UNIVERSITÀ DELLA CALABRIA

Master Degree in Telecommunications Engineering

"Mobile Radio Networks" Class

5G: Core Network & Slicing

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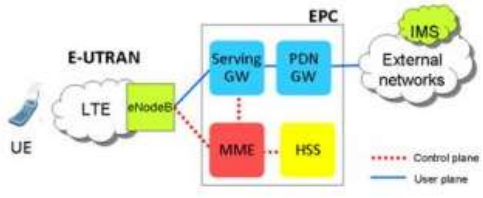
5G service based architecture

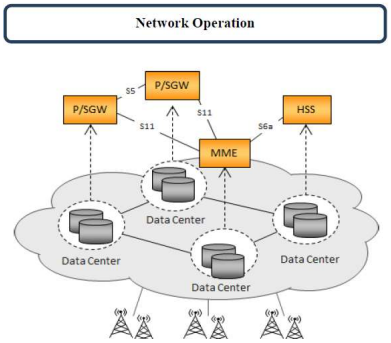
- A flexible and agile deployment & management of Network Slices (which we will see later) derives from the fact that the 5G network infrastructure will exploit technologies such as NFV (Network Function Virtualization) and SDN (Software Defined Networking) and that Virtualized Networks Functions (VNF) will be distributed in the Data Center of the Telecom Operators.
- This leads to **another way to represent the 5GC** architecture: alongside a traditional representation, with point-to-point interfaces between network elements, a new one called **SBA (Service Based Architecture).**
- it is good to specify that these are two representations of the same architecture, not two different architectures.
  - compared to previous generations, 5G network functions are natively designed with reference to IT technologies
  - where possible and advantageous, each element of the 5G network offers its functionality to other network elements in the form of micro-services;
  - signaling flows are carried out by a sequence of services (service chain) exchanged between the elements of the network.

NFV (NTW Function Virtualization): use case #5

Virtualization of a Mobile Core Network (and IMS)



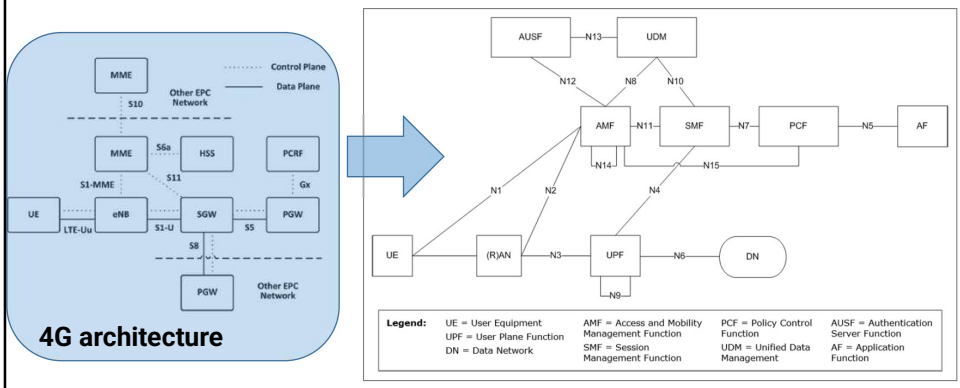
EPS architecture



Virtualized EPC

Network Functions Virtualization (NFV); Use cases. ETSI GS NFV 001, v1.1.1 (2013-10)

The 5G Architecture in reference point representation



- 3GPP TR 23.799 V14.0.0 (2016-12), 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on Architecture for Next Generation System (Release 14).
- 3GPP TR 38.801 V2.0.0 (2017-3), 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on New Radio Access Technology; Radio Access Architecture and Interfaces (Release 14).
- 3GPP TR 23.501 V0.3.1 (2017-03), 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; System Architecture for the 5G System; Stage 2 (Release 15).
- http://www.telecomitalia.com/tit/it/notiziariotecnico/edizioni-2017/n-1-2017/capitolo-6.html

The 5G Core Architecture Model

- The 5G System architecture is defined to support data connectivity and services enabling deployments to exploit state-of-the-art NFV and SDN technologies.
- **The 5G architecture is defined as (micro-)service-based**.
- Network functions within the 5G Core Network Control Plane shall only use service-based interfaces for their interactions.

The 5G Core Architecture Model

- Some key principles and concepts at the foundations of the **5G Service-based Architecture (SBA)** are to:
  - Separate the User Plane (UP) functions from the Control Plane (CP) functions, allowing independent scalability, evolution and flexible deployments
    - e.g. centralized location or distributed (remote) location.
  - Modularize the function design, e.g. to enable flexible and efficient network slicing.
  - Wherever applicable, define procedures (i.e. the set of interactions between network functions) as services, so that their re-use is possible.
  - Enable each Network Function to interact with other NF directly if required.

The 5G Core Architecture Model

- Minimize dependencies between the Access Network (AN) and the Core Network (CN).
- Support a **unified authentication** framework.
- Support **cloud-native "stateless" NFs**, where the "compute" resource is decoupled from the "storage" resource.
- Support **capability exposure**.
- Support concurrent access to local and centralized services.
  - To support low latency services and access to local data networks, UP functions can be deployed close to the Access Network.

