

Session on policies and regulatory methods for broadband deployment and broadband access technologies

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Key aspects and considerations for 5G

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Summary

- 5G glossary
- Key capabilities enhancements
- Usage scenarios for 5G
- Requirements from a Service point of view
- Requirements from a Network Operation point of view

5G Glossary

New Radio



✓ Non-standalone NR (NSA NR), which implies using LTE as the control plane anchor; and standalone NR, which implies full control plane capability for 5G NR

New waveform



✓ Generalized frequency-division multiplexing (GFDM); filter bank multicarrier (FBMC); universal filtered multicarrier (UFMC); and filtered OFDM (f-OFDM) are the new ones.

✓ New multiple access schemes are also being researched, including sparse code multiple access (SCMA), non-orthogonal multiple access (NOMA), and resource spread multiple access (RSMA).

Spectrum



✓ WRC-19 will consider the following bands for 5G under agenda item 1.13:

24.25-27.5 GHz, 31.8-33.4 GHz, 37-43.5 GHz, 45.5-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz, and 81-86 GHz.

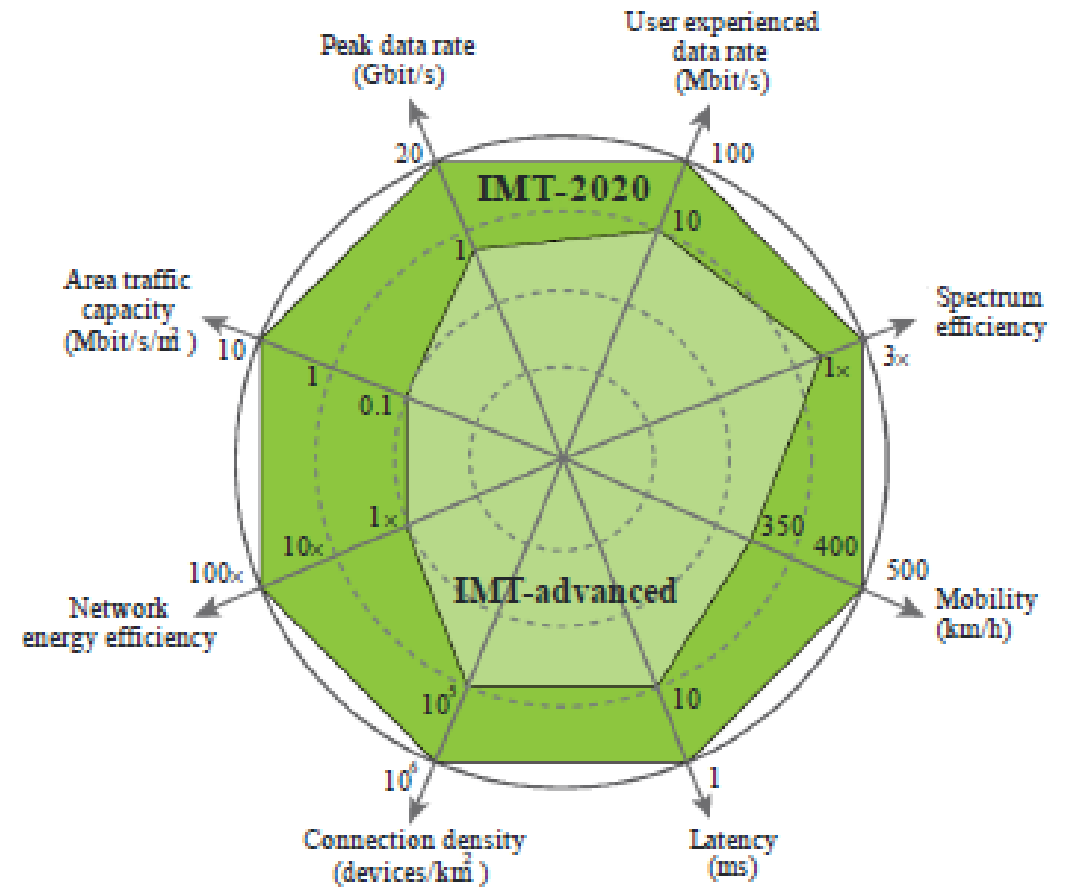
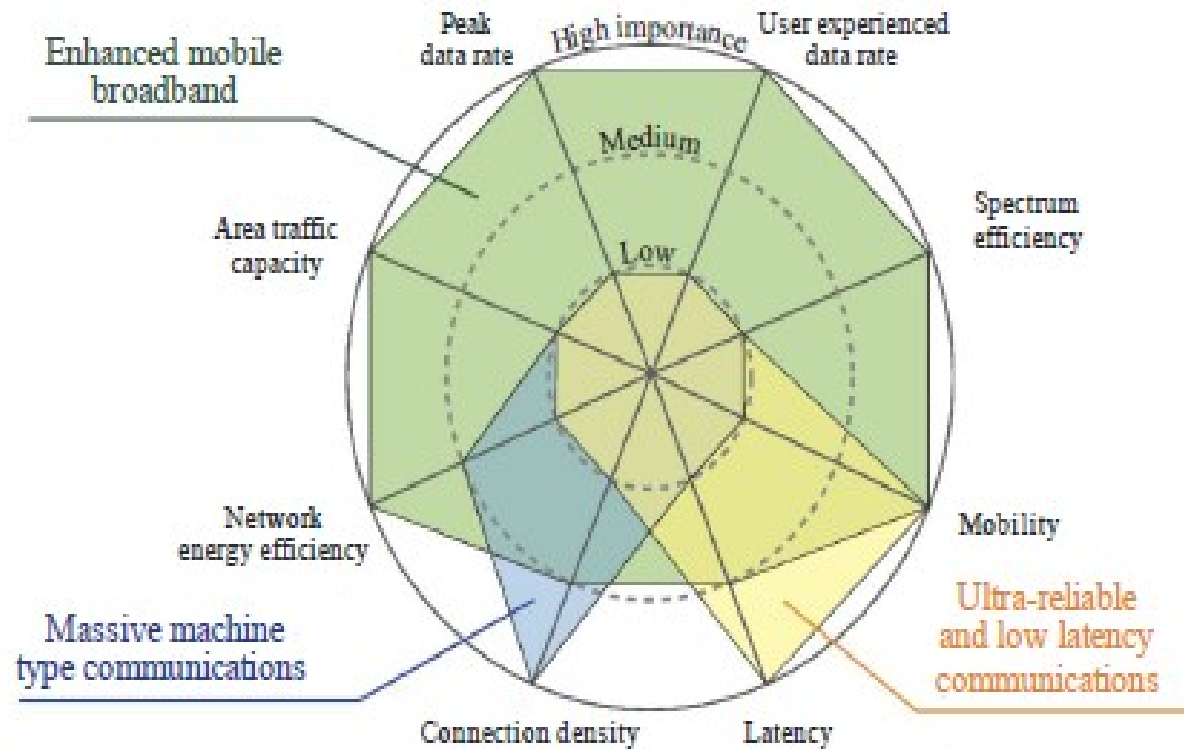
SDN/NFV



