B. Fundamentals of 5G
Chapter #2: Introduction to (5G) Networking

ET0743
5G and AIoT Applications

Week #2 – #3

Learning Objectives

At the end of instruction, the learner should be able to:

- Understand 5G and its fundamentals (online learning of Qualcomm Training)
- Explain the 5G network architecture and its components.
- Describe the 5G spectrum and its frequency bands.
- Understand the 5G radio access technology (RAT) and its evolution.
- Understand the 5G core network and its services.

QWA: 5G Primer

- Click on:
  https://academy.qualcomm.com/course-catalog/5G-Primer
- Add to cart.

QWA: Fundamentals of Cellular Communication and 5G

- Then click on:
  https://academy.qualcomm.com/course-catalog/Fundamentals-Cellular-Communication-5G
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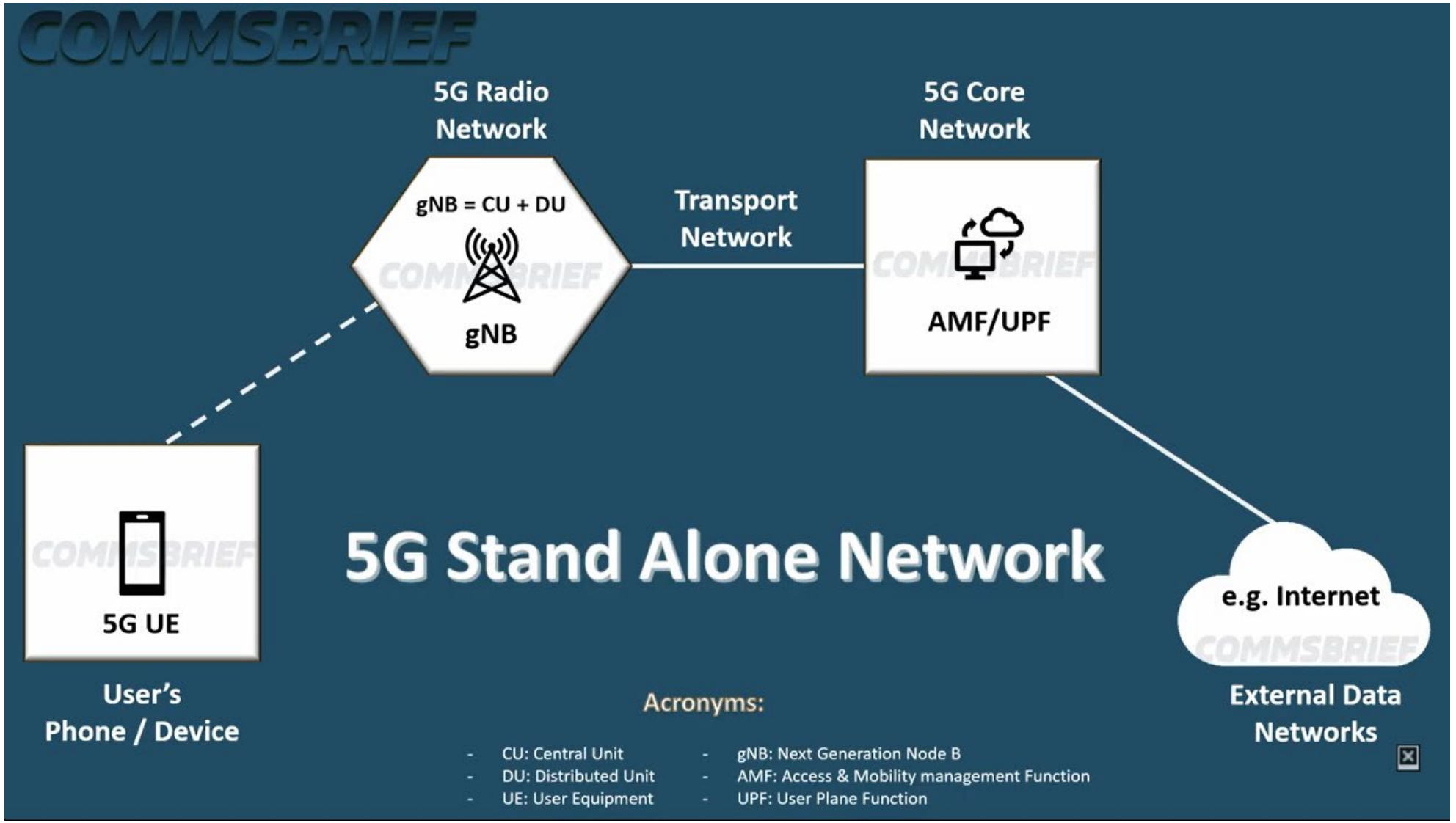
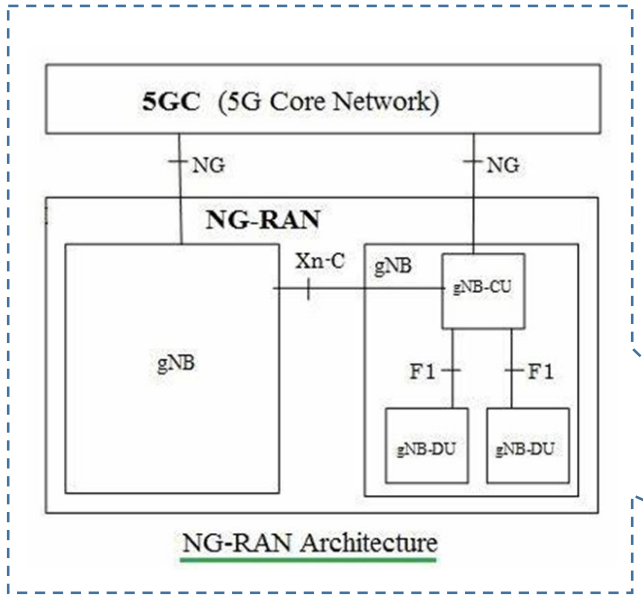
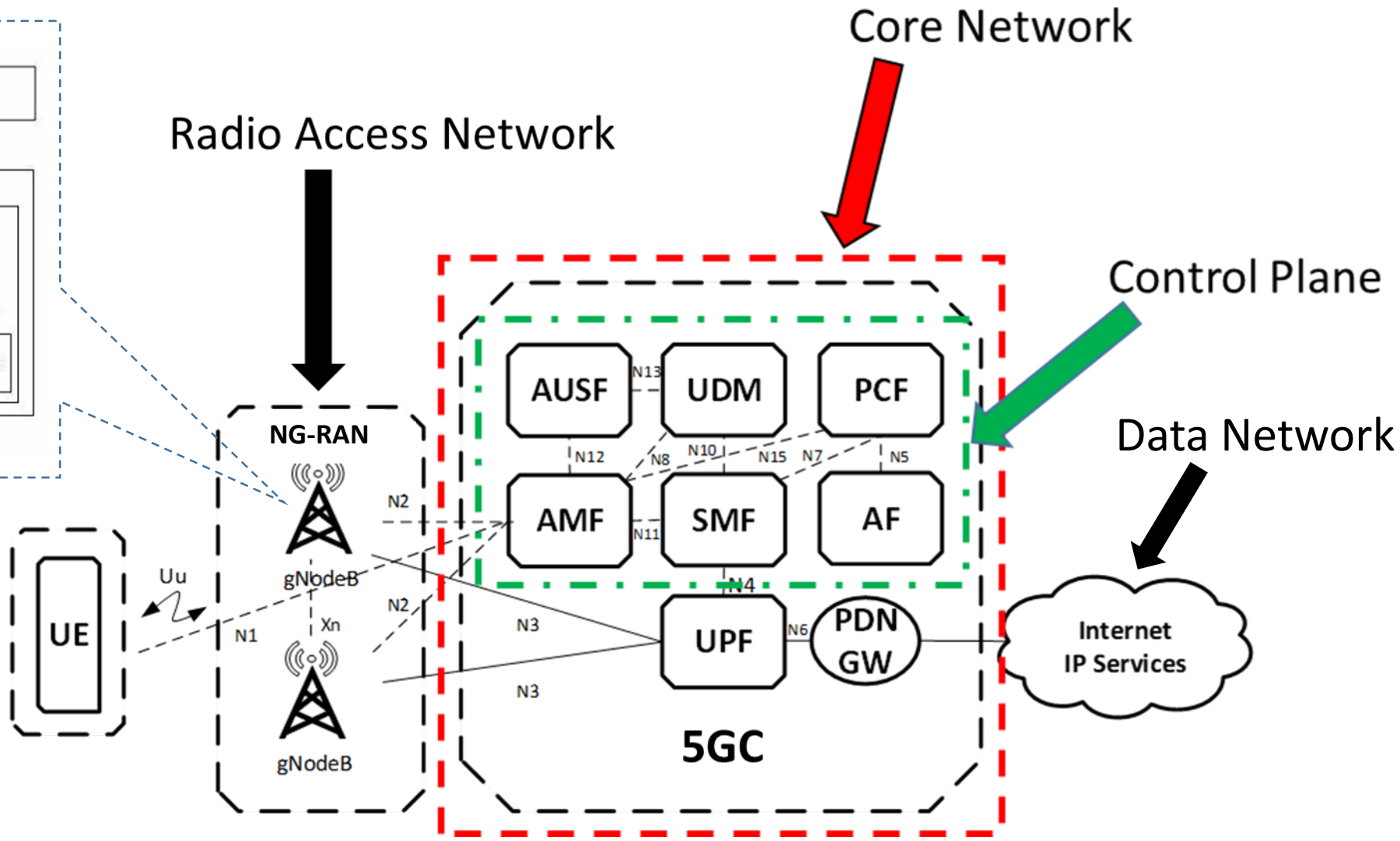
5G Network Architecture and its Components



