5G- frequency bands and spectrum allocation

- 5G cellular technology represents a massive leap forward for wireless mobile communications. In terms of data rates, security and latency, 5G far surpasses previous generations of communication platforms:
- 4G (LTE, LTE-Advanced, LTE-Advanced Pro, WiMax)
- 3G (UMTS, WCDMA, CDMA, 1xEV-DO)
- 2G (GSM, GPRS, CDMA, 1xRTT)

5G- frequency bands and spectrum allocation

Low-, Mid- and High-Band 5G Spectrum Frequencies and Their Allocations

- **Low-Band Spectrum**
- Low-band spectrum is “sub” 1 GHz spectrum. U.S carriers primarily use low-band spectrum for 3G and LTE. It provides consumers with a broad coverage area and good building penetration, but data speeds peak around 100 Mbps.
- Operators will reclaim this spectrum for 5G in the coming years with concluded 3G sunsets.
- According to Digital Trends, T-Mobile is the leading player in the low-band spectrum space. The operator bought a large block of 600 MHz (i.e., Band n71 in 5G) spectrum during FCC auctions in 2017.

- **Low-, Mid- and High-Band 5G Spectrum Frequencies and Their Allocations**

- **Mid-Band Spectrum**
- This spectrum between 1 and 6 GHz provides faster throughput and lower latency than the low-band spectrum. As Digital Trends notes, mid-band transmissions are less suitable for building penetration.
- However, peak speeds can reach as high as 1 Gbps and provide more capacity to the network. 4G and 5G standards use this spectrum. Mid-band spectrum is the foremost 5G coverage and capacity contributor.
- To do this, mobile operators apply multiple-input, multiple-output (MIMO) technology to the 5G deployment. MIMO groups several antennas at one cell tower, creating multiple radio links to each mobile device.

Low-, Mid- and High-Band 5G Spectrum Frequencies and Their Allocations

High-Band Spectrum

- High-band spectrum enables speeds in the tens of Gbps range at even lower latency. However, the high-band coverage area is limited and has poor building and rain penetration. It's considered as line-of-sight for practical purposes.
- For mm Wave mobile devices to work, the cell and the mobile device must use new antenna technology that can dynamically steer and form the radio beam to and from the cell tower. Steering and forming are done through power modulation and interferometry to and from tightly packed antenna module arrays. These modules are small because the signal is in the millimeter wavelength spectrum.
- Mm Wave is fundamental to achieving 5G speed and latency targets. Therefore, major telecommunication companies are developing the technology to address these propagation challenges.
- As 5G starts rolling out in the high-band spectrum, carriers will piggyback off 5G FR1 and LTE while overlaying the infrastructure to support 5G FR2.
- Small cells are low-power base stations positioned in high density so that each covers a small area at high speeds. Building many of these small cell clusters will expand coverage, particularly that of mm Wave, but this will take time.

- **Low-, Mid- and High-Band 5G Spectrum Frequencies and Their Allocations**

5G Frequency Bands

- Radio Frequency bands used in the 5G system are subdivided into three groups according to their frequencies:

Low Band 5G Spectrum

- A usable frequency spectrum below 1GHz is known as Low Band in 5G. Low-frequency spectrum provides more comprehensive coverage and can penetrate obstacles better. Service providers are familiar with these bands since the introduction of 2G networks, and they are commonly used globally

Low Band 5G Spectrum

NR Operating Band	Uplink		Downlink		Duplex Mode
	Low	High	Low	High	
n71	663 MHz	698 MHz	617 MHz	652 MHz	FDD
n28	703 MHz	748 MHz	758 MHz	803 MHz	FDD
n5	824 MHz	849 MHz	869 MHz	894MHz	FDD
n8	880 MHz	915 MHz	925 MHz	960 MHz	FDD

Mid Band 5G Spectrum

- The mid-band frequency is a good choice for both urban and suburban areas because it provides a balance between coverage and capacity. Mid bands were commonly used in earlier 5G deployments due to their higher bandwidth to provide higher data rates than low bands.

NR Operating Band	Uplink		Downlink		Duplex Mode
	Low	High	Low	High	
n1	1920 MHz	1980 MHz	2110 MHz	2170 MHz	FDD
n2	1850 MHz	1910 MHz	1930 MHz	1990 MHz	FDD
n3	1710 MHz	1785 MHz	1805 MHz	1880 MHz	FDD
n80	1710 MHz	1785 MHz	N/A	N/A	SUL
n40	2300 MHz	2400 MHz	2300 MHz	2400 MHz	TDD
n41	2496 MHz	2690 MHz	2496 MHz	2690 MHz	TDD
n7	2500 MHz	2570 MHz	2620 MHz	2690 MHz	FDD
n78	3300 MHz	3800 MHz	3300 MHz	3800 MHz	TDD
n77	3300 MHz	4200 MHz	3300 MHz	4200 MHz	TDD
n79	4400 MHz	5000 MHz	4400 MHz	5000 MHz	TDD

High Band 5G Spectrum

High-frequency bands provide fast data transfer and quick response times, but their coverage is limited and mainly utilized in crowded cities. High band spectrum operates in the millimeter wave frequency range, suitable for higher bandwidth applications for ultrafast data.

NR Operating Band	Uplink		Downlink		Duplex Mode
	Low	High	Low	High	
n257	26.5 GHz	29.5 GHz	26.5 GHz	29.5 GHz	TDD
n258	24.25 GHz	27.5 GHz	24.25 GHz	27.5 GHz	TDD
n260	37 GHz	40 GHz	37 GHz	40 GHz	TDD
n261	27.5 GHz	28.35 GHz	27.5 GHz	28.35 GHz	TDD