INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

5G Infrastructure

5ISS – From 3G to 6G

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Outline of the presentation

- **Introduction :** 5G justification
- **Part 1 :** 4G architecture
- **Part 2 :** 5G architecture : microservices
- **Part 3 :** The different services and their interactions
- **Part 4 :** An example of an UE’s connection
- **Conclusion and perspectives**

Introduction

The Internet of Things (IoT) is one of the main challenges of this decade. Nowadays, everything from the car to the house becomes connected.

IoT devices has their own needs that are different from any other wireless equipment :

- Massive connectivity
- Low bandwidth by device
- Low energy

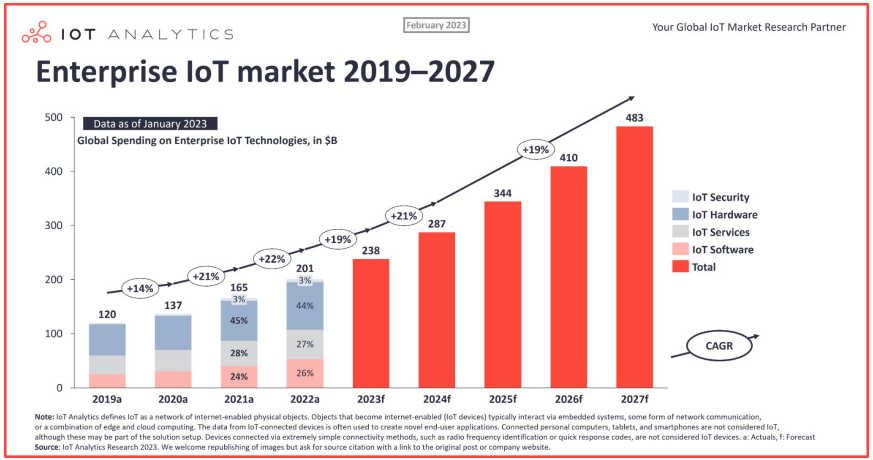


Fig.1: The growth of the IoT market from 2019 to 2027

The 5G standards takes into consideration these new needs to address them more accurately

Introduction

Introduction

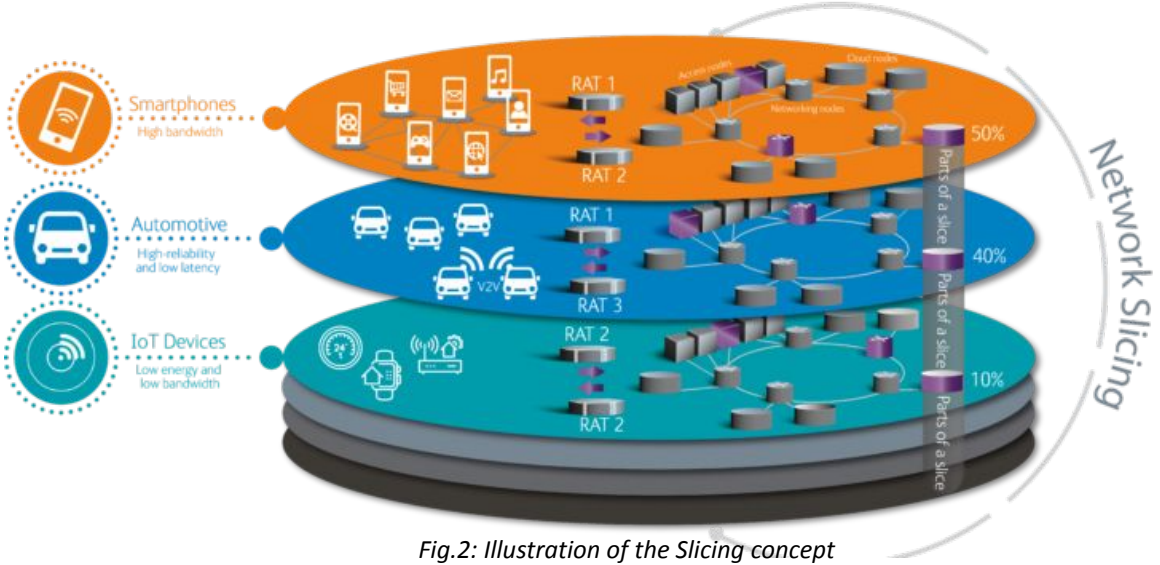


Fig.2: Illustration of the Slicing concept

Introduction by 5G standards of the Slice concept

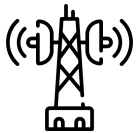
- The network is divided in subnetwork depending on the need of the application with different guaranties
- It is more flexible and evolutive
- Takes into account rising topics like IoT and automotive cars