✓ NFV and SDN are expected to play fundamental roles in 5G, especially in terms of network topology and the realization of 5G targets

✓ Take advantage of Datacenter innovations and cloud computing

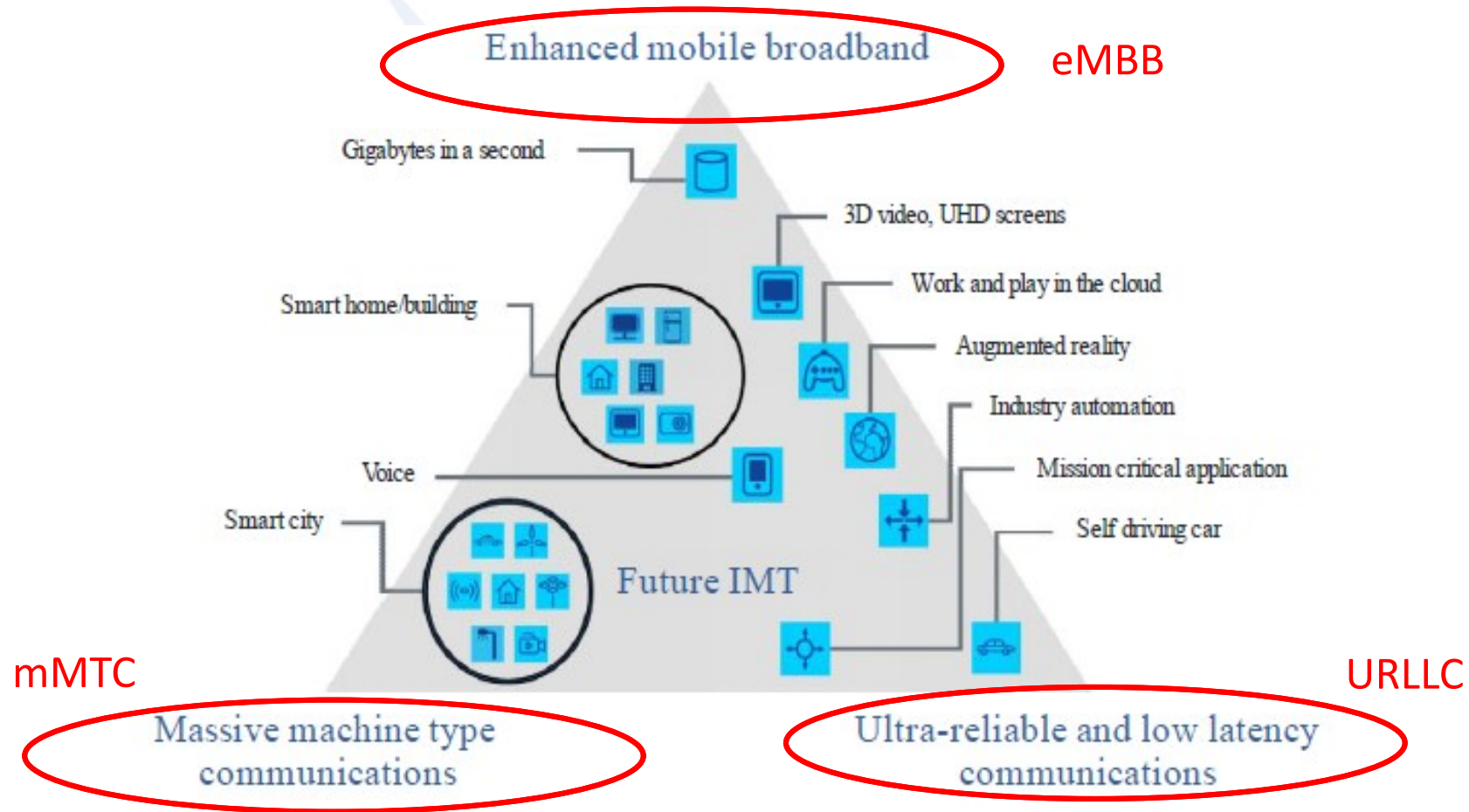
Key capabilities enhancements



Reference: Recommendation **ITU-R M.2083** IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond



Usage scenarios for IMT for 2020 and beyond



Reference: Recommendation **ITU-R M.2083** *IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond*





Requirements from the service point of view

Enhanced mobile broadband services

✓ UHD display, multi-view high-definition display, mobile three dimensional (3D) projections, immersive video conferencing, **AR (Augmented Reality)** and mixed reality display and interface

✓ This will lead to a demand for significantly higher data rates in the IMT-2020 network.

✓ IMT-2020 Network is required to support **diverse mobile fronthaul (MFH) and mobile backhaul (MBH)** technologies in order to cope with extreme traffic or connection density

✓ **Higher capacity in densely populated areas**



✓ **Enhanced connectivity – broadband access**



