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EN 帶你入門 5G 核心網路

Introduce to 5GC

Ian Chen

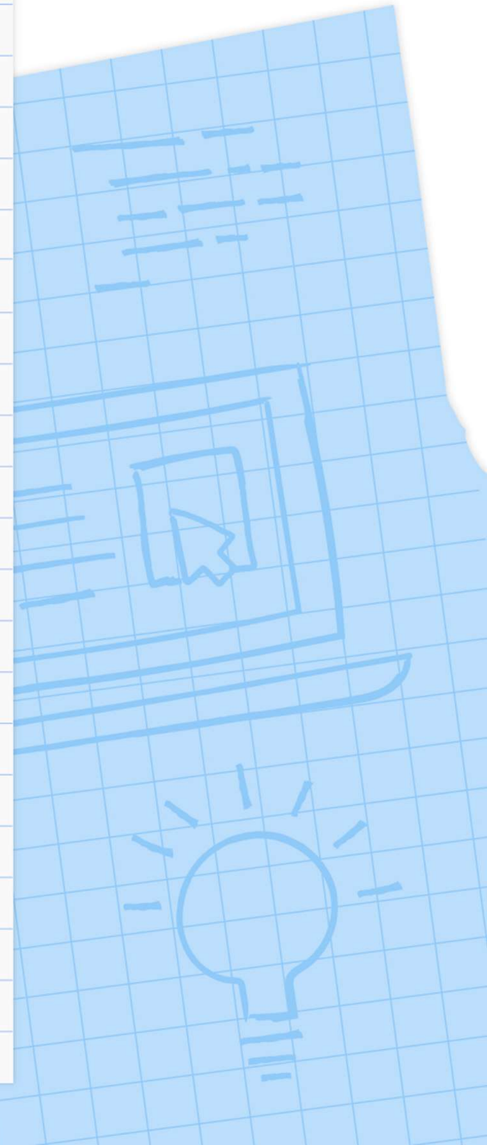
Google Developer Student Clubs

About me

Ian’s profile

- M.S student [at] NYCU | 5G Software Developer [at] Saviah
- Open-source contributor
- Google DSC @ NCTU 2021-2022
- Also was a speaker at SITCON/COSCUP/GDG DevFest...

ianchen0119



```
function getOutLine() {
    // Introduce to 5GC
    outLine = new presentation();
    outLine.subTitle(“What’s Core Network?");
    outLine.subTitle(“Network Functions in 5GC");
    outLine.subTitle(“SBA & Reference points");
    outLine.subTitle(“Common procedures in 5GS");
    outLine.subTitle(“free5GC Introduction");
    outLine.subTitle(“How to contribute?");

    return outLine;
   }
```

What’s Core Network?

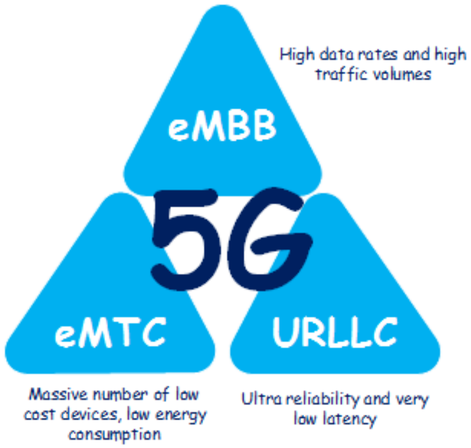
`Core Network is powerful back-end software in 5GS.`

- Subscriber’s information management
- QoS (Quality of Service) management & enforcement
- User’s mobility/session/connection management
- Responsible for user’s packets delivery to/from DN (Data Network)

What’s Core Network?

