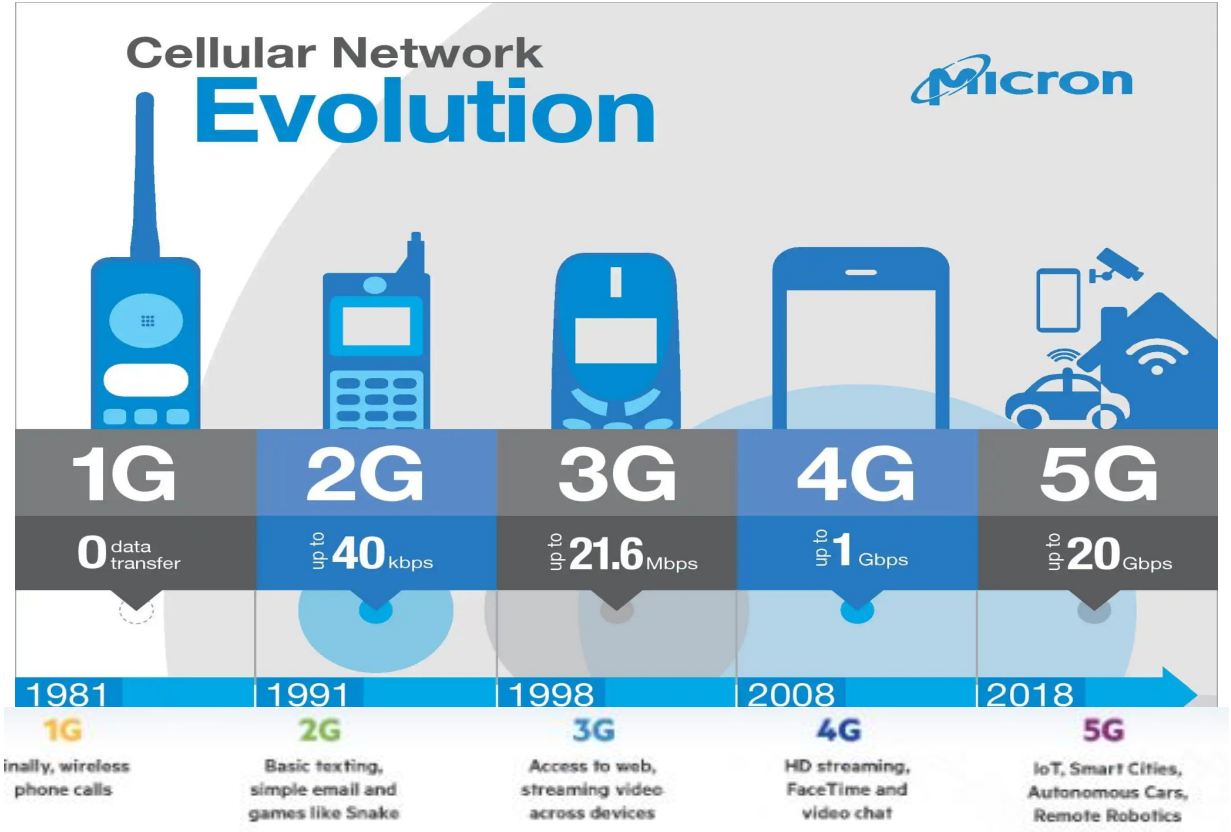
5G Network in Automotive industry

By Josue Nunez

History of Mobile Networks



What does 5G offer

-Significantly low latency
-Greater capacity over wireless systems
-Better utilization of a higher-frequency spectrum.
-Enhancement and improved overall quality in comparison to previous technologies.