The 5G Common API Framework (CAPIF)

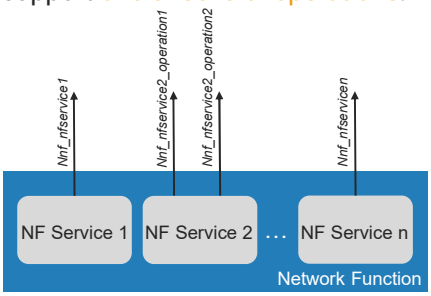
- 3GPP took the forward-looking decision to use **RESTful APIs**, widely used in cloud computing environments.
- All the 5G Core Network internal communications are based on functional exposure (see 3GPP TS 29.50).
- RESTful APIs:
  - Exploit HTTP and its methods (GET, PUT, POST, DELETE) to push/pull/delete data elements.
  - Data elements are usually encoded in JSON, YAML, XML markup languages.
  - It is a stateless approach, perfectly suiting the cloud-native environment.

Network Function Services

- An NF service is meant to offer a capability to authorised consumer NFs.
- Network Functions might expose multiple different NF services to distinct consumers.
- Each of the NF services offered by a Network Function shall be self-contained, reusable.
  - Even if there can be dependencies between services within the same Network Function due to sharing some common resources (e.g. context data), such services are managed independently of each other.

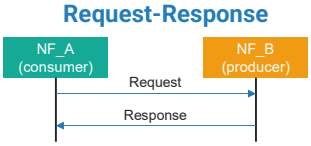
Network Function Services

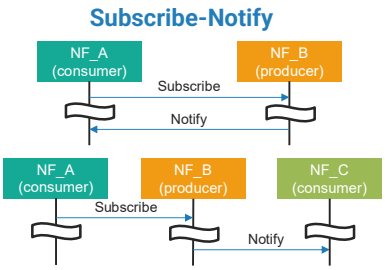
- Each NF service shall be accessible by means of a RESTful interface.
- An interface may support one or several operations.



Network Function Service Framework

- The interaction between two Network Functions (Consumer and Producer) within this NF service framework follows two mechanisms:





Network Function Service Framework

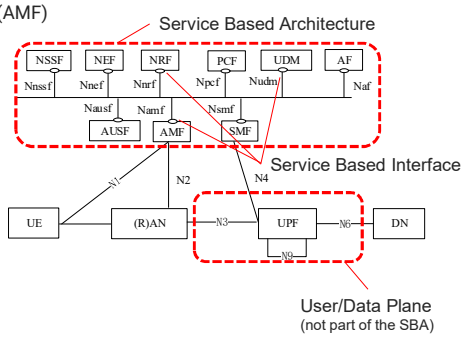
- A 5G Core Network (CN) NF can expose its capabilities as services via its service-based interface.
- The NF service discovery enables a CN NFs to discover NF instance(s) that provide the expected NF service(s).
- The NF service discovery is implemented via the NF discovery functionality.

Network Function Service Authorization

- NF service authorization ensures the NF Service Consumer is authorized to access the NF service provided by the NF Service Provider.
- Service authorization information is configured as one of the components in NF profile of the NF Service Producer.
  - It includes the NF type and NF realms/origins allowed to consume the producer's Service(s).
- Due to roaming agreements and operator policies, a consumer can be authorised based on UE/subscriber/roaming information and NF type.
- The Service authorization entails two steps:
  - Check whether the Service Consumer is permitted to discover the requested Service Producer instance.
  - Check whether the Service Consumer is permitted to access the requested Service Producer with a request type granularity.

The 5G Service-based Architecture

- The 5G Service-Based Architecture consists of the following network functions (NF).
  - Authentication Server Function (AUSF)
  - Access and Mobility Management Function (AMF)
  - Unstructured Data Storage Function (UDSF)
  - Network Exposure Function (NEF)
  - Network Repository Function (NRF)
  - Network Slice Selection Function (NSSF)
  - Policy Control Function (PCF)
  - Session Management Function (SMF)
  - Unified Data Management (UDM)
  - Unified Data Repository (UDR)
  - Application Function (AF)
  - 5G-Equipment Identity Register (5G-EIR)
  - Security Edge Protection Proxy (SEPP)
  - Network Data Analytics Function (NWDAF)



The 5G Service-based Architecture

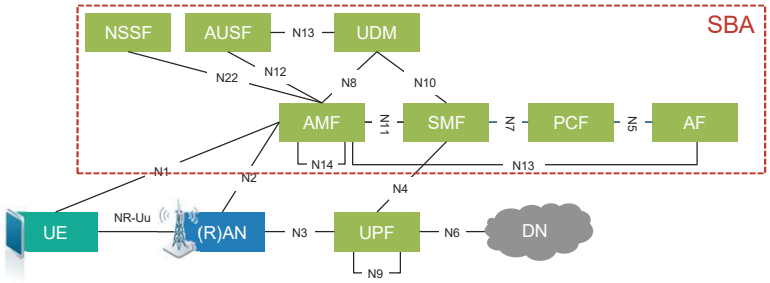
- 2-4G:
  - Functional entities (e.g., MME, HSS, PCRF, etc.)
  - Single Core
  - Dedicated Protocols

VS

- 5G
  - Service Based
  - Virtualization and Slicing
  - Softwarization
  - Application Programming Interfaces
  - Harmonized Protocols (HTTP/RESTfull)
  - Exposure to 3rd parties
  - Backward and Forward Compatibility

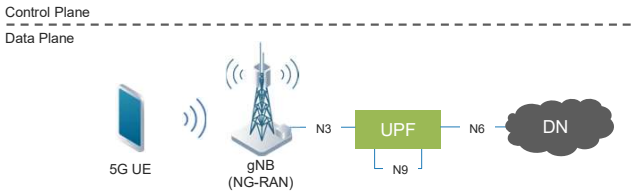
SBA Referece Point Representation

- Reference point representation allows to explicitly report the main «producer-consumer» interactions among 5G NFs.