New concepts in 5GC

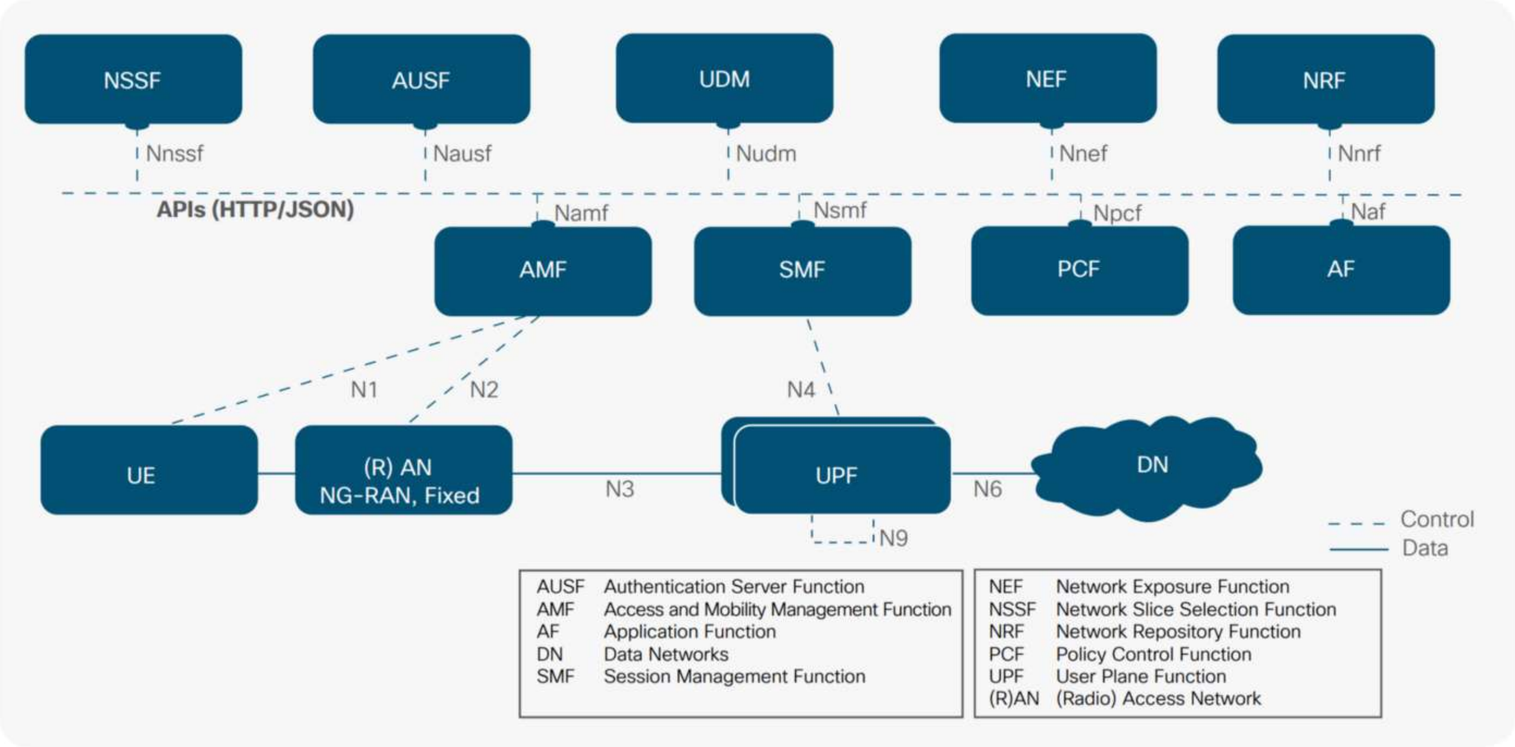
- Service Based Architecture
- Network Slicing
- Multi-access Edge Computing (MEC)
- Main targets
  - enhanced Mobile BroadBand (eMBB)
  - massive Machine-Type Communication (mMTC)
  - Ultra-Reliable and Low-Latency Communication (URLLC)



Ref: http://anisimoff.org/eng/5g/5g_uc_requirements.html

What’s Core Network?

Let’s get a look into architecture of 5GS!



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Ref: https://medium.com/5g-nr/5g-service-based-architecture-sba-47900b0ded0a

Network Functions in 5GC

Access and Mobility Management Function (AMF)

- 4G-5G or 5G-5G Handover
- UE reachability
- SMF selection (based on TAC, Slice or DNN)
- Network Slicing (collaborate with NSSF)
- C-IoT Optimization

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Session Management Function (SMF)

- Session Management
- Maintain the channel between AN and UPF
- IP Allocation for UE
- Sends the QoS rules to UPF for QoS enforcement

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

User Plane Function (UPF)

- Packet buffering, forwarding
- IP allocation for UE
- QoS enforcement
- Usage report for charging function

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Authentication Server Function (AUSF)

- Keys storage (used for ciphering & integrity protection)
- EAP authentication server for security procedures (with AMF)
  - Support both 3GPP & non-3GPP access.

