Wireless Broadband Access

Mobile wireless broadband is a term used to describe wireless connections based on mobile phone technology. Broadband is an electronics term which is a classification of a communication with a bandwidth in excess of 256 kbps. In general, when you see the terms mobile wireless broadband, you are talking about any form of wireless communication that supports data rates at or above 256 kbps. Below in the New Figure Clear you see a USB modem device that will allow a laptop or similar device to connect to Clear broadband service through a USB port. The USB device is a wireless broadband modem.

Mobile wireless broadband service can be added to a device through a USB port

USB modems are tiny mobile broadband modems that plug into any laptop with a USB port and allow the computer to connect to the Internet using mobile broadband. Some companies refer to their USB broadband USB modems as laptop sticks or data cards. Some USB modems can also be used as storage devices, as well similar to a USB flash memory device. USB modems with storage capacity often include installation manuals, and software applications in addition to required drivers. No separate installation disc is required.

Note: There are several different definitions of broadband speed. For example, the FCC's definition of high-speed access is at least 3 Mbps downstream and 768 Mbps upstream. The IEEE defines broadband: as having instantaneous bandwidths greater than around 1 MHz and supporting data rates greater than about 1.5 Mbps.

Sharing Wireless Broadband Connections

There are two general methods used to share wireless broadband Internet access. The first is to share the connection through a wireless broadband equipped device such as a smart phone or tablet or laptop. The second way is to use a dedicated device that makes a connection to the wireless broadband provider and then shares the connection using Wi-Fi or network cables. A dedicated wireless broad device that shares the service provider Internet connection to other devices is referred to as a router. The router can also be called other names by the provider such as a jet pack, or wireless pocket router.

Tethering

Connecting a mobile device to another device is called tethering.   Mobile wireless broadband services are provided by communication companies such as Verizon, Sprint, and AT&T Mobile as well as many more similar communication companies. A single device can be configured to share the access to mobile broadband services. For example, a smartphone can share its wireless broad service with other devices such as computers, or tablets. You can create and share an Internet connection using a smartphone or tablet device equipped with cellphone access such as 3G or 4G. Sharing an Internet connection through a wireless broadband device is called tethering. Look at the Figure below, Win8 Tethering ID Blocked, to see the Internet sharing configuration on a Windows 8 phone.
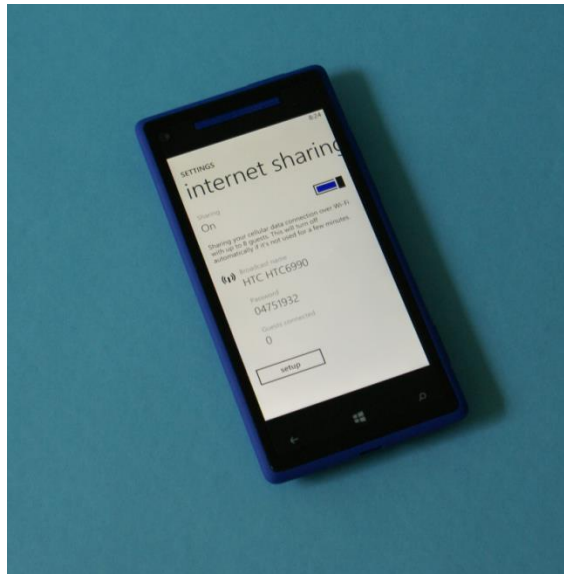
Mobile devices can be configured to share their Internet connections with other devices

The connection to the Internet is made using the Windows 8 home. The connection between the mobile devices is using Wi-Fi technology. This particular device can be configured to share its Internet connection with up to eight other devices. To connect to the smartphone Internet share you need two things to connect: the broadcast name of the wireless network, also known as the SSID and a password. The password is also referred to as a security key, passphrase, or passcode.

Another way of sharing an Internet connection is through the use of a dedicated device that is especially designed to connect to the Internet wireless broadband service and then distribute the connection to other devices. This type of device is referred to as a hotspot or a mobile hotspot.

