

# ROADMAP TO 5G



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## Table of Contents

Introduction .....	4
Why 5G? .....	4
5G Infrastructure .....	5
5G Architecture .....	5
5G Deployment Options .....	6
Hardware Backbone .....	6
Small Cells .....	6
RAN cell towers.....	7
Network Infrastructure Security .....	7
Future Scope of 5G .....	7
Healthcare .....	7
Manufacturing .....	8
Education .....	9
Agriculture .....	9
Conclusion .....	9

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## Introduction

We've seen a slew of new gadgets and technologies in recent years that include modern computer sciences like artificial intelligence (AI) and machine learning (ML) to make our lives safer and easier. These gadgets necessitate high-speed network access. Therefore, the technology sector has adopted 5G to keep up with this innovation and advancement. It is a new wireless standard meant to deliver higher multi-Gbps peak data speeds such that there is very low latency, and the network is more reliable than its older counterparts. It is capable of carrying large network capacities while guaranteeing high availability. The network model is high performance and boasts improved efficiency, allowing the user to have a truly unique and unmatched experience.

There are many underlying technologies that lead to 5G. It is based orthogonal frequency-division multiplex (OFDM), during which a method of modulating a digital signal across several different channels to reduce interference. It uses 5G NR air interface alongside OFDM principles. It uses wider bandwidth technologies such as sub-6 GHz and mmWave. It operates on the same networking principles as 4G LTE but the new interface enhances OFDM and delivers a higher degree of flexibility and scalability which results in more access to people and a larger range of applications.

Through virtualization and edge computing, 5G offers greater performance such as high data rates, low latency, and increased reliability. 5G networks are also expected to handle the increased traffic and demand caused by machine-to-machine communications and the Internet of Things.

This translates to faster download speeds and less lag time. As a result, the way we consume and access information, run our businesses, and live our lives in general is being revolutionized.

## Why 5G?

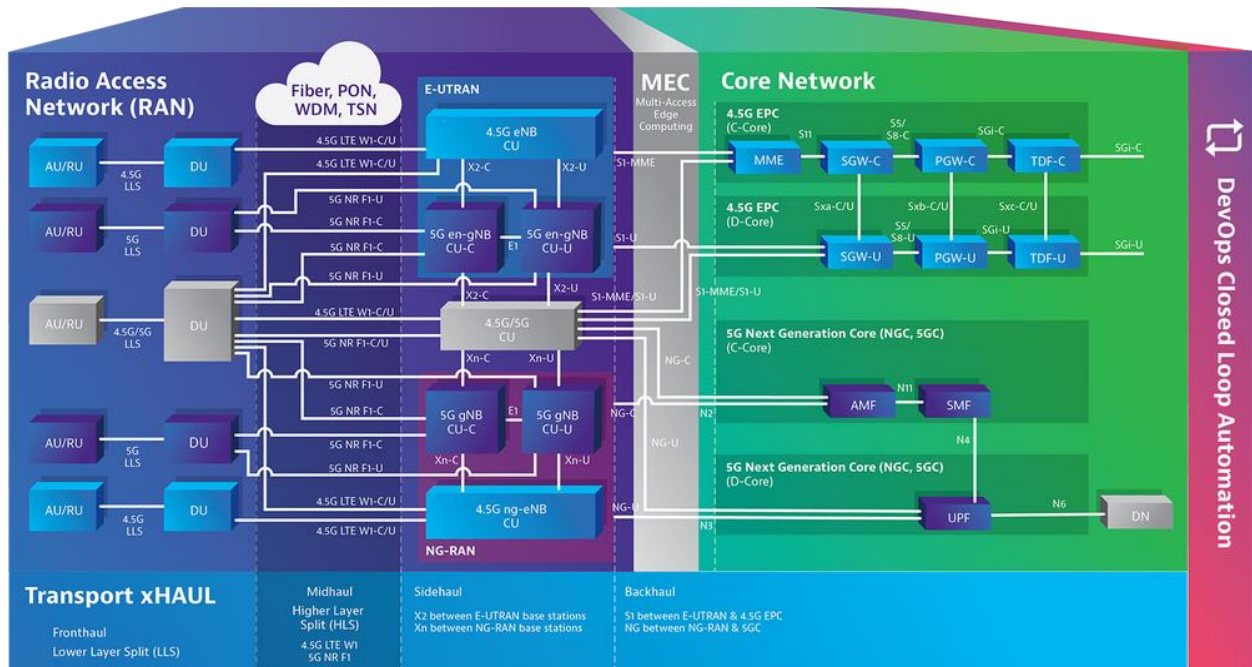
The main upgrade with 5G is the speed. It is predicted that 5G will have 100 times faster speed and 10 times lesser latency compared to 4G LTE. Theoretically, the speed will be upward of 20Gbps for downlink and 10Gbps for uplinks. The networking module also boasts limited to no latency with increased availability and flexibility. 5G networks bring in a whole new range of mission critical applications that will continue to expand as the technology is worked on. It is extremely scalable, making it a very useful resource for big companies and businesses.

