

The background of the slide is a close-up, artistic photograph of a speedometer. The needle is pointing towards the '5G' mark, which is illuminated in a bright blue light. Other markings like '4G' and '3G' are visible but blurred. A small, metallic SIM card is partially visible on the left side of the frame. The overall color scheme is dark with blue and red highlights.

# 5G Glossary

#Making**5G**Real

insee**go**

# 5G Glossary Alphabetical Index

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## 3GPP

3rd Generation Partnership Project - The industry body that comes up with standards/specifications for cellular technologies. These specifications are published periodically in what are called Releases.



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## 5G

5th generation of cellular wireless technology.



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## 5G-NR

5G-New Radio - The new wireless technology/interface for communication between the cells sites (towers) and devices, to be used for 5G. All operators will launch with the 3GPP Release 15 approved standard.

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## 5GTF

5G Technical Forum - A forum formed in 2015 by Verizon in cooperation with ecosystem partners to start building 5G products in advance of 5G standards completion. The forum published a set of specifications and requirements, referred to as 5GTF (aka Pre-5G). Some products that support 5GTF may be upgraded to the official 5G standard (see 5G-NR).

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## 802.11ax

The latest in the evolution of Wi-Fi. 802.11ax focuses more on network capacity than peak speeds. This means that users will be able to get faster speeds and a better user experience in crowded places such as airports, conference halls, even in homes and offices with lots of smartphones, laptops, PCs, consumer electronics and IoT devices.

# A

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**Antenna Array**

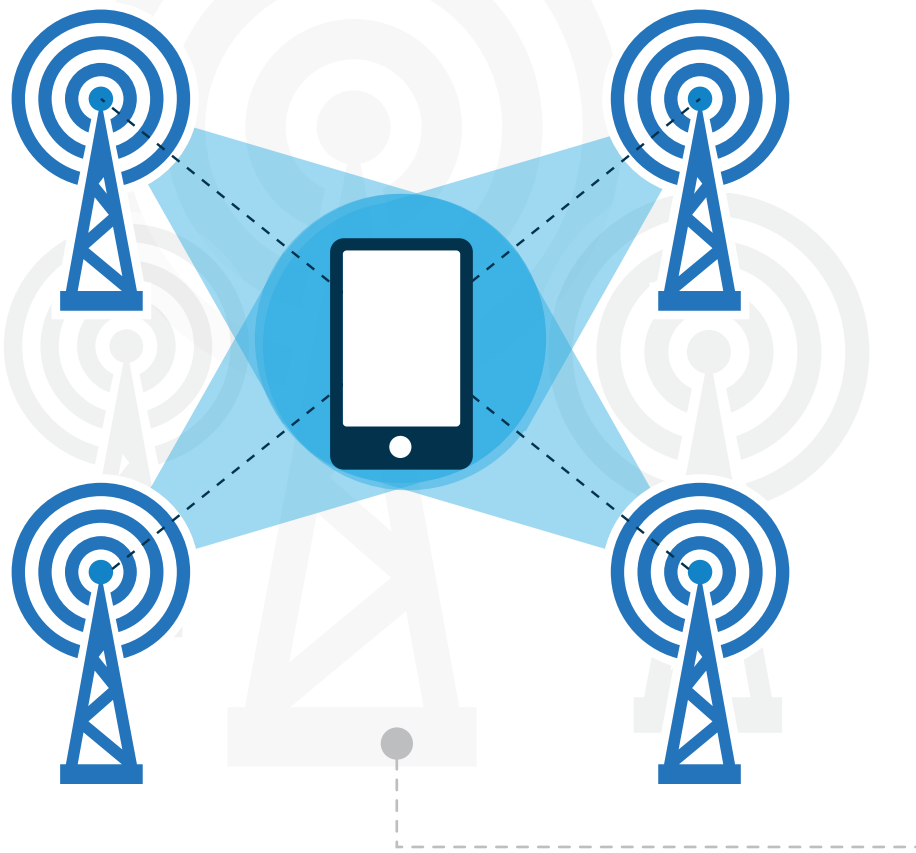
Collection of many antennas to improve coverage and performance. These are specifically used for mmW spectrum, as their coverage is limited. To provide good performance with mmW, you will need many antennas, as many as 256 in some cases. The mmW antennas are very small (a few centimeters long/wide), and hence many can be conveniently assembled and configured in to an array.

