Workshop on "Control plane of IMT-2020 and emerging networks. Current issues and the way forward"
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Development Status of 5G Core Network in ETRI

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Agenda

- Standardization Overview
- R&D Status in ETRI
- Q & A
Standardization Overview

IMT-2020
5G KPIs and Usage Scenarios

ITU-R M.2083
Architecture Design Goals

• Support of network slicing
  – Support of diverse devices and applications
• Common core network
  – Minimum access dependency
• Separation of control and user planes
• UP and CP functions can be flexibly deployed
• Support of network capability exposure
• Unified authentication framework
• Support of various transport technologies
• Leveraging existing techniques
5G Requirements (1/2)

- Requirements from service points of view
  - Enhanced mobile broadband services
  - Enhanced massive machine type communications
  - Ultra-reliable and low latency communication services

- Requirements from network operation point of view
  - Network flexibility and programmability
  - Fixed-mobile convergence
  - Enhance mobility management
  - Deployment and migration
  - Network capability exposure

Source: Requirements of IMT-2020 (ITU-T Y.3101)
5G Requirements (2/2)

- Requirements from network operation point of view (cont’d)
  - Authentication
  - Security and personal data protection
  - Efficient signaling
  - QoS Control
  - Network management
  - Charging
  - Interworking

Source: Requirements of IMT-2020 (ITU-T Y.3101)
5G Network Architecture in ITU-T

Logical view of IMT-2020 network

## 5G Requirements in 3GPP

<table>
<thead>
<tr>
<th>TR 22.861: FS_SMARTER – massive Internet of Things</th>
<th>Massive Internet of Things focuses on use cases with massive number of devices (e.g., sensors and wearables). This group of use cases is particularly relevant to the new vertical services, such as smart home and city, smart utilities, e-Health, and smart wearables.</th>
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<tbody>
<tr>
<td>TR 22.862: FS_SMARTER – Critical Communications</td>
<td>The main areas where improvements are needed for Critical Communications are latency, reliability, and availability to enable, for example, industrial control applications and tactile Internet. These requirements can be met with an improved radio interface, optimized architecture, and dedicated core and radio resources.</td>
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<tr>
<td>TR 22.863: FS_SMARTER – enhanced Mobile Broadband</td>
<td>Enhanced Mobile Broadband includes a number of different use case families related to higher data rates, higher density, deployment and coverage, higher user mobility, devices with highly variable user data rates, fixed mobile convergence, and small-cell deployments.</td>
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<tr>
<td>TR 22.864: FS_SMARTER – Network Operation</td>
<td>The use case group Network Operation addresses the functional system requirements, including aspects such as: flexible functions and capabilities, new value creation, migration and interworking, optimizations and enhancements, and security.</td>
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</tbody>
</table>

- Service requirements for the 5G system” *(TS22.261)*
5G Architecture in 3GPP

- Each Network Function (NF) is represented by the services it provides and their exposed interfaces.
- Instead of defining a single and unique reference point between two different Core network entities, as before, each one of the services belonging to the NF may be exposed through a number of operations that can be consumed by other authorized NFs.
R&D Status on 5G Core Network in ETRI
Big Picture of ETRI R&D on 5G Core

- Development of core technologies for 5G core network
  - To support 5G, WiFi, fixed and even any future access networks in a single core network
  - To cope with traffic explosion
  - To embrace new services efficiently
  - To reduce CAPEX/OPEX

Fixed-mobile convergence control signalling platform
- Common NAS signalling across different access networks
- Multi-RAT resource and mobility management
- Anchor-free mobility management

Converged Gateway (CGW)
A common single gateway supporting multi-access networks
- Access technology independent distributed forwarding
- IP flow-based QoS control
- Coordinated traffic forwarding across Multi-RATs
5G Network Architecture

- Integrated support of 3GPP/non-3GPP
- Separation of CP/UP
- Converged Function in (R)AN
- Common NAS across multiple different access networks

Control Plane Architecture

- Function modularization: Access control/Session Management/Mobility Management
- Support of MTC (Machine type communication)
- Common NAS signalling regardless of access technologies
5G Network Architecture

- **UE** (User Equipment)
- **N3IWF** (N3 Interface with Network Functions)
- **N3GPP Access (WiFi)**
- **RAN** (Radio Access Network)
- **AMF** (Access and Mobility Management Function)
- **SMF** (Session Management Function)
- **UPF** (User Plane Function)
- **CGW** (Control Gateway)
- **DNN** (Diameter Default Network)
- **AUSF** (Access and User Plane Function)
- **UDM** (User Data Management)
- **SMB** (Security Management Function)
- **MMB** (Mobility Management Function)
- **N1** (N1 interface)
- **N2** (N2 interface)
- **N3** (N3 interface)
- **N2B** (N2 interface for Bearer)
5G Common NAS

- NAS signaling framework to support a single NAS across multiple different (R)ANs
  - Same NAS signalling
  - Inter-RAT NAS message handling

![Diagram of 5G Common NAS](image)
5G Common NAS

UE connects to trusted non-3GPP access network (WiFi Association)

EAP-Res (User Id)

IKE_SA_INIT

IKE_AUTH Req (User Id)

IKE_AUTH Res (EAP-REQ / 5G-START)

IKE_AUTH Res (EAP-RESP / 5G-START)

Initial UE Message (Registration Request)

Initial Context Setup Request (Registration Accept)

Initial Context Setup Response (Registration Accept)

SMC Request over UDP/IP

SMC Complete over UDP/IP

Registration Accept over UDP/IP

Registration over UDP/IP

SMC Request over IPsec

SMC Complete over IPsec

NAS over IPsec: SMC Request

NAS over IPsec: SMC Complete

UE configures an IP and discovers the IP address of N3IWF

IP

SCTP/L2/L1

N12

N2

WLAN

WLAN AP

N3IWF

AMF

AUSF

N12-AP

N2-AP

N12 Lower Layers

UE

WLAN AP

N3IWF

AMF

AUSF
5G QoS Model

Data flows from applications

QoS rules
(mapping packets to QoS flows and apply QoS flow marking)

Mapping QoS flows to AN resources

QoS-applied Data flows
(all packets separately identified for QoS purposes)

Data flows from applications

SDF Templates
(classify packets to identify QoS of their flows)

Application/Service Layer

UE

AN

CGW

PDU session
5G QoS

- Dynamic QoS management for Non-GBR and GBR traffic
  - Both of non-GBR and GBR traffic is bound to session AMBR
  - Per-flow QoS management
5G Session Management

- Single PDU Session over Multiple I/F
- A single IP address for multiple I/Fs using a logical interface
- Flow Mobility
- Session Mobility by allocating multiple logical IFs

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- Separate IP address per I/F
- 1 PDU Session across Multiple I/Fs is not supported
  - Maybe considered later
- Flow mobility not considered
5G Mobility

- Simultaneous Multiple Connectivity
- Inter-5GBS(intra-RAT) Handover and Inter-AN(or RAT) IP Flow Mobility
- ATSSS: Access Traffic Selection/Steering/Splitting (Splitting yet to be developed)
5G Mobility – ATSSS (1)

- **Access Traffic Steering**
  - selects the "best" access network for a new data flow and transfers the traffic of this data flow over the selected "best" access network.
5G Mobility – ATSSSS (2)

- **Access Traffic Switching**
  - moves all traffic of an ongoing data flow from one access network to another access network in a way that maintains the continuity of the data flow
5G Demo Testbed
Demo Video
Thank you
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