



Outlook on 5G: Network Transformation & Key challenges

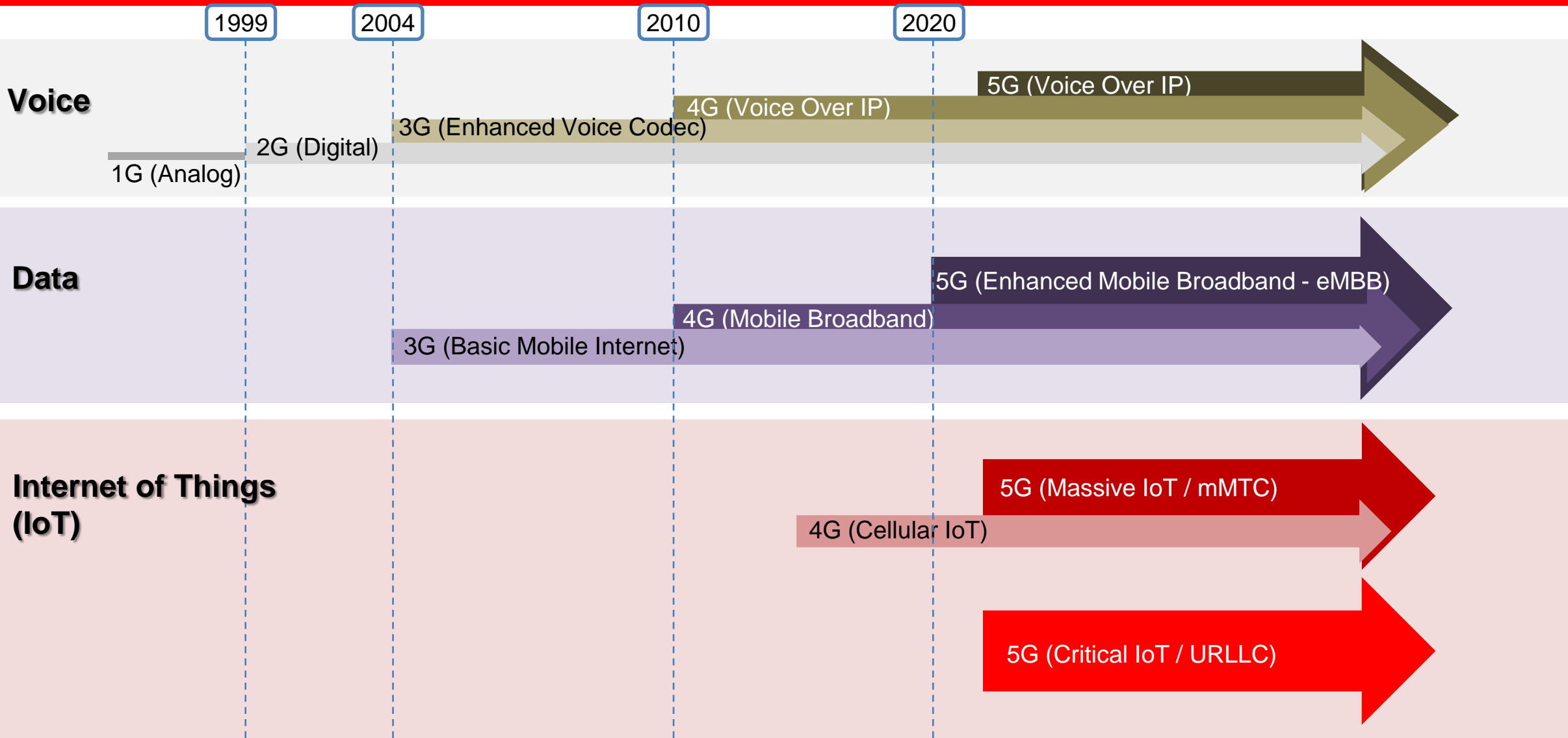
Network Planning & Strategy, TRUE Corporation