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**Augmented Reality (AR)**

Real environments modified (or augmented) by computer generated objects. AR has been around for some time but the low latency delivered by 5G will enable use cases that require very limited delays.





# B

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## Baseband

The part of any modem that performs all the digital processing. Baseband and RF systems are like the brains and the piping in any wireless modem.

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## Beamforming

When there are four or more antennas, the signal from those can be manipulated in such a way that you form a virtual beam toward a specific user, so that the coverage is significantly increased.

Beamforming can be easily explained with this example: Think of how streetlights work. They are designed to cover an area. Now, imagine if streetlights were replaced with spotlights that can steer light beams to follow pedestrians. Such spotlights can illuminate areas where light is needed instead of casting light in an empty spot. Beamforming is very similar to that.

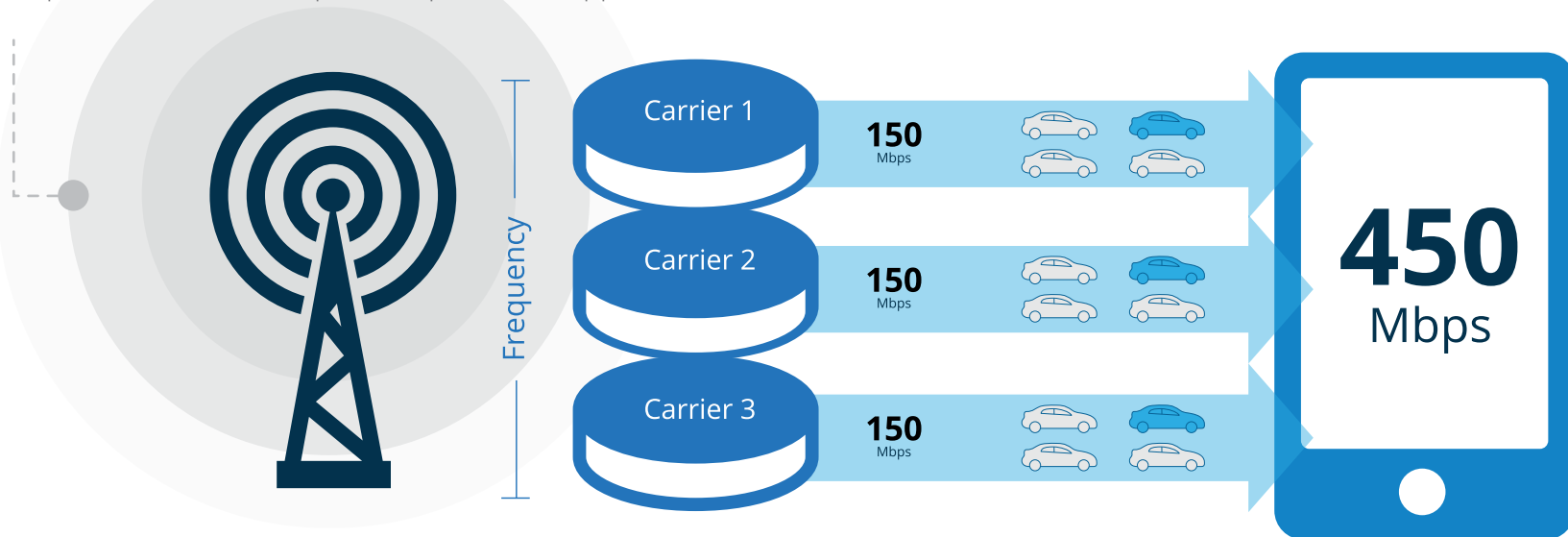
## Beamtracking

Beamtracking is the ability of the cell site to continuously track the users so that it can accurately focus the signal “beam” on where they are.