✓ **Higher user mobility**



Massive machine type communication

✓ As more and more devices get connected, many new services that benefit from the devices connected will appear (e.g., services for **smart grid, agriculture, healthcare, vehicle-to-vehicle and vehicle-to-road infrastructure**).

✓ The IMT-2020 network is required to support consistent **E2E QoS even in the presence of a large number of concurrent connections**

✓ Cooperative vehicles



✓ Pre-crash sensing and mitigation



✓ Smart Grid



✓ Smart cities



Ultra-reliable and low latency communication

✓ Services with high-reliability and real-time constraints are essential if they are to be supported on the IMT-2020 network.

✓ The IMT-2020 network is required to support increased service reliability according to service requirement

✓ The IMT-2020 network is required to provide enhanced service performance by reducing E2E latency according to service requirements.

✓ Augmented reality



✓ Autonomous driving



✓ Remote surgery



✓ Virtual reality





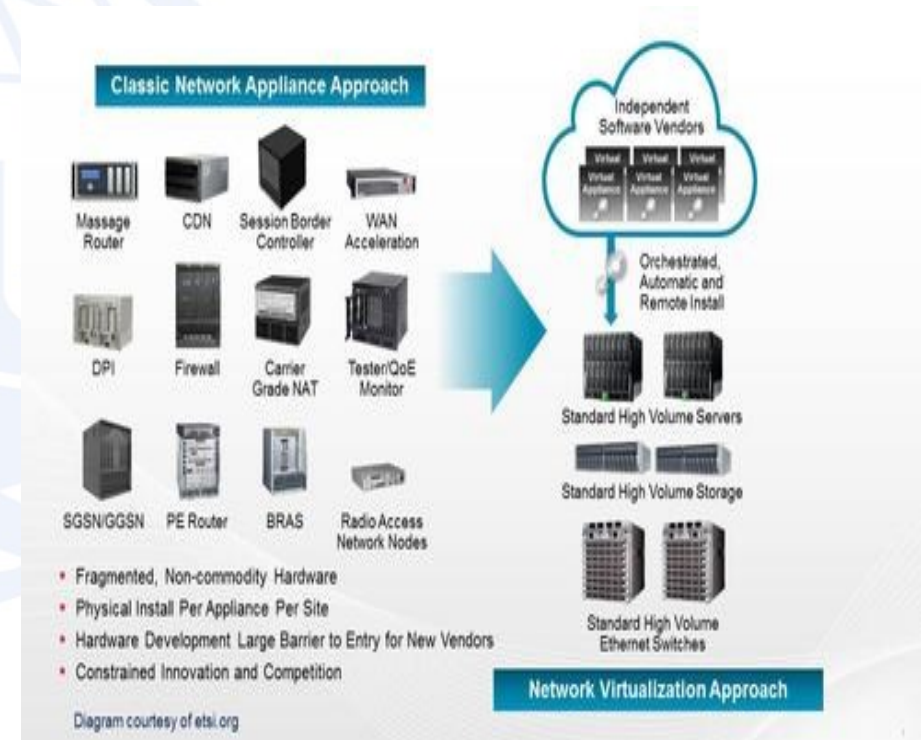
Requirements from the network operation point of view

