Evolution of cellular core network functions from 3G to 5G and of their mapping requirements

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Outline

- Core Network Evolution
- 5G Core Specificities
- Interactions between 5G entities
- Mapping Problem
- Challenges
References


Core Network Evolution
Core Network Evolution: from 3G to 5G

3G UMTS Core Network
- Mobile Switching Centre (MSC)
- Gateway MSC (GMSC)
- Serving GPRS Support Node (SGSN)
- Gateway GPRS Support Node (GGSN)
- Home Location Register (HLR)
- Equipment Identity Register (EIR)
- Authentication Centre (AuC)

4G Evolved Packet Core
- Mobility Management Entity (MME)
- Packet Data Node Gateway (PDN-GW)
- Serving Gateway (S-GW)
- Traffic Detection Function (TDF)
- Home Subscriber Server (HSS)
- Policy and Charging Rules Function (PCRF)

5G Core Network
- User plane Function (UPF)
- Access and Mobility Management Function (AMF)
- Session Management Function (SMF)
- Unified Data Management (UDM)
- Policy Control Function (PCF)
- Authentication Server Function (AUSF)
- Network Exposure Function (NEF)
- Application Function (AF)
- Network Slice Selection Function (NSSF)
- Security Edge Protection Proxy (SEPP)
- Location Management Function (LMF)
- Binding Support Function (BSF)
- Charging Function (CHF)
- Non-3GPP Inter Working Function (N3IWF)
- SMS Function (SMSF)
- Unified Data Repository (UDR)
- Network Data Analytics Function (NWDAF)
- Unstructured data Storage Function (UDSF)

Diagram Legend:
- Control Plane
- User Plane
- Optional Functions
- Control+User Plane
- A (partially) becomes B
5G Core Specificities: decomposition

- Completely integration between NFs
  - directly communicate with each other by interactions such as request/response and subscribe/notify
  - NF service producer and NF service consumer
Interactions between 5G entities
Mapping Problem

Flat Core Network Mapping

Core Network

CP

UP

Shared Control Plane Mapping

Core Network

CP

UP 1

UP 2

Hard Core Network Isolation Mapping

Core Network

CP 1

UP 1

CP 2

UP 2

Soft Core Network Isolation Mapping

Core Network

C-CP

D-CP 1

D-CP 2

data and signaling flow for Communication Service 1
data and signaling flow for Communication Service 2
Mapping problem

- Shared and Dedicated Network Functions
  - Isolation
  - Security
  - Redundancy

- Scalability and Distribution
  - Scaling In
  - Scaling Out
  - Traffic redistribution
Challenges
Challenges

- Orchestration decision levels
  - Mapping Network Functions into Network Slices (Subnet)
  - Mapping Network Slices into Communication Services
  - Mapping Network Slices Subnet into Network Slices
  - Mapping Network Slices Subnet into Network Slices Subnet

- Network Function granularity
  - How to program NFs with the right set of services?
    - Who does that?
  - Scalability and Distribution

- Shared and Dedicated Network Slices (Subnet)
  - More Security vs Less Redundancy
Thank you for your attention.