30 May 2018

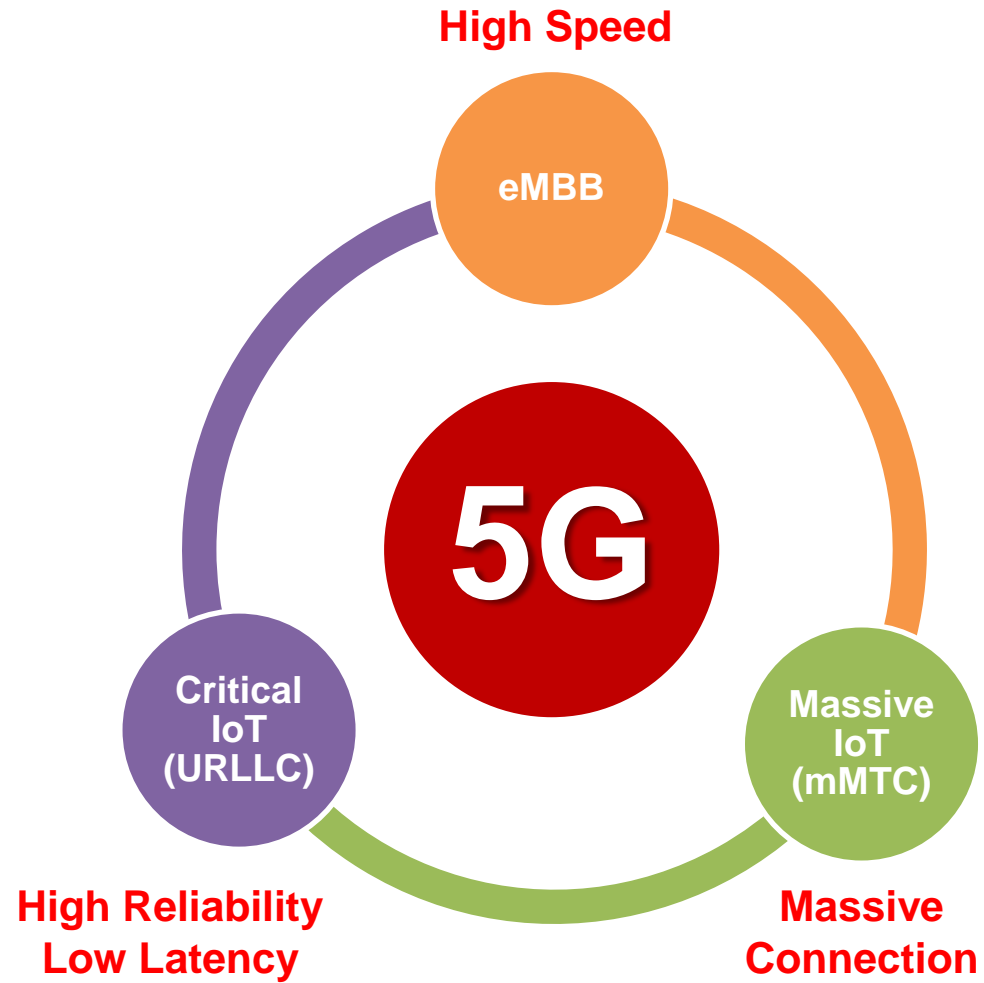
Contents

- A brief history of mobile network generations.
- Outlook on 5G Services.
- Road to 5G & Key challenges:
 - Network Infrastructure transformation
 - 5G Spectrum
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- Summary

A brief history of mobile network generations



5G Services



5G Use cases: eMBB

Virtual Reality



Augmented Reality



8K Ultra HD Video



5G Use cases: Massive IoT

FUTURE FARMS small and smart

SURVEY DRONES

Aerial drones survey the fields, mapping weeds, yield and soil variation. This enables precise application of inputs, mapping spread of pernicious weed blackgrass could increase wheat yields by 2-5%.

FLEET OF AGRIBOTS

A herd of specialised agribots tend to crops, weeding, fertilising and harvesting. Robots capable of micro-dose application of fertilizer reduce fertilizer cost by 99.9%.

FARMING DATA

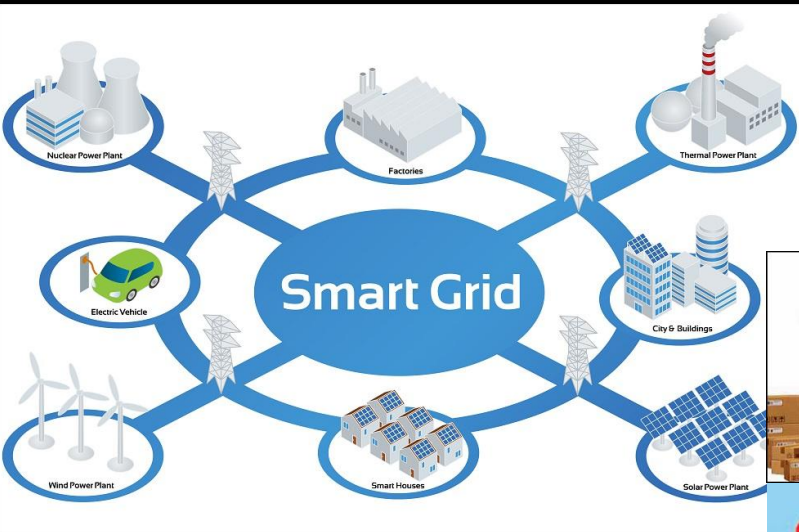
The farm generates vast quantities of rich and varied data. This is stored in the cloud. Data can be used as digital evidence reducing time spent completing grant applications or carrying out farm inspections saving on average £5,500 per farm per year.

TEXTING COWS

Sensors attached to livestock allowing monitoring of animal health and wellbeing. They can send texts to alert farmers when a cow goes into labour or develops infection increasing herd survival and increasing milk yields by 10%.

SMART TRACTORS

GPS controlled steering and optimised route planning reduces soil erosion, saving fuel costs by 10%.



ASSET Tracking

Illustration showing blue shipping containers and cardboard boxes with wireless signals, representing asset tracking in logistics.

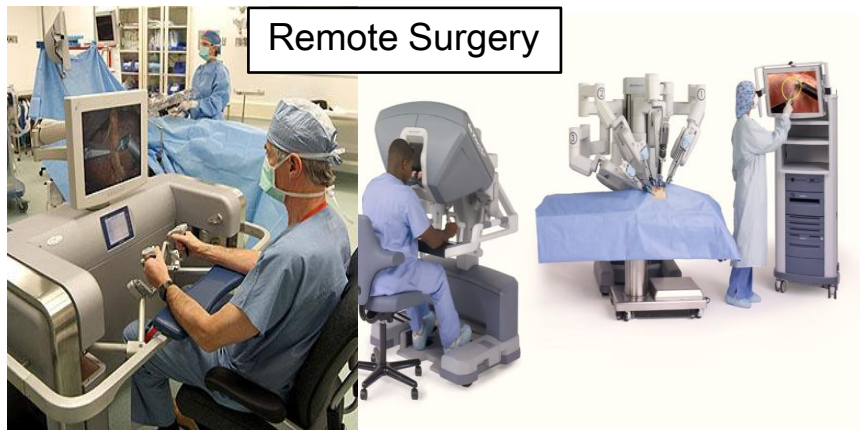
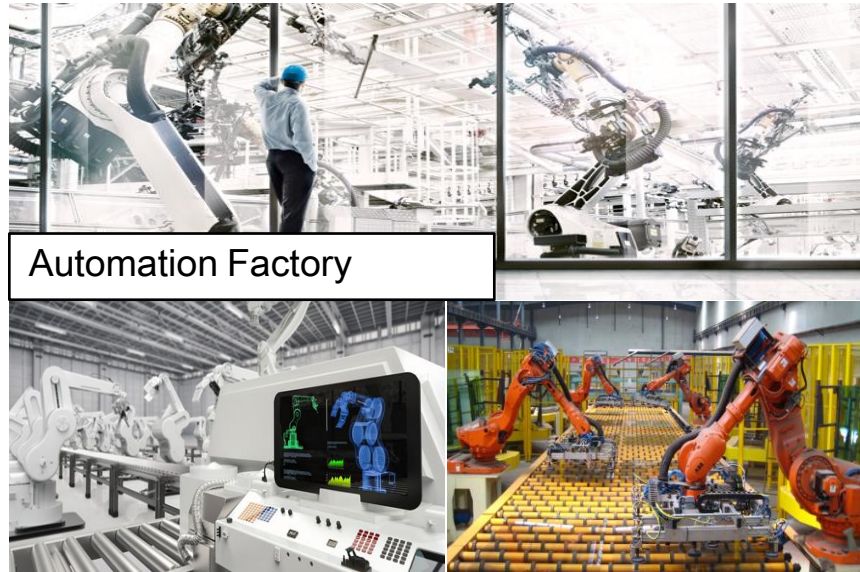