Mobile Hotspots

Mobile hotspots are portable wireless routers that allow multiple devices to share a common wireless broadband Internet connection. The mobile hotspot connects to the wireless broad service and then shares the connection with other devices using W-Fi wireless.

A mobile hotspot can provide a shared Internet access to other Wi-Fi capable devices from any location that has compatible mobile broadband service.

Some mobile hotspots have mobile broadband capability built into the device and are typically marketed by the broadband service provider. Other mobile hotspot devices that are not mobile broadband enabled devices use a mobile broadband USB modem to establish a connection to the mobile broadband service provider. After a broadband connection is established with a service provider, the connection can be shared with other devices using either Wi-Fi or by cable connections.
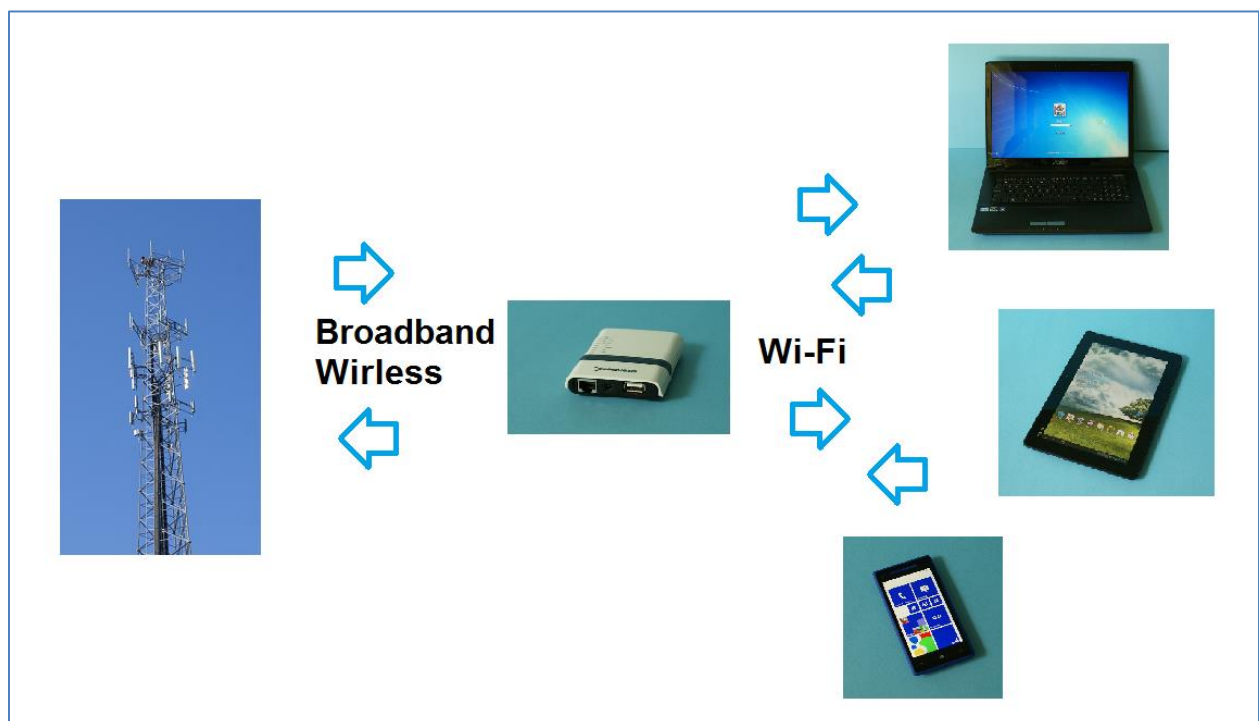
A wireless broadband modem or hot spot converts broadband radio wave frequencies and format to Wi-Fi frequency and format.

