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Multi-Access (Mobile) Edge Computing for 5G

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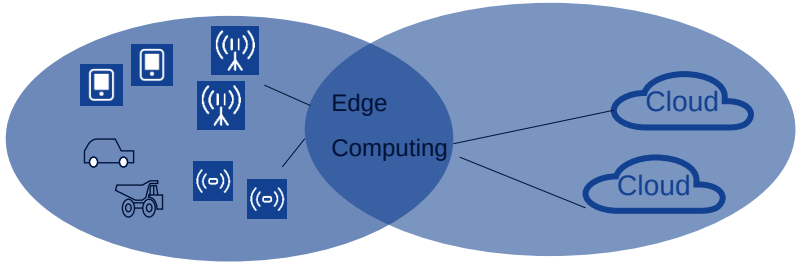
Multi-Access Edge Computing : Introduction

What is MEC?

- Edge computing is an evolution of cloud computing that brings application hosting and the related storage from centralized data centres down to the network edge, closer to consumers and the data generated by applications.

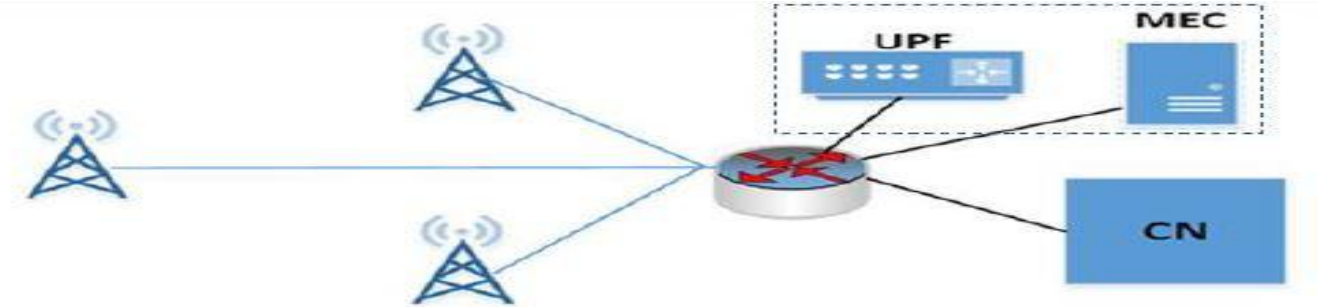


Why is it needed?

- MEC is a key enabler to meet the demanding latency and throughput requirements of 5G system.
- In case of several IoT applications, there is a need to localize good amount of processing instead of sending all data to central Cloud
- MEC can transform telecom networks into versatile service platforms for industry segments and specific customer segments and thereby transforming telecommunication business.