SMART TRANSPORT

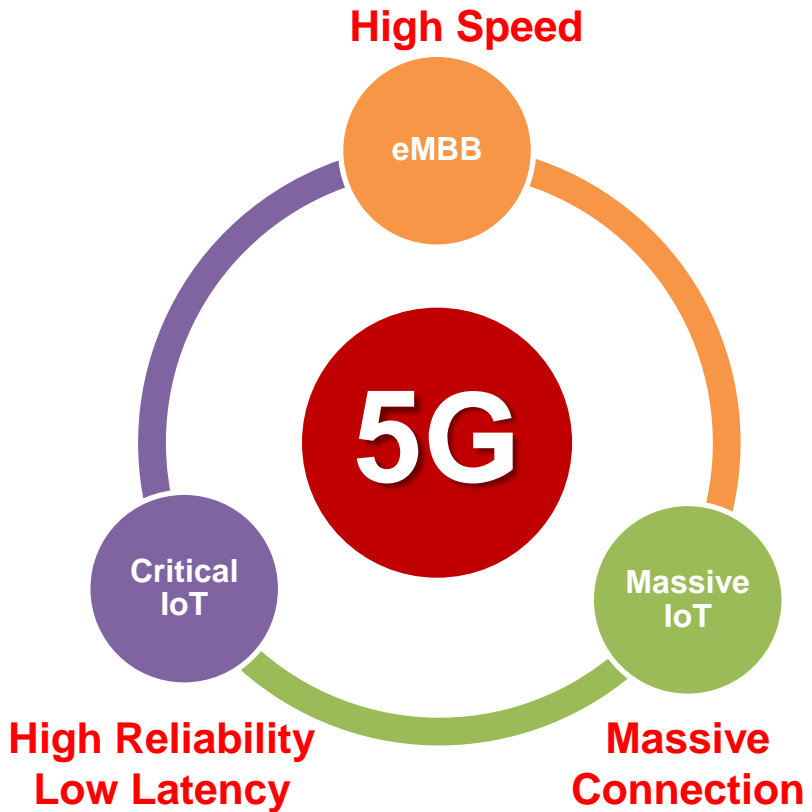
ระบบติดตามและตรวจสอบยานพาหนะอัจฉริยะ

Illustration of a red truck on a road, with a hand using a smartphone and tablet displaying navigation maps and speed (80 km/hr).

