



# Overview of 5G Technology

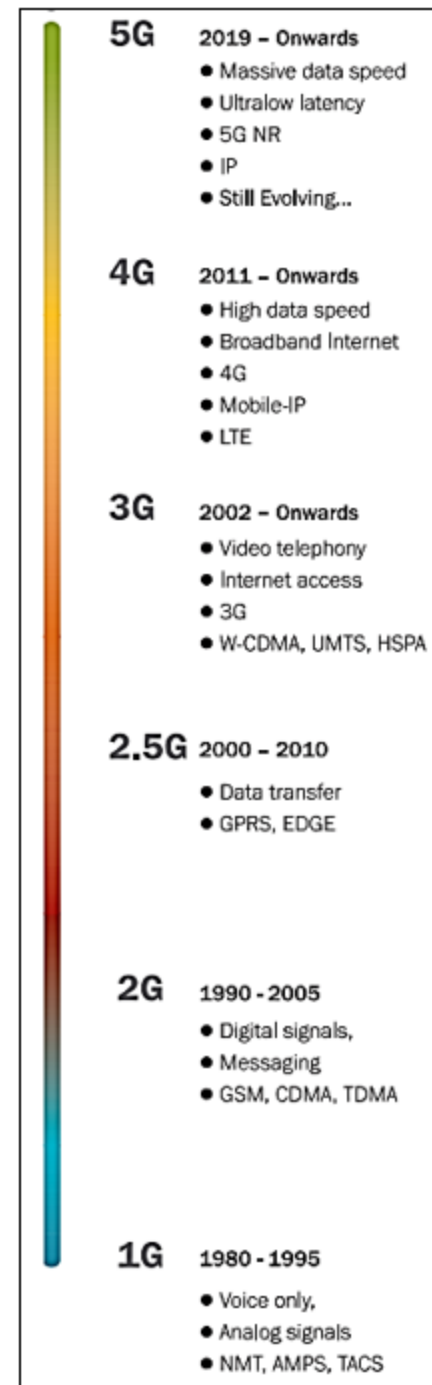
*By*  
*V Jaya Shravan*  
*R&D Engineer in IoT Security @ CDACH*

# Agenda

- *Introduction*
- *Evolution Mobile Communication Technologies*
- 5G Communication Classification
- 5G NR
- Radio Access Network
- Technologies in 5G
- *5G Specification Requirements*
- *5G Pros & Cons*
- References

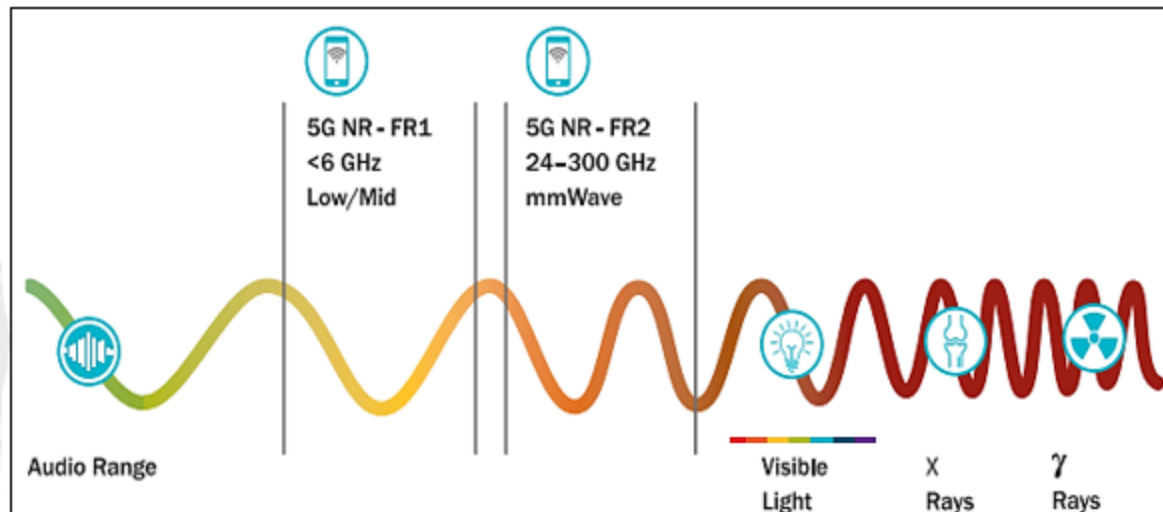
# Evolution Mobile Communication Technologies

- **1G - Introduced in 1979.**
  - Voice only, Analog Signals
  - 850 Mhz and 1900 Mhz
- **2G - Introduced in 1991.**
  - Digital, Encrypted conversations, Data services
  - 900, 1800 Mhz
- **2.5G - Introduced around 2000**
  - Same as 2G, packet switching along with circuit switching
- **3G - Introduced in 1998**
  - Higher bandwidths, broadband access
  - 2100 Mhz
- **4G - Introduced in 2008**
  - 850 Mhz, 1.8 Ghz
  - Much more higher bandwidths, IP telephony, cloud computing
- **5G - Introduced in 2019**
  - 3Ghz to 300 Ghz
  - Low Latency, Massive Data Speed, 5G NR, Edge Computing



# 5G Communication Classification

- 5G works in three different frequency ranges
  - Low Band, Mid Band, Millimeter Wave (mm Wave)
- Low Band 5G uses the same frequency as 4G
  - Uses below 3GHz
  - Slightly more data speed than 4G
- Mid Band 5G uses frequency up to 6GHz
  - Used by Wi-Fi, to provide downlink speed of 1Gbps
- Millimeter wave uses
  - Frequency range 24GHz and 300 GHz
  - Downlink speed of 2Gbps, which can even go up to 20 Gbps.



