5G Dtac

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Telenor Group

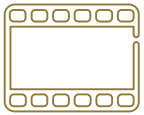
Value Creation Towards 2020

- Continued revenue growth and increased cost efficiency , driven by digitizing core business
- Focus on simplification and prioritization of resources
- Building a solid foundation for continued value creation for our shareholders

- 178 Million mobile subscribers
- Revenues in 2017: NOK 125 bn (USD 15 bn)

Why we need 5G ?

MORE USAGE



mobile data traffic between 2018 and 2022 driven by video

MORE PEOPLE

8 billion MBB subscriptions by 2022

MORE THINGS

1.5 billon cellular IoT devices by 2022

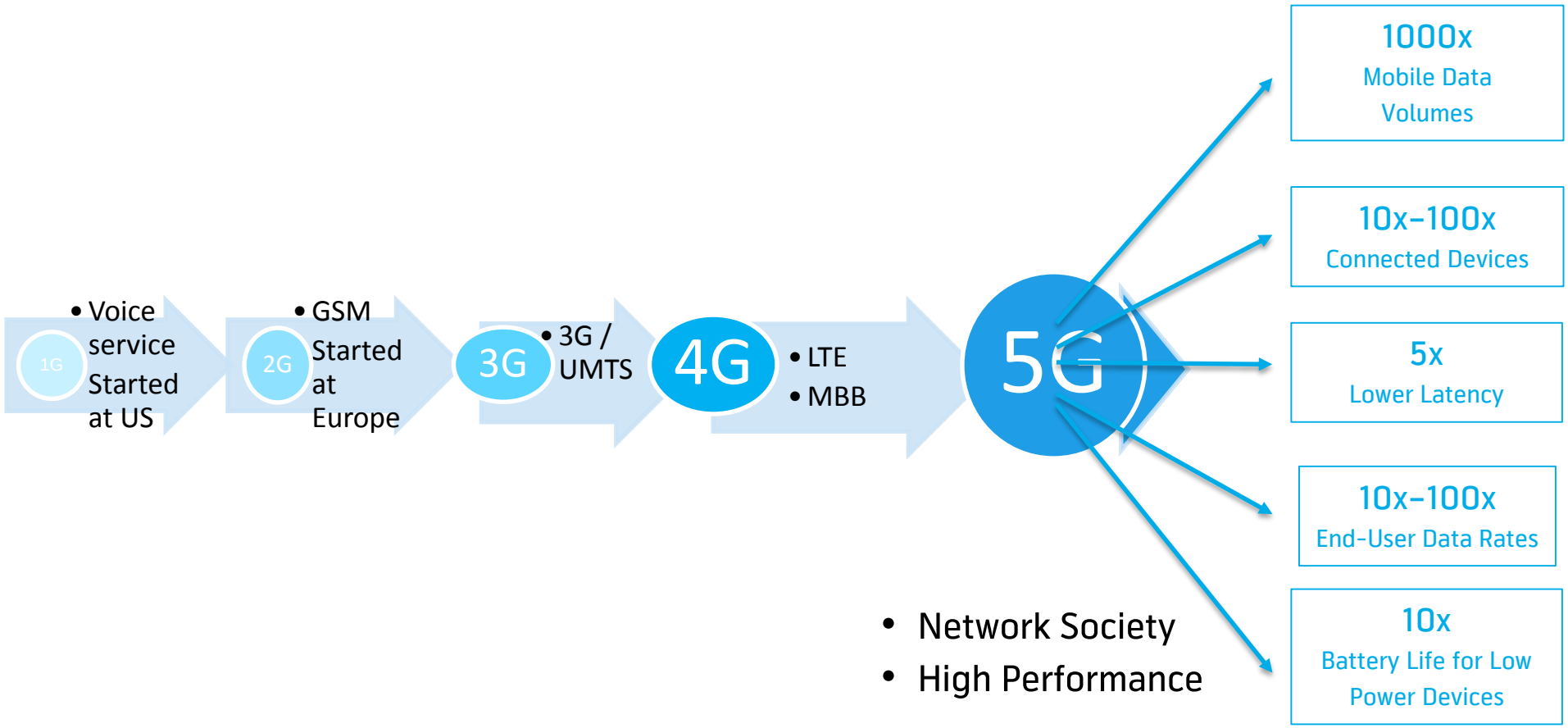
MORE BUSINESS

Fixed Wireless Access, Vehicle-to-vehicle

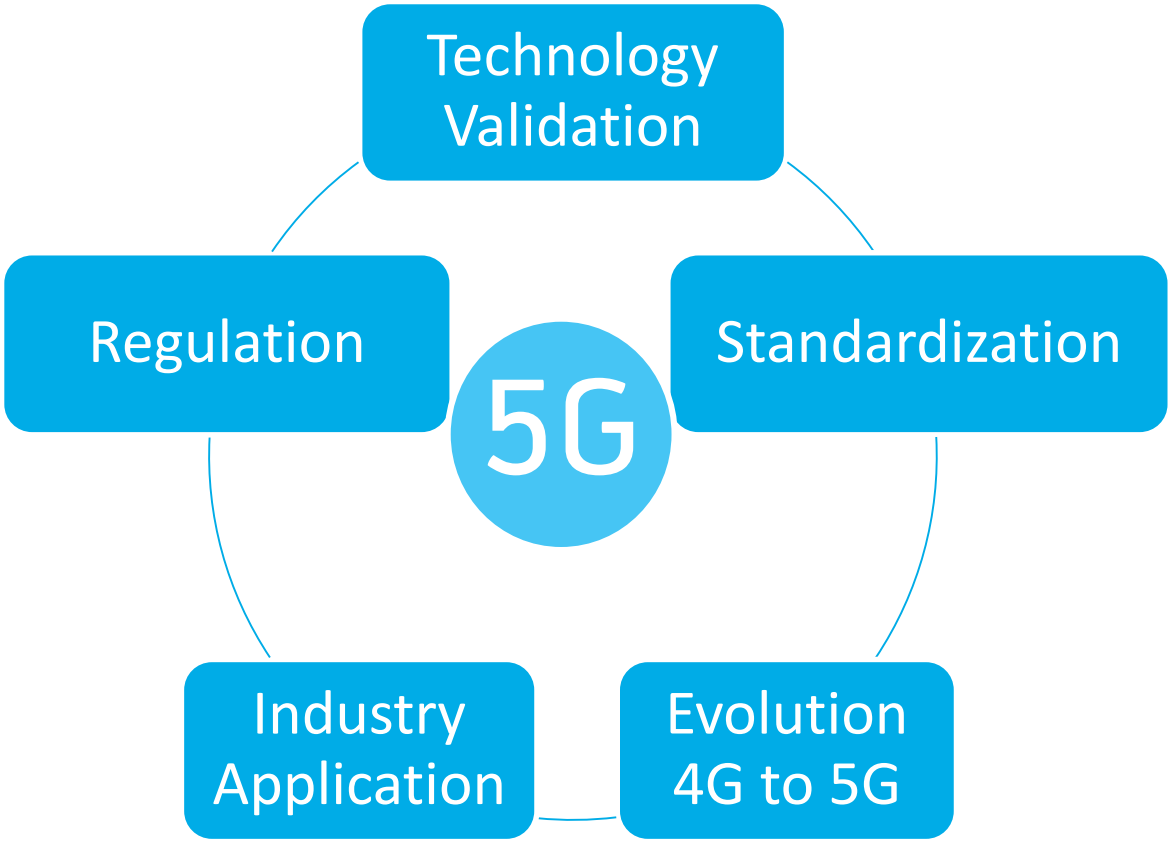
Note: From Vision to Reality – 1GB per User per day
Mobile data in Finland 2017, 1 GB per day (5500 TB /day / 5.5 M population)

Source: 3GPP

What to expect at 5G ?