Network Functions Virtualization (NFV)

Network Functions Virtualization (NFV) is about using standard IT virtualization technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage

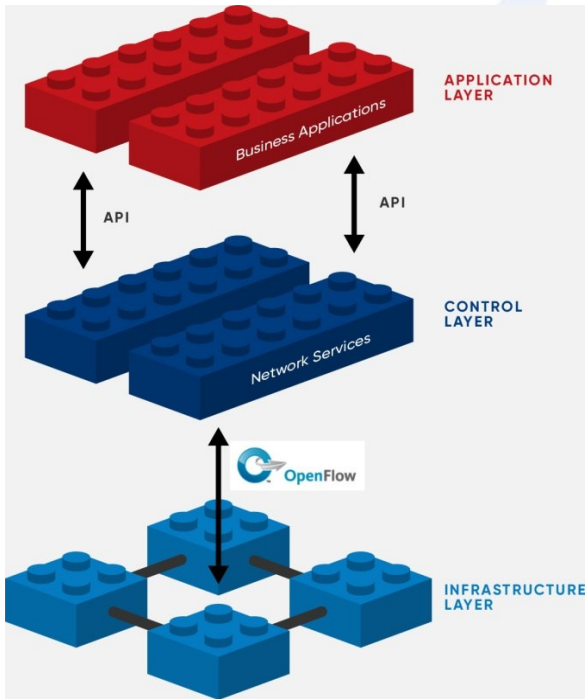
NFV benefits

- ✓ **Reduced operator CAPEX and OPEX** through reduced equipment costs and reduced power consumption
- ✓ **Reduced time-to-market** to deploy new network services
- ✓ **Improved return on investment** from new services
- ✓ **Greater flexibility to scale up**, scale down or evolve services
- ✓ **Openness to the virtual appliance** market and pure software entrants
- ✓ **Opportunities to trial** and deploy new innovative services at lower risk



Software Defined Networking (SDN)

SDN is a set of techniques that enables users to directly program, orchestrate, control and manage network resources, which facilitates the design, delivery and operation of network services in a dynamic and scalable manner



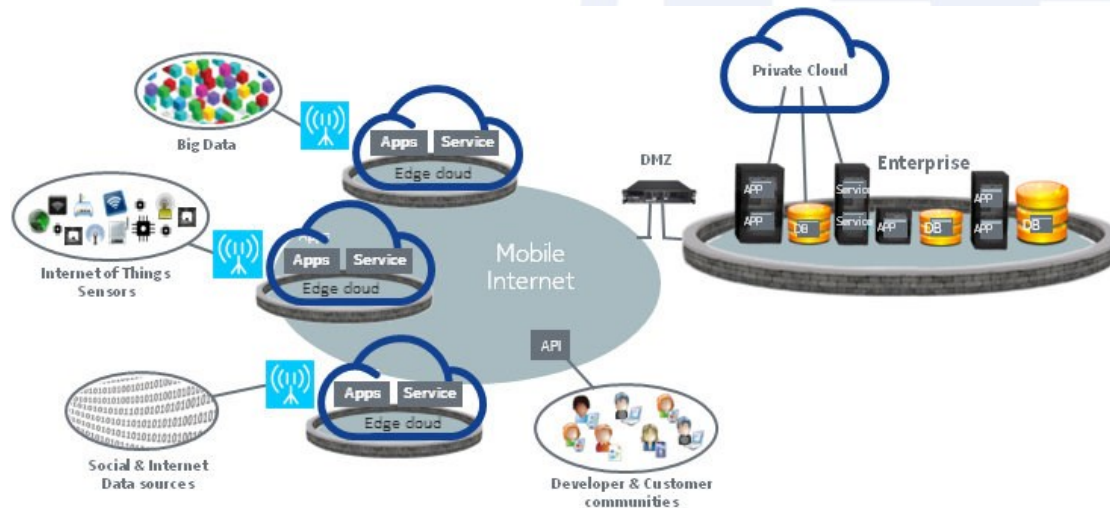
Source: Open Networking Foundation

SDN benefits

- ✓ Greater efficiency and flexibility.
- ✓ Enables the administrator to manage their entire network as a single unit
- ✓ Possibility of damaging the network due to human error is drastically reduced.