In this article, we will explore 5G in greater depth, how it is on the road to revolutionizing every sector across the globe, the challenges that we may face and possible ways to overcome those while using it to its full efficiency. Furthermore, we will discuss and highlight the incorporation of 5G in multi-national companies (MNCs) and see how it can affect the business as well.

## 5G Infrastructure

Let's answer some basic questions like Infrastructure requirements, scope of 5G in the future and how manages to keep security in mind while being dynamic, coherent and advanced.

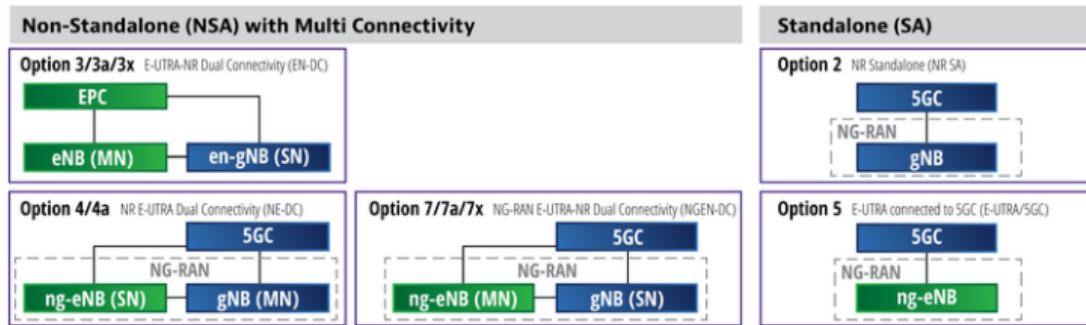
### 5G Architecture



As mentioned above, 5G is a dynamic, cohesive, and flexible framework of modern technologies that can serve a wide range of applications. 5G network infrastructure is made up of macro- and small-cell base stations with edge computing capabilities.

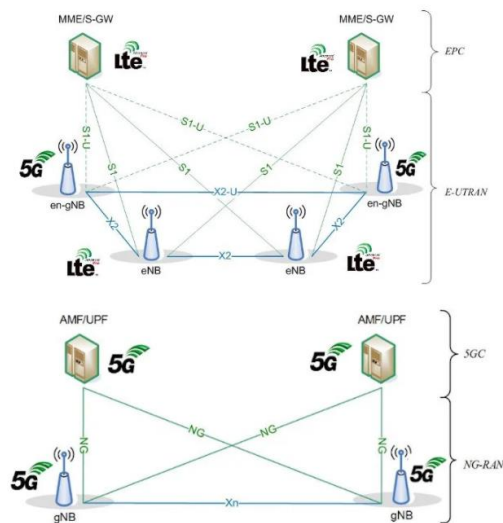
**Macrocells** are huge cell towers which were used traditionally to serve a wide area. The differentiating factor for 5G is that all networking functions are virtualized and executed as software. Most carriers will use existing 4G LTE radio access networks (RANs) supplemented with new antennas until 5G networks reach their full capacity and become self-sufficient. This enables carriers to migrate from 4G to 5G by providing improved services while the new physical infrastructure is being created.