## Carrier Aggregation

Carrier Aggregation is a feature of LTE Advanced that allows combining of multiple channels to offer extremely high speeds. CA allows for Gbps of users speeds (CAT 20 LTE is up to 2 Gbps), and is supported in LTE Advanced Pro as well as 5G.



## Cat-M1/M2

Categories of devices that support LTE-M/eMTC. Cat-M1 supports up to 1 Mbps speed and Cat-M2 supports up to 2.4 Mbps DL speeds.

## Cat-NB1/NB2

Categories of devices that support NB IoT. Cat-NB1 supports 10s of Kbps speed and Cat-NB2 supports 100+ Kbps of speed.

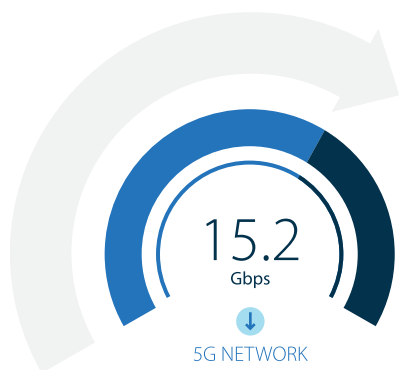
## CBRS

Citizens Band Radio Service - It is a patch of spectrum within the 3.5 GHz band in the USA. Unlike traditional spectrum, it is shared among designate parties and is likely licensed. Currently the wireless industry is in the process of setting up LTE based infrastructure in this band.

## E

### eMBB

Enhanced Mobile Broadband - The broadband services offered through 5G that provide Gigabit user speeds (~10x higher than what is offered by 4G now).



### eNB

e Node B - LTE cell site (aka tower)

### EPC

Evolved packet core - The core network for LTE. EPC manages the connections between the cellular network and the internet and other cellular networks.

## F

### FWA

Fixed Wireless Access - Utilizing wireless technologies/networks for residential/enterprise fixed broadband services, similar to Cable or DSL. FWA is more cost-effective and quicker to deploy than traditional Cable and DSL. In many locales wireless is the only option to provide broadband due to terrain and other issues. Use cases include in-home, small offices.



# G

## **Gigabit LTE**

The version of LTE that offers up to 2 Gbps peak theoretical speed. That means users could easily get 100s of Mbps of real speeds on their devices. Some of the leading operators globally support Gigabit LTE.

Gigabit LTE networks will become the foundation of 5G. This is because during the initial phases, 5G coverage will be limited to metros and high-traffic areas, and 5G devices will rely on LTE networks when they move out of 5G coverage area.

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## **gNB or ngNB**

next-gen eNode B - 5G-NR cell site (aka tower).

# I

## **IMT-2020**

This is a term defined by ITU which will form the basis or wireless telecommunications for 2020 and beyond. This will be used to certify any technology that wants to be considered as 5G, and get that moniker. 5G-NR will satisfy the requirements set by IMT-2020. LTE Advanced Pro may also qualify for that moniker.

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## **ITU**

International Telecom Union - The telecommunications arm of the United Nations. ITU is the agency that officially certifies any technology to be 3G, 4G or 5G. It publishes a set of requirements to be met by the technology to get the moniker. For example, IMT-2000 were the requirements for 3G, IMT-Advanced was for 4G and IMT-2020 is for 5G.



# L

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**LAA**

Licensed Assisted Access - Enables the coexistence of LTE and Wi-Fi in the 5 GHz unlicensed spectrum, which had been traditionally used exclusively for Wi-Fi. LAA allows operators to increase the capacity of their networks by utilizing unlicensed bands without significantly affecting Wi-Fi performance.

For many operators, LAA is the only option to offer Gigabit LTE.