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Network Repository Function (NRF)

- Service discovery
- Maintains the NF profile of available NF instances
  - NF instance ID
  - NF type
  - PLMN ID
  - IP addr of NF
  - Capacity information
  - ...

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

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Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Network Slice Selection Function (NSSF)

- Select a proper slice set for serving UE
- Determine the allowed NSSAI & configured NSSAI
- Base on subscription data & location to select the AMF set for serving UE

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Unified Data Management (UDM)

- Responsible for generate the 3GPP AKA auth credentials
- Storage and management of SUPI for each subscribers.
  - Be used to authentication procedure with AUSF
- Subscription management

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Unified Data Repository (UDR)

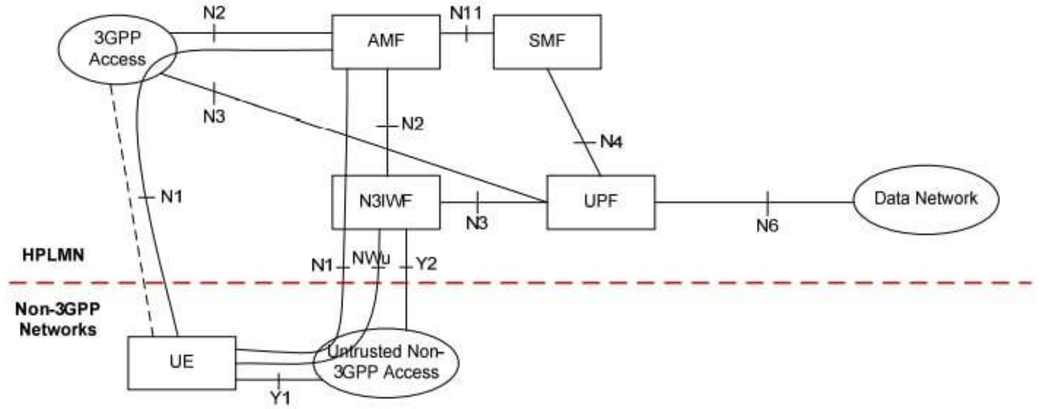
- Data Access Provider
  - Subscription data
  - Policy data
  - Structured data for exposure
  - Application data
- Consumed by:
  - UDM
  - PCF
  - NEF

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

Non-3GPP Interworking Function (N3IWF)

- Provides non-trusted 3gpp access, e.g. wifi
- NAS/NGAP message processing
- Encapsulation/decapsulation on N3 and IPsec packets.
- IPsec tunnel establishment



Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

Network Functions in 5GC

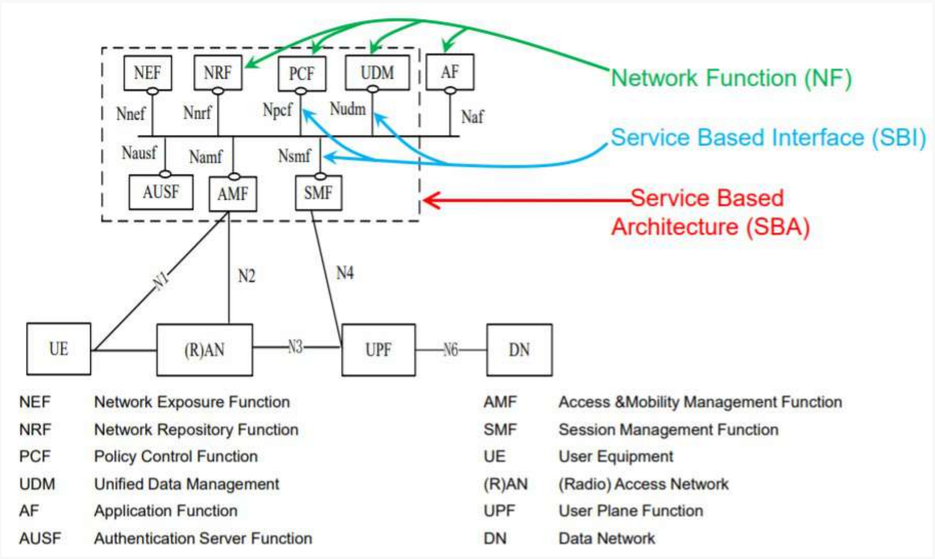
Policy Control Function (PCF)

- Supplies policy rules to control plane function
  - Access subscription info from UDR
  - AM policy control (Service Area, Restrictions...)
  - SM policy control (PCC rules, QoS policy, Charging policy...)