Edge Computing

5G is enabling a host of new applications, including augmented reality, virtual reality, IoT, autonomous vehicles and more. With these new applications, communications service providers (CSPs) worldwide have recognized the need for compute, storage and networking infrastructure to be placed close to the locations where these applications are consumed.



✓ Edge Computing benefits:

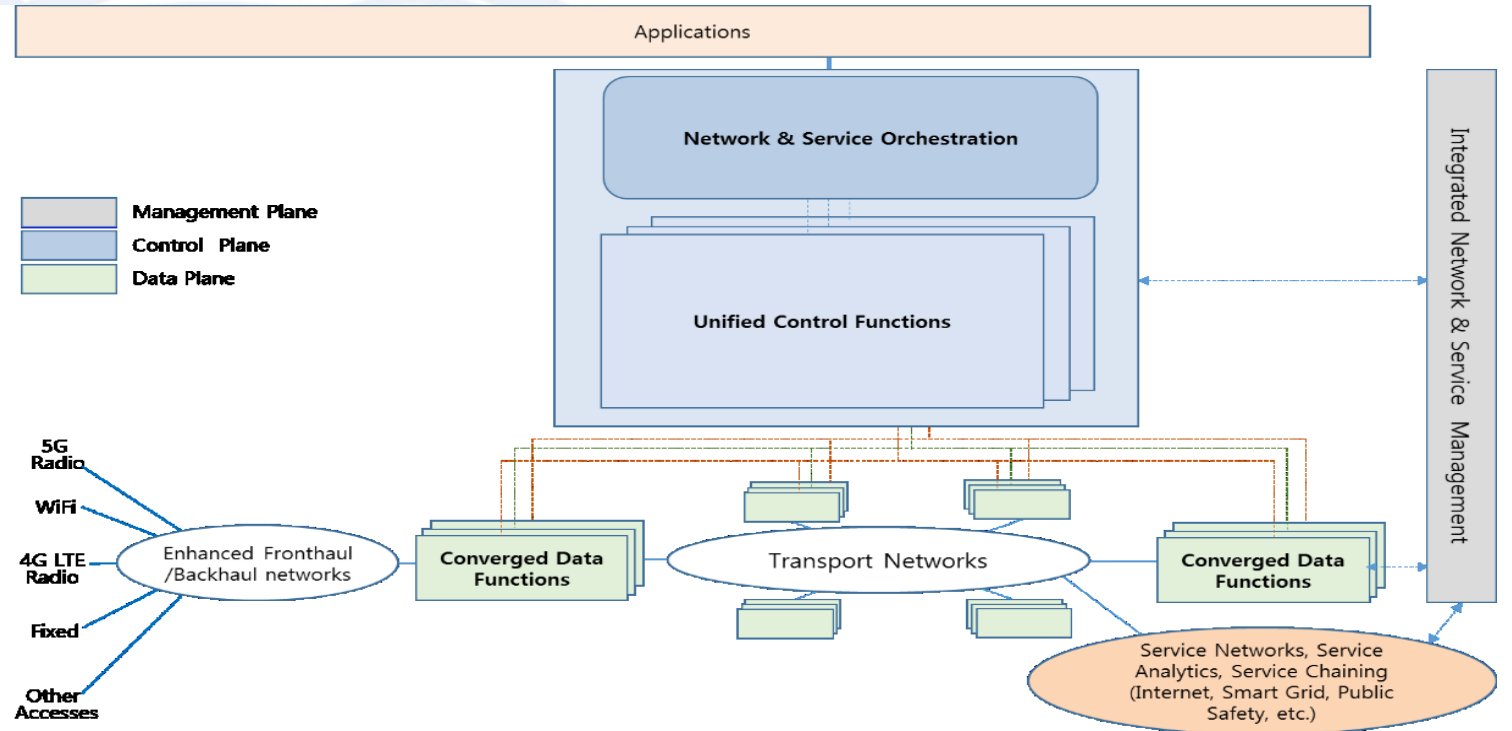
- ✓ (Ultra-)low latency: disruptive improvement of customer experience
- ✓ Reduction of backhaul/core network traffic: cloud services (e.g., big data) near to user
- ✓ **Data reduction: By running applications such as data analytics at the edge, operators and application vendors can substantially cut down the amount of data that has to be sent upstream**

High-level IMT-2020 network architecture

✓ An IMT-2020 network differentiates itself from legacy IMT networks by further evolution and revolution as well in **radio network, front/back-haul networks, and core networks.**

✓ **The control plane functions,** which are responsible for **mobility management, QoS control, etc.,** controls the user traffic to be served agnostically to the access networks to which it is attached.