5G Network Architecture and its Components





5G Network Architecture consists of:

- gNodeB
- Access and Mobility Function (AMF)
- User Plane Function (UPF)
- Session Management Function (SMF)
- Authentication Server Function (AUSF)
- Unified Data Management (UDM)
- Policy Control Function (PCF)
- Application Function (AF)

5G Spectrum and its Frequency Bands

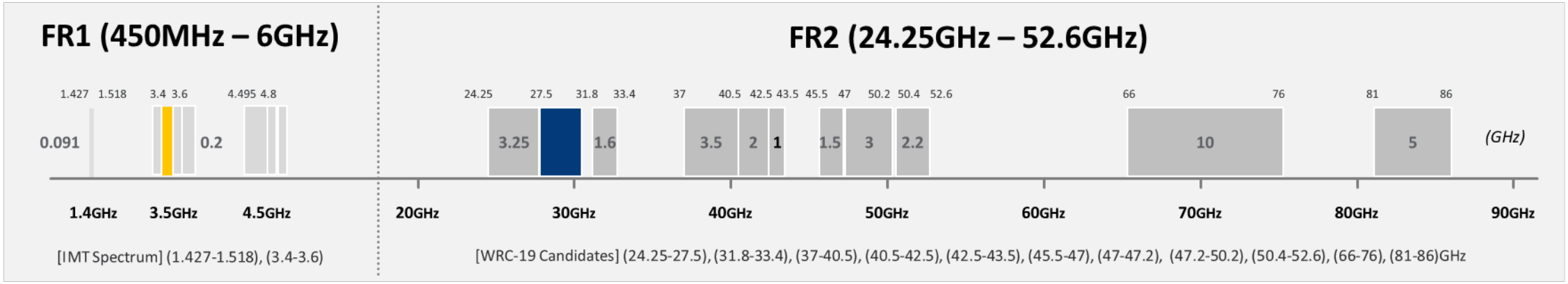
What is 5G New Radio (NR)?

Source:
https://www.verizon.com/about/our-company/5g/what-is-5g-nr

- Mobile phones use ***R***adio ***F***requency (RF) waves to facilitate (voice/digital signals/internet data) communications.
- 5G NR stands for a ***5***th ***G***eneration ***N***ew ***R***adio interface (Examples of other kinds of radio access technologies are Bluetooth, Wi-Fi and 4G LTE.)
- 5G NR uses two frequency ranges:
  - ***F***requency ***R***ange 1 (FR1) includes 6 GHz frequency bands and below.
  - ***F***requency ***R***ange 2 (FR2) includes bands in the millimeter wavelength (or mmWave) range, which includes 24 – 100 GHz.