Introduction

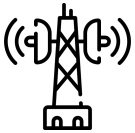
4G architecture

From 2G (**GPRS**) to 4G (**LTE**) : The same network architecture

User equipment



Base station



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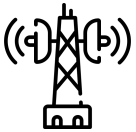
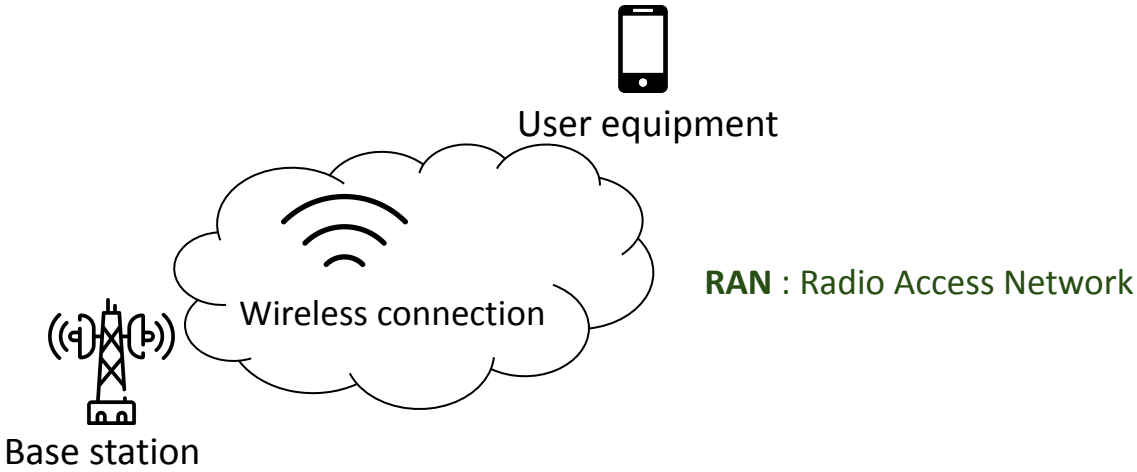


Base station

4G architecture

From 2G (**GPRS**) to 4G (**LTE**) : The same network architecture



RAN : Radio Access Network

Part 1 : 4G architecture

4G architecture

From 2G (**GPRS**) to 4G (**LTE**) : The same network architecture

The base station is connected to the operator network thanks to optical fiber for example

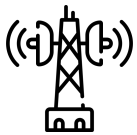
GGSN : gateway to internet

SGSN : gateway for the zone

Each operator has its own network

HLR : operator database

VLR : database for the zone



Base station

One zone : several base stations

Part 1 : 4G architecture

4G architecture

From 2G (**GPRS**) to 4G (**LTE**) : The same network architecture

GGSN : gateway to internet

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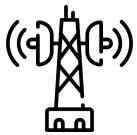


Base station

Fixed components -> no flexibility

Part 1 : 4G architecture

5G architecture : microservices

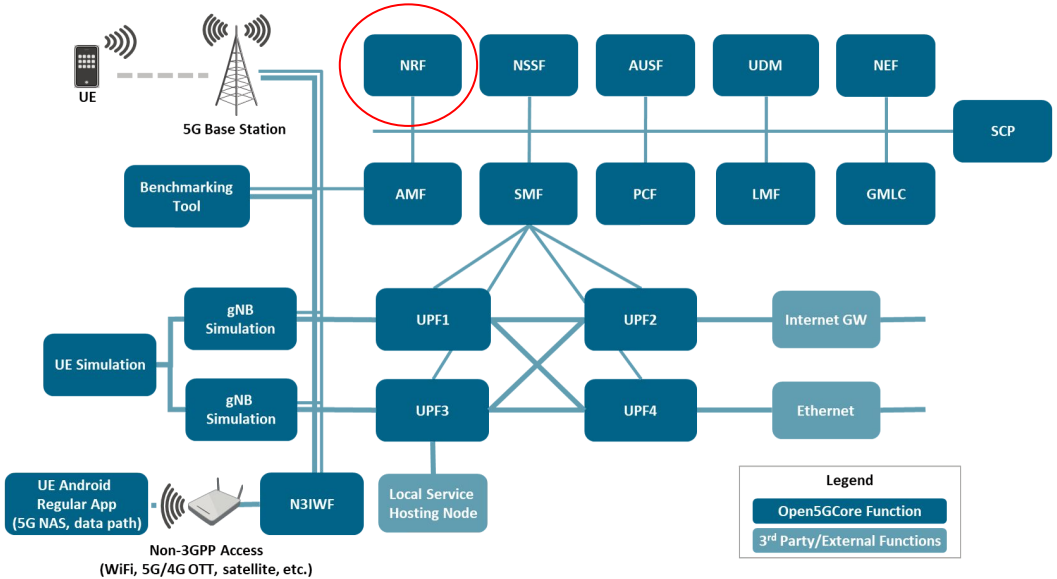


Fig.3: 5G Core network architecture for the Open5GCore project

5G core network architecture is **service oriented**

- Each Network Function (NF) is implemented in a service
- The interaction of the different services makes possible the communication
- Each service contacts the Network Repository Functions (NRF) to know all the NFs available and how to contact them