✓ Multiple various access points are connected to a **converged data plane functions** via an integrated access network so that mobile devices can be serviced through an access technology-agnostic network core

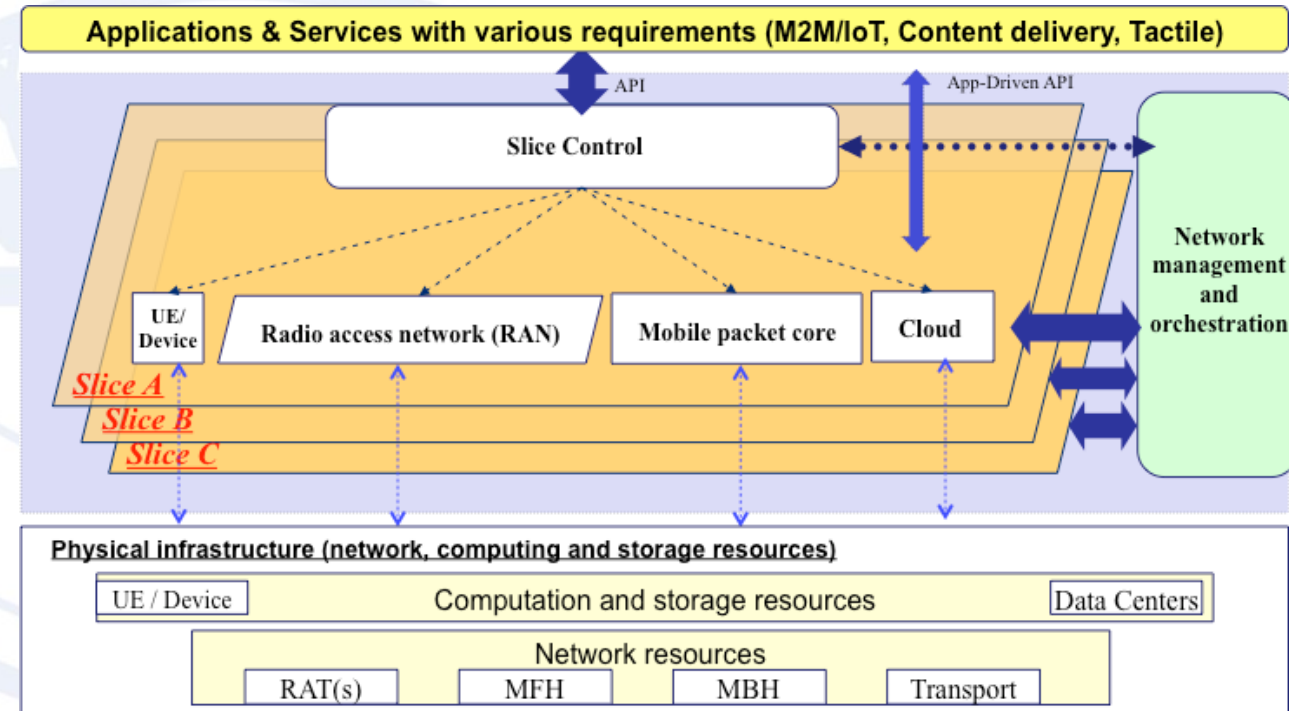


A distributed functional architecture

Network Softwarisation in IMT-2020 Networks

✓ Network softwarization is an overall transformation trend for **designing, implementing, deploying, managing and maintaining network equipment and network components** by software programming,

✓ Includes **Software Defined Networking (SDN)** and **Network Functions Virtualization(NFV)**, **Network Virtualization, Mobile Edge Computing, Cloud** and **IoT** technologies.