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Network-Functions

SBA & Reference points

Lots of protocol used in 5GS…

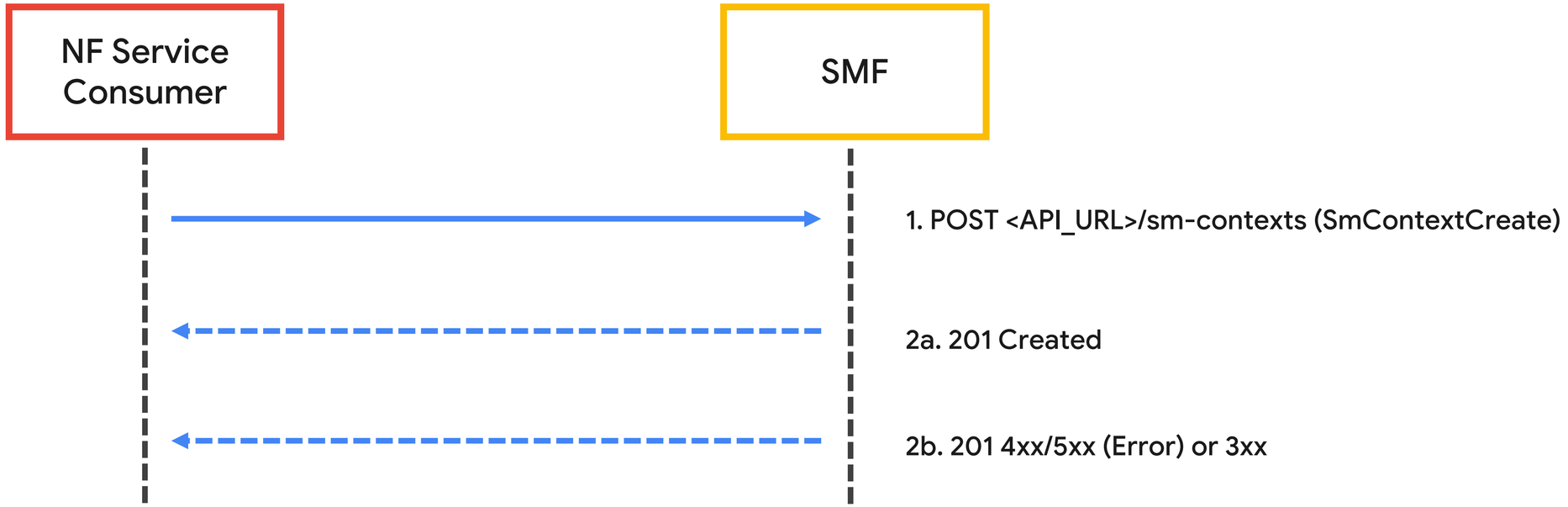


- N1: NAS
- N2: NGAP (SCTP base)
- N3: GTP-U (UDP base)
- N6 & N9: 5G UP encapsulation
- SBI: http2