5G NF Operations

5G NF Operations



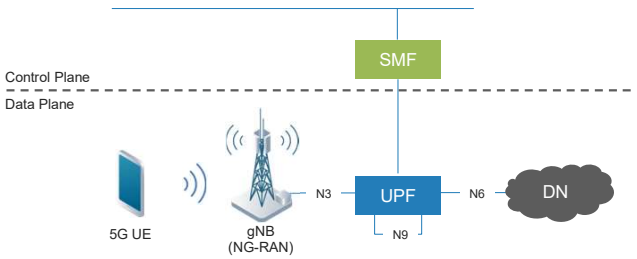
The User plane function (UPF)

- UPF provides **user-plane functionalities** similar to the ones of S/P-GW in 4G but exposed in a more flexible and programmable fashion.
- The **UPF includes the following functionality**.
  - Anchor point for mobility (when applicable).
  - External PDU Session point of interconnect to Data Network.
  - Packet routing & forwarding (e.g. support of Uplink classifier to route traffic flows to an instance of a data network, support of Branching point to support multi-homed PDU Session, etc.).
  - Packet inspection (e.g. Application detection based on service data flow template and the optional PFDs received from the SMF in addition).
  - User Plane part of policy rule enforcement, e.g. traffic gating, redirection, flow steering).
  - Downlink packet buffering and downlink data notification triggering.
  - Support for IPv4, IPv6, non-IP, and Ethernet PDU types

The User plane function (UPF)

- The **separation between *SMF (Session Management Function)* and *UPF (User Plane Function)*** allows the Operator to deploy the UPF in the most effective way, according to the type of services they are assigned to convey;
  - for example, for services where very low latency is required, the UPF and service platforms will be deployed as close as possible to the devices to be controlled.

5G NF Operations



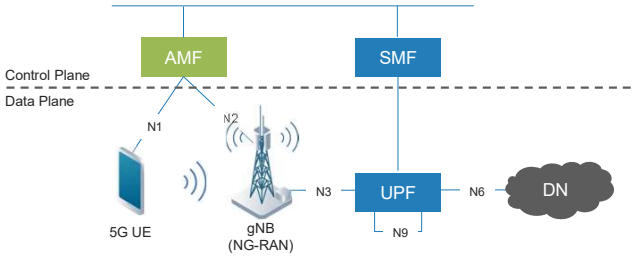
Session Management Function (SMF)

- Multiple SMFs (one per each slice) can be associated to the same UE.
- The SMF includes the following functionality:
  - Session Management e.g. Session Establishment, modify and release, including tunnel maintain between UPF and AN node.
  - UE IP address allocation & management (including authorization):
    - e.g., DHCPv4 and DHCPv6 functions for IP PDUs.
    - ARP proxying and / or IPv6 Neighbour Solicitation Proxying for the Ethernet PDUs.
  - Configures traffic steering at UPF to route traffic to proper destination (e.g., an attached Data Network or other UPF instances).

Session Management Function (SMF)

  - Support for interaction with external DN for transport of signalling for PDU Session authorization/authentication by external DN.
  - Termination of interfaces towards Policy control functions to handle local enforcement to apply QoS SLAs at UPFs.
  - Lawful intercept.
  - Control and coordination of charging data collection at UPF.
  - Termination of SM parts of NAS messages.
  - Initiator of AN specific SM information.
- In addition to the functionalities of the SMF described above, the SMF may include policy related functionalities.

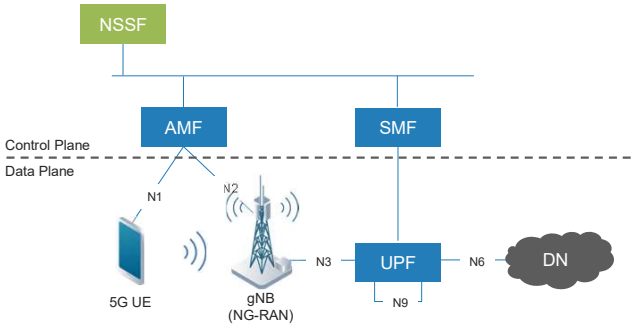
5G NF Operations



Access and Mobility Management Function (AMF)

- The Core ***AMF (Access and Mobility Management Function)*** constitutes the access point to 5GC for signaling to and from the terminal similarly to the MME of 4G networks.
- A first element of novelty in the new network architecture is the separation of mobility control from user data session control
  - unlike MME, AMF only manages the registration and mobility of the terminal,
  - the signaling relating to the creation and management of user data sessions is forwarded transparently to the ***SMF (Session Management Function).***
- This modularization of the functions allows to increase the flexibility with which they can be composed to create service chains and plays an important role in one of the distinctive characteristics of 5G networks, that is the Network Slicing which will be discussed later.

5G NF Operations

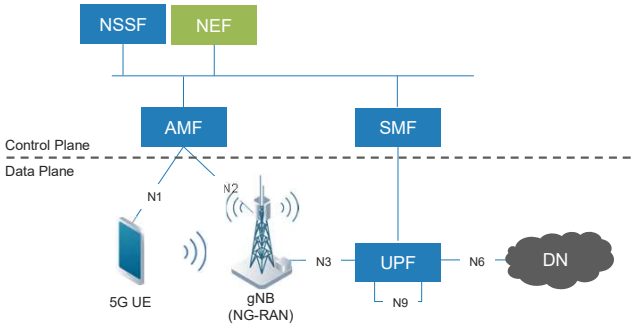


Network Slice Selection Function (NSSF)

- The NSSF supports the following functionality:
  - Selecting the set of Network Slice instances serving the UE.
  - Determining the Configured NSSAI and, if needed, the mapping to the Subscribed S-NSSAIs,
  - Determining the Allowed NSSAI and, if needed, the mapping to the Subscribed S-NSSAIs,
  - Determining the AMF Set to be used to serve the UE, or a list of candidate AMF(s), possibly by querying the NRF.