5G Spectrum and its Frequency Bands

- 5G Candidate frequency bands



- New 5G frequency allocation status

USA
- 27.5 - 28.35GHz
- 37 - 38.6GHz
- 38.6 - 40GHz
- 37 – 43.5 GHz

Europe
- 3.4 – 3.8GHz
- 24.25 – 27.5GHz

China
- 3.3 – 3.6GHz
- 4.8 – 5.0GHz
- 24.25 – 27.5GHz
- 37 – 42.5GHz

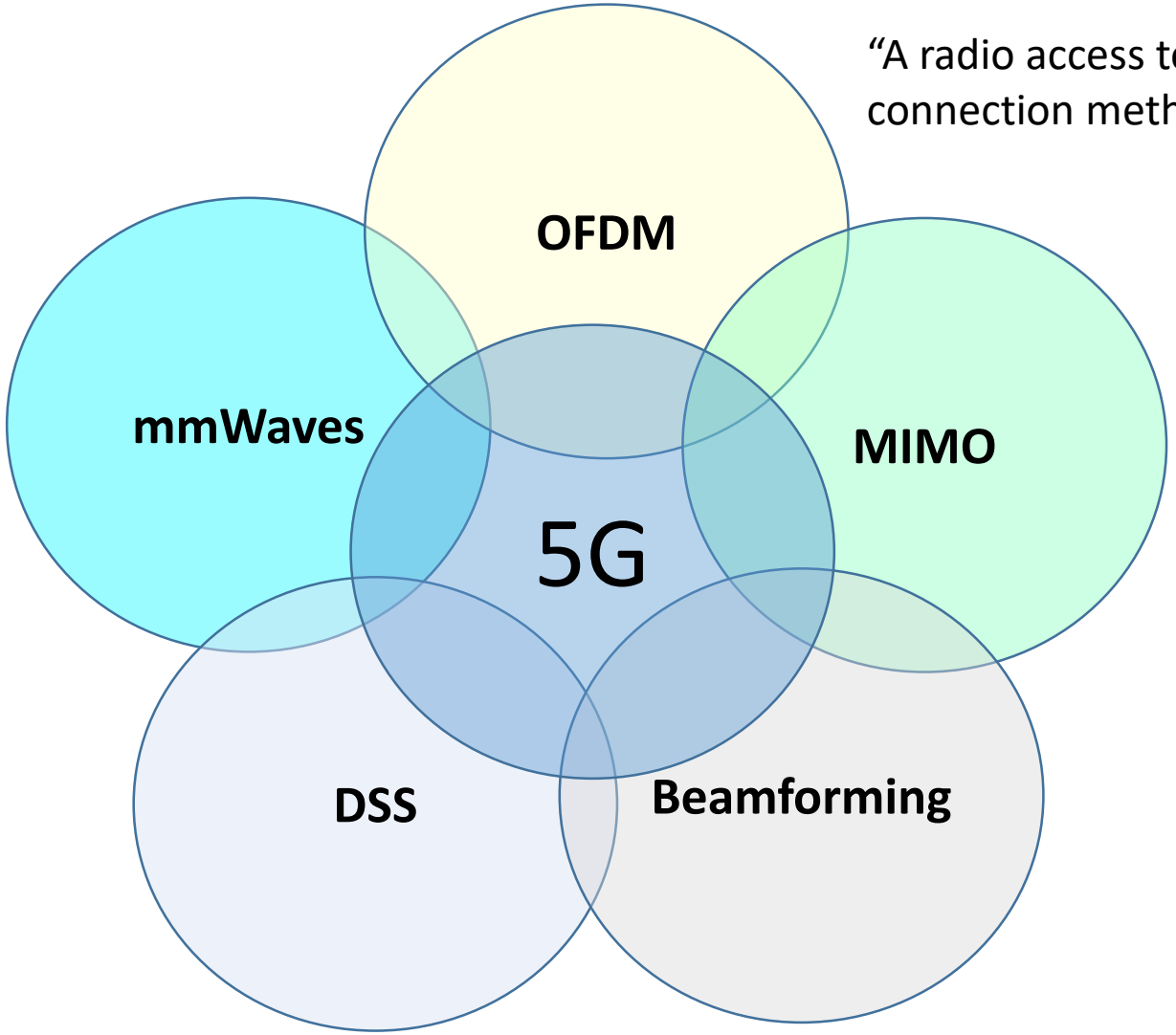
Japan
- 3.6 - 4.2GHz
- 4.4 - 4.9GHz
- 27.5 - 29.5GHz