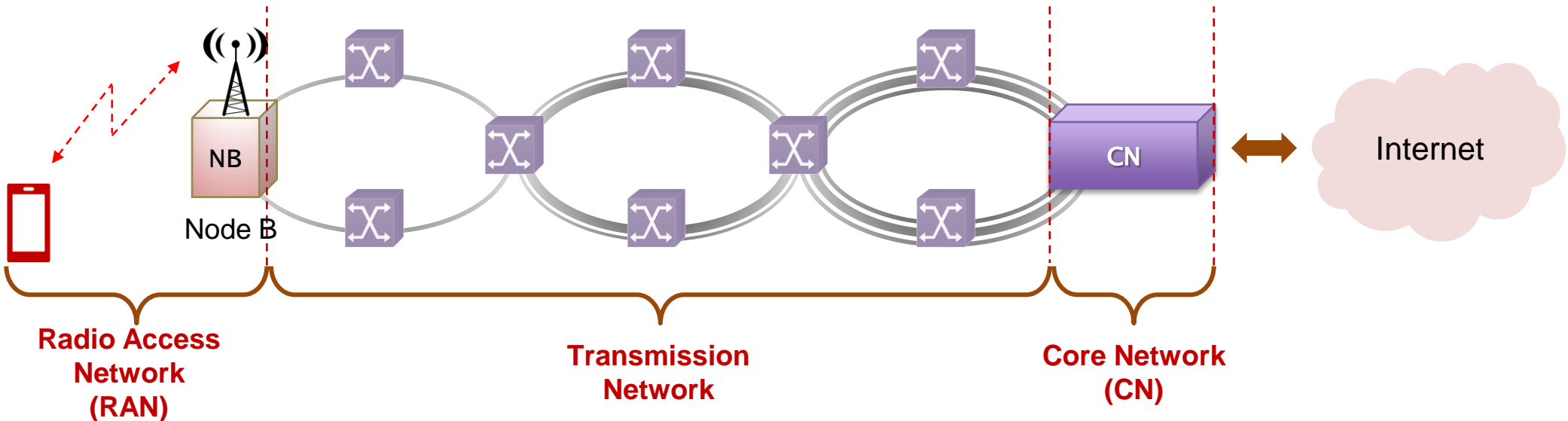
5G Use cases: Critical IoT



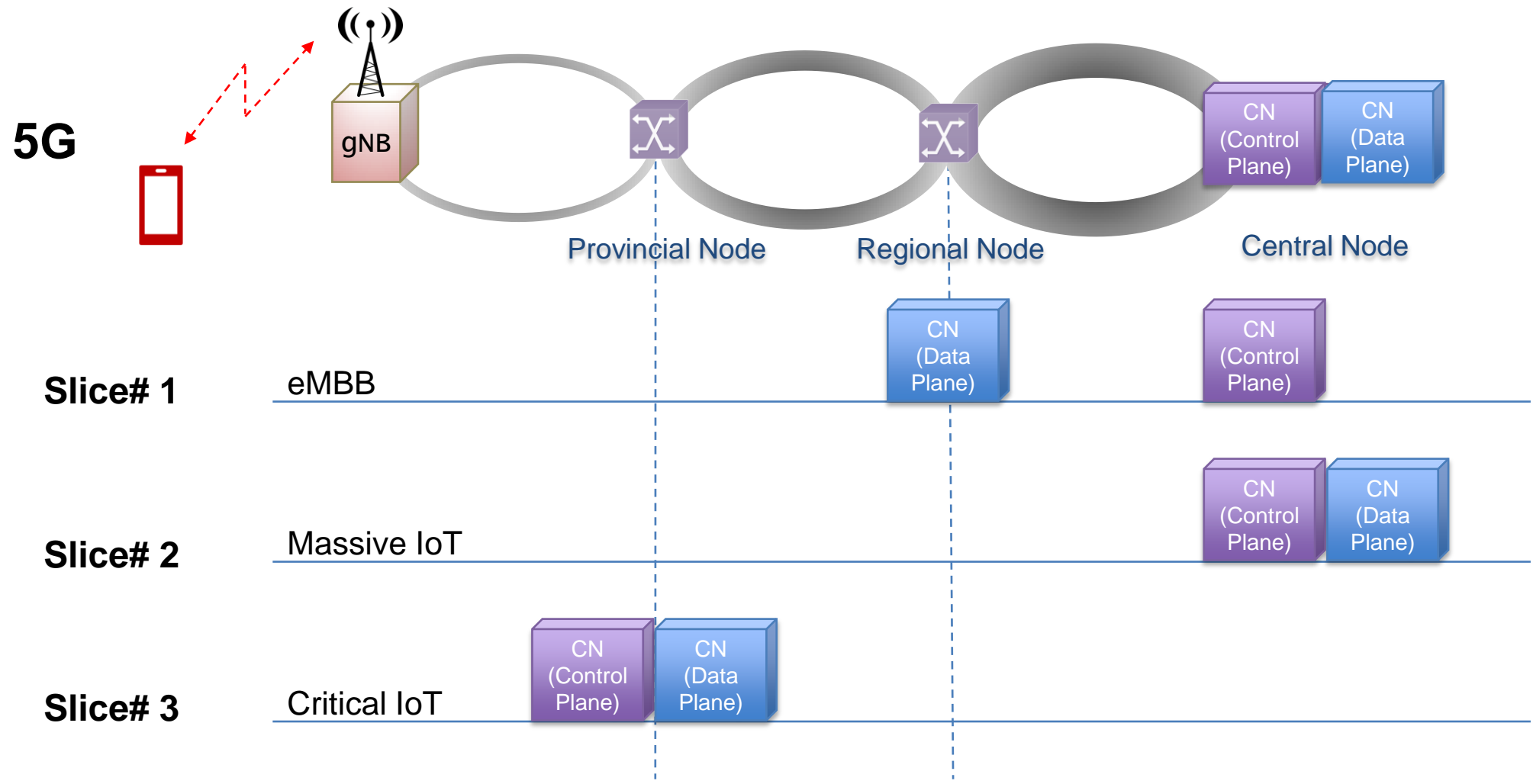
5G Services



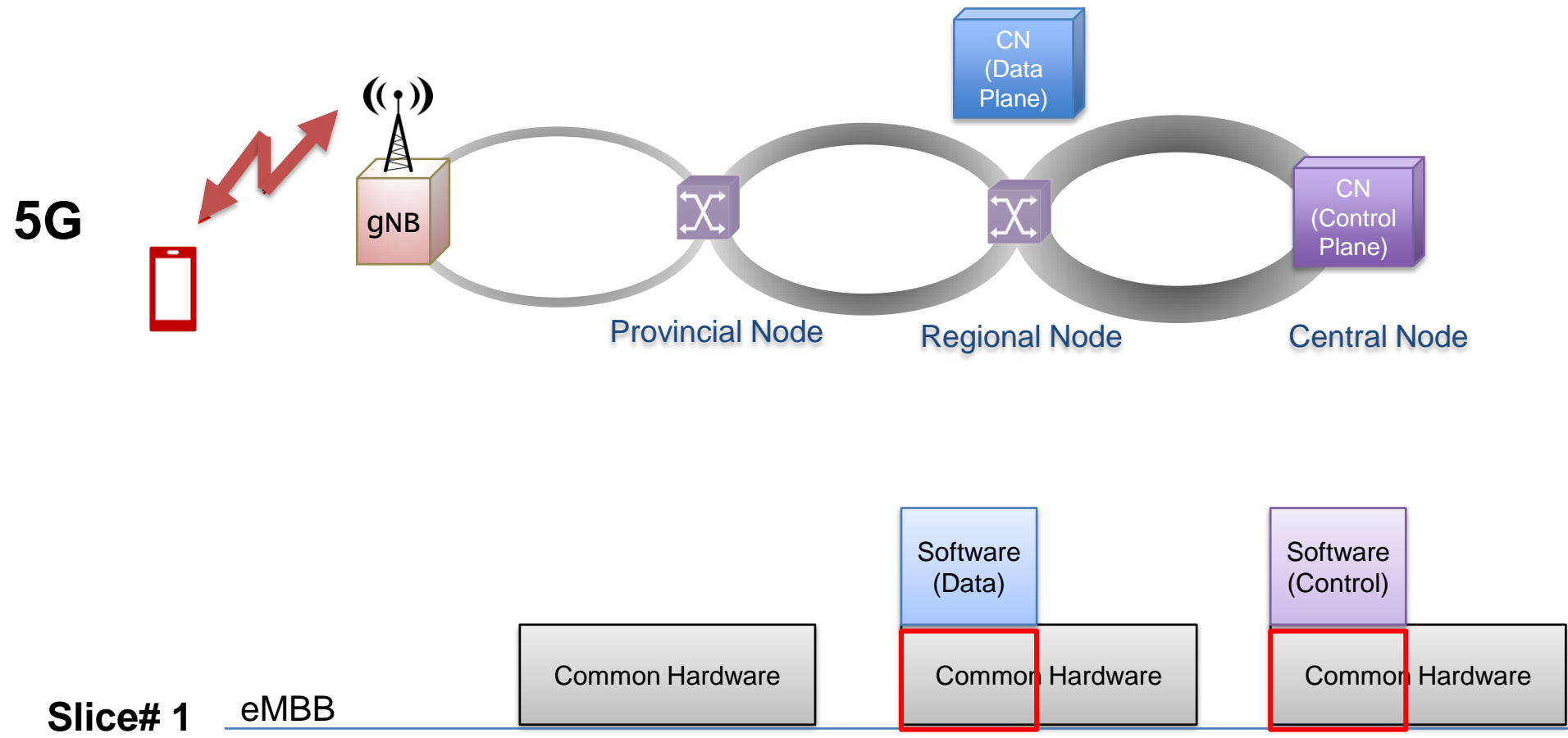
Mobile Network Infrastructure: Overview



