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Orchestrating and composing slices within 5G networks - Key to the programmable world

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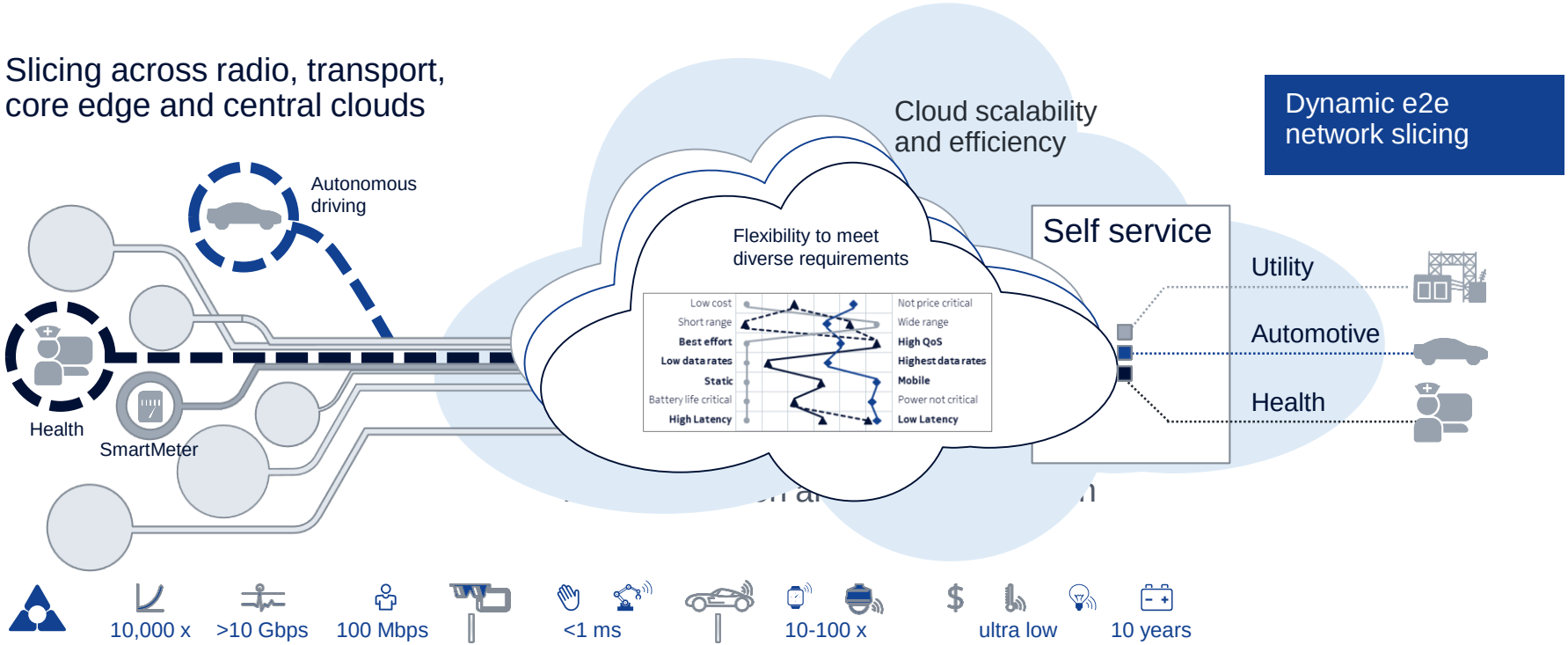
Agenda

- Motivation for Network Slicing
- Network slicing is not only 5G, what is possible today?
- Key topics in Network Slicing
  - Management and orchestration
  - Composing slices from network functions
  - Slice selection
  - Architectural impact to core and RAN

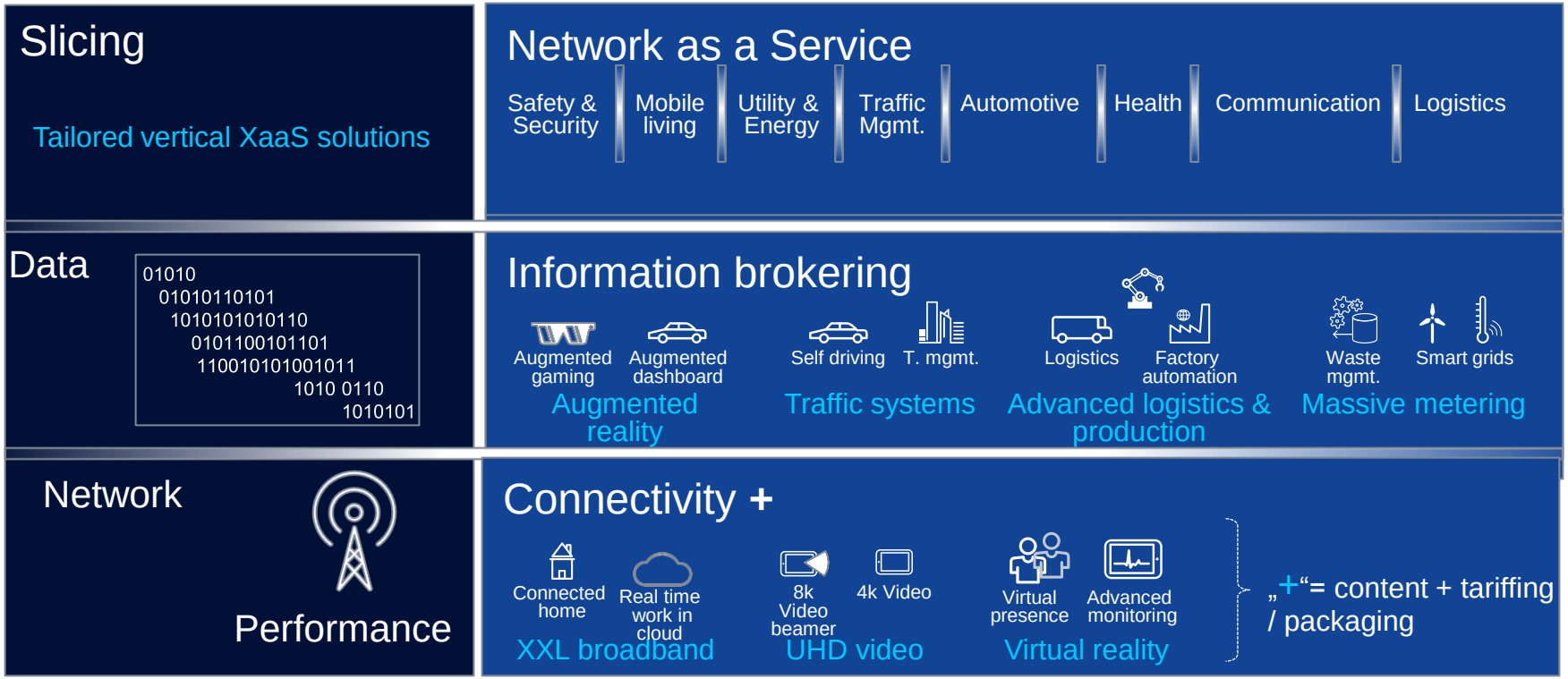
Network Slicing | Optimized service delivery for heterogeneous use cases