You can also create a Wi-Fi hot spot for sharing Internet access through devices such as tablets. Below you can see an Android tablet configuration option for creating a Wi-Fi hot spot.
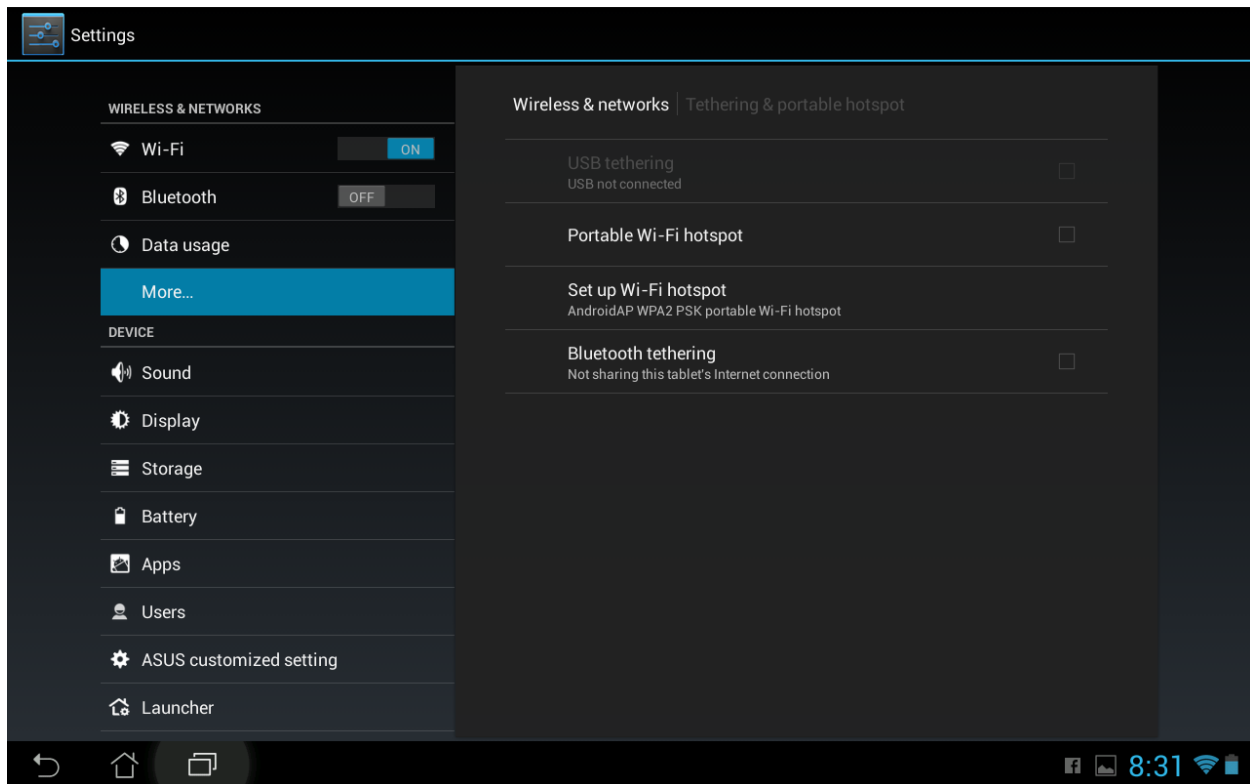
Most tablets have a configuration option for tethering or creating a W-Fi hot spot.

Some tablets are equipped with a SIM card that allows the tablet to share a mobile wireless broadband connection to other devices.

3G and 4G

To date, there have been four major generations of mobile wireless technology starting with the first mobile wireless communication device in world war two portable radios called "walkie talkie." Since then, each time there is a totally radical change in the development of portable wireless communication that requires all new electronic concepts and parts, and the device is not backward compatible, is referred to as a generation. In other words, you cannot upgrade one designated portable wireless device or specific generation into the next generation.