Predicted speeds of up to 10 Gbps represent up to a 100x increase compared to 4G

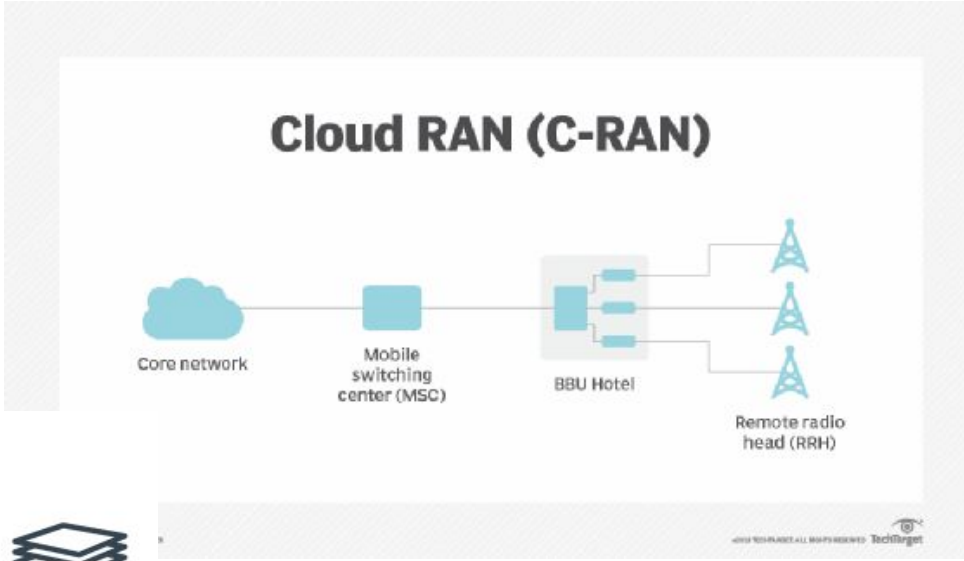
The New 5G networks will have even lower latency than 4G LTE, with the round-trip Connections of data taking less than five milliseconds.

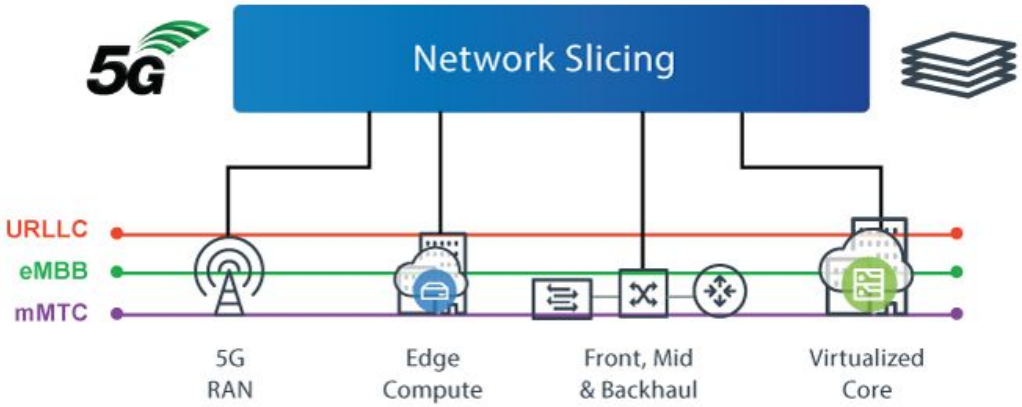
Increased capacity on 5G networks can minimize the impact of lag spikes.

5G New Technology

Similarly 5g network include new technology within itself: These include:
-Network slicing
-Beamforming
-MIMO(Multiple Input Multiple Output)