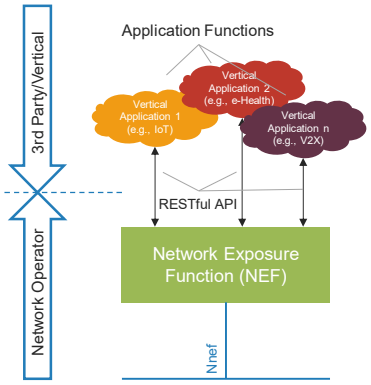
- NSSAI - Network Slice Selection Assistance Information
- S-NSSAI Single – NSSAI Used in support of Network Slicing, to uniquely identify a Network Slice.
- **5G** Network Repository Function (**NRF**)

5G NF Operations



Network Exposure Function (NEF)

- Capability exposure is one of the key innovation aspect of the 5G specification.
- **Capability exposure consists of making 5G Core Network functionalities available to 3rd parties such as service providers and vertical industries outside the operator's domain.**
- This capability is offered by the Network Exposure Function (NEF).
- 3GPP decided that 5G service exposure by the NEF should be based on RESTful APIs.



Network Exposure Function (NEF)

- The Network Exposure Function (NEF) uses the 5G Common API Framework (CAPIF) as northbound interface.
- The NEF supports the following independent functionality:
  - Exposure of capabilities and events **to** Application Functions:
    - 3GPP NFs expose capabilities and events to other non-3GPP NFs via NEF.
    - NF capabilities and events are securely exposed for e.g. 3rd party, Application Functions, Edge Computing.
    - NEF stores/retrieves information as structured data using a standardized interface (Nudr) to the Unified Data Repository (UDR).
  - Secure provision of information **from** Application Functions to 3GPP network:
    - It provides a means for the Application Functions to securely provide information to 3GPP network, e.g. Expected UE Behaviour.
    - In that case the NEF may authenticate and authorize and assist in throttling the Application Functions.

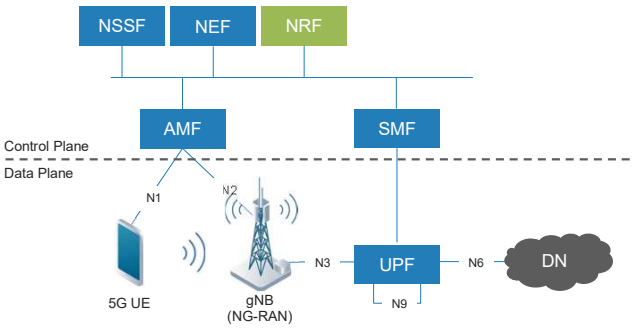
Network Exposure Function (NEF)

- External exposure can be categorized as:
  - Monitoring capability: for monitoring of specific event for UE in 5G system and making such monitoring events information available for external exposure via the NEF (UE's mobility management context such as UE location, reachability, roaming status, and loss of connectivity).
  - Provisioning capability: is for allowing external party to provide information which can be used for the UE in 5G system (for the mobility mngmt of the UE, Mobility Pattern can be provisioned; for the session mngt of the UE, communication pattern can be provisioned such as periodic communication time, communication duration time, and scheduled communication time).
  - Policy/Charging capability: for handling QoS and charging policy for the UE based on the request from external party.

Network Exposure Function (NEF)

- **Translation** of internal-external information: It translates between information exchanged with the Application Functions and information exchanged with the 5GC NFs.
  - Masking of network and user sensitive information to external Application Functions according to the network policy.
  - In detail, NEF:
    - receives information from other network functions (based on exposed capabilities of other network functions).
    - stores the received information as structured data using a standardized interface to a Unified Data Repository (UDR).
    - re-exposes stored data to other network functions and Application Functions and used for other purposes such as analytics.

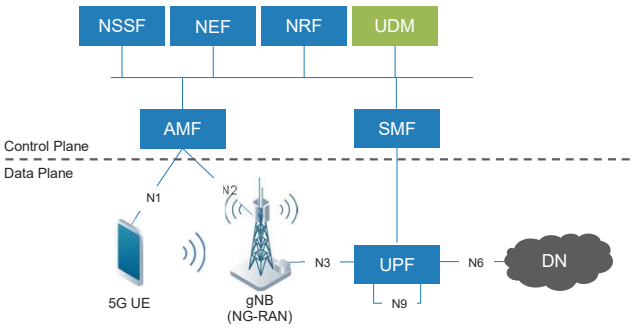
5G NF Operations



Network Repository Function (NRF)

- The Network Repository Function (NRF) supports the following functionality:
  - **Supporting service discovery function:** Receive NF Discovery Request from NF instance and provides the information of the discovered NF instances (be discovered) to the NF instance.
  - **Maintaining the NF profile** of available NF instances and their supported services.
    NF profile of NF instance maintained in an NRF includes the following information:
    - NF instance ID, NF type, PLMN ID, Network Slice related Identifier(s), FQDN or IP address of NF, NF capacity information, NF Specific Service authorization information, Names of supported services, Endpoint Address(es) of instance(s) of each supported service, identification of stored data/information, other service parameter, etc.