The acronyms 3G and 4G represent third generation (3G) and fourth generation (4G) when used in respect to mobile wireless broadband systems encountered today. 3G

and 4G are not technical terms and are not specifications, but rather an entire set of various standards and electronic technologies. The terms 3G and4G are terms used in advertisement and marketing of broadband wireless portable devices. In fact, when used in advertisement and marketing, 3G or 4G may be based upon entirely different sets of mobile radio communication standards depending on the service provider. In general, with respect to devices and services classified as 3G and 4G, 4G is far superior as compared to 3G. You can download or upload a great deal more data with 4G as compared to 3G.

Data Rates

Data rates vary greatly between wireless broadband service providers and technologies. Data rates vary a great deal when comparing 3G to 4G. In general, 4G is significantly faster than 3G, but there are many factors that can directly affect data rates. At best, the true data rates will be much lower than actual advertised data rates. For example, you will see data rates as high as 100 Mbps uplink and 50 Mbps downlink for LTE 4G wireless. In actuality the average user data rates are 5-12 Mbps downlink and 2-5 Mbps uplink.

The reasons for the difference is radio interference, distance from the service provider, as well as, how many users are accessing the service at the same time. 1) Radio interference can be a real problem for both 3G and4G service. There are so many devices that rely on radio technology that the air is simply full of signals generated from many different sources. 2) The distance from the service provider can also affect the data rate. The father the mobile device is from the service provider. This is caused by the fact that the radio signal becomes weaker the further it travels, thus causing a loss of data generally in direct proportion to the distance. 3) Lastly, the total numbers of users sharing the same frequency can cause a fluctuating data rate. Since the frequency is a shared medium. There will be a direct correlation between the number of users sharing the frequency and individual user-download and upload data rates.

Note: Another factor that affects data rates is location which is directly related to the data rate factors mentioned above. A mobile device might work great in a city like Atlanta but seem to be sluggish in another city. This is because of all the factors mentioned above.

Below is a chart of approximate data rates recommended for use of different services.

Application	Data Rate
Multimedia Messaging	8 – 64 kbps
Video Telephony	64 – 384 kbps
General Web Browsing	32 kbps – 1 Mbps
Video and Audio Streaming	32 kbps – 2 Mbps
High Definition Video	4 Mbps and higher

> ➢ Multimedia Messaging – A combination of texting and attached image.
> ➢ Video Telephony – Telephone with a live video feed.
> ➢ General Web Browsing – Web page viewing from simple static webpage presentation to dynamic web page with animation.
> ➢ Video and Audio Streaming – Viewing both video and audio media such as television or movies with modest resolution.
> ➢ High Definition Video – Viewing both video and audio media such as television or movies with excellent resolution.

The chart has suggested or recommended data rates for good performance. You can still obtain some of these services, but the performance will be poor.

Verizon Wireless advertises data rates as follows based upon independent third party test.

> ➢ 4G LTE network: typical download speeds of 5-12 Mbps and upload speeds of 2-5 Mbps;
> ➢ 3G Evolution Data Optimize (EVO): download speeds of 600 Kbps – 1.4 Mbps and upload speeds of 500 – 800 Kbps.

Metered Bandwidth Consumption

Most providers charge users by the amount of bandwidth they consume. For example a service provider may sell a service plan based on consuming 2 GB of bandwidth a month and may only cost $40.00 but an additional 1 GB may cost an additional $15.00. In other words it is like an electric bill, the more you consume the more it will cost you. Because most plans charge for additional usage, many wireless mobile devices have some type of metering so that you can view your total consumption. Some devices will also send you a text alert to let you know when you are getting close to exceeding your total bandwidth allocation.

Consumption	Emails	Music	Video
1 GB	250	3 hours	2 hours
4 GB	2,000	15 hours	8 hours
10 GB	10,000	30 hours	20 hours

Assigned Frequencies

Wi-Fi has definite assigned frequencies such as 2.4 GHz or 5 GHz depending on which standard is being applied such as 802.11a, 802,11b, 802,11g and 802.11n. There is no single assigned radio frequency for mobile communications but rather several different assigned frequencies that can be used by service providers. Some commonly encountered frequencies are 700MHz, 800 MHz, 850 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900 MHz, and 2100 MHz. Many devices can work on multiple frequencies. A device that can work on two frequencies is called dual band, three frequencies a tri-band and four frequencies a quad-band device.