Multiple independent instances on one physical network



*5G Novel Radio Multiservice adaptive network Architecture

Business models powered by slicing, data and network performance



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Network Slicing in various research projects and SDOs

5GPP

- 5G NORMA EU Project
- METIS II: RAN Slicing
- 5GPPP PII
- SDOs
  - 3GPP SA2: TR 23.799 Study Item, key issue#1 *Network Slicing*
  - 3GPP SA5 : approved TR 28.801 SI "*Management & Orchestration of Network Slicing"*
  - ETSI NFV EVE
  - NGMN WS1: NW slicing document gives definitions and administrative domains
  - NGMN NMWO: *Management & Orchestration*
  - TM Forum defines "*Customer Facing Service"* and "*Resource Facing Service"*
  - ONF Technical Recommendation TR-526, titled "Applying SDN Architecture to 5G Slicing"

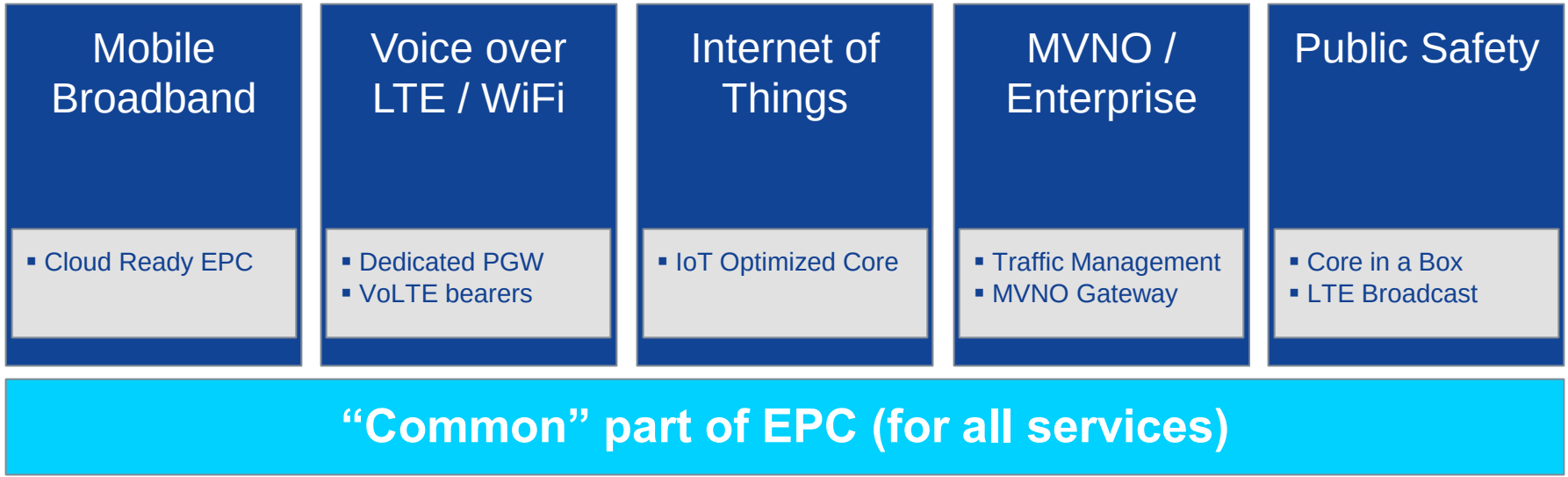
5G NORMA in a nutshell
EU funded R&D project within 5GPPP Initiative, aiming on building consensus on E2E mobile network architecture and rapid implementation
Duration : July 1st, 2015 – Dec 31st, 2017