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Service-Based-Interface

SBA & Reference points

Example of SBI service



Ref: https://github.com/ianchen0119/Introduce-to-5GC/Service-Based-Interface

Common procedures in 5GS

Registration

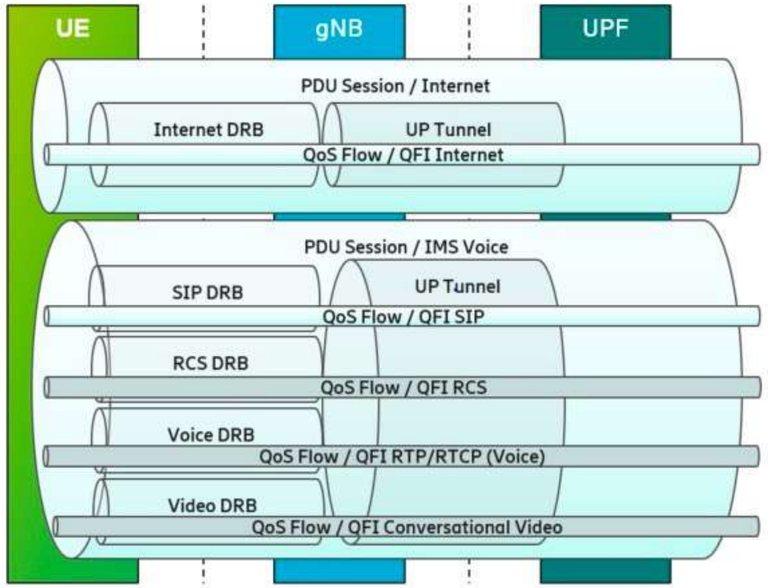
- Initial registration
- Periodic registration
- Mobility registration
- Emergency registration

Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Common-procedures-in-5G

Common procedures in 5GS

Session Management

- PDU Session enables UE connect to Data Network.
- PDU Session Procedures:
  - Establishment
  - Modification
  - Release

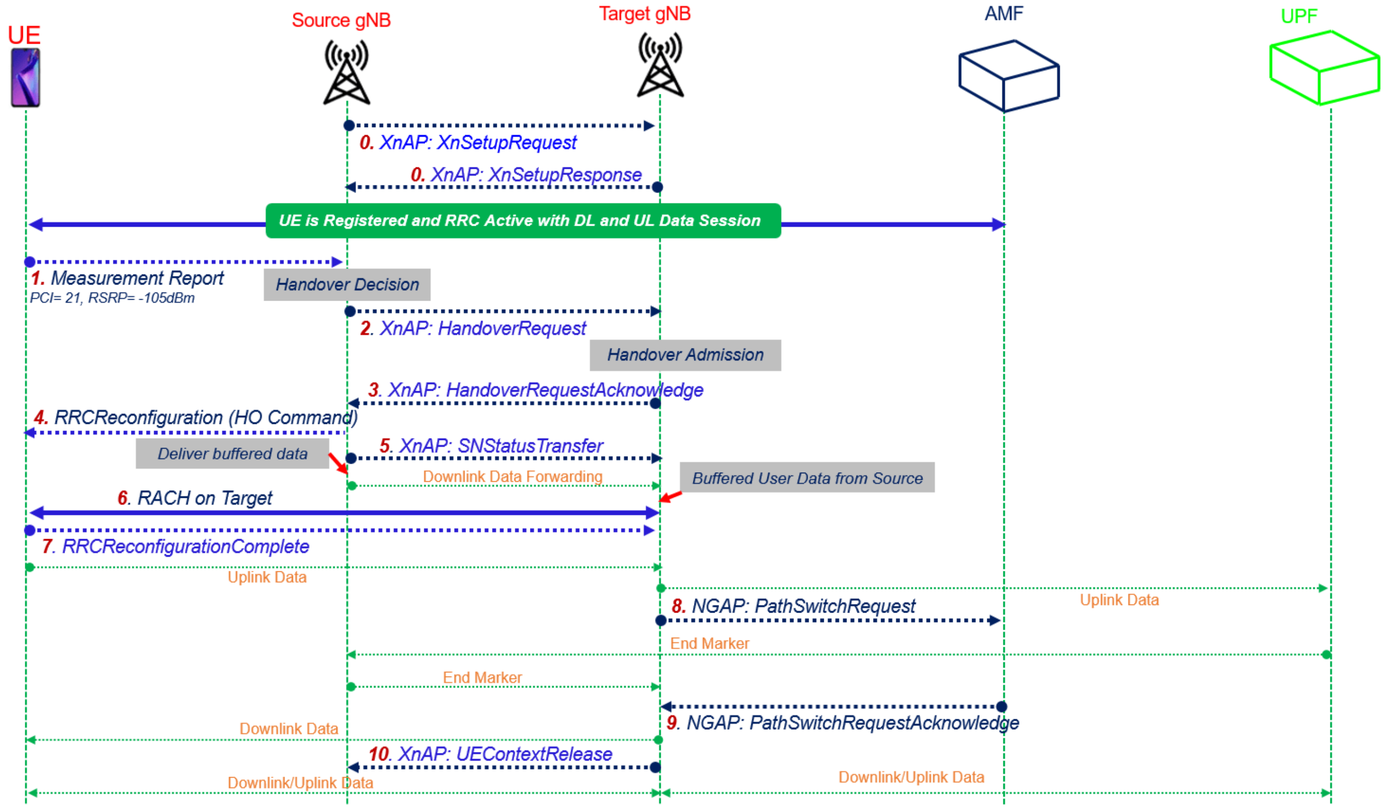


Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Common-procedures-in-5G
https://www.5gworldpro.com/5g-knowledge/what-is-pdu-session-in-5g.html