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**LoS**

Line Of Site - The ability of the cell site (tower) and the device to see each other, without any major obstruction in between. Having LoS is extremely important when it comes to mmW.

**LTE Advanced**

This is defined in the 3GPP's Releases 10,11 and 12. LTE Advanced offers speeds of 100s of Mbps. Many of today's commercial networks support LTE Advanced.

**LTE Advanced Pro**

This is the next evolution from today's LTE Advanced. It is defined in the 3GPP's Release 13 and beyond. LTE Advance Pro offers Gigabit Speeds and many enhancements to enable CV2X and URLLC. LTE Advanced Pro will also be able to meet the IMT-2020 requirements and get the 5G moniker.

**LTE IoT**

A set of IoT technologies that enable cellular networks to be used for IoT. Initially, LTE was designed and developed for high-speed broadband services. But later it incorporated features that are essential for IoT, such as years of battery-life, extended coverage, less expensive devices, and others.

LTE IoT is used as an umbrella term to represent LTE-M/eMTC/Cat-M1/Cat-M2, NB IoT/Cat-NB1/NB2 and other IoT technologies that will be developed under LTE/LTE Advanced.

**LTE-M**

Also, known as eMTC (enhanced Machine Type Communications) or Cat-M1/M2, LTE-M is part of LTE IoT technologies. It offers up to 2.4 Mbps downlink speeds, years of battery-life, and extended coverage. This is suitable for latency sensitive IoT applications such as tracker, wearables, and for any use case that need voice and full mobility support.

## L cont.

### LTE Cat x (1,2,...)

LTE device categories. The device category defines the peak uplink and the downlink speeds the LTE device will support. Usually the higher the number, the higher is the supported speed. Through Release 13, devices used to have a single combined category representing specific uplink and downlink peak speeds. That changed with Release 14 and devices will now have separate categories for uplink and downlink. Here are some of the popular categories and their respective speeds:



UPLINK ONLY	
Cat-NB1	20 - 250Kbps
Cat-M1	1 Mbps
Cat-M2	6 Mbps
Cat-3	50 Mbps
Cat-5	75 Mbps
Cat-7	100 Mbps
Cat-14	1 Gbps
Cat-17	2 Gbps

COMBINED		
Cat-NB1	250 Kbps DL	250 Kbps UL
Cat-M1	1 Mbps DL	1 Mbps UL
Cat-M2	4 Mbps DL	6 Mbps UL
Cat-1	10 Mbps DL	5 Mbps UL
Cat-4	150 Mbps DL	50 Mbps UL
Cat-6	300 Mbps DL	50 Mbps UL
Cat-10	450 Mbps DL	100 Mbps UL
Cat-12	600 Mbps DL	100 Mbps UL

DOWNLINK ONLY	
Cat-NB1	250Kbps
Cat-M1	1 Mbps
Cat-M2	4 Mbps
Cat-1	10 Mbps
Cat-4	150 Mbps
Cat-6	300 Mbps
Cat-10	450 Mbps
Cat-12	600 Mbps
Cat-16	1 Gbps
Cat-17	2.5 Gbps
Cat-18	1.2 Gbps
Cat-20	2 Gbps