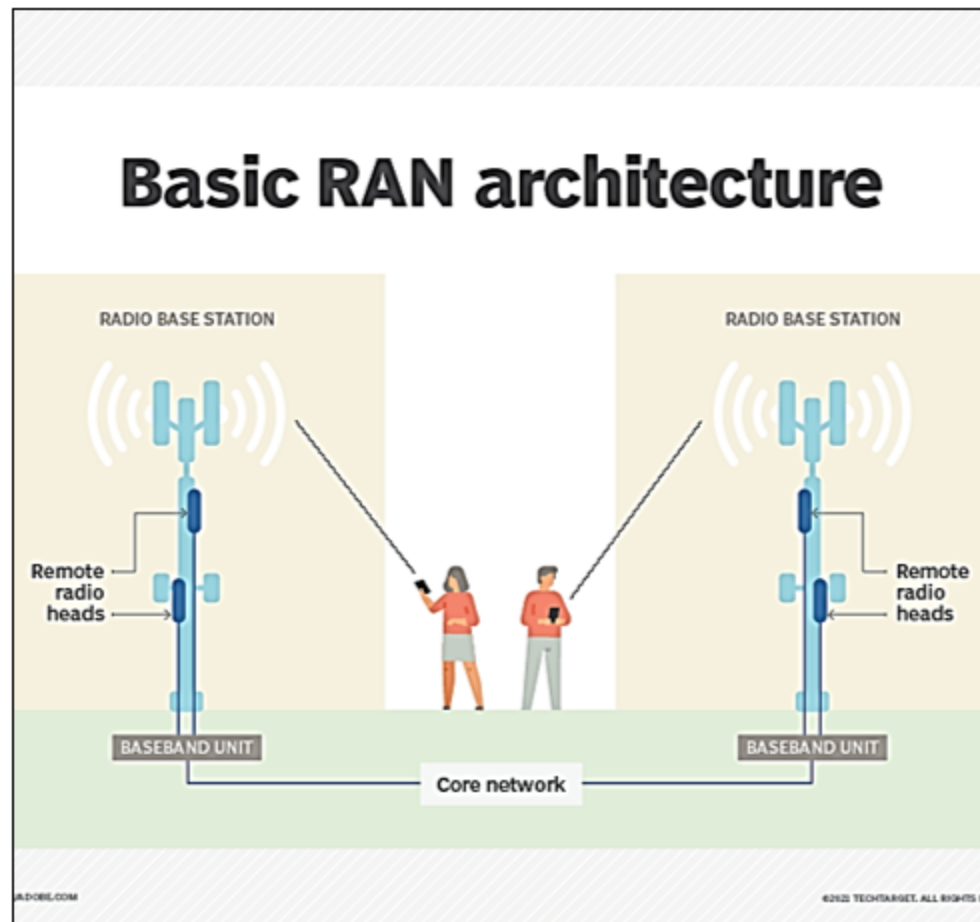
# 5G NR

- The 3GPP, has proposed 5G NR (New Radio) as a new global standard for air interface of 5G Networks.
  - **Under 5G NR there are two frequencies ranges:**
    - FR1 < 6 GHz (Range 3.3 – 4.2 GHz) with max channel bandwidth 100 Mhz
    - FR2 > 24 GHz (Range 24 GHz to 300 GHz) with channel bandwidth min 50Mhz and max 400 Mhz.
  - ***The low band 5G can be built on the existing 4G infrastructure.***
  - **Mid band and mm Wave** require new spectrum auctions, low band 5G fully rolled out in coming years
- $\lambda = c/f$
- More cell towers will be required to build a seamless 5G network.



# Radio Access Network

- A **Radio Access Network (“RAN”)** connects wireless devices to other parts of the network through radio waves.
- A RAN comprises of a base station and antenna.