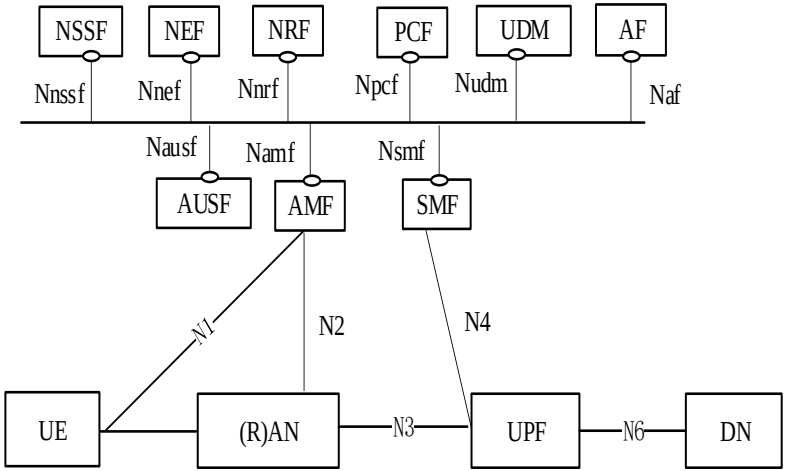
Possible Deployment Scenario

Deployment at an Aggregation Point

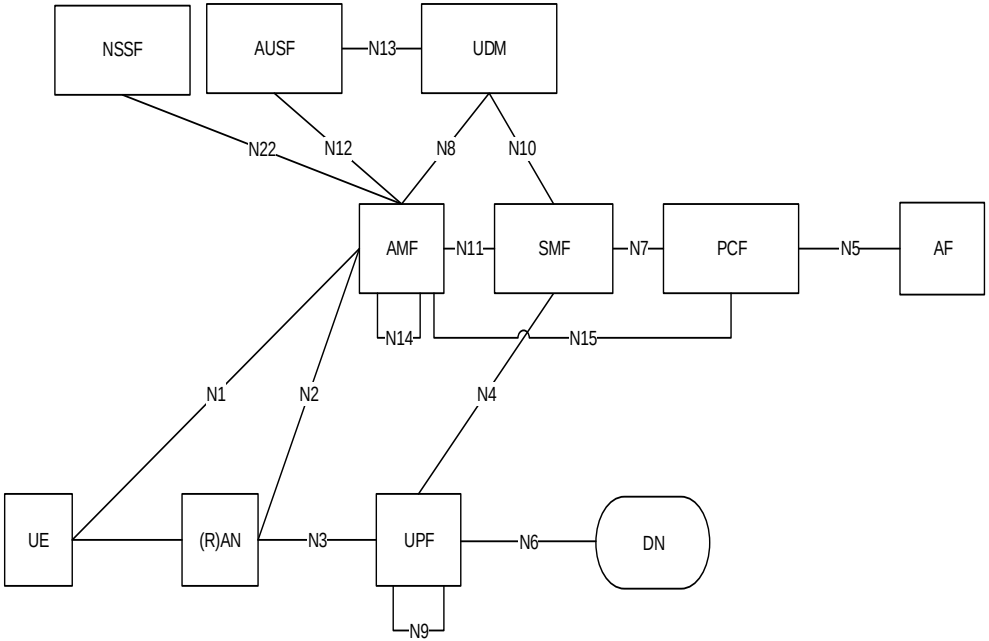


- Alternate deployment scenario wherein MEC and local UPF are collocated with base station is also possible.