## M

### Massive IoT

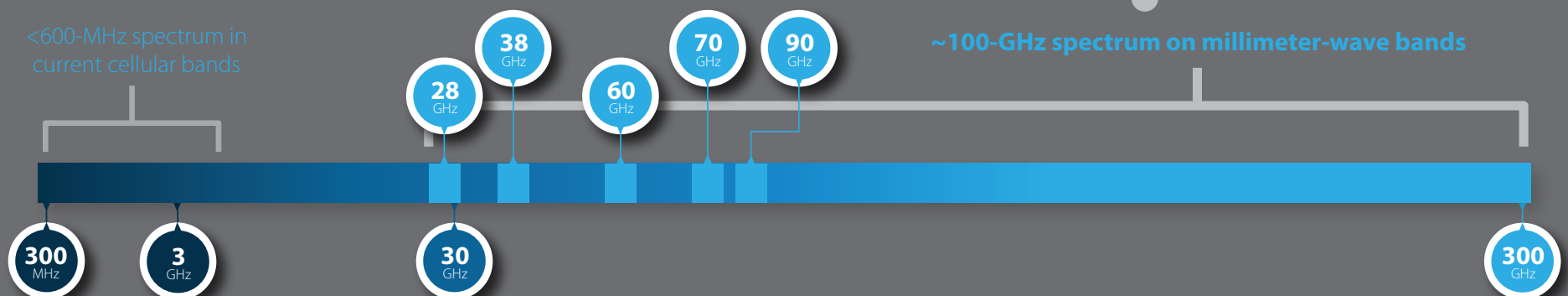
The ability to efficiently connect an extremely large number of densely located IoT devices (e.g. ~1.6 million devices in 1 Sq. Mile area). 5G is capable of supporting Massive IoT.

### Massive MIMO

Massive Multiple Input Multiple Output - MIMO refers to the technique of using multiple antennas at the cell site (tower) and devices to increase speeds and capacity. In wireless, the more antennas used, the higher the speed and capacity. Today's commercial networks and devices support up to 4x4 MIMO (4 antennas on both cell site and device). Massive MIMO refers to using a large number of antennas at the cell site, up to 64 or even 256 antennas, so that you substantially increase speeds and capacity.

### mmWave

Millimeter wave - The type of spectrum (airwaves) that is being used for some 5G networks. There is a great deal of unused spectrum in the mmWave bands. However, being much higher on the spectrum scale, the coverage of cell sites with this spectrum will be far smaller than today's bands.



# N

**Network Slicing**

A functionality of 5G technology where the network can be virtually divided and configured for vastly different characteristics. For example, one slice could be configured to suit the needs of automobiles, another could support specific industrial and factory controls etc. Such slicing is not possible with today's 4G networks (so operators have to deploy separate networks for such diverse needs).

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**NSA Mode**

Non Stand Alone mode - In this mode of 5G deployment, 5G devices rely on 4G network for signaling, and use 5G only for user traffic. Most of the operators will initially opt for this mode as they can leverage their existing investments in the 4G network and build 5G gradually as an overlay.

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**NB IoT**

NarrowBand IoT - Also known as Cat-NB1/NB2, NB IoT is a part of LTE IoT technologies. It offers 10s of kbps of speed, years of battery-life, and deep coverage. It is suitable for latency tolerant and low complexity, cost-effective applications, such as parking sensors, soil sensors for agricultural use, industrial sensors for pipeline and many others.

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**NG-Core**

Next-Gen Core - The core network for 5G.

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# R

**RAN**

Radio Access Network - The cellular radio network that includes the cell sites (aka towers), and antennas.

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**Release (Rel.) 14,15,16**

These are the specifications published by 3GPP for cellular technologies. For example, LTE was defined as part of Rel 8, LTE Advanced was part of Rel 10, and 5G-NR is part of Rel 15.

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**RF Module**

The modules that include RF ICs, and other RF components, tightly coupled in a compact form factor. These are used for today's LTE devices and will also be used in Sub-6 GHz 5G devices.

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# S

**SA Mode**

Stand Alone mode of 5G. This is a fully self-contained mode of 5G, where 5G devices get both signaling and data from the 5G network. Initially, very few operators will opt for this mode as they have to build a brand new and robust network (both RAN and core) with good coverage everywhere to minimize the dependency on 4G. 5G devices can handoff to 4G when they run out of 5G coverage.

**Shared Spectrum**

Shared Spectrum is a new type of licensing and is a hybrid of licensed and unlicensed approaches. Licensed spectrum stipulates that only one entity has the full rights to transmit in those frequencies. All of today's cellular networks are using licensed spectrum. Unlicensed spectrum stipulates that anybody could transmit in those frequencies, as long as they adhere to some simple co-existence mechanisms. All of today's Wi-Fi networks/ devices work on unlicensed spectrum.