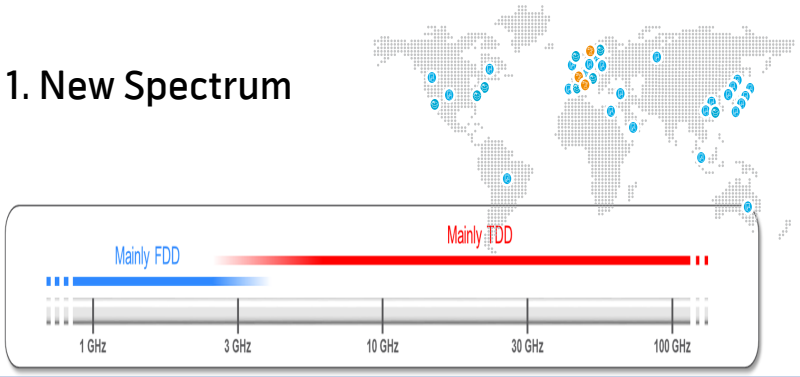


Pave the way to 5G

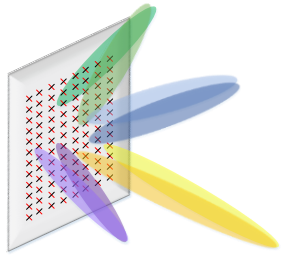


5G Key Technology Components

1. New Spectrum



2. Beam Forming / Massive MIMO

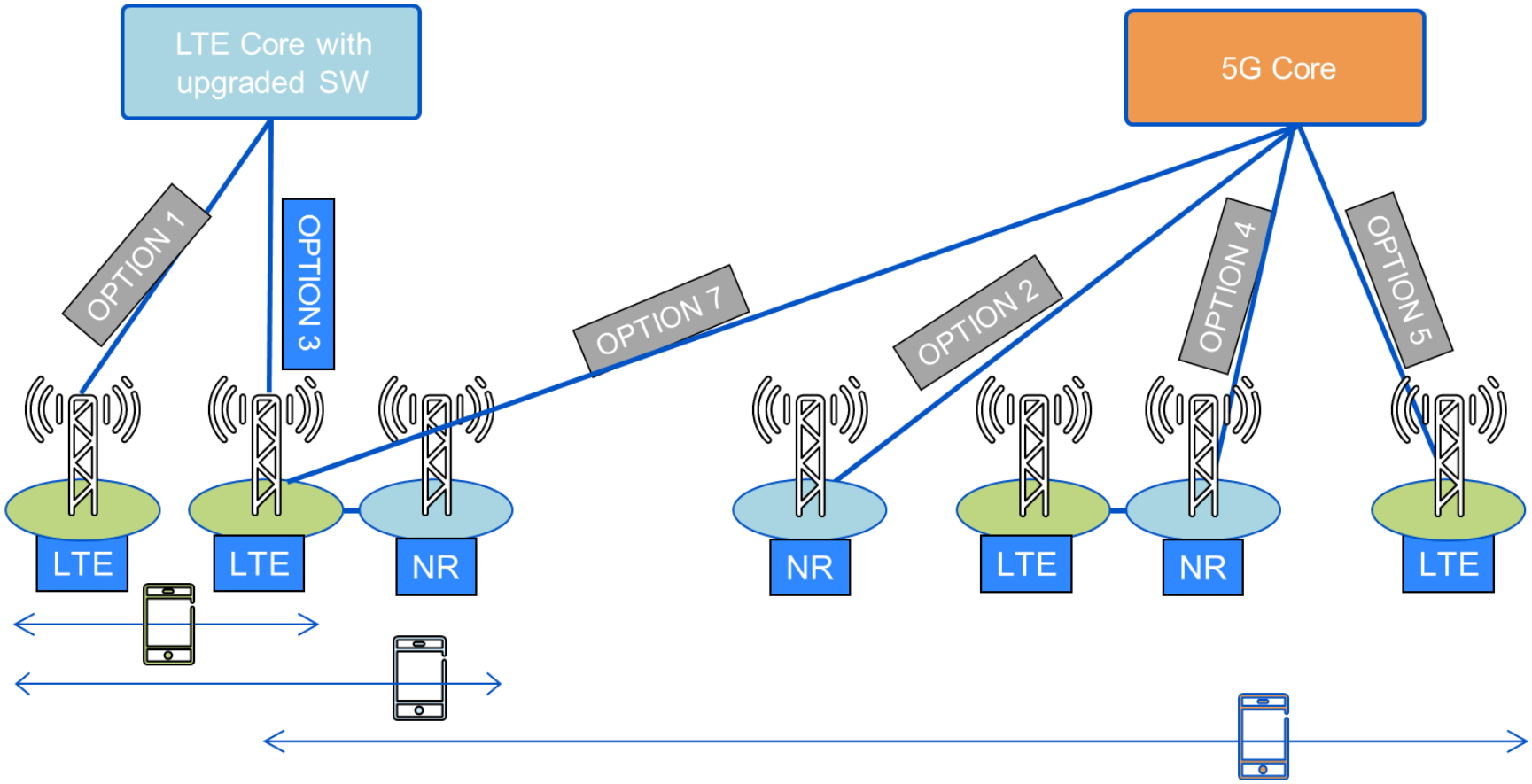


3. Network Slicing / Flexibility / Cloud

4. Multi – Connectivity / 5G – LTE - WIFI

3GPP Architecture Options

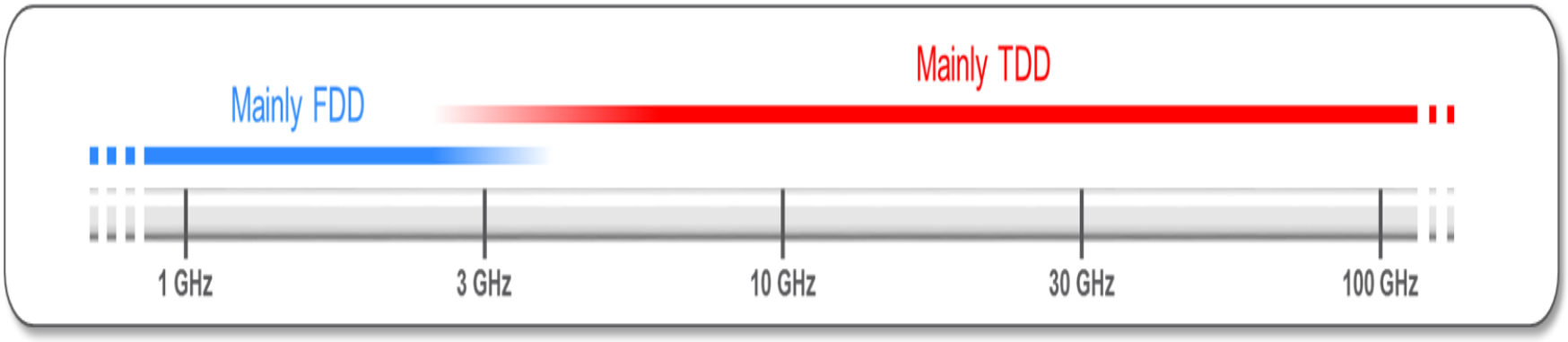
Option 3 have the highest priority in 3GPP, Q2-2018,
5G synergy with existing 4G as the same family.



Source: Picture from E/// supplier

3GPP 5G Band

Spectrum range relevant for 5G wireless access



3GPP 5G / NR Band

5G/NR - below 6 GHz			
Band	Frequencies [MHz]	BW [MHz]	Duplex mode
n77	3300 - 4200	10 - 100	TDD
n78	3300 - 3800	10 - 100	TDD
n79	4400 - 5000	40 - 100	TDD
n80	1710 - 1785 / N/A	5 - 30	SUL
n81	880 - 915 / N/A	5 - 20	SUL
n82	832 - 862 / N/A	5 - 20	SUL
n83	703 - 748 / N/A	5 - 20	SUL
n84	1920 - 1980 / N/A	5 - 20	SUL

5G/NR - mmWave			
Band	Frequencies [GHz]	BW [MHz]	Duplex mode
n257	26.5 - 29.5	50 - 400	TDD
n258	24.25 - 27.5	50 - 400	TDD
n260	37.0 - 40.0	50 - 400	TDD
TBD	37.0 - 43.5	50 - 400	TDD

SUL = Supplementary Uplink
SDL = Supplementary Downlink

5G/NR - refarmed			
Band	Identifier	Frequencies [MHz]	BW [MHz]
n1	IMT Core Band	1920 - 1980 / 2110 - 2170	5 - 20
n2	PCS 1900	1850 - 1910 / 1930 - 1990	5 - 20
n3	1800	1710 - 1785 / 1805 - 1880	5 - 30
n5	850	824 - 849 / 869 - 894	5 - 20
n7	IMT Extension	2500 - 2570 / 2620 - 2690	5 - 20