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

4G Based Network Slicing

EPC with Business Verticals

New Service Introduction, Cloud Transformation, Overlay deployment



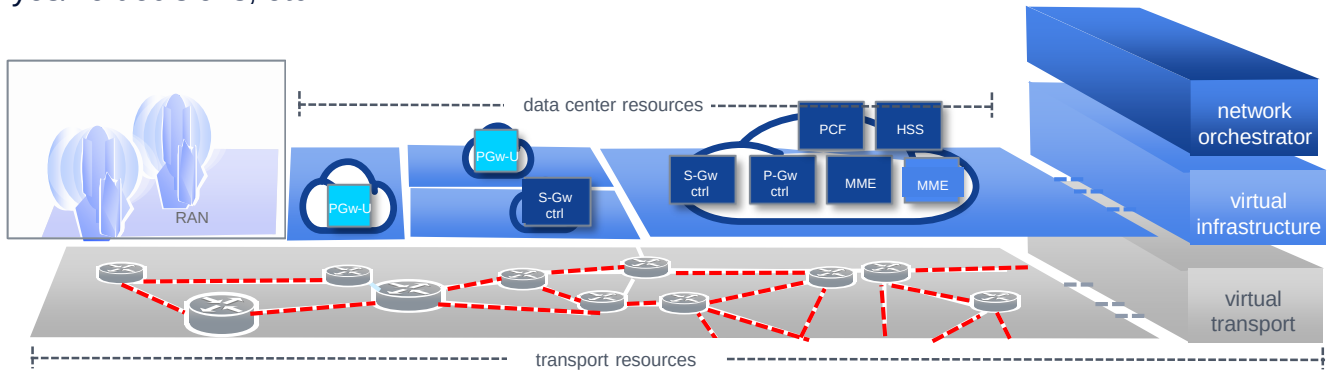
… implementing already network slicing to a certain extent …

Network Slicing in LTE

Scaling is done with EPC granularity, MME and S/P-GW

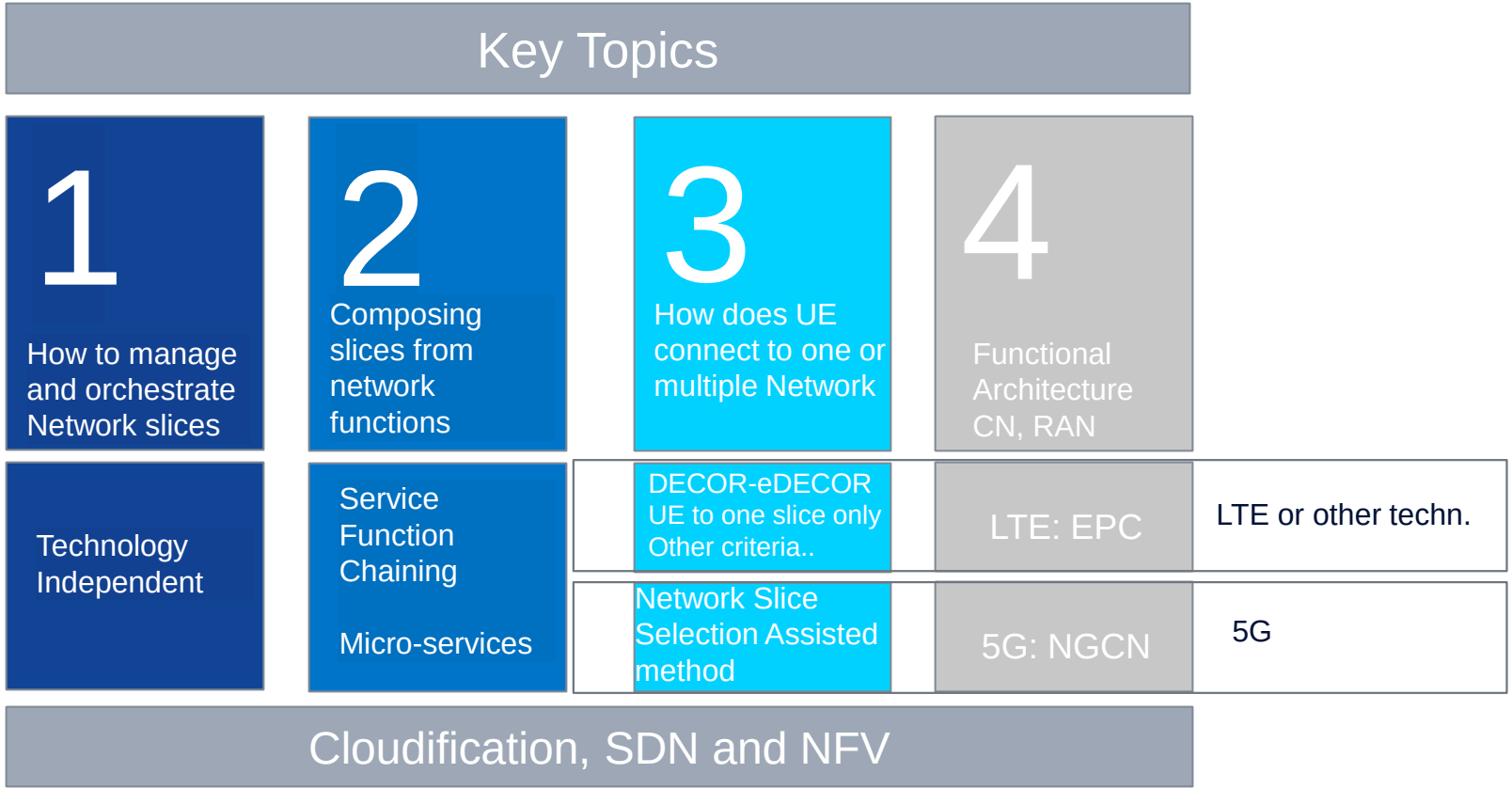
- **LTE**: Scaling of Network Functions based on EPC, that is MME, S/P-GW. One feature/feature upgrade may impact many Network Functions. SW upgrade and deployment is done in “Traditional-way”.