5G System Overview



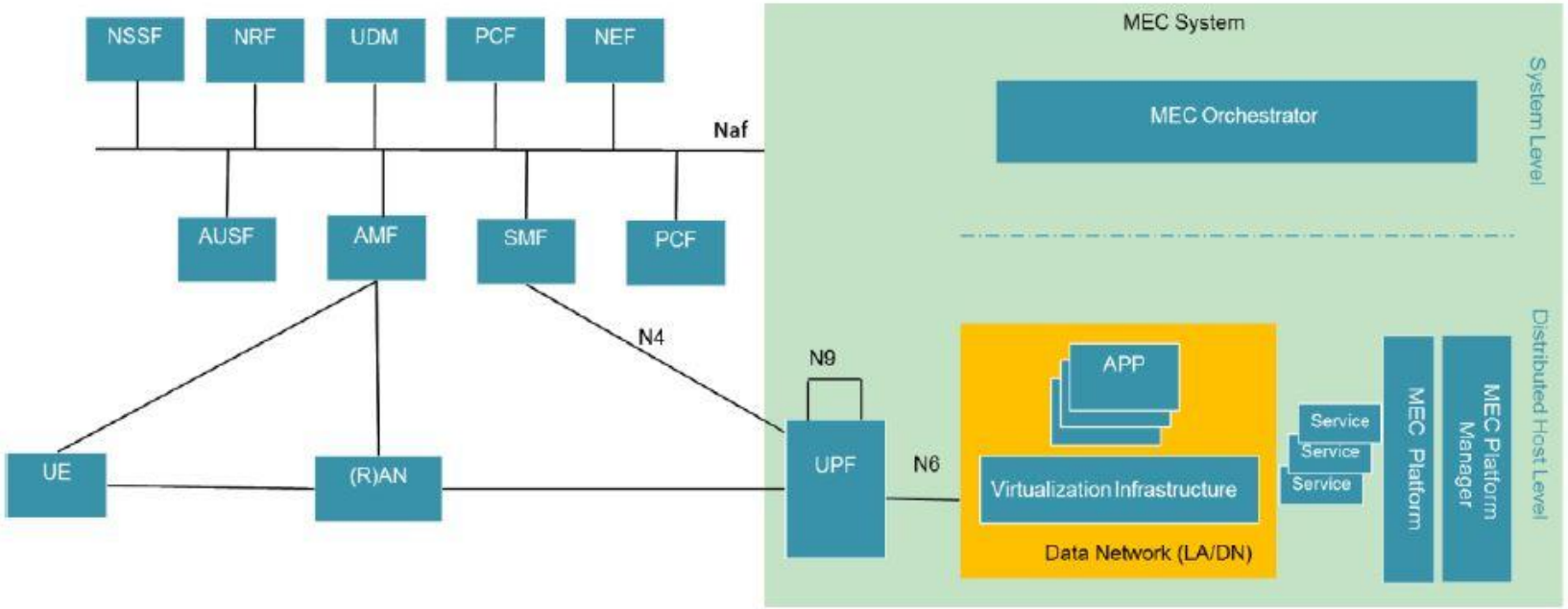
a. Service Based Representation



b. Reference Point Based Representation

MEC Deployment in 5G Network

MEC System as a 5G Application Function



What do MEC Applications Expect from 5G System?

- Support from 5G User Plane towards the respective MEC application.
- Support from 5G Control plane towards the respective MEC application
- Session and Service continuity
- Isolated network for MEC Application traffic
- Support of charging and lawful interception

5G User Plane Support & Enablers

5G User Plane Capability Required

- Routing of user plane data to the respective application

5G User Plane Enablers

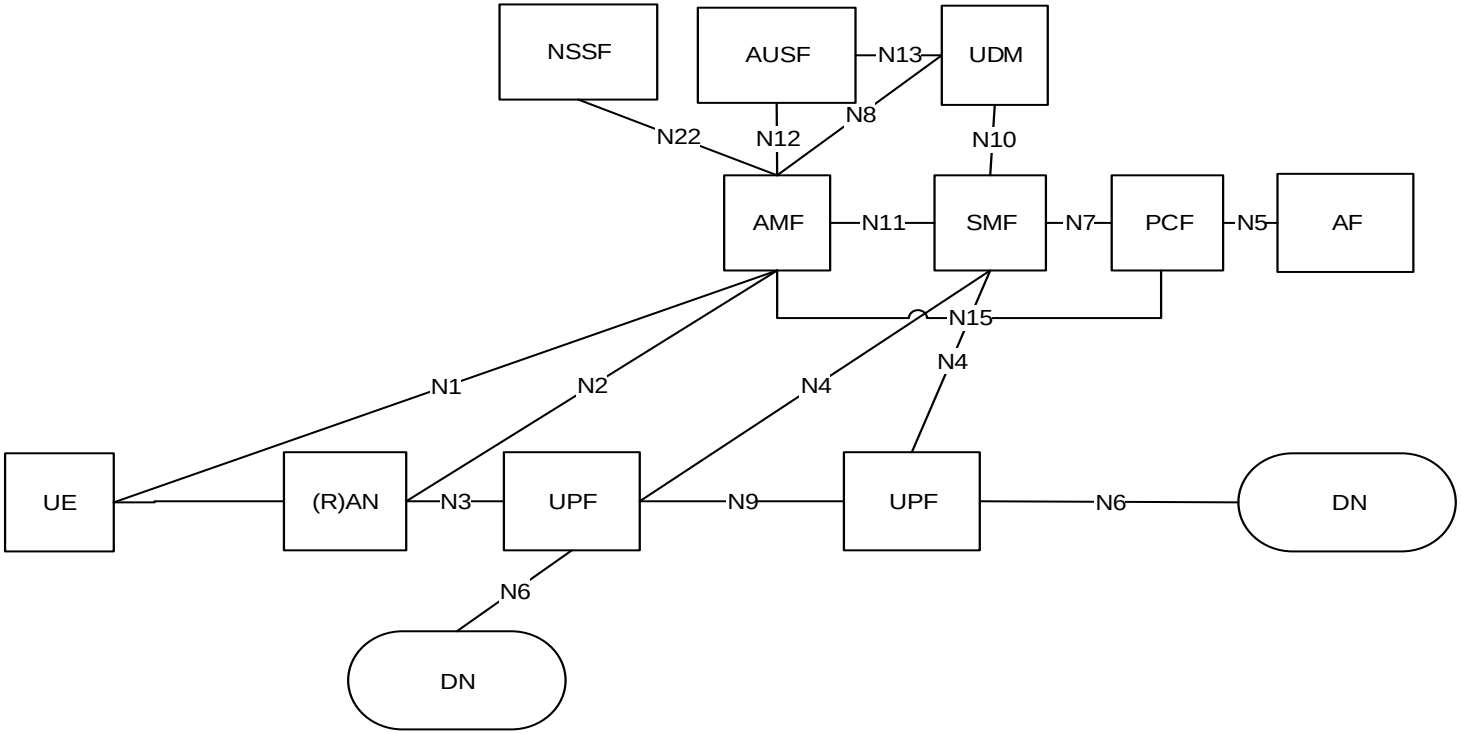
- Support of Local Area Data Network (LADN)
- Distributed UPF with PDU Session Anchor functionality
- 5G QoS