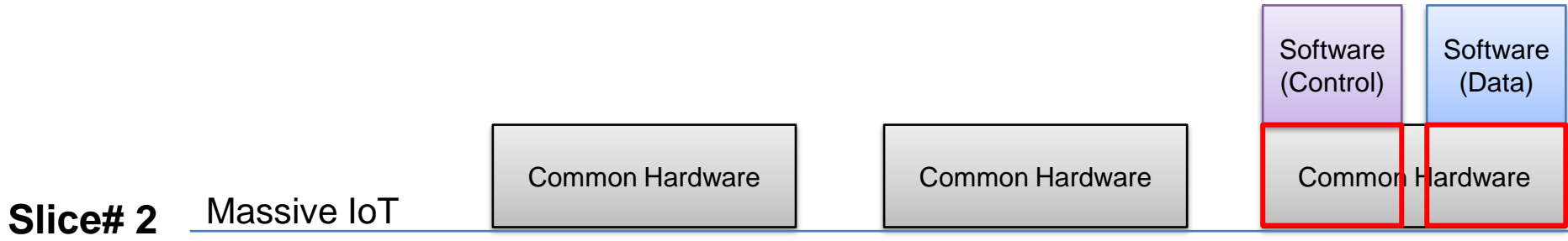
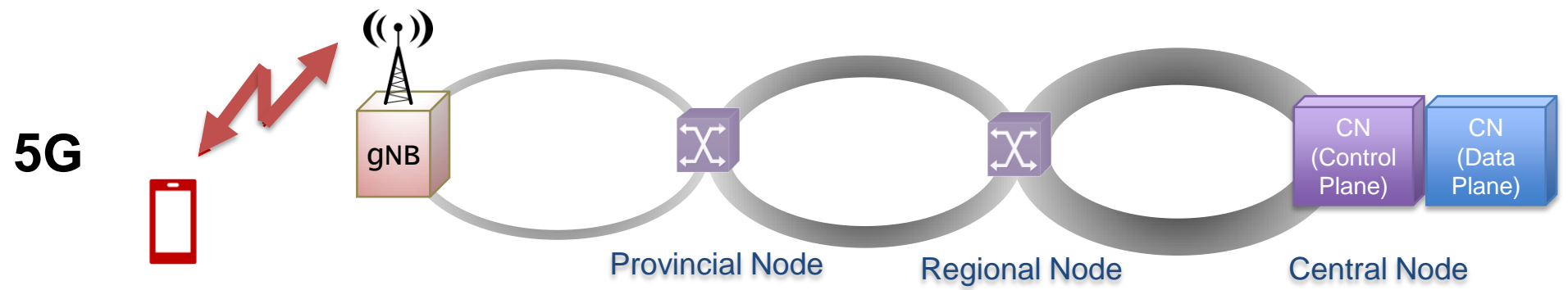
CN transformation: Network Slicing



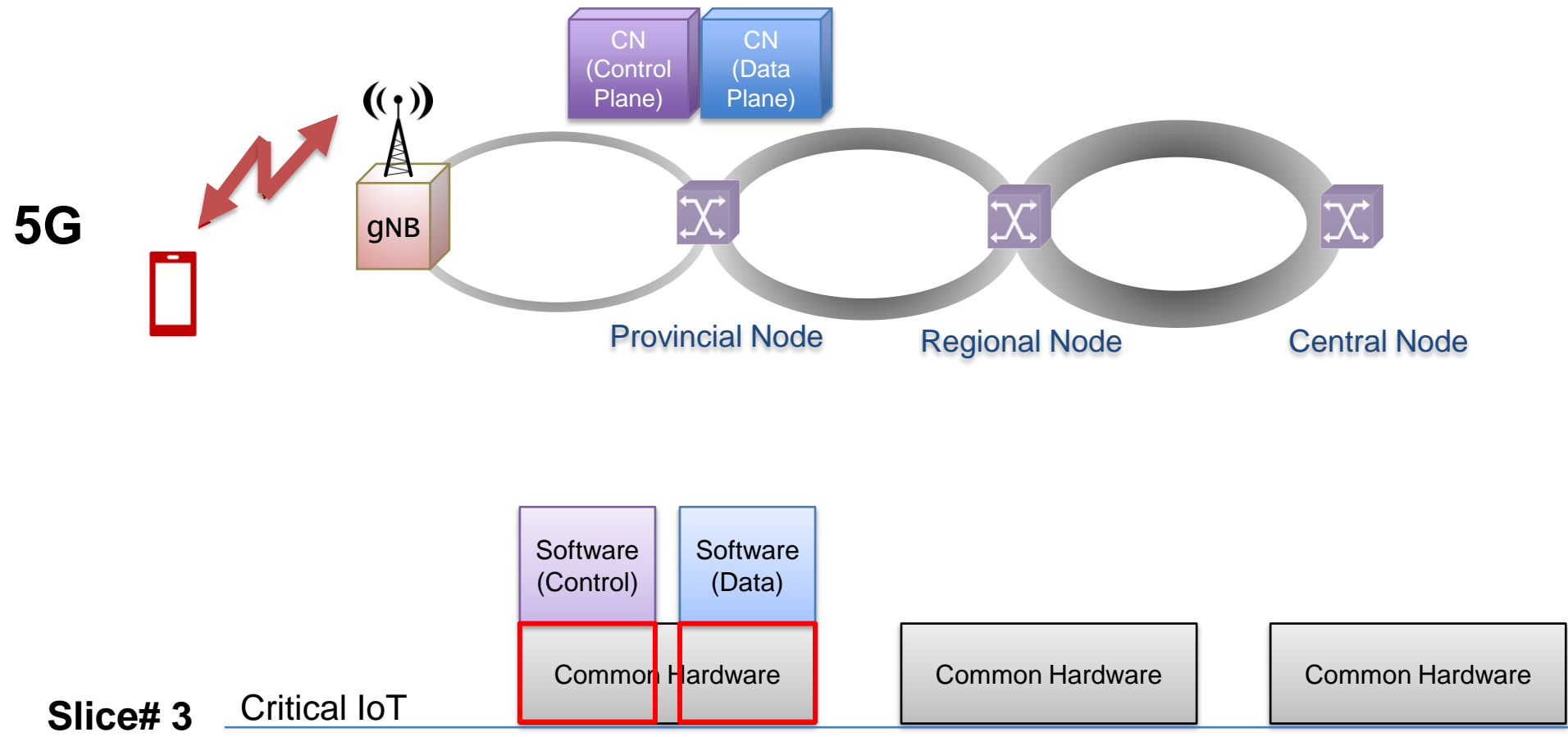
CN transformation: Network Virtualization