Korea
- 3.4 – 3.7GHz
- 26.5 – 29.5GHz

n77	3.3 – 4.2 GHz
n78	3.3 – 3.8 GHz
n79	4.4 – 5.0 GHz
n257	26.5 – 29.5 GHz
n258	24.25 – 27.5 GHz
n260	37 – 40 GHz
n261	27.5 – 28.35 GHz

Source: 3GPP

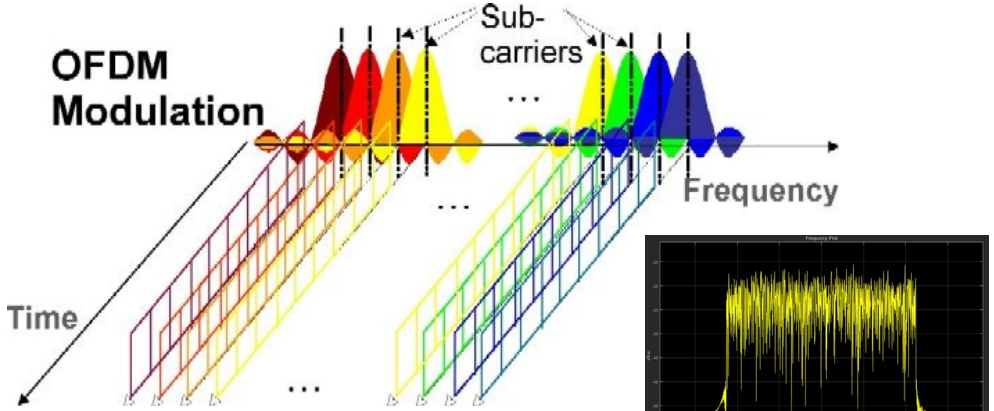
5G Radio Access Technology (RAT) and its Evolution