- In **5G** the architecture is cloud native Devops SW upgradeable
  - Network architecture structure has less dependent modules, e.g. SM should be less dependent from other NFs as possible ; MM has no role for fixed access, thus the need of separating functions that are specific to one access.
- and composition of NFs is flexible; there is not a strict definition of a number of functionalities but it follows business case and slice requirements. For ex. the uGW, depending on use cases/business case/slice can be composed of tunnel termination, DPI yes/no decisions, etc.



5G Network Slicing

Key topics in Network Slicing



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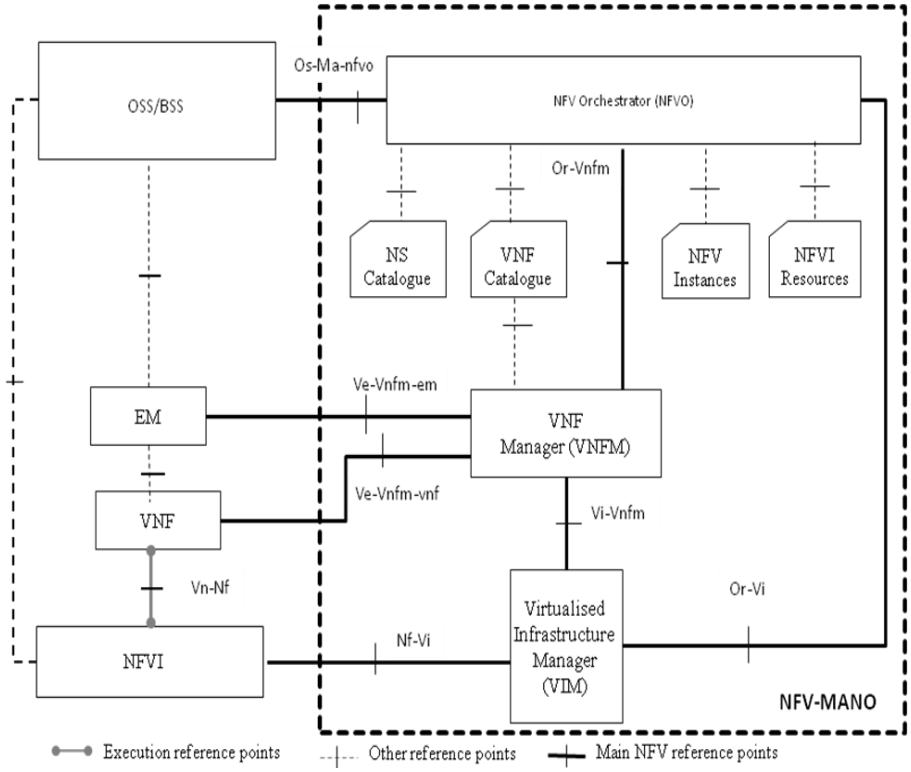
Is ETSI-MANO Network Service Orchestrator sufficient for slice orchestration?

- A Network slice is composed by a number of VNFs and PNFs. PNF Life cycle management as well as 3GPP semantic of Network Functions are not in the scope of ETSI NFV.
- **Network slicing needs application service to network service relationship to take into account. The application service is out of scope of ETSI NFV defined NFVO.**
- The scope of ETSI NFV MANO defined in Release 2 specifications is single administrative domain only (single tenant). **The multi-tenancy support is needed.**
- But we can reuse the concept of ETSI-NVF Network Service (NS) per Network Slice management. In this case the sub-network instance defined by NGMN is a Network Slice. NFVO NS can be used in recursive way.