Support of LADN

- The access to a DN via a PDU Session for a LADN is only available in a specific LADN service area.
- A LADN service area is a set of Tracking Areas.
- LADN service area and LADN DNN are configured in the AMF on a per DN basis
- The UE is configured to know whether a DNN is a LADN DNN and association between application and LADN DNN.

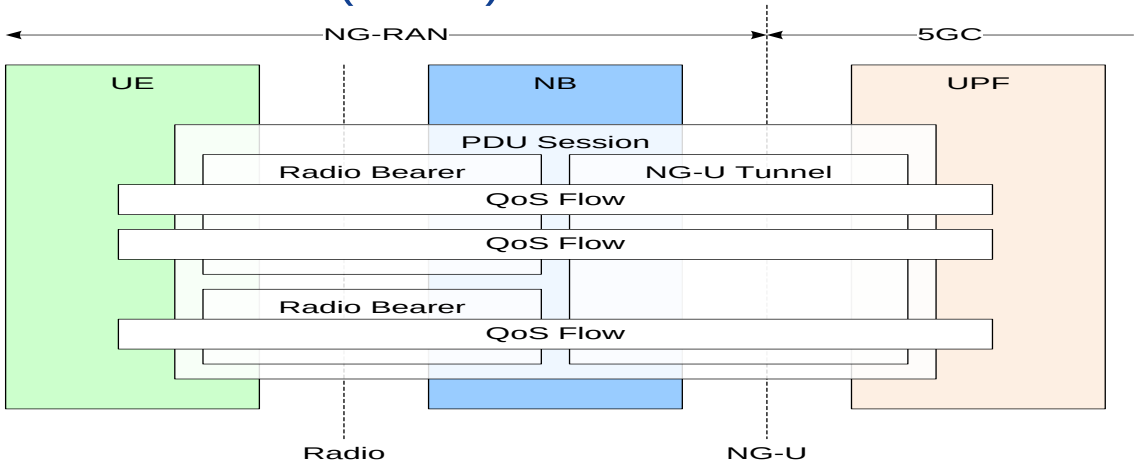
5G User Plane Enablers (contd)

Distributed UPF With PDU Session Anchor Functionality



5G User Plane Enablers (contd)

5G QoS



- QoS flow is the granularity for QoS control in 5G system.
- QoS flow level QoS control ensures that the individual packet flows of an application can get different treatment.
- QoS Flow Indicator (QFI) is used to identify a QoS flow
- 2 levels of QoS Mapping
  - NAS level packet filters in the UE and in the 5GC associate UL and DL packets with QoS Flows
  - AS-level mapping rules in the UE and in the NG-RAN associate UL and DL QoS Flows with DRBs