## 5G Deployment Options



The **5G non-standalone standard**, established in late 2017, uses current LTE RAN and core networks as an anchor, with a 5G component carrier added on top. Non-standalone mode will enhance bandwidth by tapping into millimeter wave frequencies, notwithstanding the reliance on existing architecture.

**5G standalone mode** is essentially a complete 5G deployment with a new core architecture and all 5G hardware, capabilities, and capability. As non-standalone mode gives way to future 5G mobile network architecture deployments, careful planning and implementation will ensure that the user base is not affected. The 5G core network relies on a service-based 5G architecture framework with virtualized network functions.



Top: The architecture for NSA 5G infrastructure with 5G and 4G LTE base stations. Bottom: The architecture for standalone 5G infrastructure with 5G base stations. Source: 3GPP

## Hardware Backbone

### Small Cells

In a 5G infrastructure, small cell base stations necessitate a significant development. These antennas take up less space and are designed to blend in with the existing terrain in densely populated regions, such as cities. With millimeter wave (mmWave) frequencies, these small cell antennas transmit and receive the upper band radio frequency spectrum. High-band frequencies may transport more information in a shorter amount of time. As a result, they don't cover a lot of ground and must be packed in tightly.

Beamforming is a technique for extending the range of a mmWave transmission. The radio waves are focused into narrow beams directed toward the target. The goal is to optimize signal quality while avoiding radio wave interference.

### **RAN cell towers**

Radio Access Networks (RAN's) play a pivotal role in supporting this technology. A RAN is a major component of a wireless telecommunications system that connects individual devices to other parts of a network through a radio link.

The RAN is an important component of cellular communications, and it helps 5G networks cover medium and large geographic areas. 5G RAN focuses on radio frequencies in the mid- and lower-bands, such as sub-6 GHz, which may cover a bigger area but transport less data. As a result, this component of 5G infrastructure will be employed more frequently in less populated locations where network congestion is lower, enabling better speeds and a more distributed infrastructure.

### **Network Infrastructure Security**

The nature of 5G networks is virtualization. They are truly software-defined networks. With that comes new network security challenges as operators are forced to rethink traditional focuses.

Although 5G builds on previous generations of mobile technology's security procedures, the trust model has grown considerably more expansive as more actors are involved in the service delivery process. The Internet of Things and user propagation increase the number of endpoints significantly, with many of these traffic inputs no longer overseen by human hands.

Unified authentication to decouple authentication from access points, extensible authentication protocols to accommodate secure transactions, flexible security policies to address more use cases, and subscriber permanent identifiers (SUPI) to ensure network privacy are among the improved 5G security features detailed by the 3GPP standards.

### **Future Scope of 5G**

5G technology does not limit itself to just the telecom industry and mobile internet; it extends its applications to several industries. 5G features such as high latency, reliability and bandwidth make the technology useful for many people regardless of their purposes. Some of the applications are listed below:

#### **Healthcare**

COVID-19 pandemic has disrupted the healthcare industry. Healthcare organizations are now relying increasingly on the telehealth technologies to help the needs of the patients. There is an accelerated demand for telehealth devices all over the world. And wireless technologies like 5G are fueling the growth and use of these devices within the healthcare industry. 5G networks cannot just improve but also transform the critical components of healthcare. 5G can massively support Internet of Things (IoT) and the smart hospital infrastructure. Some of the use cases are-

- **Improved Home Healthcare**

For the aging population living alone at home devoid of any direct medical support, companies such as People Power have developed devices which are equipped with multiple sensors. For, example if the patient falls the motion sensors would be activated and an emergency alert will

be sent to the family members. With the help of AI used in the tech it can also detect if a fall is about to happen. A single 5G connection can enable this device and ensure that solutions like these are easily connected to the network.