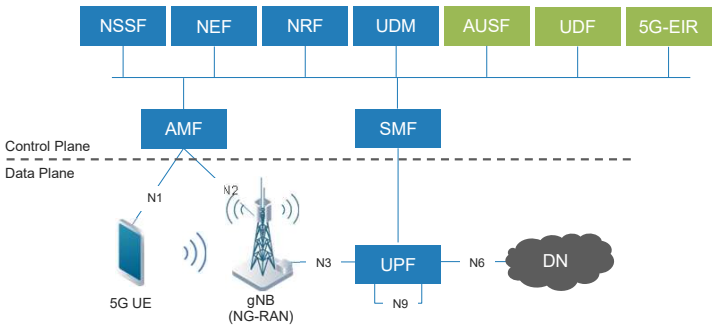
5G NF Operations



Unified Data Management (UDM)

- The Unified Data Management has a similar but extended role with respect to the 4G HSS.
- The UDM supports following functionalities:
  - Generation of 3GPP AKA Authentication Credentials.
  - User Identification Handling.
  - Support of de-concealment of privacy-protected subscription identifier (SUCI).
  - Access authorization based on subscription data (e.g. roaming restrictions).
  - UE's Serving NF Registration Management (e.g. storing serving AMF for UE, etc.).
  - Support to service/session continuity.
  - MT-SMS delivery support.
  - Lawful Intercept Functionality.
  - Subscription management.
  - SMS management.

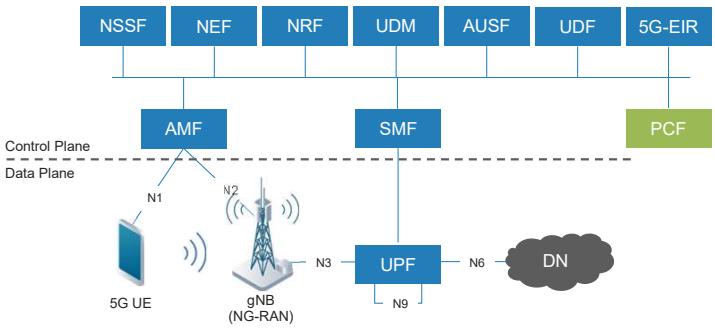
5G NF Operations



Other NF

- The **Authentication Server Function (AUSF)** supports the authentication for 3GPP access and untrusted non-3GPP access.
- The **Unstructured Data Storage Function (UDF)** is an optional function that supports the storage and retrieval of information as unstructured data by any NF.
- The **5G Equipment Identity Register (5G-EIR)** is an optional network function that supports the status check of the Permanent Equipment Identifier (PEI – e.g. to check that it has not been blacklisted).

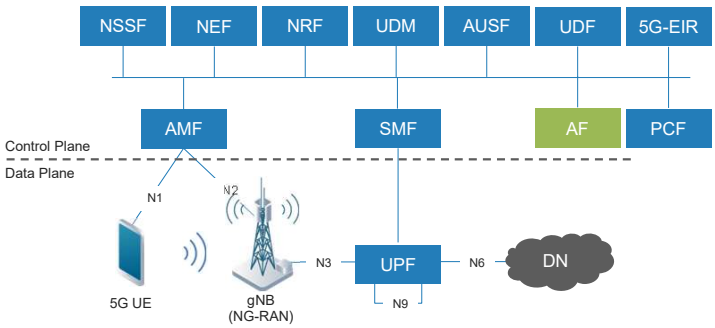
5G NF Operations



Policy Control Function (PCF)

- The Policy Control Function (PCF) includes the following functionality:
  - Supports **unified policy framework to govern network behaviour**.
  - Provides policy rules to Control Plane function(s) to enforce them.
  - Accesses subscription information relevant for policy decisions in a Unified Data Repository (UDR).

5G NF Operations



Application Function (AF)

- Application Function(s) can be internal or external to the 5GS Providers.
- External AF(s) are meant to adopt CAPIF to connectect with NEF.
- representing any additional CP function which might be required by specific Network Slices, potentially provided by 3rd parties

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5G definition

"5G systems are conceived as **highly flexible and programmable end-to-end (RAN + CN) communication**, networking, and computing infrastructures that provide increased performance in terms of throughput, latency, reliability, capacity, and mobility **while meeting diversified requirements from multiple services**."

5G network slicing

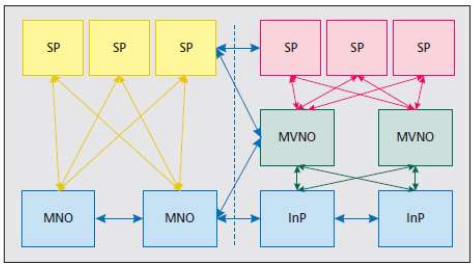
Early network sharing scenarios

The challenge for mobile operators is to accommodate high traffic volumes without increasing operational and infrastructure costs.

The trend toward network densification for increasing network capacity and the practice of overprovisioning adds further burden into the operational complexity and cost, diminishing the Return of Investment (RoI).

Mobile operators can share network infrastructures accelerating network roll-outs and offer services to customers with reduced costs.

Mobile network virtualization: business models



MNO: mobile network operator

InP: infrastructure provider

MVNO: mobile virtual network operator

SP: service provider

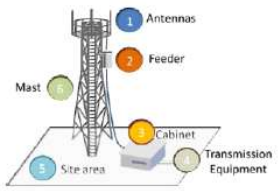
OTT: over-the-top service provider

- **MNO** owns and operates the physical network
- **MVNO** lacks network infrastructure and leases the network resources from InP, creates virtual resources based on requests from SPs and operates/assigns them to the SPs
- **SPs** lease, operate and program virtual resources to offer e2e services to mobile users
- **OTT** operates on top of a network infrastructure belonging to an MNO based on a set of pre-defined SLAs
- **Vertical industries** may exploit an MNO network infrastructure for services complementary to the telecommunication industry.