5G Control Plane Support & Enablers

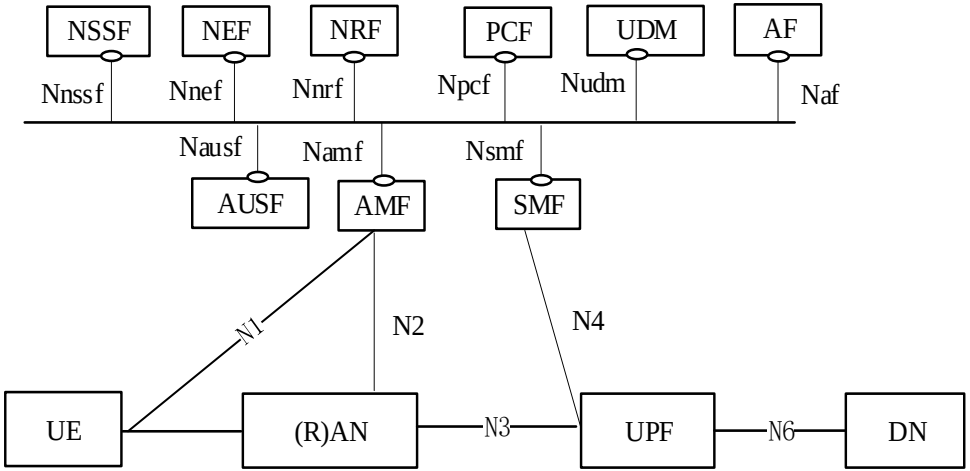
5G Control Plane Capabilities Required

- Application influence to facilitate optimized user plane routing
- Control plane event exposure
  - Specific event exposure; e.g. loss of connectivity, UE reachability etc;
  - 5G Core Network Internal event exposure; e.g. UE mobility event
- Information retrieval
- Parameter provisioning

5G Control Plane Enablers

- Service Based Architecture
- Service Registry and Discovery through NRF
- Capability and Event exposure through NEF
- Shared Data through UDR

5G Control Plane Enablers (contd) : Service Based Architecture (SBA)



- Procedures supported by a given network function are exposed to other network functions over service based interfaces.
- NF services are derived from the system procedures that describe end-to-end functionality
- Service registry and discovery are supported by NRF (Network Function Repository)
- In case the network function is not trusted, authorized access is provided by NEF
- Service interactions could be request / response based or based on subscription / notification
- MEC as an Application Function (AF) network function could consume any of the available services offered by other network functions. For e.g., MEC application could wake up a UE using Namf_MT : UE Reachability service

5G Control Plane Enablers (contd) : Illustrative Examples of Services Provided By Network Function AMF & SMF

- AMF Services

Service Name	Description
Namf_EventExposure	Enables other NF consumers to subscribe or get notified of the mobility related events and statistics.
Namf_MT	Enables an NF consumer to make sure UE is reachable.
Namf_Location	Enables an NF consumer to request location information for a target UE.

- SMF Services

Service Name	Description
Nsmf_PDUSession	This service manages the PDU Sessions and uses the policy and charging rules received from the PCF. The service operations exposed by this NF service allows the consumer NFs to handle the PDU Sessions.
Nsmf_EventExposure	This service exposes the events happening on the PDU Sessions to the consumer NFs.

5G Control Plane Enablers (contd) : Network Exposure Function (NEF)

- Network Capability exposure
  - Monitoring capability, provisioning capability and policy/charging capability
- Network event exposure
  - Specific events : few examples

Event	Description
Loss of Connectivity	Network detects that the UE is no longer reachable for either signalling or user plane communication.
UE reachability	It indicates when the UE becomes reachable.
Location Reporting	It indicates either the Current Location or the Last Known Location of a UE. One-time and Continuous Location Reporting are supported for the Current Location..

  - Core network mobility events
- External Parameter Provisioning
  - Provisioning capability allows an external party to provision the expected UE behavioural information to 5G network functions.
  - The provisioning information consists of information on expected UE movement trajectory