In the shared spectrum concept, there is a primary user who is licensed to use the spectrum. However for whatever reason, they may not be fully utilizing that spectrum. In such a case, a secondary user can be allowed to operate in that spectrum, as long as it doesn't harm the original licensee.

A good example is the US Navy, which allocated a chunk of spectrum for its operation across the country. But they only have installations and usage on the shores, and nothing in the inlands. In such cases, operators could work with the Navy to utilize the unused spectrum for their services.

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**Sub-6 Band**

Spectrum (airwaves) that are under 6 GHz frequency. The sites utilizing these bands have much larger coverage. But the available spectrum in this band is limited. Today's cellular systems use this spectrum, and they will also be used for 5G.

## U

### UE

User Equipment - Wireless device such as a smartphone, mobile hotspot, or router.

### URLLC

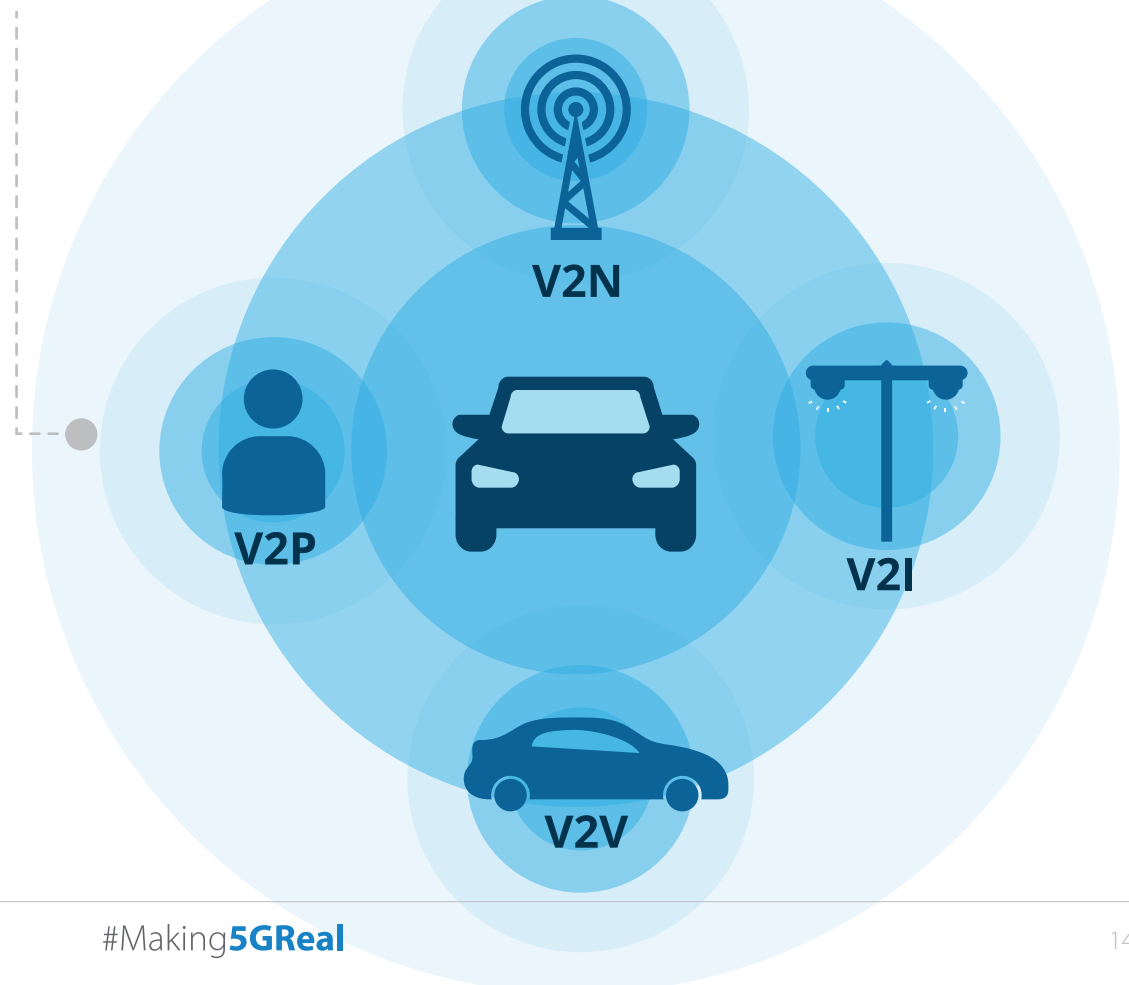
Ultra Reliable Low Latency Communication - A type of link with latency as low as 1ms or less, which is significantly lower compared to today's 10ms or higher. Such low latency is essential to utilize wireless for applications that rely on wired connections today. Some examples of these applications are industrial command and control mechanisms in factories, robotics, real-time voice translation, remote surgery etc.