Wireless Virtualization for Next Generation Mobile Cellular Networks, IEEE Wireless Communications 2015

Early network sharing scenarios

- Passive infrastructures can be shared among multiple operators
- Passive sharing is defined as the sharing of site locations or physical supporting infrastructure of radio equipment, such as masts.
  - Site sharing allows mobile operators to share space and optionally share certain support equipment such as shelters or power supply, but with separate installations of masts, antennas, cabinets and backhaul equipment.
  - In mast sharing, mobile operators can co-locate their sites and even share the antenna frame, but still install their own radio equipment, maintaining separate coverage.

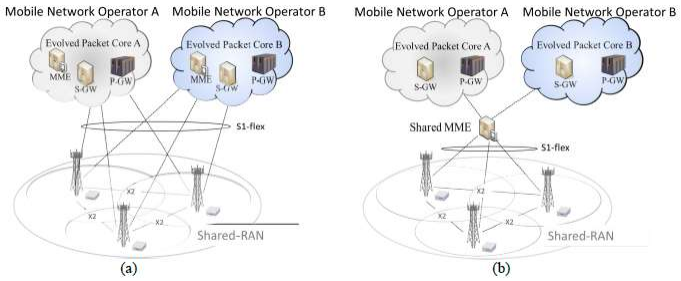


From Network Sharing to Multi-Tenancy: The 5G Network Slice Broker, IEEE Comm. Mag. July 2016

Early network sharing scenarios

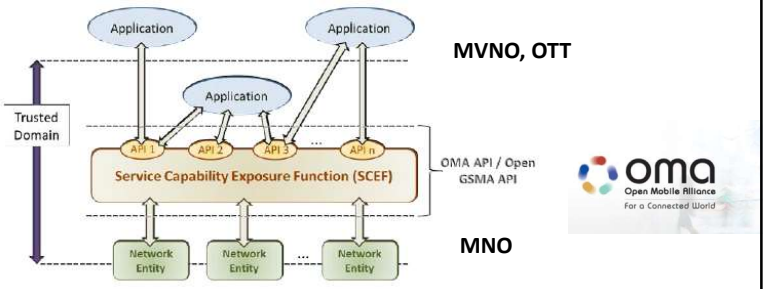
Active RAN sharing allows the sharing of network elements of the whole mobile network

- In active RAN sharing, MNOs can pool spectrum resources, which are shared alongside other RAN equipment based on fixed, contractual agreements.
- The interest in sharing the resources dynamically introduced new requirements, beyond the original RAN sharing concepts, where MNOs share core transmission equipment, billing platforms and core network equipment.



From Network Sharing to Multi-Tenancy: The 5G Network Slice Broker, IEEE Comm. Mag. July 2016

Service Capability Exposure Function



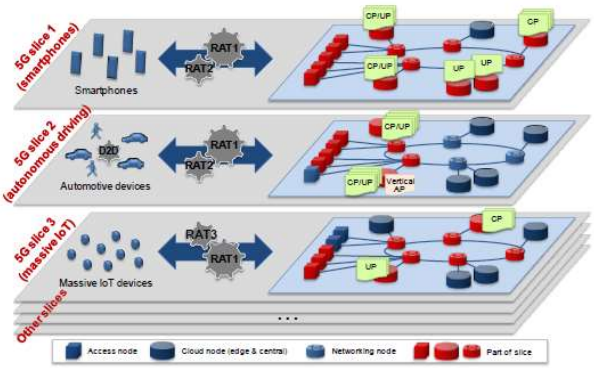
- Vertical industries and OTT providers, which do not own a network infrastructure, need to interact with MNO to request network resources and to negotiate SLAs. This is achieved by **allowing exposure of the service capabilities to third parties**.
- The 3GPP **SCEF** is the *key entity within the 3GPP architecture for service capability exposure that provides a means to securely expose the services and capabilities provided by 3GPP network interfaces (ref. Release 13, 3GPP)* via proper APIs.
- It acts as a **mediator between the third party and the 3GPP MNO infrastructure**.

From Network Sharing to Multi-Tenancy: The 5G Network Slice Broker, IEEE Comm. Mag. July 2016

Network slicing

- Cloudification and virtualization affect not only the edge but the entire mobile network
- To support 5G deployment, the underlying network procedures (i.e., network functions) need to be virtualized and deployed in cloud-based environments
  - a more optimized usage of the infrastructure resources
  - dynamical and flexible adaptation to the traffic demands of different vertical scenarios.
- Network slicing logically isolates network functions (NFs) and resources that are specifically tailored to a vertical market's need on a single common network infrastructure

Network slicing



- A slice potentially spans all 5G network domains across CN and RAN segments.
- **Isolation**: communication in one slice should not negatively affect services in other slices

5G network slices **implemented on the same infrastructure**

UP: user plane
CP: control plane

NGMN 5G White Paper, February 2015

Network slicing definitions (1)

"Network slice: a slice can be defined as a **composition** of adequately configured **network functions** (NF), **network applications** (NA), specific **RAT settings** and **underlying cloud infrastructuctures** that are bundled together to **meet the requirements of a specific use case** or business model"

Concept introduced by NGMN and adopted by the main Telco manufacturers.

"Network slicing allows the creation of a **dedicated network with its own processing, management and connectivity characteristics that shares the same physical resources with other network slices**."