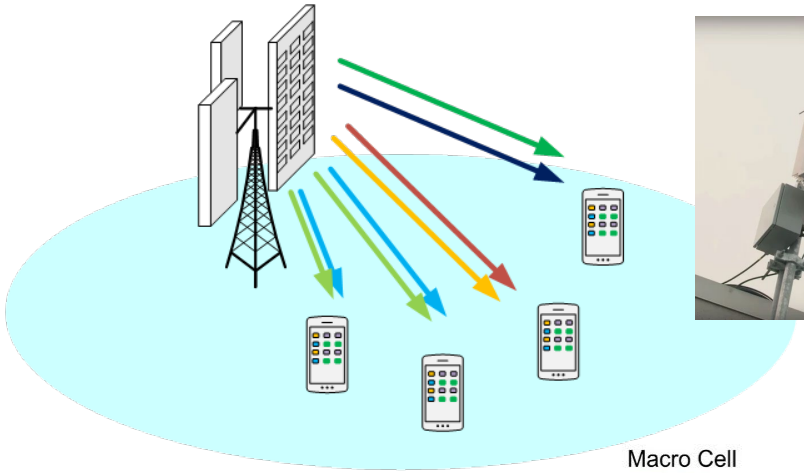


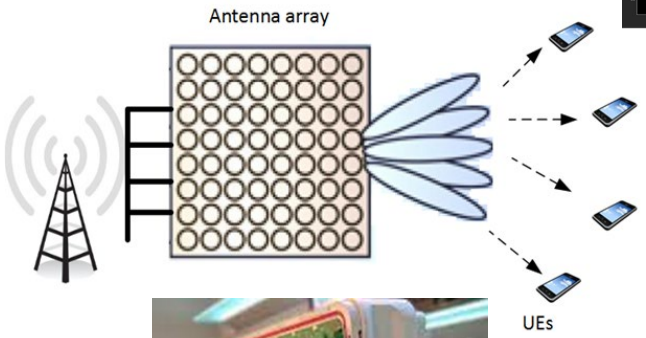
"A radio access technology (RAT) is the underlying physical connection method for a radio communication network." – Wiki

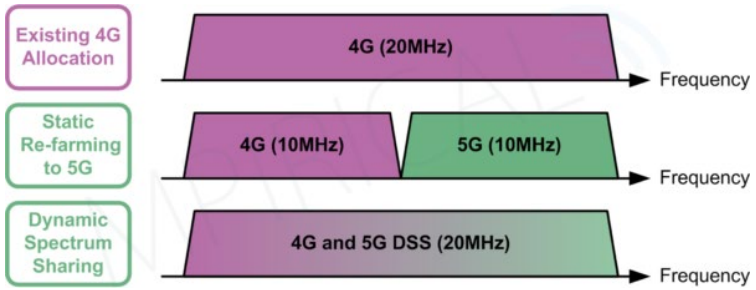
- Extension of orthogonal frequency-division multiplexing (OFDM), which is a method of encoding more digital data onto multiple carrier frequencies.
- Multiple-input and multiple-output (MIMO), which involves using many antennas simultaneously to increase data speeds and reduce errors.
- Beamforming, which combines RF signals from multiple antennas to produce a stronger signal that is focused toward a specific device or receiver.
- Dynamic spectrum sharing (DSS) provides a very useful migration path from LTE to NR by allowing LTE and NR to share the same carrier.
- 5G can also use higher frequencies known as millimetre waves (mmWaves) where much more spectrum is available.

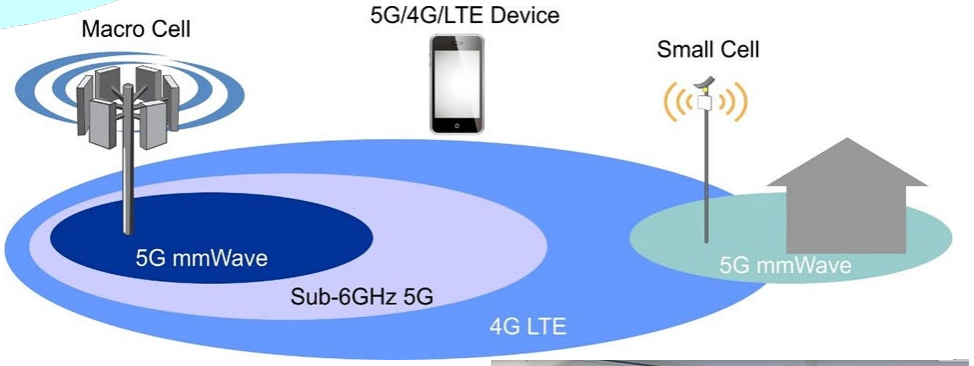
5G Radio Access Technology (RAT) and its Evolution

