

Science Policy Outreach Task Force at Northwestern University

5G Technologies, Legislation, and Impacts



SPOTlight: The higher frequencies of 5G offer faster wireless connection while requiring infrastructure changes to accommodate the new technology.

The Basics of 5G

- Fifth generation, or “5G”, is the next generation of wireless technology.
- Within 5G are three frequency bands: low, mid and high band.
- In the United States, the Federal Communications Committee (FCC) auctions spectrum use.
 - The FCC updates the status of the frequency bands and plans for upcoming auctions on their website [1]. Table 1 defines the 4G and 5G bands, including which are in use and their status of deployment. “Partially” indicates that parts of the frequency band are in use and the rest of the frequency band remains under consideration for auction.

	4G	5G			
	Total	Low band	Mid band	High band	
Frequency	600 – 5200 MHz	600 – 900MHz	2.5, 3.5, 3.7-4.2 GHz	24, 28 GHz	37, 39, 47 GHz
In use in US	Yes	Yes	Partially	Partially	No
Upcoming plans by the FCC		Plans to widen the deployment.	Auctioned off most of the band. Currently being deployed.	28 GHz was auctioned. 24GHz is being auctioned.	FCC hopes to completely auction the 5G high band by the end of 2020.

Characteristics of 5G

- Because 5G is higher frequency than 4G, it provides lower latency (faster connection) [2].
- Due to fundamental properties of electromagnetism, higher frequencies travel shorter distances [3].

Impacts

1. Satellite Weather Forecasting at 24 GHz

- Weather forecasting satellites measure water vapor in the atmosphere by probing the 24GHz water absorption line. This aligns with one of the 5G high-bands.
- In May of 2019, acting NOAA Administrator Neil Jacobs explained to House Representatives that a wide-deployment of 24 GHz cell-service could decrease forecasting abilities by 77%. Jacobs suggested a –50 dB limit would result in nearly 0% data loss for weather forecasting satellites [5].

2. Biological Effects

- In April of 2019, the Food & Drug Administration (FDA) concurred with the current FCC spectrum limits and stated there is little scientific evidence supporting health problems caused by radio cellphone emissions [6].
- In 2017, the EU addressed a 5G Appeal signed by hundreds of scientist and medical doctors warning of the health detriment of 5G. The EU referenced the years of research with no evidence of harm to humans from radio frequency exposure [7].

3. Social Impacts

- Technology innovations with the faster speeds of 5G [8]:
 - Public health and safety
 - Artificial Intelligence
 - Social media and virtual reality
- Government regulations and specific development of comprehensive security measures can aid in quenching and mitigating privacy concerns at the user level [9].

Legislating

- **How:** Spectrum use is regulated with an “out-of-band emission” limit. Out-of-band emissions are signals that spill over from a frequency bandwidth.
 - These signals are measured in decibel-watts (dBW) for every .2 GHz. A more negative number is a more stringent limit (I.e. -50 is a higher limit on emissions than -40).
 - Emission limits are decided for “base units” or cell towers, and “mobile units” or user devices.
- **Who:** Every three to four years, the International Telecommunication Union (ITU) holds the World Radiocommunications Conference (WRC) where countries debate the next generation of frequency legislation [4].
- **What:** The WRC in 2019 decided that emission limits would become more stringent after September 1, 2027, in line with the expected increase in the number of international telecommunication stations (IMTs) operating on or after that date [4,5].
 - A limit of -33 (-29) dBW and -39 (-35) dBW applies for base (mobile) stations brought into use before and after September 2027, respectively.

References and additional resources

- [1] The FCC's 5G FAST Plan, <https://www.fcc.gov/5G>
- [2] *Latency Critical IoT Applications in 5G: Perspective on the Design of Radio Interface and Network Architecture*, IEEE Communications Magazine, (55)2, 2017 <https://ieeexplore.ieee.org/abstract/document/7842415>
- [3] *Technologies for 5G Networks: Challenges and Opportunities*, IEEE, 2017, (9)1 <https://ieeexplore.ieee.org/abstract/document/7839836>
- [4] International Telecommunications Unit WRC, 2019, <https://www.itu.int/en/ITU-R/conferences/wrc/2019/Pages/default.aspx>
- [4.5] International Telecommunications Unit WRC19 News Magazine, 2019 https://www.itu.int/en/itunews/Documents/2019/2019-06/2019_ITUNews06-en.pdf
- [5] House of Representatives Committee on Science Space and Technology, 2019, <https://science.house.gov/hearings/the-future-of-forecasting-building-a-stronger-us-weather-enterprise>
- [6] Food and Drug Administration, *Scientific Evidence for Cell Phone Safety*, 2020, <https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety>
- [7] UE Response to the 5G Appeal, 2017, http://www.5gappeal.eu/wp-content/uploads/2018/06/reply_vinciunas.pdf
- [8] World Economic Forum, *The Impact of 5G: Creating New Value across Industries and Society*, 2020, http://www3.weforum.org/docs/WEF_The_Impact_of_5G_Report.pdf
- [9] *A Survey on Security and Privacy of 5G Technologies: Potential Solutions, Recent Advancements and Future Directions*, IEEE, 2019 <https://ieeexplore.ieee.org/document/8792139>

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