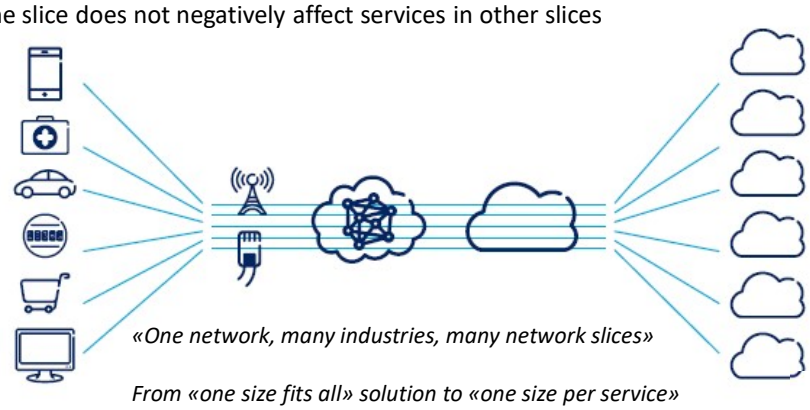
It is discussed in 3GPP (specifications by 2019) :

- 3GPP TR **23.799**, Technical Specification Group Services and System Aspects; Study on Architecture for Next Generation System; July 2016, (Rel. 14)
- 3GPP, TR **22.891** v.14.2.0, "Feasibility Study on New Services and Markets Technology Enablers"; September 2016, (Rel. 14).
- 3GPP TR **38.801** V2.0.0, " Study on New Radio Access Technology; Radio Access Architecture and Interfaces", March 2017 (Rel. 14).

NGMN 5G White Paper, February 2015

Network slicing definitions (2)

An operator is allowed to *compose* and *operate* different network slices in parallel **over the same physical infrastructure**, e.g., to host multiple enterprises, while guaranteeing **slice *isolation***, so that data communication in one slice does not negatively affect services in other slices



«One network, many industries, many network slices»

From «one size fits all» solution to «one size per service»

Ericsson white paper, 5G systems, Jan. 2015

How many slices?

Not practically efficient to define a different slice for each single service

- Higher number of slices may result into **huge slice maintain and management effort**.
- Limiting the number of slices may also create a **bottleneck** since a single **use case may require functionality of two or more different slices**.

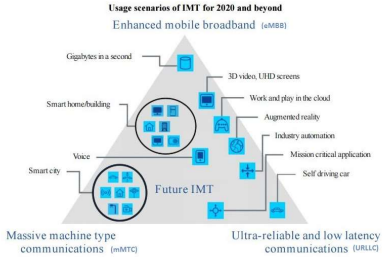
Solution: slicing based on **vertical applications**

M.R. Sama, et al. "Reshaping the Mobile core network via function decomposition and network slicing for the 5G era." *Wireless Communications and Networking Conference Workshops (WCNCW), 2016 IEEE.*

Main 5G service types@ITU

- **Enhanced Mobile Broadband** (eMBB) addressing human-centric use cases for access to multimedia content, services and data
- **Ultra-reliable-low latency communications** (URLLC) with strict requirements in terms of reliability, latency and availability
- **Massive Machine Type Communications** (mMTC) for a very large number of connected devices typically transmitting a relatively low volume of non-delay-sensitive information

...



NGMN 5G White Paper, February 2015

Network slicing

Some reference guidelines

- **Not all slices contain the same functions** in order to provide only the traffic treatment that is necessary for the use case and avoid all other unnecessary functionality
  - **Security, reliability and latency** wil be critical for a 5G slice supporting automotive use cases. All the necessary and potentially dedicated functions can be instantied at the **cloud edge node** due to the latency constraints.
  - For a 5G slice supporting mMTC devices some **basic CP functions can be configured, omitting, e.g., any mobility/paging functions**, with **contention-based resources for the access (due to high number of nodes)**.

NGMN 5G White Paper, February 2015

Network Slicing in a Nutshell

- Network Slice is
  - a logical end-to-end network
  - created in an as-a-Service fashion
- Different Network Slices for different services types
  - committed service → Network Slice type
  - dedicated customers
- A Network Slice can include
  - 5G Core Network
  - 5G Radio Access Network
  - Interworking Functions to non-3GPP Access Networks
- Each 5G UE connects
  - To maximum 8 Network Slices in parallel
  - A single AMF for all the slices

5G Network Slices

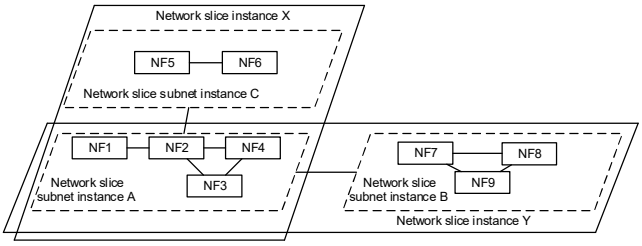
- Network Slice Instance (NSI): a set of network functions and the resources for these network functions which are arranged and configured, forming a complete logical network to meet certain network characteristics.
- Network Slice Subnet Instance (NSSI): a set of network functions and the resources for these network functions which are arranged and configured to form a logical network.
- Network Slice Subnet Template (NSST): description of the structure (and contained components) and configuration of the network slice subnet.
- Network Slice Template (NST): description of the structure (and contained components) and configuration of a network slice.
- Physical Resource Isolation (PRI): regime of resource management when a physical resource used by one network slice instance cannot be shared with another network slice instance.

network slice subnet instance (NSSI)

- A network slice subnet instance (NSSI) can:
  - include NF(s).
  - be shared by two or more NSIs or completely assigned to a single NSI.
  - contain CN functions only or AN functions only or both CN functions and AN functions.
- A NF may be shared by two or more NSSI(s), in which case it is called a shared constituent of NSSI.
- The resources used by NFs and related NSSIs comprise physical and logical resources.