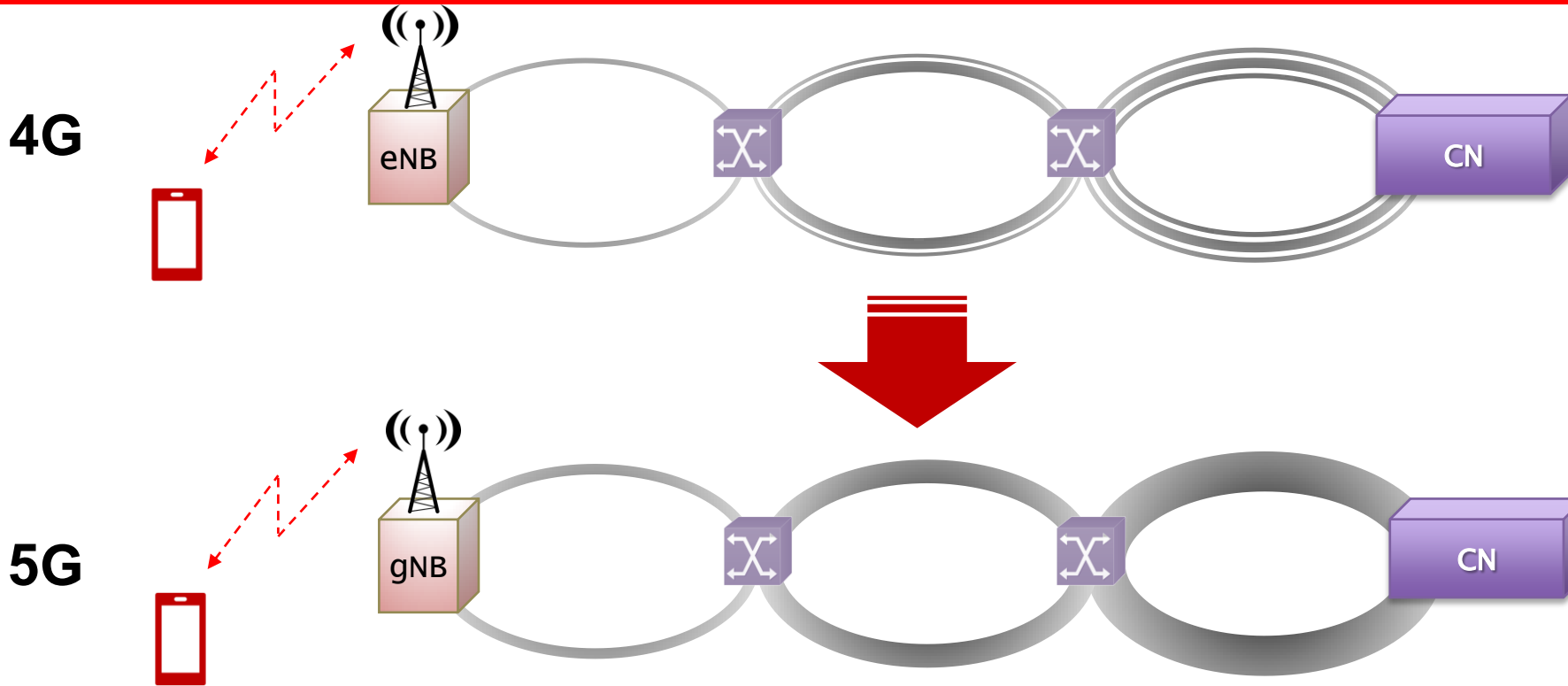
CN transformation: Network Virtualization