Network Slicing



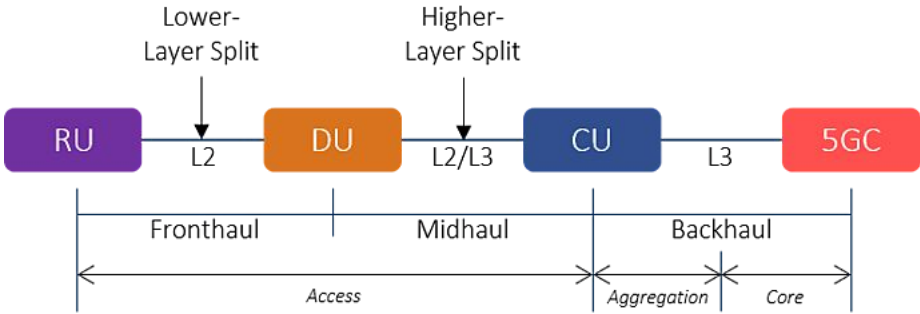


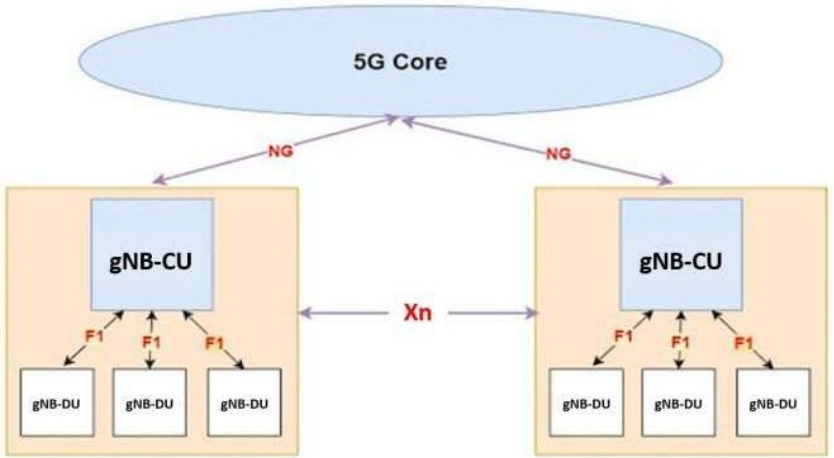
New Radio and base station

The gNB is **radio node which is equivalent of eNB in 4G architecture**.

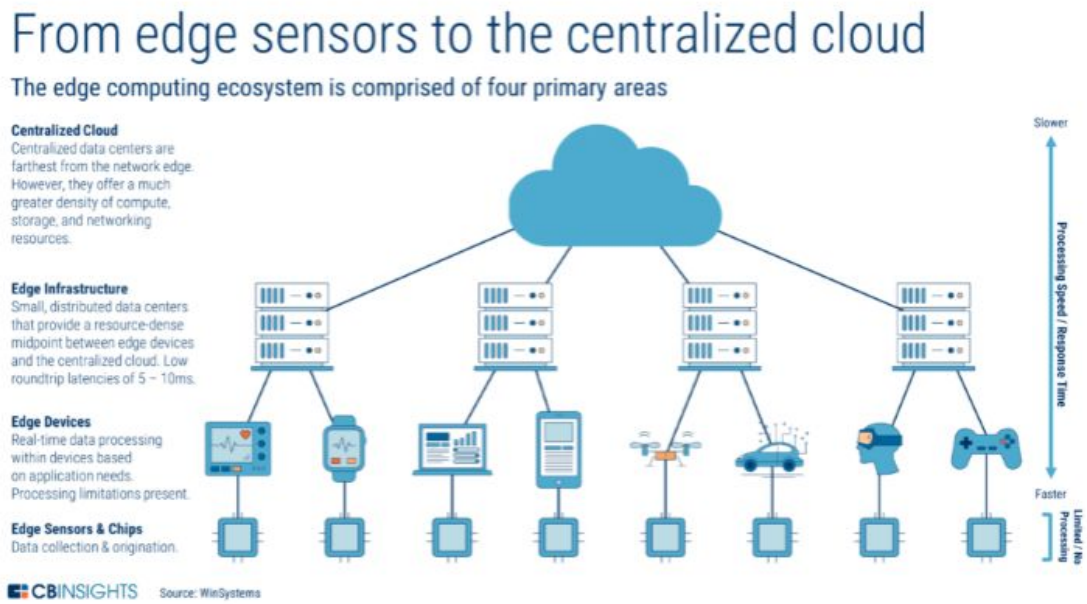
CU provides support for the higher layers of the protocol stack such as SDAP, PDCP and RRC while DU provides support for the lower layers of the protocol stack such as RLC, MAC and Physical layer

The new radio access technology for 5G is called “NR” and replaces “LTE”, and the new base station is called gNB (or gNodeB), and replaces the eNB (or eNodeB or Evolved Node B). Generation.