5G will be able to support such low latency and enable these applications.

## V

### V2X / CV2X

Cellular Vehicle to X - The technologies that are part of 4G/LTE and 5G that enable easier and efficient communication between vehicles and other objects such as other vehicles, traffic lights, road hazard indicators, pedestrians, etc.

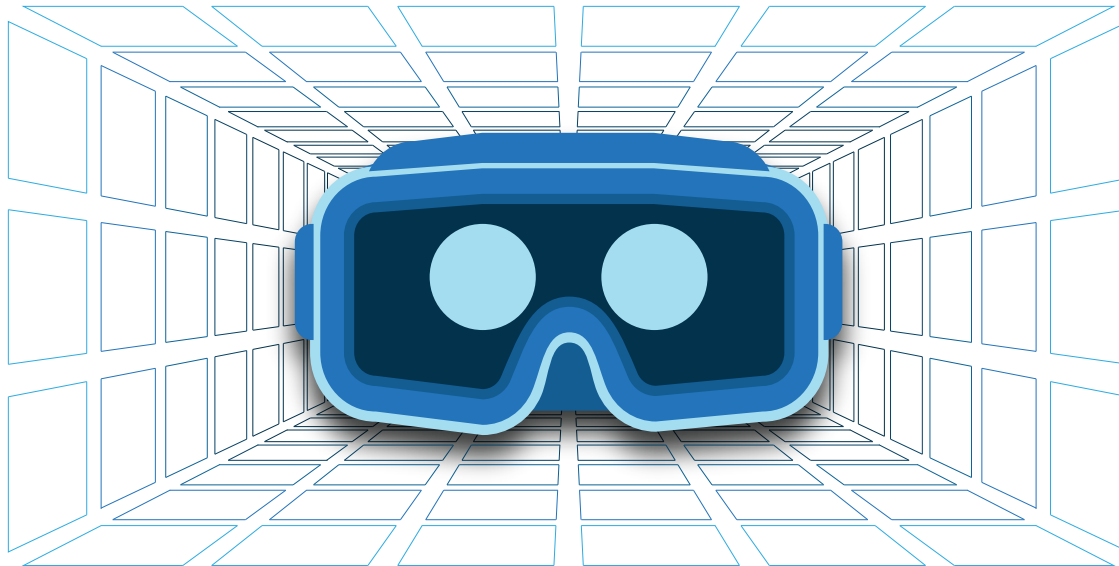


# V

cont.

## **Virtual Reality (VR)**

Three-dimensional computer simulated world in which a person can become immersed within the environment and able to manipulate objects or perform a series of actions. Aviation, medicine and military training programs and video games are some examples of VR put into action. Many applications incorporate a headset to place people into a fully immersive experience. 5G brings more bandwidth which is what is required for a seamless experience.



inseego