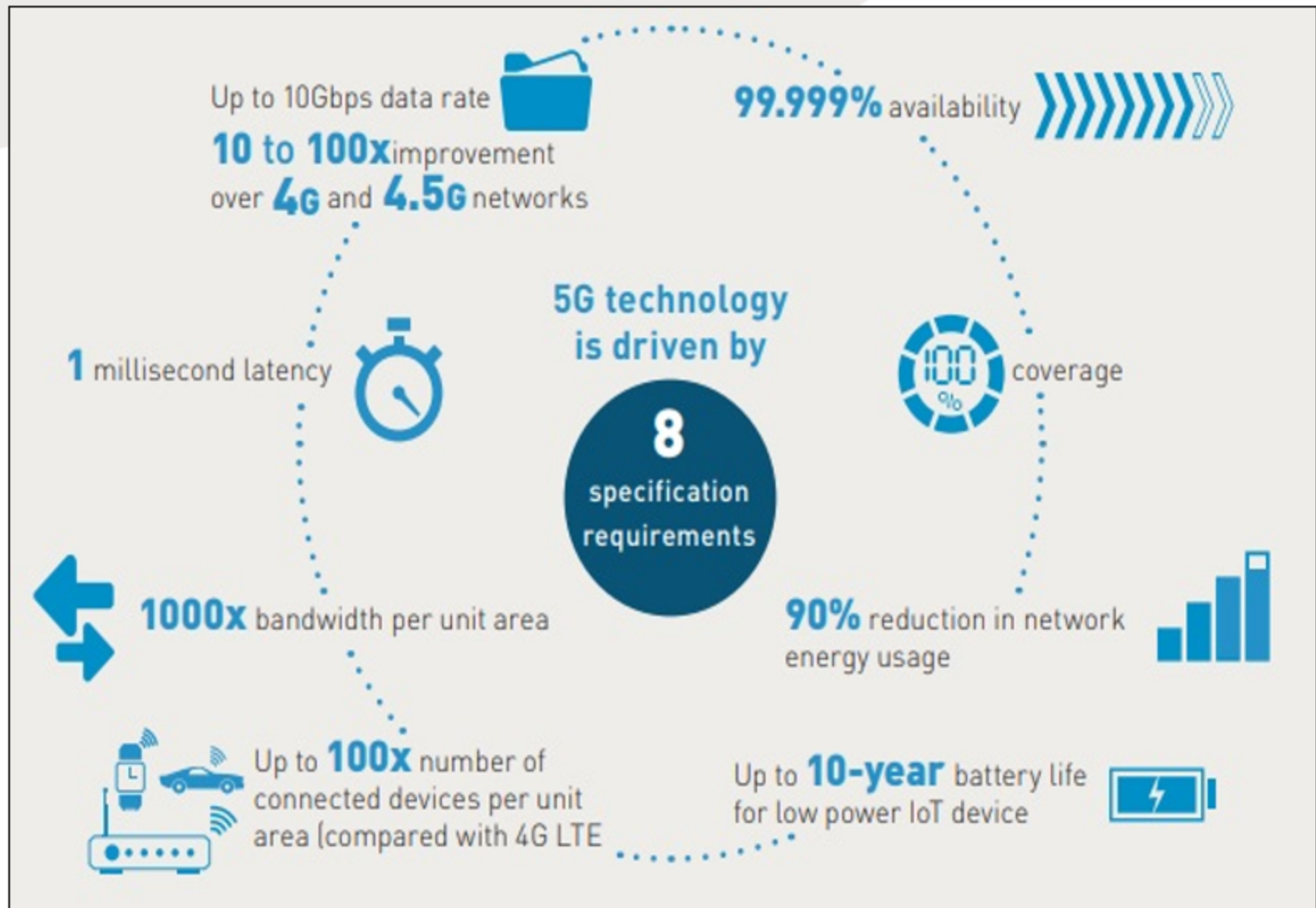
# Technologies in 5G

- Millimeter Wave
- Small Cell
- Massive MIMO
- Beam forming
- Full Duplex





# 5G Specification Requirements





# 5G Pros and Cons



- Higher data transfer speeds – more than 10x.
- Ultralow latency for synchronous communication.
- Significantly more device connections in a coverage area.
- Increased bandwidth due to more available frequency channels.
- Convergence of cellular and wi-fi technologies.
- Greater energy efficiency per bits of data transferred.
- Utility for new technologies – e.g. AI, drones, AR/VR.
- More applications – e.g. commercial, entertainment, defense.

- Massive capital expenditure required for new installations.
- Larger scale of infrastructure deployment due to small cells.
- Greater operational and maintenance costs.
- Limited coverage area due to shorter reach of the signal.
- Susceptible to atmospheric absorption and blocking through material.
- Need new 5G capable devices.
- Interference with more applications in the same frequency.
- New security and privacy issues.

# 5G Use Cases

- Use cases associated with low latency are:
  - *V2X, V2I, V2V, autonomous, connected cars*
  - *Immersive Virtual Reality Gaming*
  - *Remote surgical operations*



# References

- [https://www.nishithdesai.com/fileadmin/user\\_upload/pdfs/Research\\_Papers/5G-Technology-in-India.pdf](https://www.nishithdesai.com/fileadmin/user_upload/pdfs/Research_Papers/5G-Technology-in-India.pdf)
- [https://www.youtube.com/watch?v=GEx\\_d0SjvS0](https://www.youtube.com/watch?v=GEx_d0SjvS0)

***Thank You...!!***