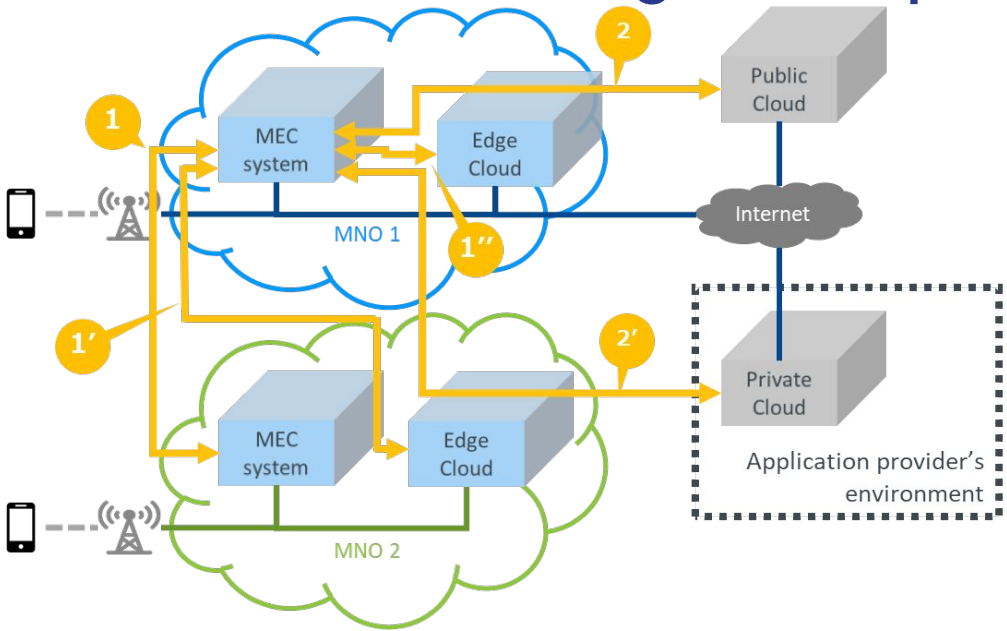


C-RAN



Cloud/Centralized Radio Access Network (C-RAN) is a next-generation Radio Access Network architecture in which the Baseband Units (BBUs) are moved from cell sites to a centralized location. This centralized location is commonly known as BBU hotel. The centralization of BBUs also enables network virtualization, in which the BBU hotel can be replaced by a server.

Multi-Access Edge Computing



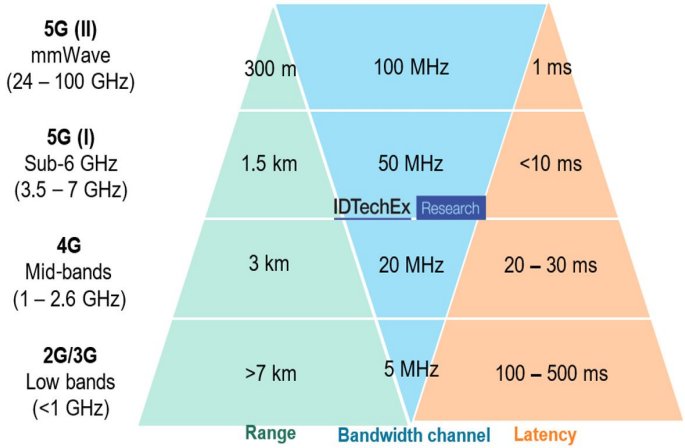
Multi-access Edge Computing (MEC) is a network solution that provides services and computing functions required by users on edge nodes. It makes application services and content closer to users and implements network collaboration, providing users with reliable and ultimate service experience.

Edge computing is about bringing compute capacity closer to where data is created to decrease the response time and load on back end servers.