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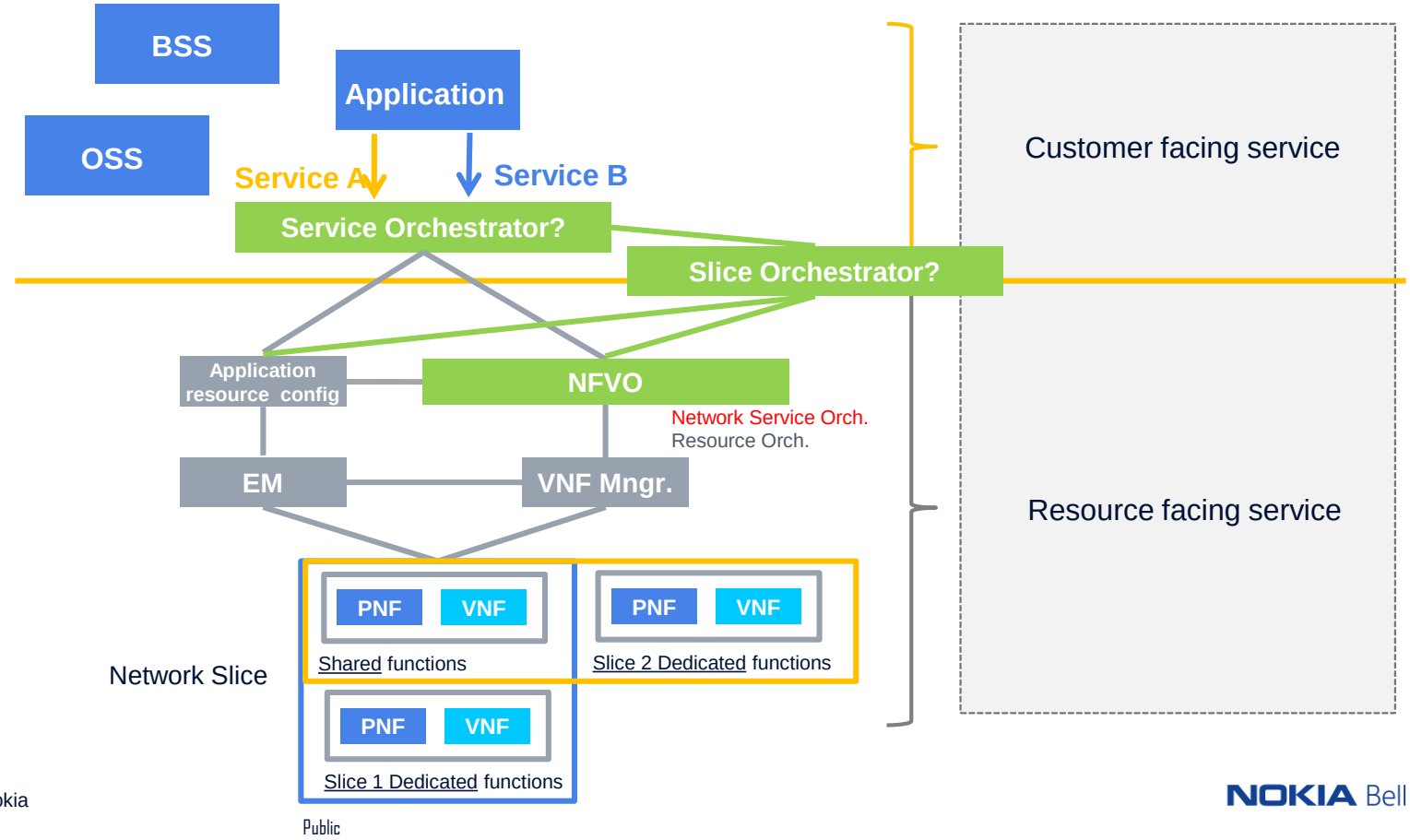
Does Network Slicing require a new level of abstraction ?

TM Forum



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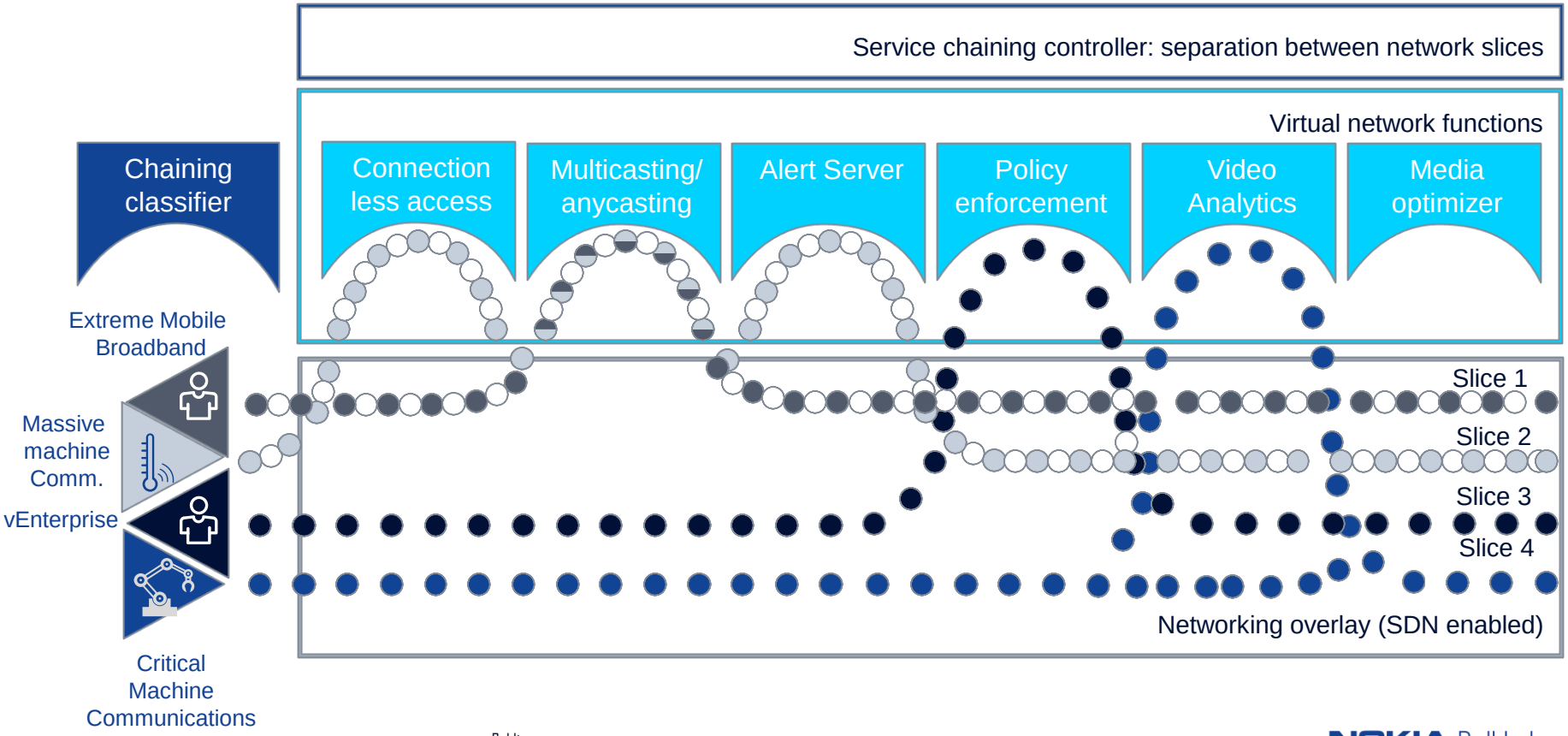
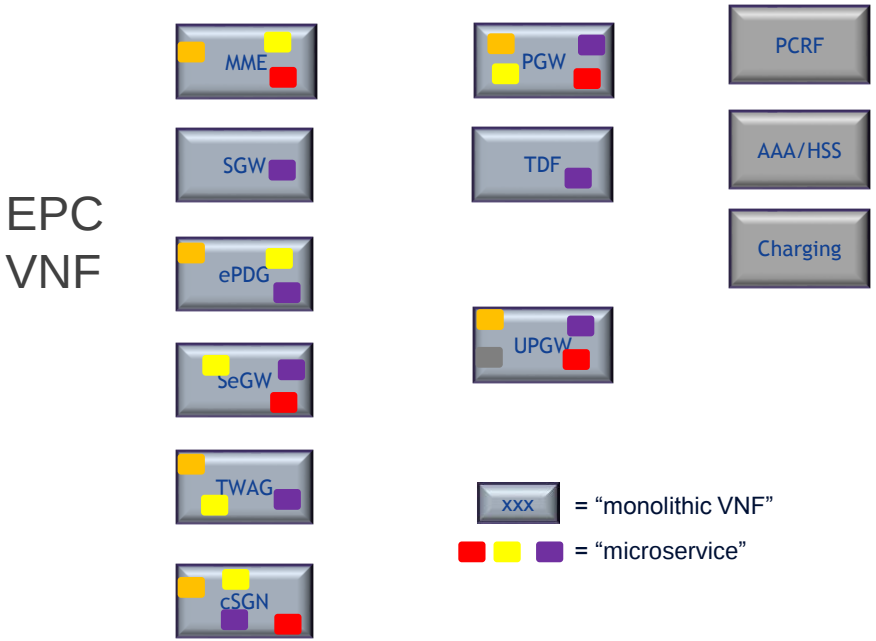
Composing a slice as service chain of network functions



