

FirstNet: Tech Terms 101



OneNet

The terms and terminology used in reference to broadband networks can be confusing and, in some cases, misused. Examples of these include 4G, LTE, Broadband, 700 MHz and others. In an effort to help those providing input and feedback on the Federal FirstNet public safety broadband network in Washington, we have compiled the following definitions and clarifications from several sources for some of the more commonly used (and misused) terms.

Bandwidth: difference between the upper and lower frequencies in a continuous set of frequencies or frequency band, and typically measured in *Hertz* (Hz) (defined below).

Broadband: refers to the wide bandwidth characteristics of a transmission medium, such as coaxial cable, optical fiber, twisted pair, DSL local telephone networks or wireless, and its ability to transport multiple signals or traffic types simultaneously.

Wireless: the transfer of information (e.g.: text, voice, data and video) between two or more points that are not connected by an electrical conductor (wire, cable, fiber or other physical connection). The most common wireless technology in use is radio. The ability to transmit radio waves varies based on several factors, including – but or limited to, the frequency being broadcast, the power of the transmitter, the height from which the signal is transmitted, and other interfering factors such as buildings, hills and mountains, trees, weather (e.g.: rain, snow, ice and wind). Each of these factors have varying degrees of influence on radio transmissions in different parts of the radio spectrum or frequency “bands” (i.e.: AM, FM, VHF, UHF, 700/800 MHz). The transmitting distance for various frequency bands can be short, such as a few kilometers for television or as far as thousands or even millions of kilometers for deep-space radio communications.

Wireless encompasses various types of fixed, mobile, and portable applications, which can include two-way radios, cellular telephones, personal digital assistants, and other wireless networking devices. Other examples of applications of radio wireless technology include **Global Positioning Satellite (GPS)** – see below) units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

GPS: The *Global Positioning System* is a space-based satellite navigation system that provides location and time information anywhere on the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides information to military, civilian, and commercial users around the world through the use of location triangulation and a comparison of the timing signals received from the GPS satellites. The GPS system maintained by the United States is one of many available globally and is provided free to anyone with a GPS receiver or other GPS-dependent device.



4G LTE: The “G” in “4G” stands for “*Generation*,” as in the next generation of wireless technologies. Each generation is designed to be faster, more secure, and more reliable than the previous generation.

Each of the *Generations* has standards that must be met to officially use the “G” designation. In general, the standards are as follow:

4G: p needs to be at least 100 Megabits per second and up to 1 Gigabit per second to pass as 4G. As it develops, 4G could surpass the speed of the average wireless broadband home Internet connection. It is important to note that, outside of the covered areas, 4G phones regress to the 3G standards (approximately 2 Megabits (~2,000,000 bits) of digital information per second).

4G LTE (Long Term Evolution): This version of service represents the latest advertised technology of the deployed 4G standard. In addition to the voice and other services of 3G, 4G LTE provides mobile broadband Internet access to laptops with wireless modems, smartphones, and to other mobile devices. Current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

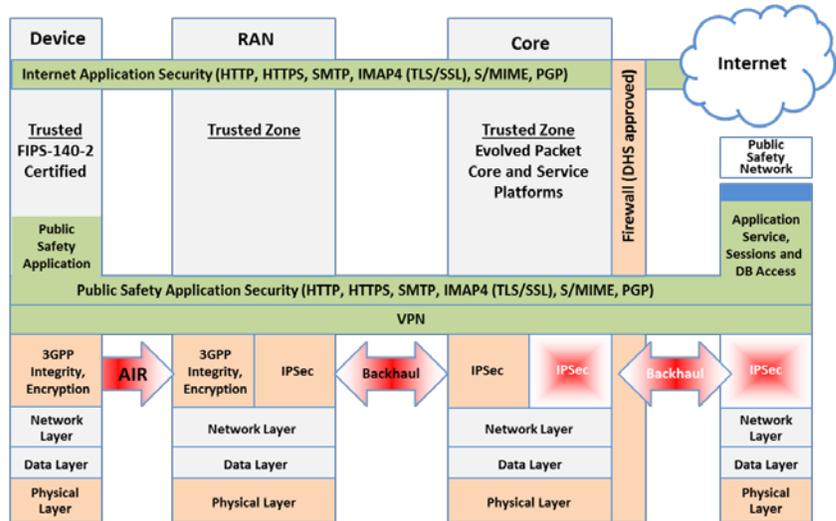
LTE: commonly marketed as **4G LTE**. It is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing wireless network capacity and speed by using a different radio interface together in conjunction with core network improvements. The standard is developed by the 3GPP (3rd Generation Partnership Project) and the features and functionality for each release are specified in its 3GPP Specification Release version matrix, which is available at: <http://www.3gpp.org/DynaReport/SpecReleaseMatrix.htm>

Various planned features and functionality include the ability to make prioritized calls, one-to-many calls, and to establish direct device-to-device communications – without the need for an intermediate tower / transmitter.