MEC is a foundational technology build into 5g

https://www.repairerdrivennews.com/2022/04/08/stellantis-pilots-ne

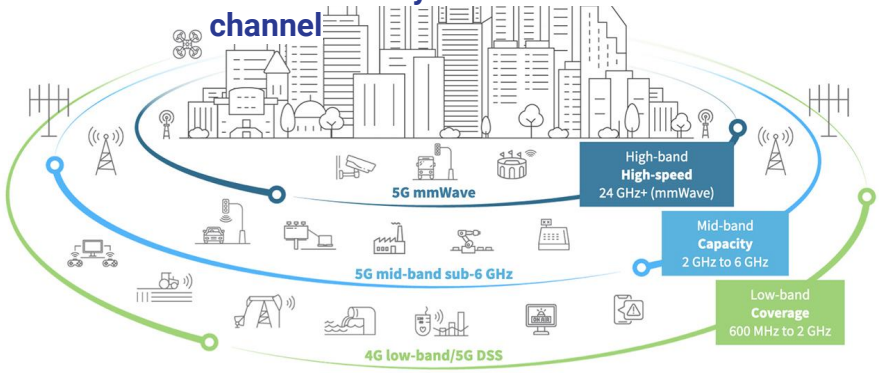
Radio Frequency Bands- mmWave



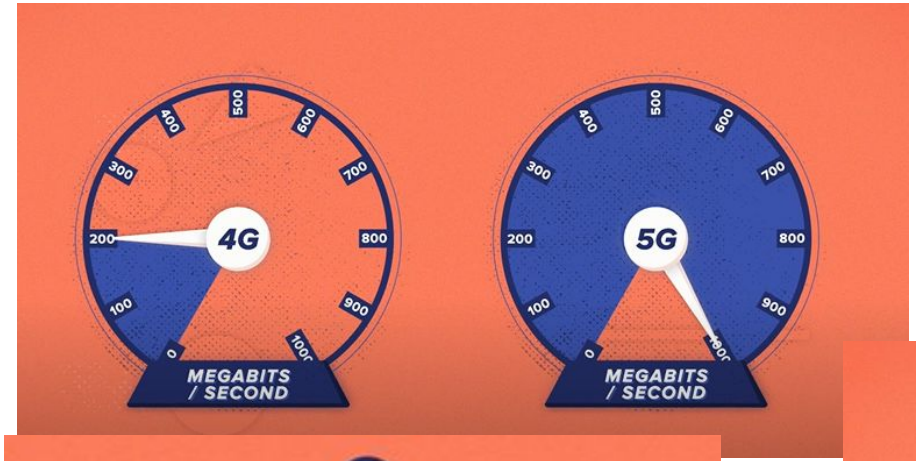
https://www.digi.com/blog/post/5g-network-architecture

mmWave portion of the spectrum was previously unused space where with 5g we can now build new pathways for connectivity.

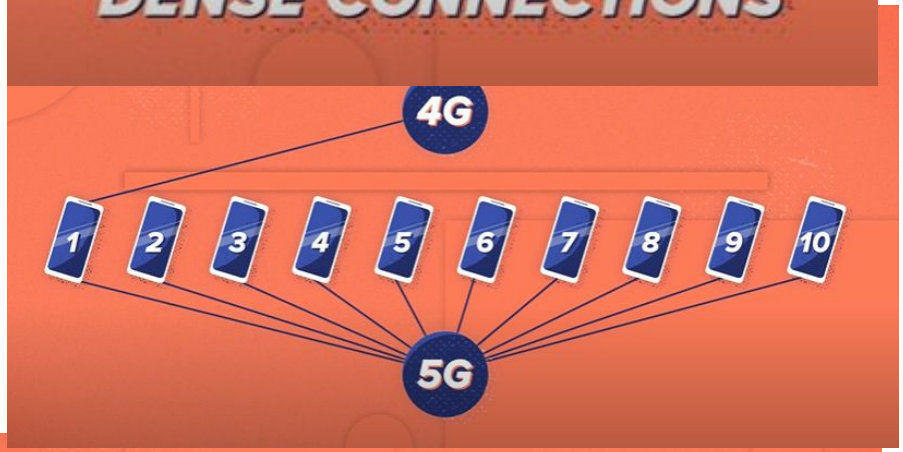
Multiple-input/multiple-out (MIMO) technology is **an established wireless communications technique for sending and receiving multiple data signals simultaneously over the same radio channel**