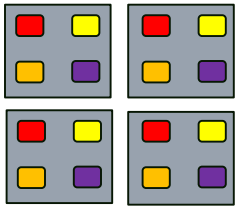
Micro-service decomposition of EPC VNFs



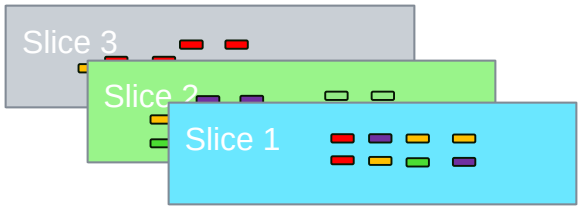
- With today’s virtualization technology it makes sense to reexamine this functional split.
- There are several case where same or similar functions are implemented in multiple elements (especially when considering 3GPP and Fixed/Non-3GPP cores:
  - Authentication/Authorization in MME, SeGW, ePDG, BNG and capability sets.
  - Security functions in SeGW, MME and ePDG.
  - Selection / Load-balancing in MME, ePDG andTWAG.
  - Routing / bearer management function in SGW, PGW, ePDG, TWAG and BNG.

Slicing with micro-services changes granularity of the slice management

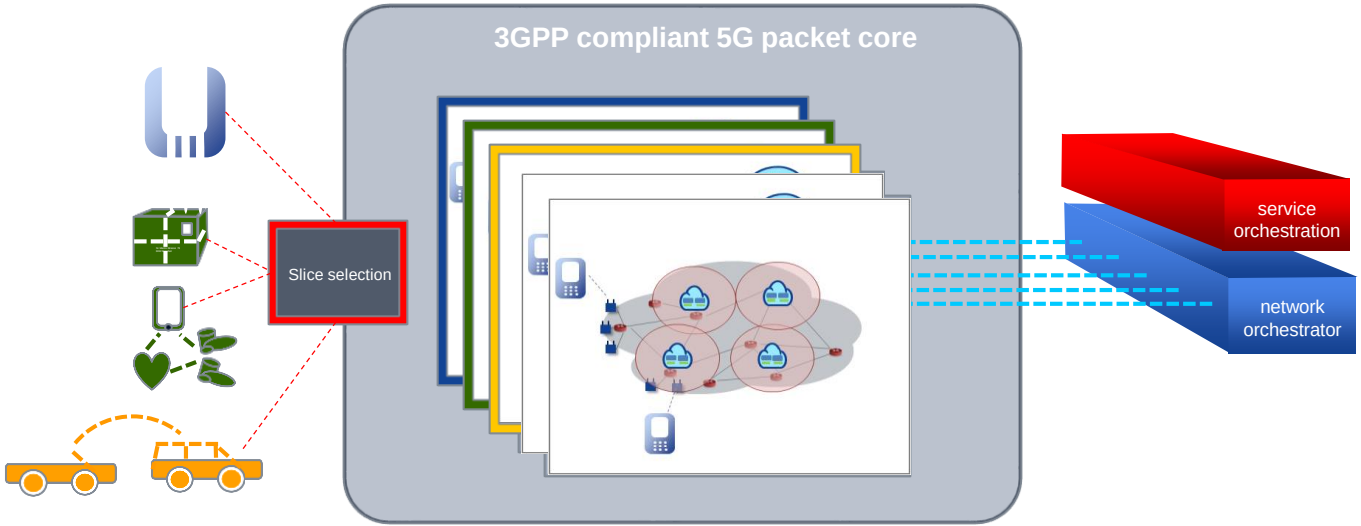
- With a traditional monolithic approach each element has a fixed set of functions that do not scale independently. The system scales by adding additional instances of that collection of functions.
- However individual functions may be underutilized.
- **This is similar to building one packet core to support all services. We just replicate core functions to achieve scale.**