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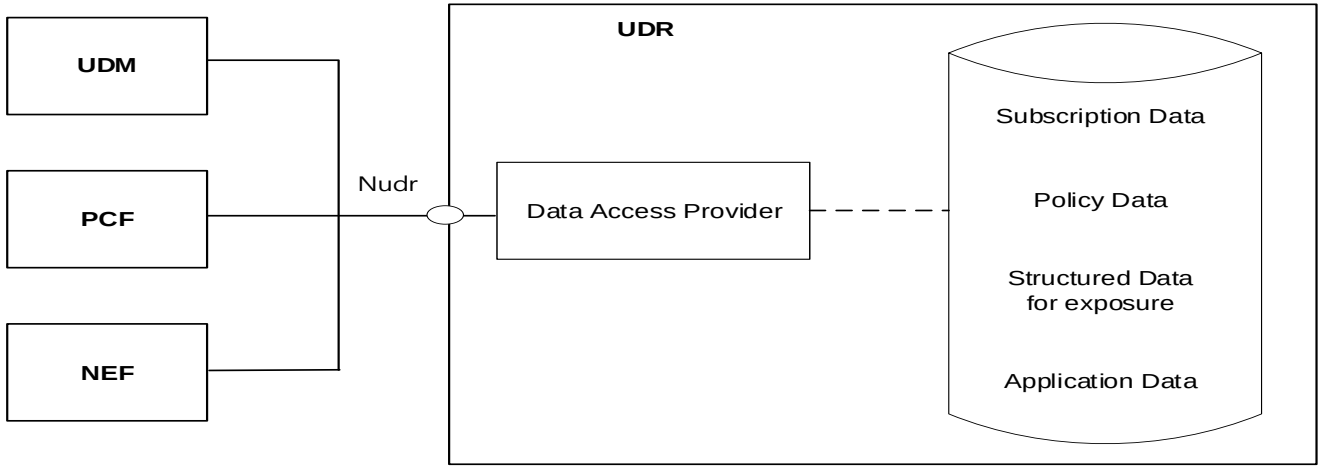
5G Control Plane Enablers (contd) : Unified Data Repository (UDR)

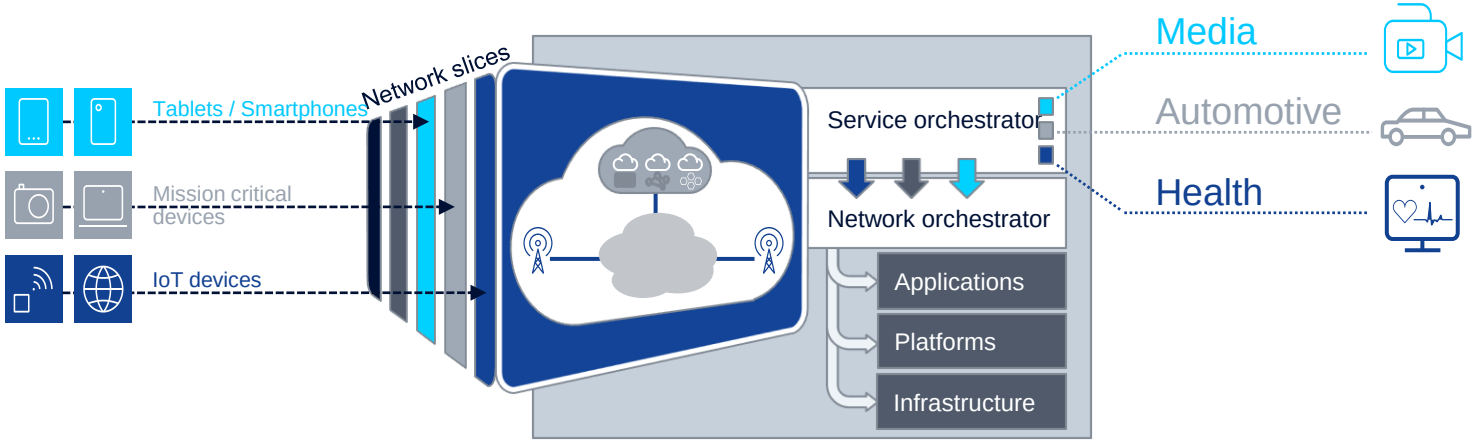


- Storage and retrieval of subscription data by the UDM.
- Storage and retrieval of policy data by the PCF.
- Storage and retrieval of structured data for exposure2 levels of QoS Mapping
- Application data (including Packet Flow Descriptions (PFDs) for application detection, AF request information for multiple UEs), by the NEF