CN transformation: Network Virtualization



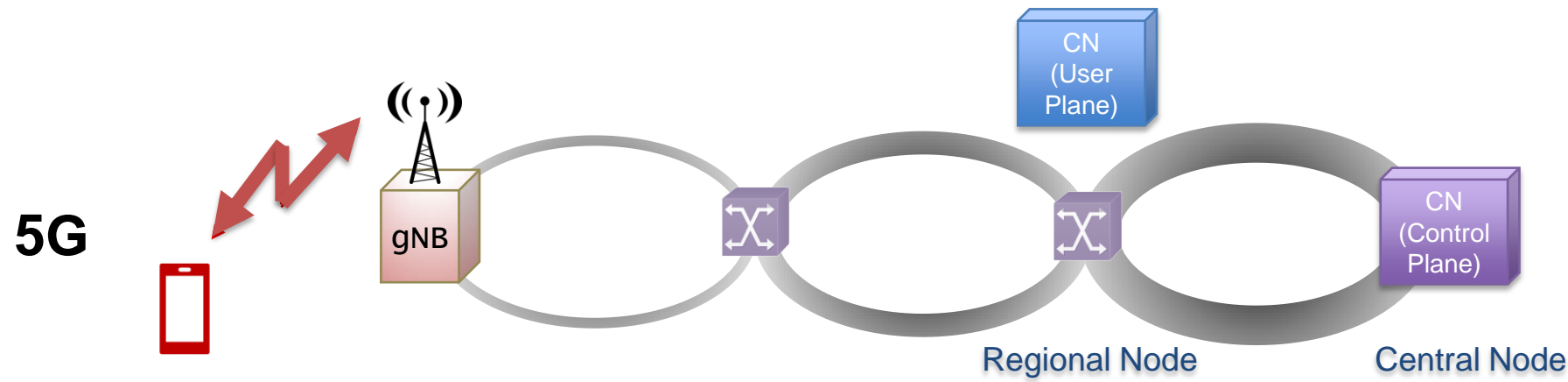
Transmission Network Transformation



Key Transformation:

- More transmission capacity.
- Low latency.
- Precise time synchronization.
- IPv6

Radio Network transformation



Key Transformation:

- More flexible => Virtualized RAN.
- More radio capacity, lower latency.

New spectrum

- 700MHz, 1.5, 2.3 and 3.5GHz
- mmW bands, >6GHz (2020+) enabling massive MIMO
- But also refarming

True Massive MIMO

- Beamforming
- Multiuser beamforming

Larger bandwidth

20

100's MHz or GHz

- Larger contiguous BW

Confined OFDM & Very low latency

- Spectrum more confined
- Vision of 1ms latency

5G Spectrum: Key challenges for 5G deployment in Thailand

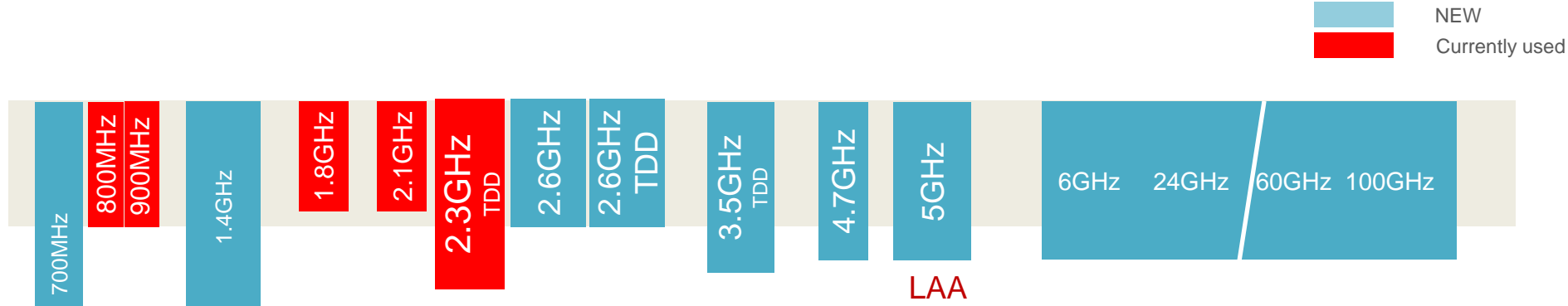


Table 14.1-1: Frequency range/LTE band requested by operators

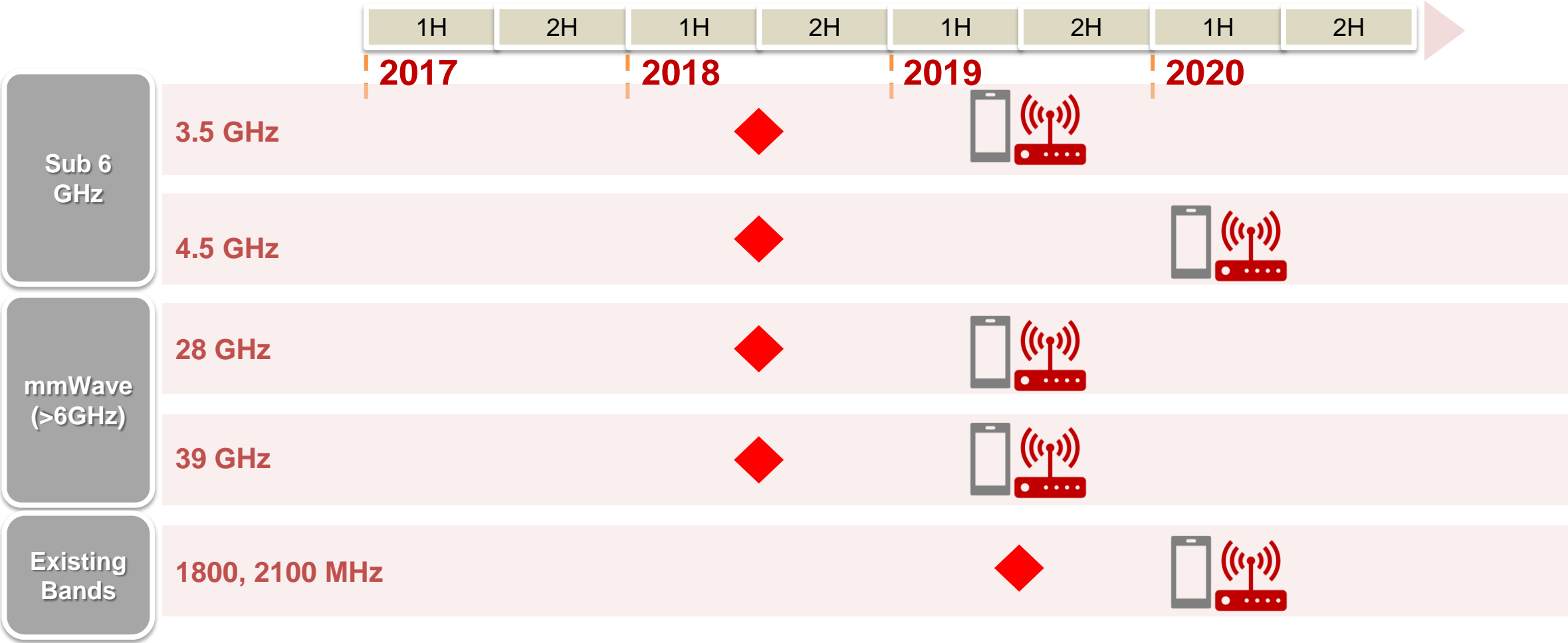
Frequency range/LTE band	Operators whose request is included in the frequency range
3.3-4.2 GHz	NTT DOCOMO, INC., KDDI, SBM, CMCC, China Unicom, China Telecom, KT, SK Telecom, LG Uplus, Etisalat, Orange, Telecom Italia, British Telecom, Deutsche Telekom
4.4-4.99 GHz	NTT DOCOMO, INC., KDDI, SBM, CMCC, China Unicom, China Telecom,
24.25-29.5 GHz	NTT DOCOMO, INC., KDDI, SBM, CMCC, KT, SK Telecom, LG Uplus, Etisalat, Orange, Verizon, T-mobile, Telecom Italia, British Telecom, Deutsche Telekom
31.8-33.4GHz	Orange, Telecom Italia, British Telecom
37-40 GHz	AT&T, Verizon, T-mobile
1.427-1.518G	Etisalat
Band 1	China Unicom, China Telecom
Band 3	CMCC, China Telecom
Band 7	CHTTL, British Telecom
Band 8	CMCC
Band 20	Orange
Band 28	Orange
Band 41	Sprint, China Telecom, C-Spire, China Unicom
band 66	T-mobile