- With a micro-services approach the system may be scaled by adding only as the micro-services needed.
- The granularity of management and orchestration impacted.
- **This technique could be used to provide individual packet cores for each type of device / service. Functions are only used where needed.**

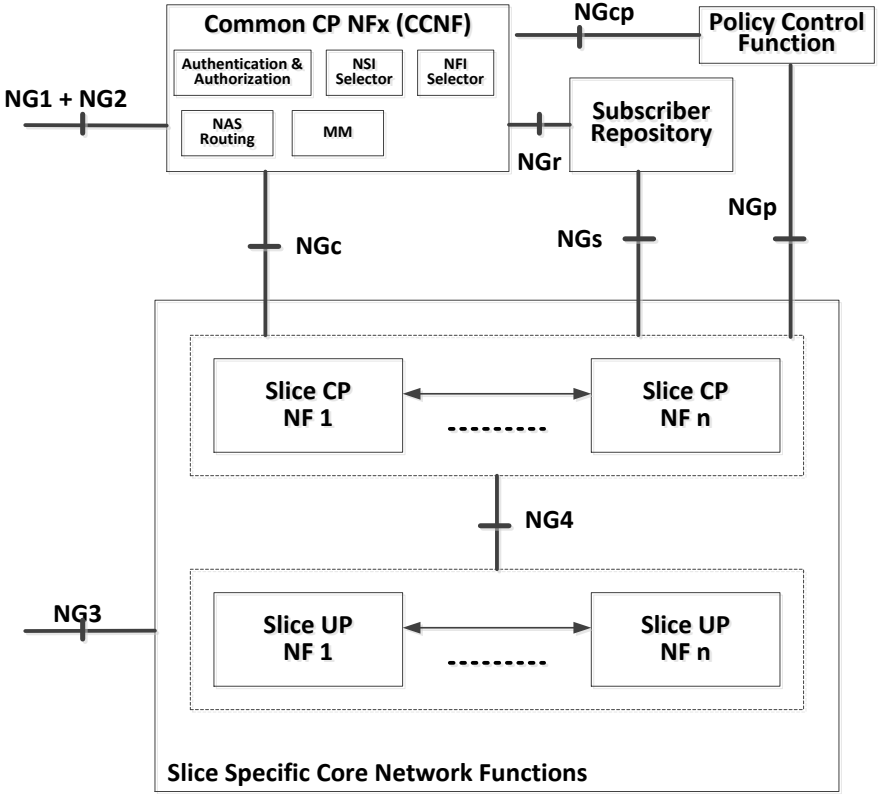


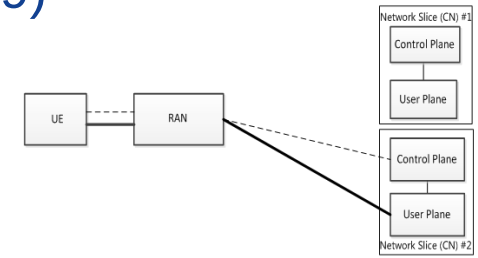
How does UE connect to one or multiple Network?
Slice selection needed



- Several proposals has been studied in 3GPP.
- Network Slice Selection Assisted method: interim agreement in 3GPP (TR 23.799).

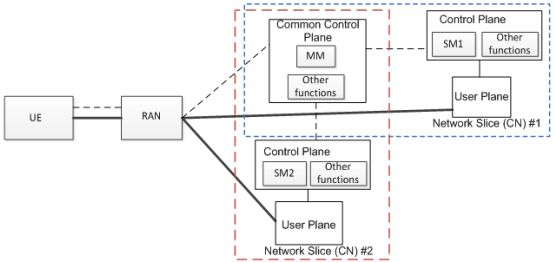
3GPP SA2 agreed Options-Scenarios (TR 23.799) for NG-core





Scenario 1: Dedicated CN network slices

Characterized by independent subscription management/mobility management for each network slice handling the UE. In this case, UE attaches only in one network slice.

