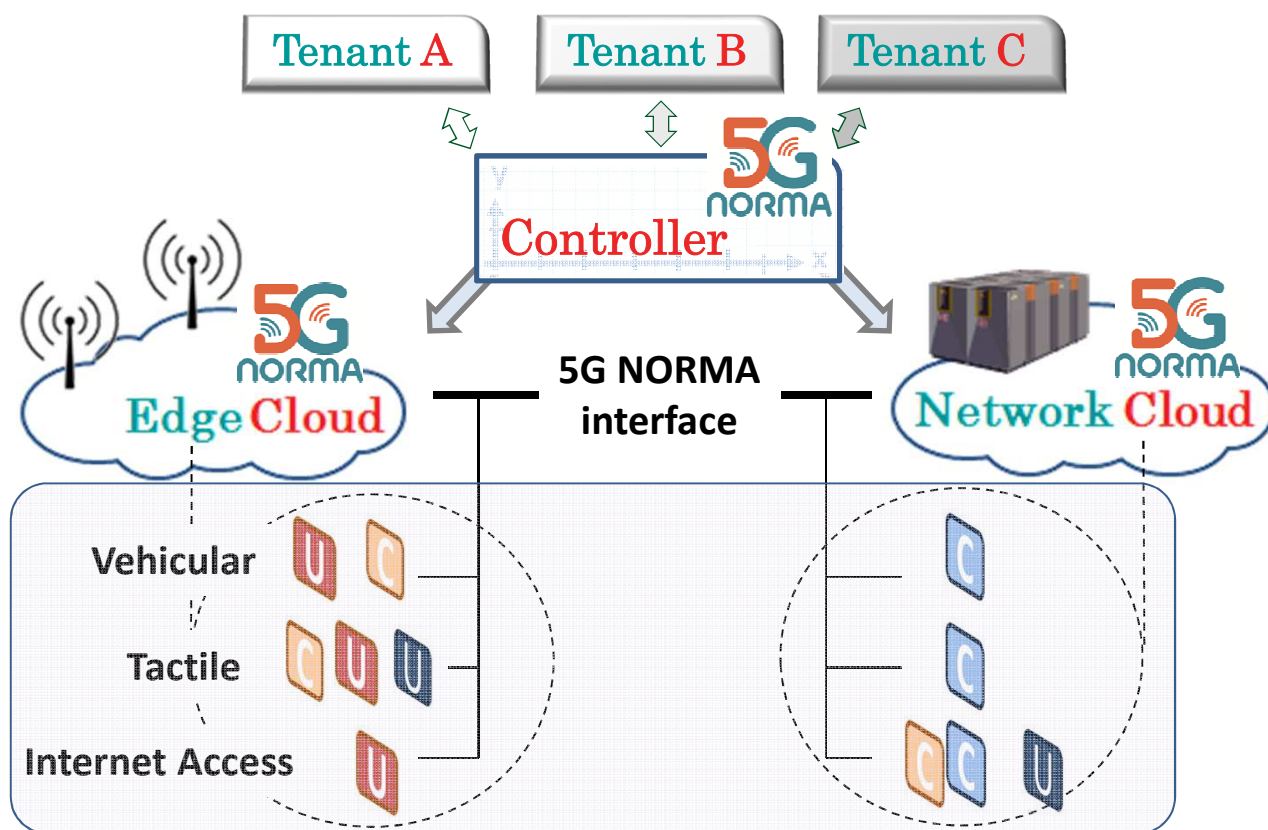
- Tenant isolation
- Service isolation
- User isolation
- Application isolation



Means of isolation

- Physical isolation
 - Separate servers
 - Separate data centers
 - Separate transport networks
- Virtual (logical) isolation
 - Separate VMs
 - Separate V(x)LANs
 - etc.

Conclusions



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1. Software Defined Mobile network Control (SDMC)
applies SDN principles to mobile network

2. Adaptive (de)composition and allocation of mobile network functions (c-plane and u-plane) between network and edge cloud that depends on the service and deployment

3. Joint optimization of mobile access/core network functions when located together in the network or edge cloud

4. Multi-service- and context-aware adaptation of network functions to support a variety of services and corresponding QoE/QoS requirements

5. Mobile Network Multi-tenancy to support on-demand allocation of edge and network cloud resources in a fully multi-tenant environment

5G NORMA Summer School London

20th - 22nd June 2016



Day 1: Invited speakers & panelists:

- Bernard Barani, EU commission
- Maria Cuevas, BT
- Ali Hossaini
- Linus Thrybom, ABB, Virtuwind
- Federico Boccardi, OFCOM
-

Day 2 and Day 3:

- 5G requirements
- 5G NORMA concepts & architecture
- SDN, NFV Orchestration, 5G NORMA SDMN control
- 5G Security aspects & solutions
- Speakers from 5G NORMA, Univ. of Surrey, Univ. of Bristol, Imperial College London

Free registration required under

<https://www.eventbrite.co.uk/e/5g-norma-summer-school-tickets-22728565752>.

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