5G Control Plane Enablers (contd) : Session & Service Continuity

- The support for session and service continuity in 5G System architecture enables to address the various continuity requirements of different MEC applications/services for the UE as the UE moves from one area to another
- 5G system supports 3 different Session & Service Continuity modes (SSC modes) : SSC Mode1, SSC Mode 2 and SSC Mode 3
  - SSC Mode 1 : UE IP address preserved
  - SSC Mode 2 : Break before make. IP address is released before new IP is allocated
  - SSC Mode 3 : Make before break. UE could have 2 different IP addresses during the change over durationStorage and retrieval of structured data for exposure2 levels of QoS Mapping
- Operator could provision the UE with different SSC mode selection policy rules.
- SSC mode selection policy rules can be used by the UE to determine the type of SSC mode associated with an application or group of applications. The policy may include a default SSC mode selection policy rule that matches all applications of the UE.

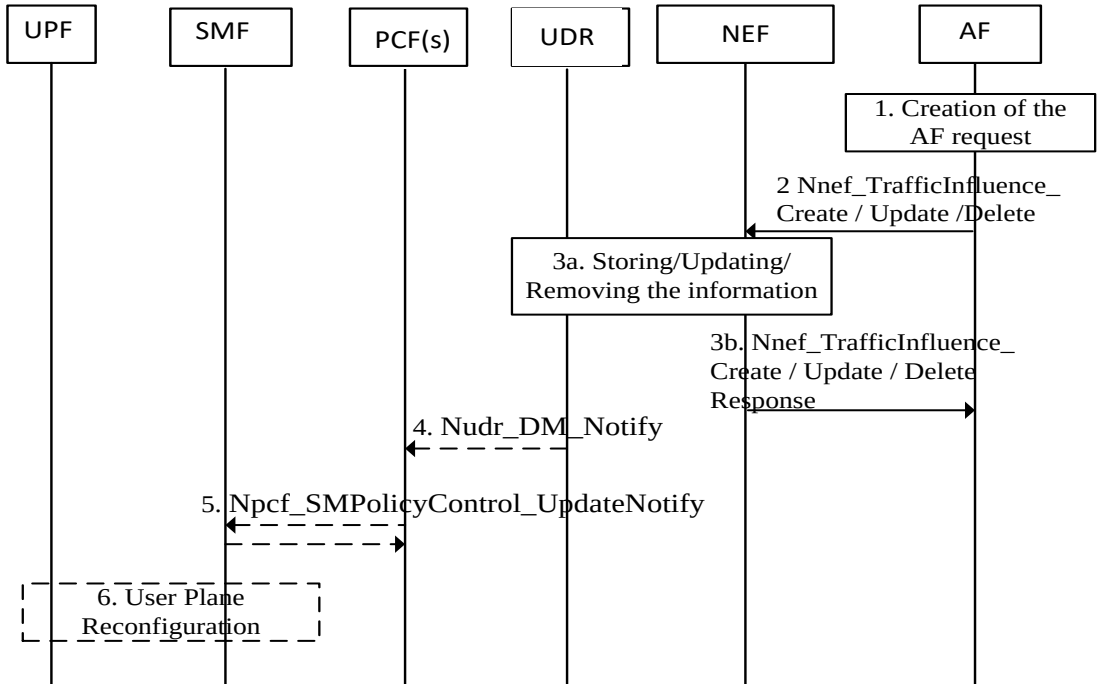
5G Control Plane Enablers (contd) : Network Slicing



- Network slicing capability can enable MEC applications as it provides an end to end isolated network for MEC applications.
- An isolated network for MEC applications ensures that high bandwidth consuming applications such as AR/VR do not degrade the promised SLA to regular users.
- Generally, MEC applications could belong to different industry verticals such as Car2X, AR/VR etc. Network slicing provides the capability for each of these applications to be run as a separate network slice.

5G Control Plane Enablers (contd) : End to End Scenario

Application Influence on Traffic Routing



Conclusion

- 3GPP Rel 15 specified 5G system provides powerful capabilities for Edge Computing to flourish.
- The need of the hour is to create the needed ecosystem including opearators, network vendors, device manufacturers, application developers and regulatory bodies to get together and make the future of MEC realizable.