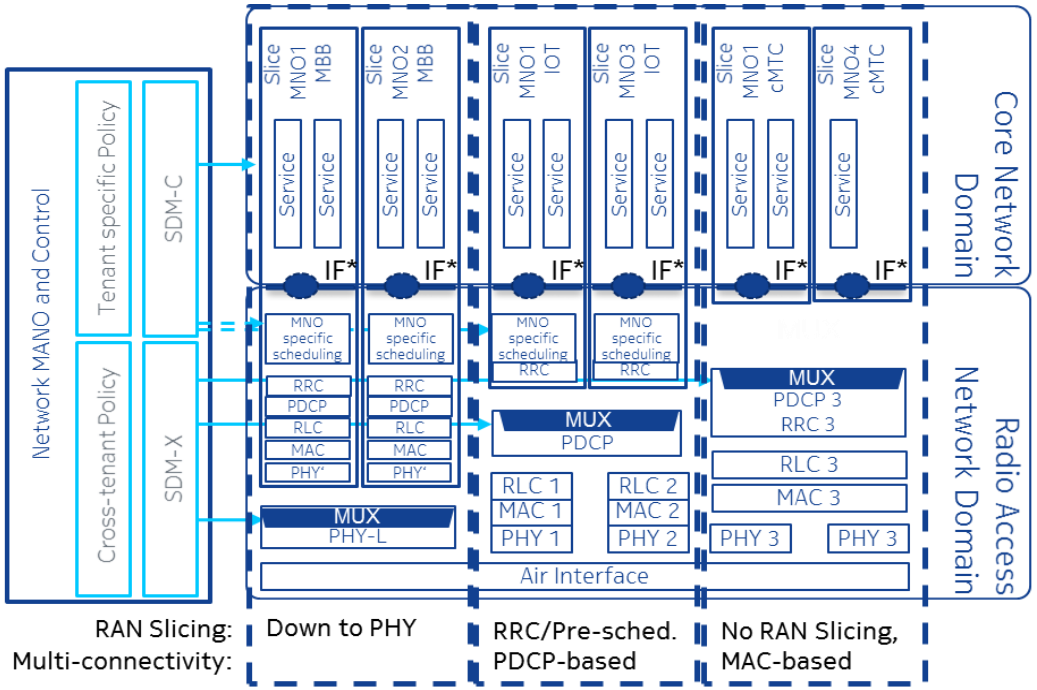


Scenario 2: CN Network slices with some shared components

Network slices with some shared components (e.g. MM function) and dedicated components (e.g. UP functions) – In this case, UE can camp in multiple network slices provided there is a single MM function for a given UE

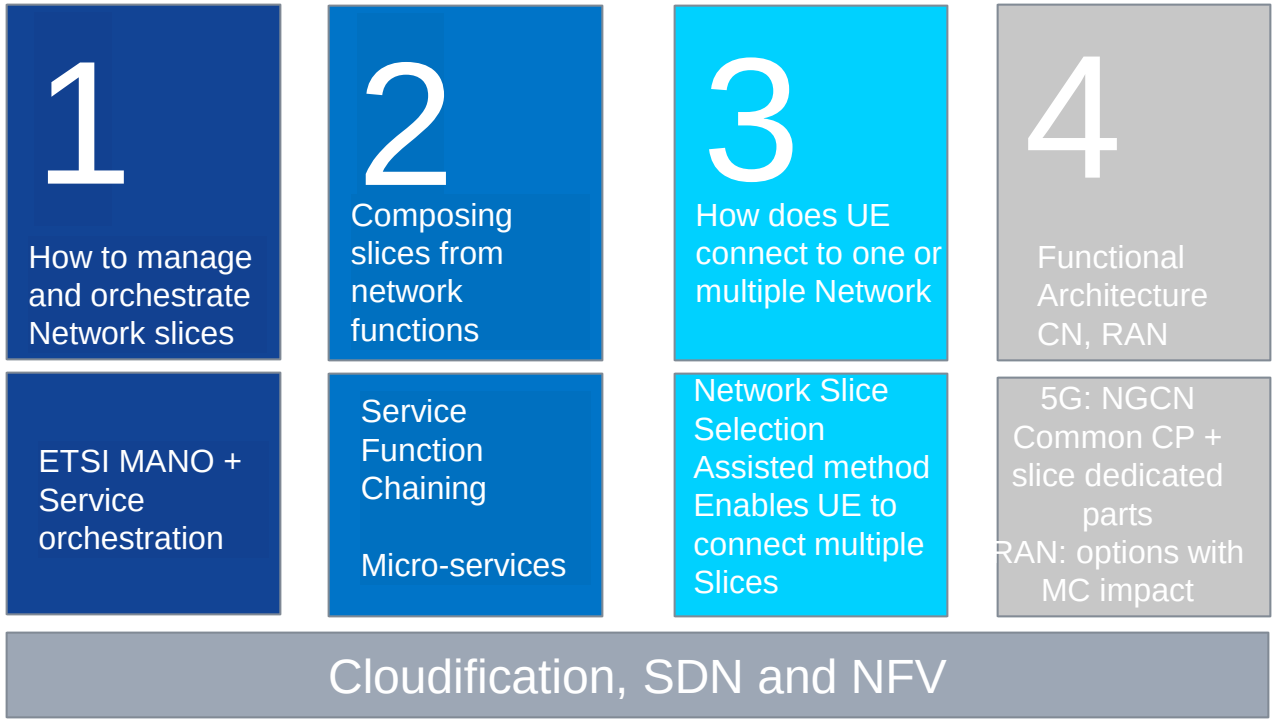
Options in slicing RAN (EU-project Norma)

- Slicing down to within PHY.
  - With slice-individual MC of any kind
  - But RAT design needs to support it to be efficient (5G only)
- RRC Slicing + PDCP MC.
  - Slice-individual data layer (RAN L123) adaptation/customization through MC
  - With per slice RRC additional customization through QoS scheduling
- No RAN slicing + MAC MC.
  - At least parts of RRC need to be shared across slices
  - Very limited/no chance for customization
  - Most straight forward 5G evolution of the current (4G) RAN sharing architecture of 3GPP DECOR



Source: P. Rost *et al.*, "Network Slicing to Enable Scalability and Flexibility in 5G Mobile Networks", submitted to IEEE Communication Mag., September 2016.

Summary of 5G Network Slicing



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