There are many different ways to implement LTE, so you can't assume all LTE network speeds or functionality are the same. For instance, carriers with more available radio spectrum for LTE can typically run faster networks than carriers with less spectrum. FirstNet will have a dedicated portion of spectrum in the 700 MHz band in which to build its public safety broadband network. The FCC for FirstNet's exclusive nationwide use nationwide licenses this spectrum.

Backhaul: Backhaul generally refers to the side of the network that communicates with the global Internet, paid for at wholesale commercial access rates to or at an Ethernet Exchange or other core network access location. In contracts pertaining to such networks, backhaul is the obligation to carry packets to and from that global network.

Cell phones communicating with a single cell tower constitute a local sub-network; the connection between the cell tower and the rest of the world begins with a backhaul link to the core of the Internet Service Provider or ISP's network (via a point of presence). The term *backhaul* may also be used to describe the entire wired part of a network, although some networks have wireless instead of wired backhaul, in whole or in part, for example using microwave bands and mesh network and edge network topologies that may use a high-capacity wireless channel to get packets to the microwave or fiber optic links.



Megabytes (MB) / Megabits (Mb): There is a distinction that needs to be made between these two terms. *Megabytes* is a unit of data storage. You're probably familiar with pen drives. An example would be one that can store 512 megabytes of information (512 MB). Whereas *Megabits* is a unit of data transfer. As an example, a dial-up internet connection (remember those?) might have a listed speed of 512 megabits per second (512 Mb/s). Each is written as follows: Megabytes - MB and Megabits - Mb.

Hertz (Hz): A *Hertz (Hz)* is the unit of frequency measurement defined as one cycle per second. The red line in Figure 1: One Hertz (below) depicts one cycle or 1 Hz.

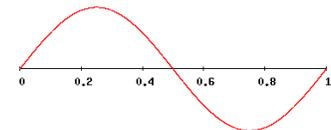


Figure 1: One Hertz

Megahertz (MHz): *Megahertz (MHz)* is a unit of (radio) frequency measurement equal to one million hertz (1,000,000 Hz). Other units of frequency are the kHz, equal to 1,000 Hz or 0.001 MHz, and the gigahertz, equal to 1,000,000,000 Hz or 1,000 MHz.

The portion of spectrum dedicated to the FirstNet public safety broadband network is located in the 700 MHz radio band.

The bandwidth of a digital signal, in megahertz, is related to the data speed in bits per second. In general, the greater the data speed, the larger the bandwidth. Data speed is not, however, the same thing as bandwidth. A high-speed cable or fiber optic modem operating at a speed of 5,000,000 bps has, in a certain sense, a nominal frequency of 5 MHz. But the bandwidth is generally much smaller, because it depends on variations in the individual data elements, not on the number of data bits per unit time.

700 MHz: In July 2007, the Federal Communications Commission (FCC) revised the 700 MHz band plan and service rules to promote the creation of a nationwide interoperable broadband network for public safety, as well as to facilitate the availability of new and innovative wireless broadband services for consumers. The FCC designated the lower half of the 700 MHz Public Safety Band (763-768/793-798 MHz) for broadband communications and consolidated existing narrowband allocations to the upper half of the 700 MHz Public Safety block of spectrum (769-775/799-805 MHz). The FCC also established a single nationwide license – the Public Safety Broadband License – for the 700 MHz public safety broadband spectrum to be used by FirstNet.

WiMAX - Worldwide Interoperability for Microwave Access – should be capable of around 40 megabits per second with a range of 30 miles. It is one of the closest technologies to meet the standards of true 4G and as it develops further, should surpass the 100MB/second which is the 4G standard. Mobile WiMAX allows the use of high speed data transfers and is the main competition for the 4G LTE services provided by cellular carriers.