

5G and 6G

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A history of mobile data

1915-First transcontinental phone call by AT&T

1927-First transatlantic phone call

Pre 1980- Analog communication over wire required direct connection between two places

1G, 1980s - Analog Voice only, Frequency Modulation (FM), Mobile Phone and Base Station

2G, 1990s - Digital Voice eg. CDMA, long term evolution

3G, 2000s - Mobile Data, Internet Access eg. CDMA2000

4G, 2010s - LTE (as opposed to CDMA), Mobile Broadband, faster access to the 'net

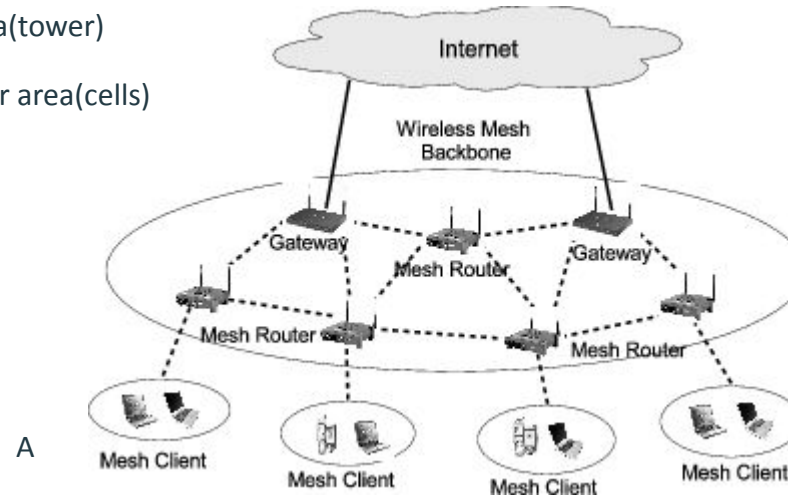
Who knows what a mesh network is?

Simply put you have a main access point providing data to an area(tower)

Then you have multiple access points dividing that data to a larger area(cells)

More access points means...

- Faster speeds
- Lower Latency
- Enhanced connectivity
- Increased capacity
- Better Network slicing



Roads are a Mesh Network!

The information Superhighway! Roads don't just go from one main city, to another down the line, and so on. Roads connect many cities, rather than being a tree, it's a web.

5G Increased Capacity

To increase cellular capacity tower density has to be increased. To do this Small cells were developed. These compact, low-powered cellular base stations can be deployed in strategic locations to supplement traditional cell towers.

This...

- Fills coverage gaps
- Ensures seamless connectivity in crowded environments
- reduces congestion and enhances data speeds

5G Low Latency

3G Latency: 100's of Milliseconds

4G Latency: ~100 down to 30 Milliseconds

5G: Single Digit Millisecond

6G: under a microsecond

Time to tower, then to server, then back has been drastically reduced. Small cells allow for denser packed towers, meaning less people per tower, as well as closer towers. Combined with Distributed Antennas, coverage and accessibility can be greatly increased.

5G Enhanced Connectivity

More access points=more connections

Dividing the network into smaller and smaller subsections allows for more people to connect. This allows for less people per tower, while still allowing for greater access as a whole. Using the Increased Capacity and Low Latency allows for greater numbers of connections, both people and Internet of Things.

5G Network Slicing

Multiplexing, as with Space division (a form of Mesh Network), code division (CDMA), frequency division (FDMA), is a method of fitting multiple inputs into the same route. By using multiple inputs, byte-encoding, or splitting frequencies, multiple transmissions are able to be sent along the same route, saving transmission space

Extra hardware? Yes but what about software

Planet is the world's first AI powered network planning and optimization tool kit

- Unified Indoor/Outdoor Planning
- AI-powered propagation models
- Automated Workflows
- Cloud-native Scalability
- 3D Visualization and Analysis

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The Fast and the Furious

Telecom Network Progression by Generation

	INTRODUCTION YEAR	TOP DOWN- LOAD SPEEDS	TIME TO DOWNLOAD A MOVIE (3GB)
1G	1979	2 Kbps	1 movie - Nearly 6 days
2G	1991	100 Kbps	1 movie - More than 2.5 hours
3G	1998	8 Mbps	1 movie - Nearly 2 minutes
4G	2008	150 Mbps	1 movie - 20 seconds
5G	2018	10 Gbps	3 movies - 1 second
6G	2030 (EXPECTED)	1 Tbps	300 movies - 1 second

Note: For 1G and 2G, these download speeds are only theoretical. 1G was an analog system and 2G was only partly connected to the internet.

Source: Ozy

GOVERNING.COM



6G improvements over 5G

- Faster speeds: 1Tbs vs 10Gbs
- Lower latency: 1 microsecond vs 1 millisecond
- More reliable connectivity
- Improved energy efficiency

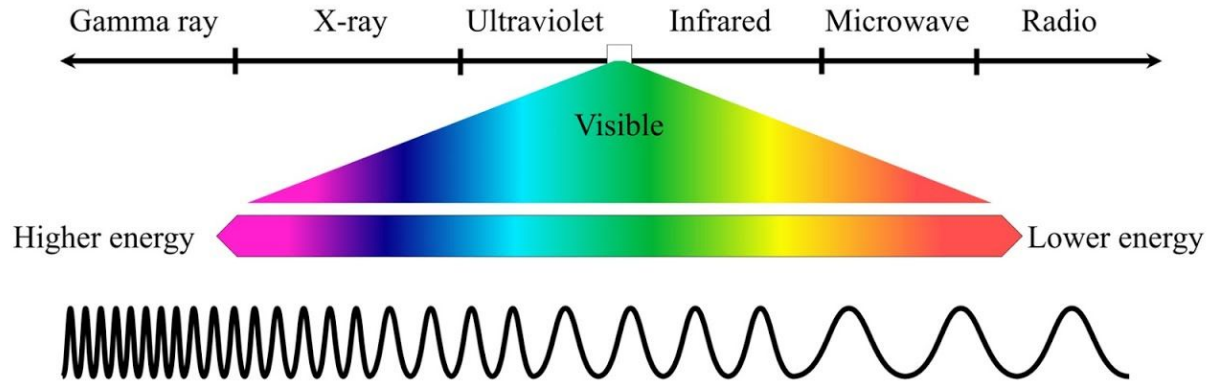
6G is expected to enable entirely new applications and services. Just as 5G has allowed for smart cities and autonomous vehicles

6G does this by...

- Increasing bandwidth range to terahertz
- Utilizing massive multiple-input multiple-output (MIMO) technology
 - More transmitters and receivers at access points and devices
- Network slicing(dividing a central network into many purpose designed virtual networks)
- Edge computing(data processing to be performed closer to the source of the data(the device))
- AI and machine learning will be used to improve network performance and efficiency
- holographic beamforming, which enables the creation of highly directional wireless signals.(reduces interference)
- Satellite communication for remote areas

The elephant in the room...

Electromagnetic Spectrum



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