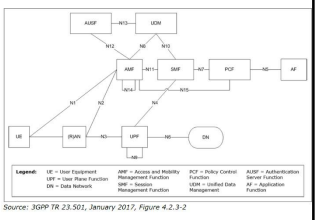
Slicing example

- NSI X and Y composed by NSSI A, B and C



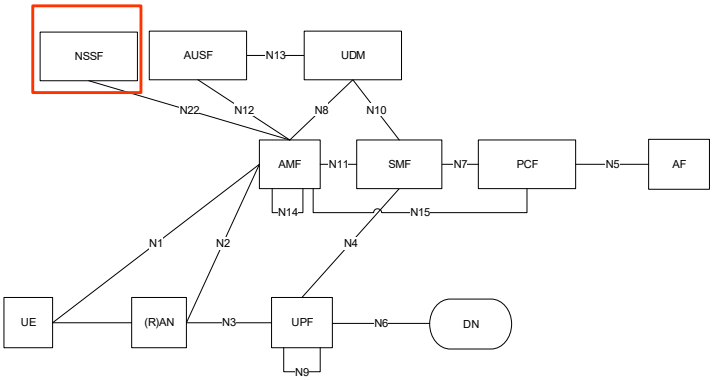
Network slicing: selection

- The definition of the Network Slice selection procedure may also have significant architectural impacts
- Starting from the agreed assumption that the UE will include slice selection assistance information in the *Registration Request*, and the selection will be performed by the NSSF, **where NSSF should be deployed**?
  - NSSF may be a sub-function of AMF
  - NSSF may be part of PCF, co-located with NRF
  - It may be conceived as a standalone NFs



Source: 3GPP TR 23.501, January 2017, Figure 4.2.3-2

Network slice selection

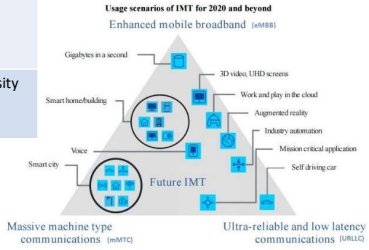


Recently solved:
NSSF is a dedicated function according to latest specifications

3GPP TR 23.501, v. 16.0.2 (**2019-04**), 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; System Architecture for the 5G System; Stage 2 (Release 15).

Standard network slice types

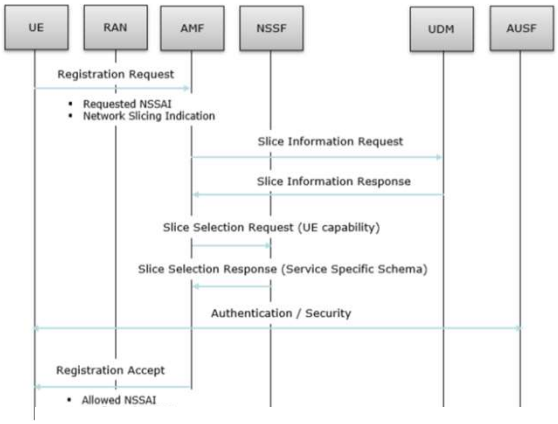
Slice/Service type	SST value	Characteristics
eMBB (enhanced Mobile Broadband)	1	Slice suitable for the handling of 5G enhanced Mobile broadband, useful, but not limited to the general consumer space mobile broadband applications including streaming of High-Quality Video, fast large file transfers, etc. It is expected this SST to aim at supporting High data rates and high traffic densities.
URLLC (ultra-reliable low latency communications)	2	Supporting ultra-reliable low latency communications for applications including, industrial automation, (remote) control systems, etc.
MIoT (massive IoT)	3	Allowing the support of a large number and high density of IoT devices efficiently and cost effectively.



3GPP TR 23.501, v. 16.0.2 (**2019-04**), 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; System Architecture for the 5G System; Stage 2 (**Release 15**).

Network slice selection: signaling flow at initial attach

- When UE send Registration Request it specifies NSSAI. By this NSSAI in Registration Request message UE tells Network saying that I want to get access to this and this type of slice.
- Then this requested Slice Information is transferred to UDM. UDM check if the requested slice is allowed for the specific UE.
- If it is allowed, the request is accepted. If not, is rejected.
- Once the slice request is accepted, (with a few more steps of checkups on core network side) the acceptance is notified to UE with a few additional information (Allowed NSSI, etc.)



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Takeaways

"5G systems are conceived as highly **flexible** and **programmable end-to-end communication, networking, and computing infrastructures** that provide increased performance in terms of **throughput, latency, reliability, capacity, and mobility** while meeting **diversified requirements** from **multiple services**."

1st technology designed in **close collaboration with verticals**

Resources

R. Li, “Towards a new Internet for the year 2030 and beyond”
https://www.itu.int/en/ITU-T/studygroups/2017-2020/13/Documents/Internet_2030%20.pdf

Network2020 association, “White Paper for Research Beyond 5G,” October 2015
https://networld2020.eu/wp-content/uploads/2015/11/B5G-Vision-for-Researchv-1.0-for-public-consultation.pdf

https://www.researchgate.net/publication/330304609_6G_The_Next_Frontier

https://arxiv.org/abs/1902.10265

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