5G 3GPP

MXS-Seminar 5
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1. Introduction

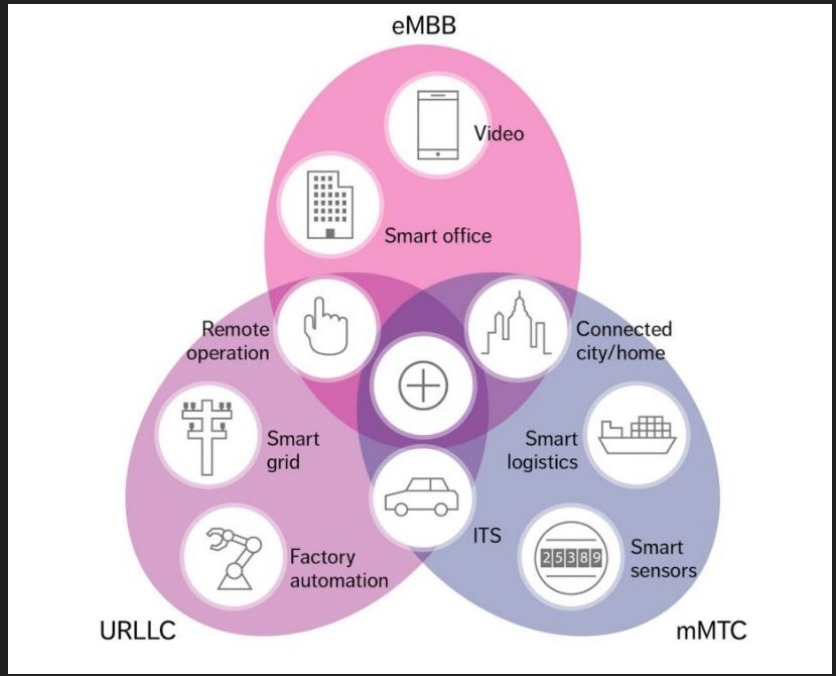
- ➔ High data rates
- ➔ Large capacity
- ➔ New requirements:
  - ❖ Low latency
  - ❖ High reliability
  - ❖ Diverse terminal reliability
  - ❖ Diverse industry support

2. 5G Standardization Schedule

- ITU-R
  - From 2016
- 3GGP
  - Release 14
    - 2016/2017
  - Release 15
    - 2018
  - Release 16
    - End of 2019

3. MAIN REQUIREMENTS FOR 5G

- ➔ 5G USE CASES
  - ◆ eMMB
    - Peak data 20 Gbps
  - ◆ mMTC
    - Distance from the base station
  - ◆ URLLC
    - Very low latency



3. MAIN REQUIREMENTS FOR 5G

Category	Related specifications	Requirements	Main use cases
eMBB	TR22.863 TS22.261	High data rate, high traffic density, diverse coverage, high user mobility	Indoor, hotspots, wide area
CriC	TR22.862 TS22.261	High reliability and low latency, high reliability, high availability, and low latency, very low latency, high accuracy positioning	Virtual presence, tactile Internet, remote control, telemedicine, remote first-aid, drone control
MIoT	TR22.861 TS22.261	Improved operation, diversified connectivity, and improved resource-usage efficiency in relation to IoT	Improved IoT device initialization, large-capacity support, wearable device communication, bio-connectivity, wide area monitoring
NEO	TR22.864 TS22.261	System flexibility, scalability, mobility, efficient content delivery, and improved security, plus diverse backhaul/access considerations and migration/interworking considerations	*Common system requirements independent of services
eV2X	TR22.886 TS22.186	High data rate, high reliability, high availability and low latency, wide area coverage	Autonomous driving, convoy driving, remote driving

CriC: Critical Communications
MIoT: Massive IoT
TS: Technical Specification
eV2X: enhanced V2X
NEO: NEtwork Operation

3. MAIN REQUIREMENTS FOR 5G

Use-cases	Key performance indicator	NR		LTE-Advanced		LTE (Release 8)	
		DL	UL	DL	UL	DL	UL
eMBB	Peak data rate	20 Gbps	10 Gbps	1 Gbps	500 Mbps	100 Mbps	50 Mbps
	Peak spectral efficiency	30 bps/Hz	15 bps/Hz	30 bps/Hz	15 bps/Hz	3~4 ×HSDPA (Release 6)	2~3 ×HSUPA (Release 6)
	C-plane latency	10 ms		Less than 50 ms		Less than 100 ms	
	U-plane latency	4 ms		Reduced U-plane latency compared to Release 8		Less than 5 ms	
	Cell/TRxP spectral efficiency (bps/Hz/TRxP)	3 times higher than LTE-Advanced		—		—	
	Area traffic capacity(bps/m^2)	3 times higher than LTE-Advanced		—		—	
	User experienced data rate (bps)	3 times higher than LTE-Advanced		—		—	
	5% user spectrum efficiency (bps/Hz/user)	3 times higher than LTE-Advanced		Cell edge user throughput (bps/Hz/cell/user)		User throughput	
				0.12 (2×2 ANT)	0.04 (1×2 ANT)	2~3 ×HSDPA	2~3 ×HSUPA
	Target mobility speed (relates also to URLLC, mMTC)	500 km/h		350 km/h		350 km/h	
	Mobility interruption time (relates also to URLLC, mMTC)	0 ms		—		—	

3. MAIN REQUIREMENTS FOR 5G

mMTC	Coverage	Max coupling loss 164 dB	Max coupling loss 164 dB (NB1)	—
	UE battery life	Beyond 10 years	Up to 10 years	—
	Connection density	1,000,000 devices/km^2	60,680 devices/km^2	—
URLLC	U-plane latency	0.5 ms	—	—
	Reliability	10^{-5} for 32 bytes with U-plane latency of 1 ms	—	—

3. MAIN REQUIREMENTS FOR 5G

- ➔ RECENT TRENDS IN STUDIES
  - ◆ Release 16
    - Railways and power
    - Automobile industry

4. Features of NR and 5G Core Network

- ➔ NR Features
  - ◆ Non-autonomous operation support
    - Provides service in combination with an LTE / LTE-Advanced area
    - No NR area provided by itself
  - ◆ Existing LTE / LTE-Advanced networks already provide services with 2 GHz and 800 MHz frequency bands.
  - ◆ 5G is implemented using new high frequency bands
    - Example: millimeter wave band
    - Scenario consisting of local deployments from areas with high demand
    - More satisfactory user communications are provided than locally provided services for NR only.