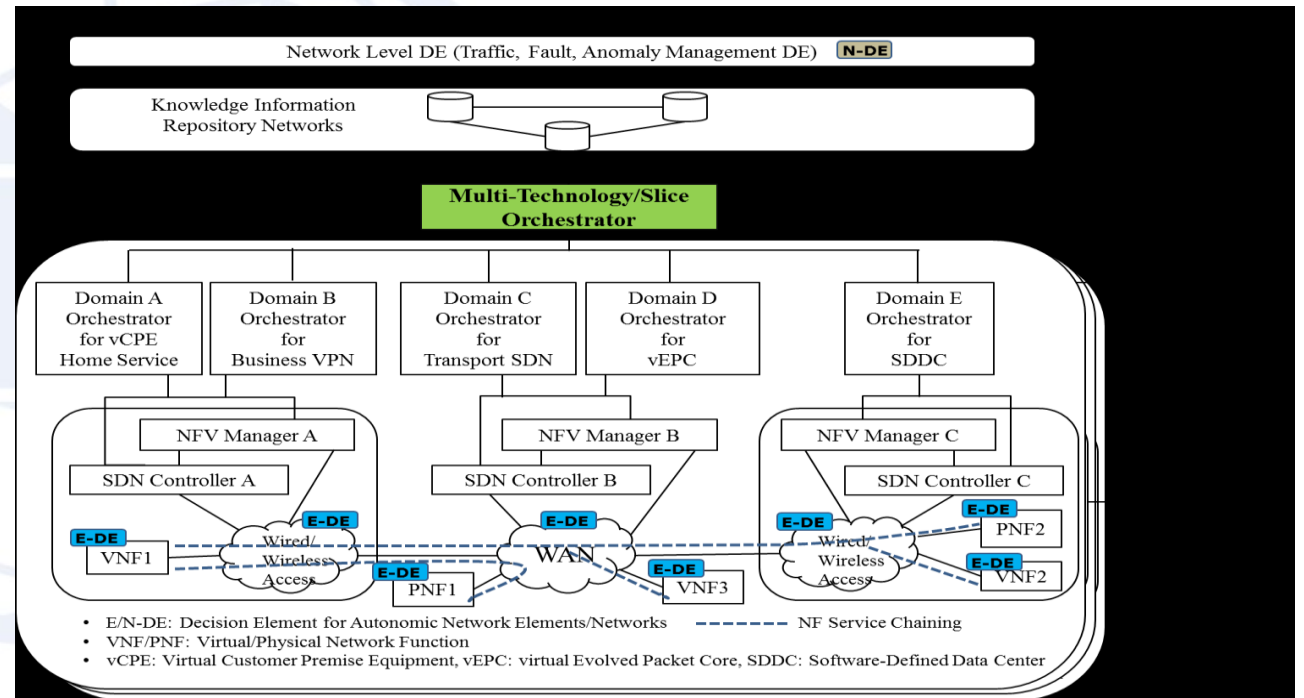
The slice A consists of radio access network (RAN), mobile packet core, UE(User Equipment)/device and cloud, each of which are collection of virtual or physical network functions

Integrated network management and orchestration for the IMT-2020

✓ Within a single slice, there can be **multiple domains of VNFs** ranging from mobile access, core, and SDDC

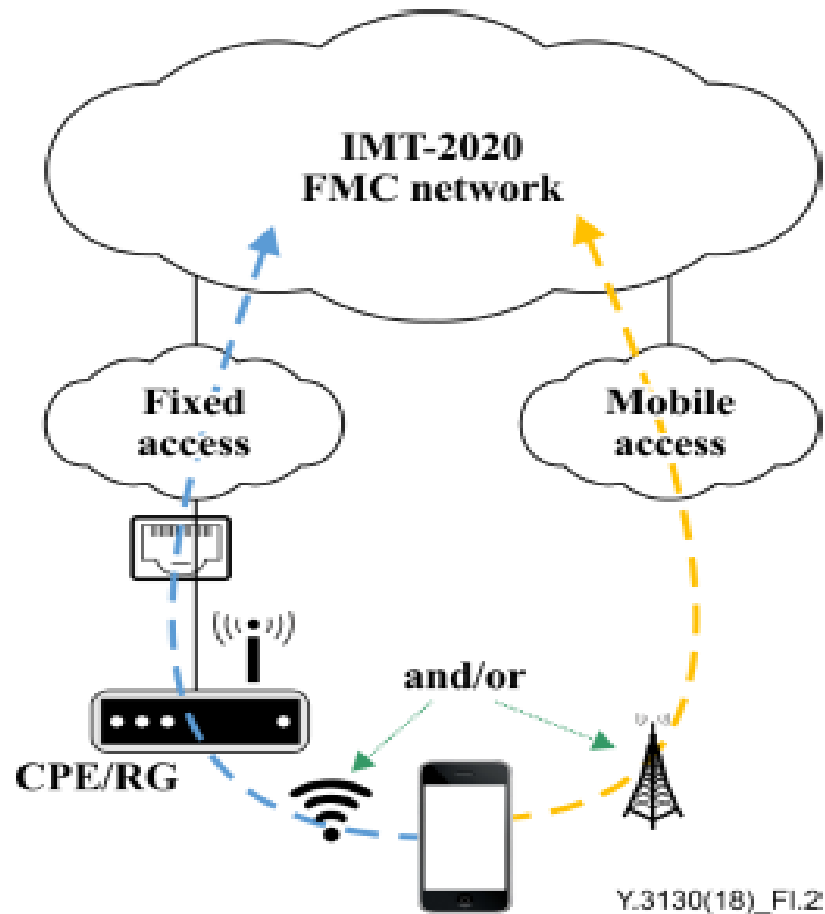
✓ Each domain can have one or **more domain specific orchestrators**.