n8	900	880 - 915 / 925 - 960	5 - 20
n13	US 700 Upper C	777 - 787 / 746 - 756	tbd
n20	CEPT 800	832 - 862 / 791 - 821	5 - 20
n25	PCS 1900 G	1850 - 1915 / 1930 - 1995	tbd
n26	E850 Upper	814 - 849 / 859 - 894	tbd
n28	APT 700	703 - 748 / 758 - 803	5 - 20
n34	TDD 2000 Upper	2010 - 2025	tbd
n38	IMT Extension Gap	2570 - 2620	5 - 20
n39	China TDD 1900	1880 - 1920	tbd
n40	TDD 2300	2300 - 2400	tbd
n41	TDD 2600	2496 - 2690	10 - 100
n50	TDD L-band	1432 - 1517	5 - 80
n51	TDD L-band, local	1427 - 1432	5
n66	AWS Extension	1710 - 1780 / 2110 - 2200	5 - 40
n70	AWS-3/4	1695 - 1710 / 1995 - 2020	5 - 25
n71	US 600	663 - 698 / 617 - 652	5 - 20
n74	FDD L-band	1427 - 1470 / 1475 - 1517	5 - 20
n75	Extended SDL L-band	N/A / 1432 - 1517	5 - 20
n76	Extended SDL L-band, local	N/A / 1427 - 1432	5

Global 5G Spectrum

Telenor ‘s view on 5G spectrum in 2020

- 5G NR will not be able to utilize the existing bands for Mobile Commnunication. These bands will still be needed for supporting the continued growth in 4G devices and traffic.
- Plus, spectrum ,currently used, is too small for enabling 5G NR performance expectations.
- So, 5G NR needed new frequency bands to get started.
- 3.5 and 3.7 GHz is identified as a pioneer 5G bands in Europe.
- Aim for at least 100 MHz license bandwidth to enable the potential of the 5G NR technology.
- The near-centimeter and millimeter waves of 26 GHz band will be used for 5G NR. However, more exploration is needed at how to use this band.