5G VS 4G



1 HIGH BANDWIDTH



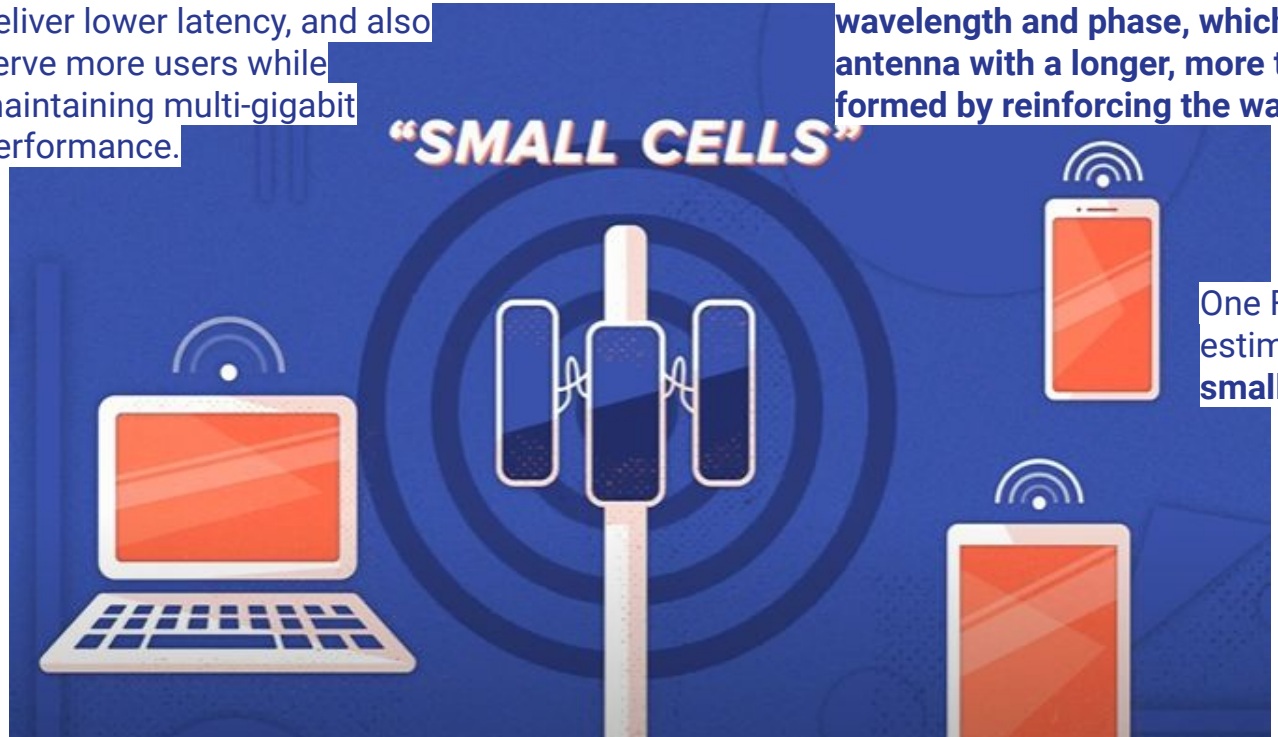
3 DENSE CONNECTIONS

2 LOW LATENCY

Small Cells and Beam Forming

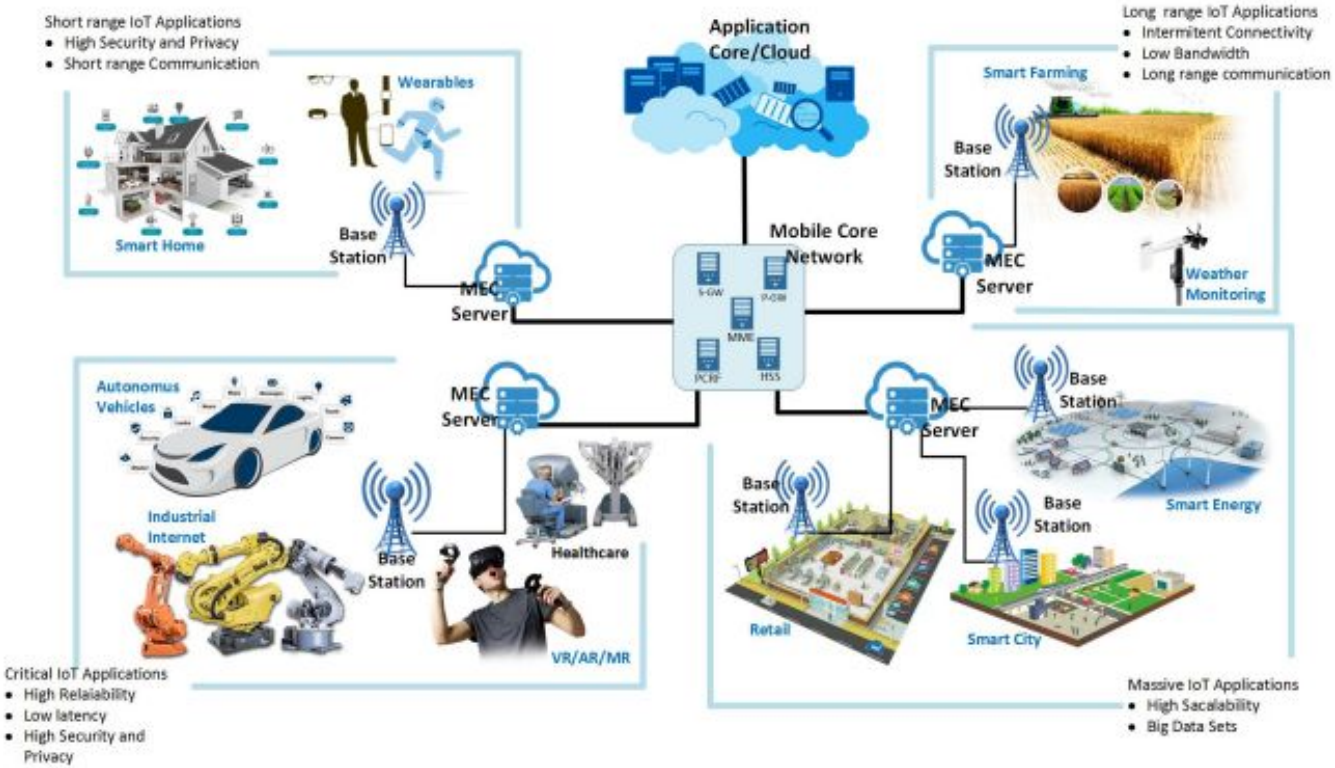
5G small cells will enable the network to extend coverage and to deliver lower latency, and also serve more users while maintaining multi-gigabit performance.

Beamforming is the application of multiple radiating elements transmitting the same signal at an identical wavelength and phase, which combine to create a single antenna with a longer, more targeted stream which is formed by reinforcing the waves in a specific direction



One FCC commissioner recently estimated that the US needs **800,000 small cells** to make 5G a reality

By the end of 2022 there will be 250 million people with mid-band 5G and nearly 285 million (90% of Americans) by the end of 2023.



Problem

Although 5g networks are well anticipated and expected to offer major improvements, there are numerous issues which arise and need to be addressed to utilize the full potential of this network.

-The utilization of the cloud technologies for 5G Networks cause security concerns due to them being open and programmable. Hence, they implementation of this technology needs to be as robust as possible to prevent any security breaches.

5g Challenges

Challenge 1

Battery Life

5G kills battery life on devices like mobile devices.

Challenge 2

Poor Coverage in Rural Areas and cost

Poor Coverage In Rural Areas. Some still can't even get 4g coverage as it is now. 5g prices for data are gonna be high since it is new network technology.