✓ some domain such as mobile core can have **multi-layer** (e.g., packet, PTN, OTN layers) **networks** and **multi-layer orchestrator** is required.



Multi-domain/layer/technology/slice Orchestration
High-level Architecture

5G/IMT2020 Fixed mobile convergence (FMC)



Objectives of FMC in IMT-2020 network:

Service objective

- ✓ *Unified user identity*
- ✓ *Unified charging*
- ✓ *Service continuity and guaranteed quality of service support*

Network evolution objective

- ✓ *Control plane convergence*
- ✓ *Authentication and authorization*
- ✓ *QoS control*
- ✓ *Charging*
- ✓ *Session management*
- ✓ *Mobility management*
- ✓ *User data management*
- ✓ *Cloud based infrastructure*
- ✓ *Security considerations*

Source: A Scenario of a mobile broadband service via fixed and (or) mobile accesses [ITU-T Y.3130]

Big-Data-driven Networking (bDDN)

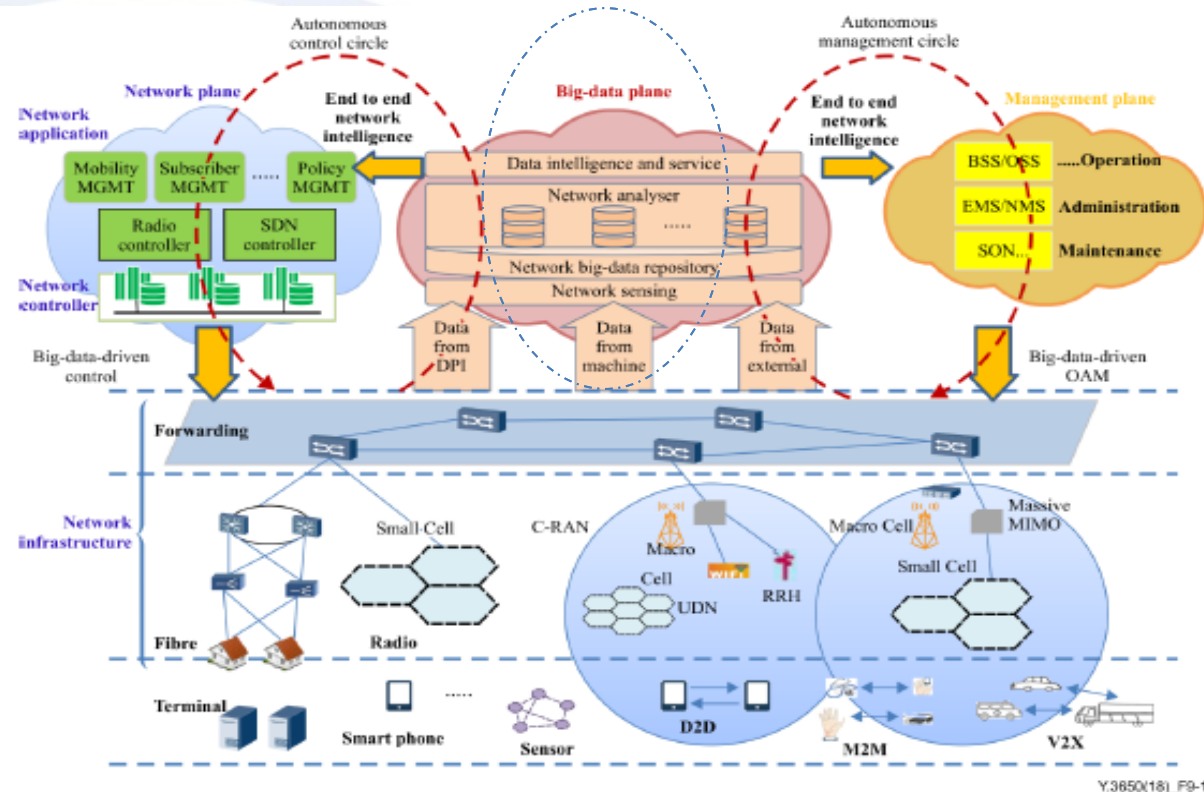
big data
[ITU-T Y.3600]:

A paradigm for enabling the **collection, storage, management, analysis and visualization**, potentially under real-time constraints, of **extensive datasets with heterogeneous characteristics**.



big-data-driven networking (bDDN)
[ITU-T Y.3650]

Big-data-driven networking (bDDN) is a type of future network framework that **collects big data from networks and applications, and generates big data intelligence** to facilitate **smarter and autonomous network management, operation, control, optimization and security, etc**



Source: The model architecture of big-data-driven networking [ITU-T Y.3650]

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Thank you for attention