- **Remote Patient Monitoring**

Lately we have seen that the hospitals all around the world are overburdened. The idea behind RMP is to equip the patients with smart wearable and e- health devices that would collect and analyze the patient attributes and keep a track of their current medical conditions, without having them to be physical present at the hospital. The doctors can monitor the patient's condition remotely and set a face-to-face appointment if needed. 5G enables the devices to be more secure and reliable and ensures that a greater number of devices are connected to the network within a certain distance.

- **Remote collaborations of surgeries**

Many times, expert surgeons are not able to reach a particular healthcare facility due to conflicting engagements. 5G allows 'telesurgery' to take place in such situations. A specialist can perform the operation from a remote location. The short-term goal for this opportunity would be to use 5G enabled VR headset which would allow the specialist to monitor the surgery that is happening in real time and in turn guide the third person present in the OT physically, how to proceed based on his experience.

## **Manufacturing**

5G is going to have a great impact on the manufacturing industry. The fourth industrial revolution is here and Internet of Things (IoT) and 5G are at the center of it.

- **Process Automation**

Smart factories are now a reality. These factories are highly digitized and connected environments where most of the processes are automated. Majority of the factory operations from production to packaging are run by robots and automated machines which have the ability to self-heal and autonomously run the operations. It reduces the risk of accidents and prevents human error. 5G is one key factor in enabling the smart factories as it ensures the creation of highly reliable systems which can handle the flow of large amount of data and information through them.

- **Breakdown and Downtime prediction**

Unplanned downtime not only affects the productivity of the manufacturers but also leads to a lot of monetary loss. With the help of predictive analytics, the manufactures can predict any breakdown in advance and take the suitable measures to ensure minimal loss and avoid any unplanned downtimes. 5G ensures reliable collection of the information.

- **Collaborative Robotics**

As factories become more automated, they utilize robots to perform several individual tasks. These robots are connected via a wired system. The existing wireless speeds are not fast enough to support the transmission of the data within the systems. 5G's increased speed and reliability will ensure that the robots are seamlessly connected wirelessly and are not limited by cables. Hence, this makes the entire process more efficient and easier to manage.



## Education

5G would ensure a faster and more reliable delivery of education. The lower latency and high bandwidth would support greater levels of communication over larger distances.

- **Improved interaction**

The quality and reliability of the video calls will be improved drastically all over the world. Teachers will be saving more time as they would not have to worry about the constant call drops and connectivity delays.

- **Personalized learning**

5G would ensure creating smart and intelligent education systems that would understand the individual and special needs of a student and create specific education plans curated for their needs.

## Agriculture

Smart Agriculture aims to use technology to make farming more efficient and productive. The aim is to empower the farmers with the data that they can utilize to make more informed business decisions.

- **Precision agriculture**

Instead of treating the entire farm similarly, precision agriculture aims towards applying precise treatments towards selected crops. Farmers can give them exactly what they want. This in turn results in reduced cost due to reduced fertilizer and water inputs. 5G increases the data upload speed. Hence, instead of uploading the data once at the end of the data it could be uploaded throughout the day resulting in increased accuracy.

- **Connected Cattle Management**

Tracking the cattle is very important for a farmer especially during calving season. Hence, IoT devices equipped with tracking modules will be utilized in the future. With the help of this device farmers can track the movement of their cattle.

- **Accurate Harvest Estimation**

To differentiate between healthy crops and the spoilt ones, high quality drones and AI-Powered cameras. With the help of 5G these devices can report the real time data to the available machinery. Faster and more effective harvesting can be done by the farmers with automated crop detection and weeding.

## Conclusion

When put in full use, 5G networks have the capability to revolutionize the technology space. The speed, performance, and flexibility it offers is unparalleled and can be worked on to build an environment that is truly fast, smart, and efficient. The roadmap to 5G showcases the endless possibilities that we have when it comes to technology and innovation. The flexibility, speed, and performance it brings can drive many such innovations and will play a significant part in shaping the technology space of tomorrow.

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