Challenge 3

5G Range

5g range still isn't the best because 5g high-band can not penetrate walls since frequencies are higher. Use small individual 5g nodes instead of just big tower.

Internet of Things

The connected car concept uses this high-speed and Edge computing technology to communicate with car sensors and pedestrian smartphones, via a user-authorized mobile app—about traffic hazards, like accidents and road construction—for Pedestrian and in-vehicle driver safety and efficient navigation.

5g in Automotive Industry

Stellantis participated in the 5G Automotive Association (5GAA) live trial of 5G cellular-connected vehicle communication and multi-access edge computing (MEC) technology in Blacksburg, Virginia.

-Making Roads Safer
-on-site cameras and sensors to collect data
- Vehicle Autonomy and future connected services and mobility technologies

Making roads safer for drivers and pedestrians is the ultimate goal of developing these next generation technologies

More

At the moment, the 5GAA claims China is the only country that has 5G Cellular Vehicle to Everything (C-V2X) enabled vehicles commercially available on the market, with 14 C-V2X vehicle models commercialised.

Key members of the 5GAA also discussed similar technologies, including a demonstration of a connected bike in which Qualcomm showcased a new hardware solution that allows vehicles to identify vulnerable road users (VRU) using Cellular Vehicle to Everything (C-V2X).

Automotive use cases