Part 2 : 5G architecture : microservices

The different services and their interactions

UPF

User Plane Function :
Encapsulate UE's PDUs and sends it to the internet. It works as a gateway

AMF

Access and Mobility Management Function:
NF of the Core Network in charge of the good management of the registrations on the network, the handovers and the maintenance of the client databases.

AUSF

Authentication Server Function:
Takes care of the authentication of the users of the 5G network. It interacts closely with the AMF and the UDM.

UDM

Unified Data Management:
Local information storage about the customers.

UDR

Unified Data Repository:
Centralized customers information such as their subscription

SMF

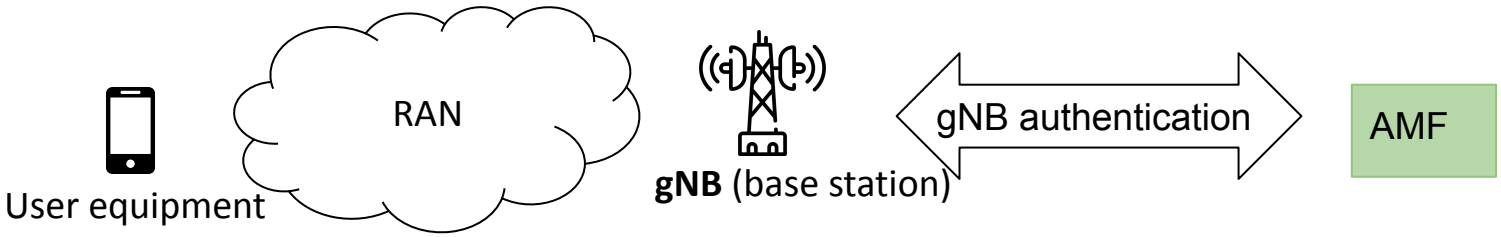
Session Management Function:
NF in charge of the management of the PDUSession, it allocates the IP addresses. It interacts closely with the UPF.

NSSF

Network Slice Selection Function :
NF in charge to determine to which slice (class of traffic) the flow belongs to.

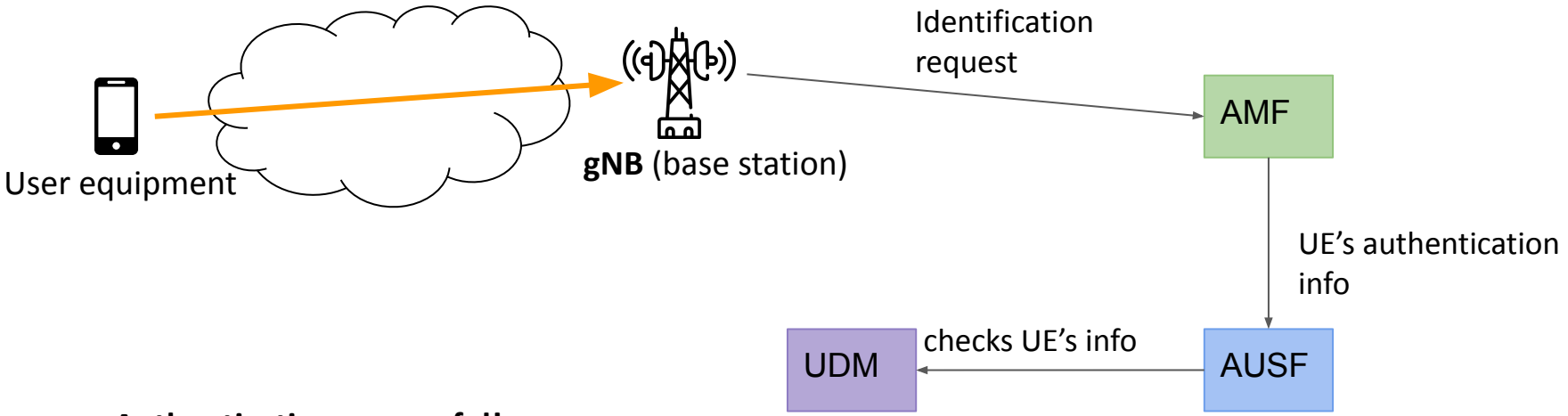
Part 3 : The different services and their interactions