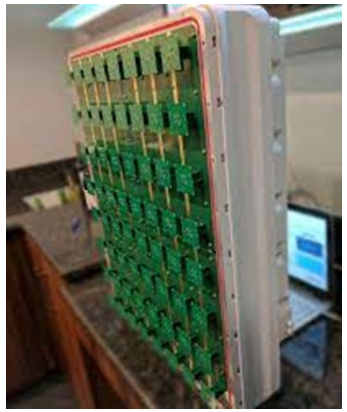


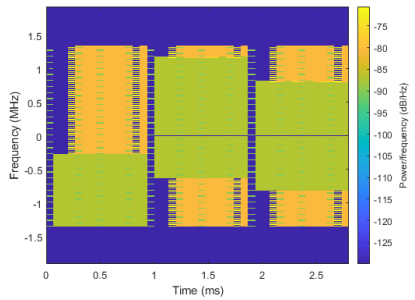




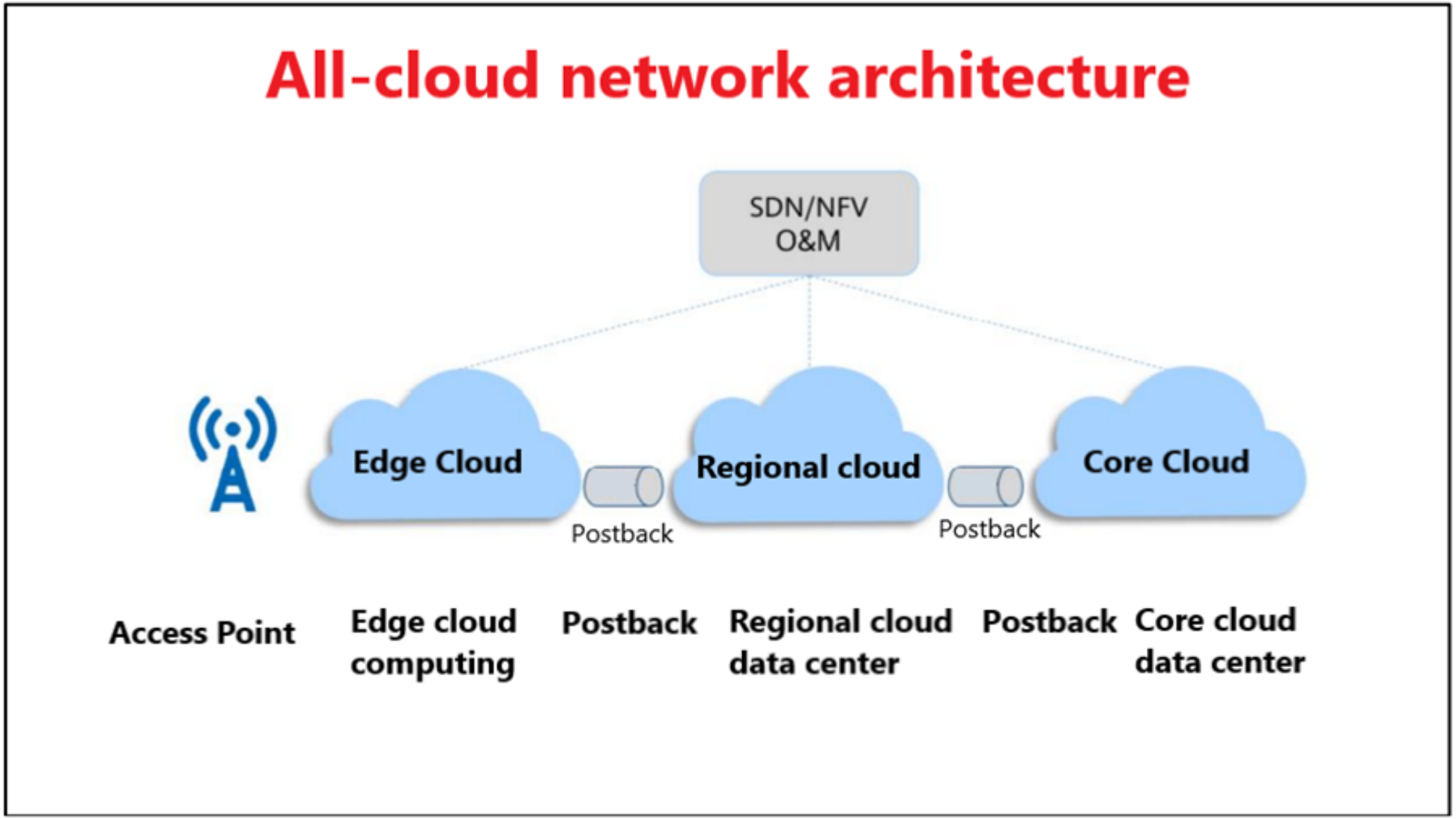








5G Core Network and its Services



5G Core Network and its Services