Main stream for 5G New Radio

New 5G spectrum bands in Thailand remain to be addressed.

Source: ETSI, TR 138.912 V.14.00

5G Ecosystem: 5G Device Roadmap (Speculated)

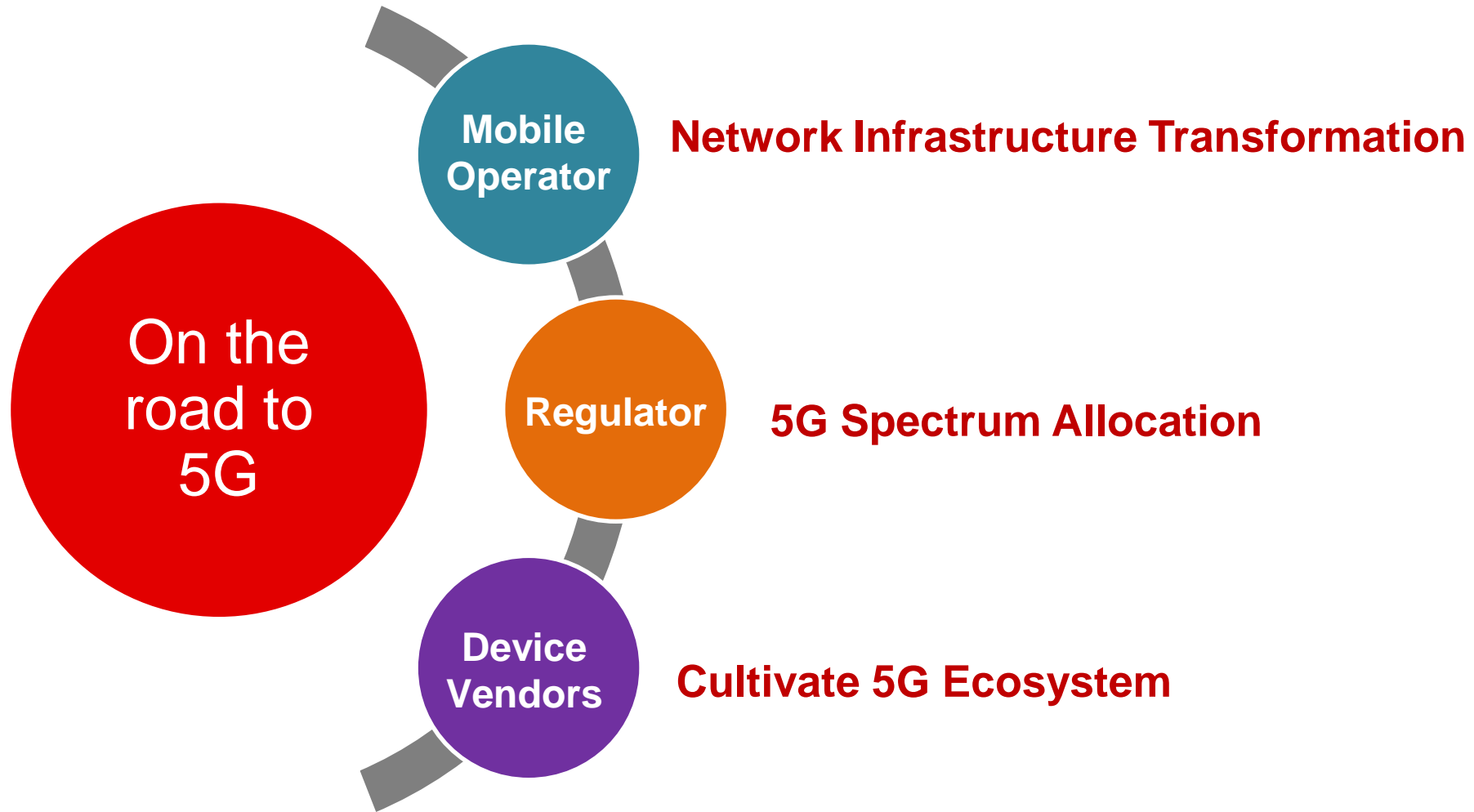


Source: Ericsson

◆ 3GPP Spec Test Start

📶 Commercially Available

Outlook to 5G: Summary



THANK YOU