Common procedures in 5GS

Handover

- UE mobility & reachability
- QoS assurance
- Example: Inter Xn handover
  - Also has n2 handover...



RACH: UE to aquire Uplink Synchronization and obtain specified ID for the radio access communication.

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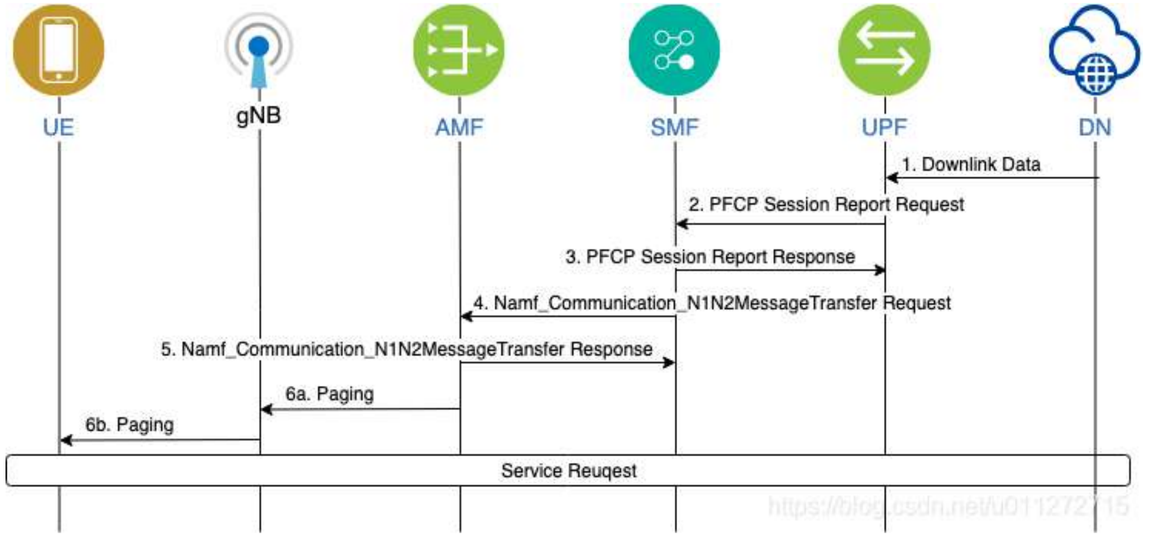
Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Common-procedures-in-5G
https://www.techplayon.com/5g-sa-inter-gnb-hanodver-xn-handover/

Common procedures in 5GS

Paging

When UE is in CM-Idle, but 5GC has buffered data need to send to UE.
5GC will initiates paging request in order to trigger Service Request.



Ref: https://github.com/ianchen0119/Introduce-to-5GC/wiki/Common-procedures-in-5G
https://www.twblogs.net/a/5e53233cbd9eee2117c38942

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free5GC Introduction

an open-source project for 5g mobile core networks

Can be installed in:

- Virtual Machine
- PC
- Docker container (free5gc-compose)
- Kubernetes (towards5GS-helm)

Ref: https://github.com/free5gc/free5gc

How to contribute?

Maybe you're interested in 5GC after this talk…

- All the Network Functions in free5GC were written in Golang
- UPF (User Plane part) is a Linux kernel module (gtp5g)
- free5gc-compose is developed by using docker & docker-compose
- Any technical issue & pull request is welcome!!
- Last but not least…
  - Pls don't forgot to give a star to my project: Introduce to 5GC

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Ref: https://github.com/ianchen0119/Introduce-to-5GC

Thanks for your listening...

Any further questions?

By the way, if you're...

- Also Interested in IT 邦幫忙鐵人賽, please contact me later.
- Want be have a connection with me, this is my LinkedIn profile:

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