- From an operator's point of view the non-autonomous operation that 5G provides in combination with LTE / LTE-Advanced allows NR to:
  - Added locally within an existing service area
  - Gradually expand according to demand

➔ Features of the 5G Core network with NR capability

- Core networks hosting NR:
  - Systems that extend Evolved Packet Core (EPC)
  - Systems to deploy a core 5G network

➔ The core 5G network, four main features:

- Reorganization of functions between terminals, the radio access network (RAN) and the central network
- Introduction of service-based architecture.
- Network virtualization support.
- Introduction of network segmentation and simultaneous connection of multiple gateways.

5. Scenarios for the implementation of NR and 5G core networks

- The rollout of 3G and LTE
  - A single stage
- The deployment of NR and the core 5G network:
  - Take advantage of the ability to provide NR through non-autonomous operation
  - Take advantage of the ability to accommodate LTE over the core 5G network.
  - Features that provide multiple deployment scenarios, see figure 1.

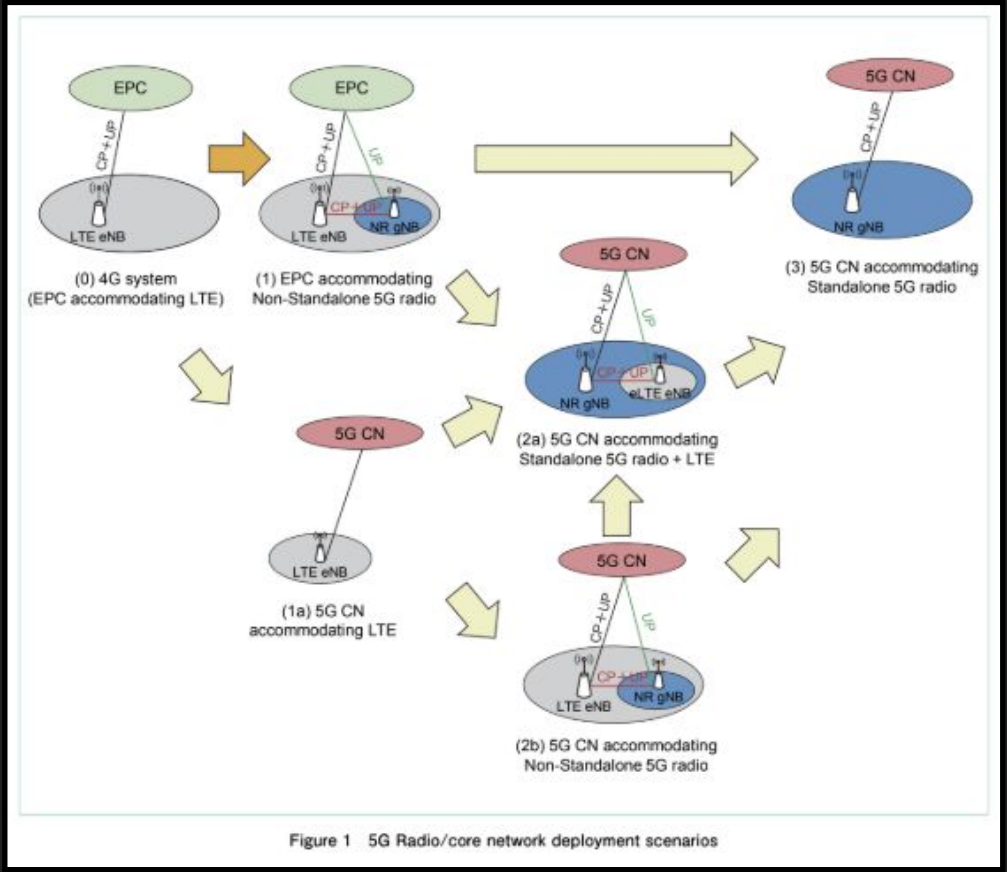


Figure 1 5G Radio/core network deployment scenarios

- ➔ Advantages of the non-autonomous NR accommodation format:
  - ◆ Maintains the stable quality of the coverage area already served by LTE / LTE-Advanced
  - ◆ Uses EPC that has proper stable operation to achieve eMBB
  - ◆ Minimize the number of new design elements and test elements at the time of 5G implementation.
- ➔ Non-autonomous NR accommodated by EPC
  - ◆ The scale of changes is limited by using EPC in its current state for the most part.
  - ◆ Studies in 3GPP include support for functions that will allow low latency even with EPC accommodation.

6. Conclusion

- ➔ General 5G standardization program
- ➔ 5G requirements and use cases
- ➔ The characteristics of NR and the core 5G network to meet those requirements
- ➔ Studies are moving forward in 3GPP
- ➔ NTT DOCOMO
  - ◆ Contributes to 5G standardization efforts in 3GPP and
  - ◆ Aims to contribute to further development of 5G standards