An example of an UE's connection

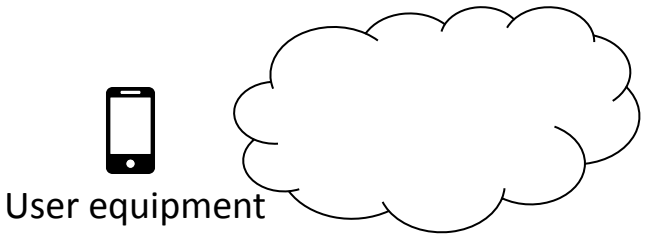


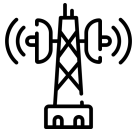
Part 4 : An example of an UE's connection

An example of an UE's connection

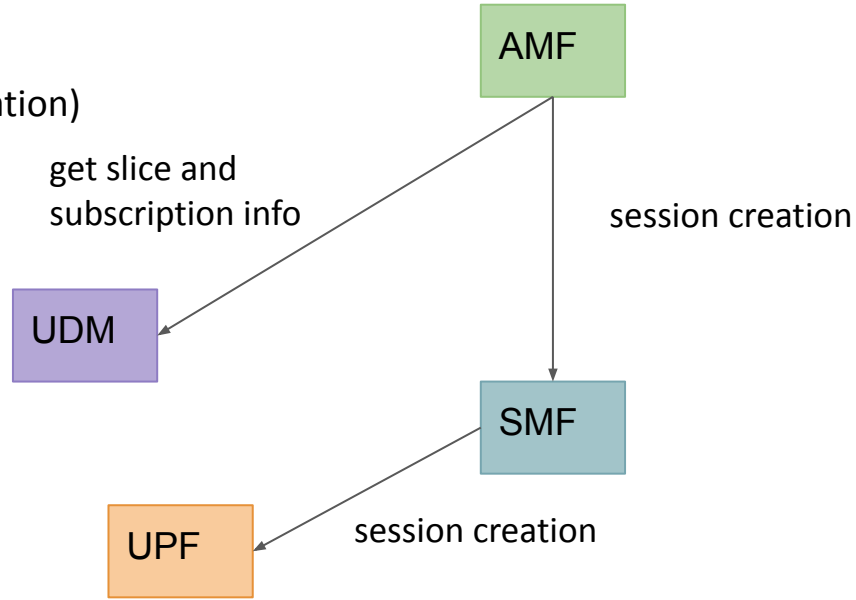


An example of an UE's connection





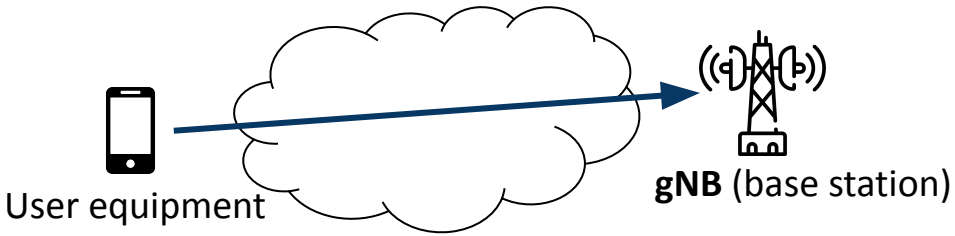
gNB (base station)



Session created and IP attributed

Part 4 : An example of an UE's connection

An example of an UE's connection



UE traffic encapsulated

UE traffic

Internet

Traffic generation

UPF

Conclusion and perspectives

Existing 5G based on the Core Network of 4G : 5G **Non Stand-Alone**

5G **Stand Alone** implementation suppose heavy modifications of the existing operators' infrastructures

5G Core Network **softwarization** offers the flexibility and adaptability to meet the needs of today's applications

Some **Open Source** 5G implementations allow you to create your own 5G network, like in LAAS-CNRS (based on OpenAirInterface)

The research and standardization work for **6G** has already started

Conclusion and perspectives

Thank you for your attention

All your questions are welcome

Sources

UE registration procedure : https://yatebts.com/documentation/concepts/5g-core-network/

Icones : https://www.flaticon.com

Growth of the IoT market : https://iot-analytics.com/iot-market-size/

Architecture of the 5G core network : https://www.open5gcore.org

Details about 5G services : https://www.3gpp.org/technologies/5g-system-overview

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