Below, you can see options related directly to the configuration of the operational mode for a Verizon cellphone.

Cellular telephone devices provide several options to match the type of cellular service.

The choices are Global, LTE/CDMA or LTE/GSM/UMTS. What do all these acronyms mean? It can be very confusing because cell phone and mobile broadband wireless technology is a worldwide technology that applies many different standards and

electronic technologies. When accessing mobile broadband services you may need to match the technology to the device before you can obtain service. For example, you may need to configure the device for LTE/CDMA service mode before the device will access local wireless service. Here are a few of the most common to help you better understand the specifications of mobile wireless broadband equipment and services.

Global System for Mobile Communication (GSM)

GSM was originally an analog wireless communication system used for voice communications or wireless telephones. Later GSM evolved into a wireless digital communication system for transmitting mobile voice and data. The European Telecommunications Standards Institute (ETSI) developed the standards used for the second generation G2, which became the defacto standard all over the world. There are some other standards, but they only account for a small percentage of all wireless communications and need not be mentioned here. These standards are maintained by the GSM Association, (www.GSMA.org) a group of cellular network operators and associated companies.

Universal Mobil Telecommunications System is (UMTS)

Universal Mobil Telecommunications System is a 3G standard developed by the Third Generation Partnership Project (3GPP). UMTS is a component of the International Telecommunications Union (ITU) set of communication standards. UMST also incorporates the electronic technology of CDMA.

Code Division Multiple Access (CDMA)

Code Division Multiple Access (CDMA) is one of the electronic techniques used to encode digital information when using radio as a medium. CDMA greatly increases the amount of data and number of users that can be carried on a single radio channel. Major carriers Sprint and Verizon networks mainly use Code Division Multiple Access (CDMA) technology, while AT&T and T-Mobile use Global System for Mobile communication (GSM) technology.   All of these carriers also support 3G networks.

LTE

Long Term Evolution (LTE) is an evolution of the GSM and UMTS standards. LTE is considered 4G and has the highest advertise data rates. LTE is the best choice for streaming music, videos and high definition. But, as mentioned earlier, the advertised

data rates and the actual data rates will vary greatly when a mobile device fails to produce consistent data rates.

Troubleshoot a Mobile Wireless Broadband Modem

Troubleshooting a wireless broadband modem is easy in contrast to a telephone dial-up modem.   In most cases, you simply unplug the device and wait one to two minutes and simply plug it back in. If it is a USB device you remove it from the USB port, and then wait, and then reinsert it. If it is a hotspot type device, you disconnect it from the electrical power, wait a few minutes and then plug it back in. Because mobile wireless broadband is actually a form of network, other methods of testing the connection will be expanded in the networking section of the textbook. Some devices do have troubleshooting software applications that will guide you through some tests. Also, service providers have troubleshooting steps and frequently ask questions listed at their websites typically under support.

WiMAX

WiMAX is a wireless technology similar to Wi-Fi but has a much greater range, and the radio broadcast direction can be controlled. Wi-Fi is limited to a few hundred feet at best, but WiMAX can be used at distances of 30 miles for fixed stations, and 3 to 10 miles for mobile stations. Some factors that will affect the distance and through-put are: terrain, weather and large buildings. Wi-Fi broadcast is typically Omni directional, meaning it broadcast in a 360 degree radius from the transmitter. WiMAX broadcast signal can be shaped to transmit in direct line of sight, Omni or sector. Omni means the radio wave is broadcast in all directions 360 degrees. Point to point means the radio wave is broadcast in a narrow beam or line of sight. A sector broadcast is a portion of the 360 degrees broadcast such as 60, 90 or 120 degrees. The patterns are produced according to the type of antenna selected.
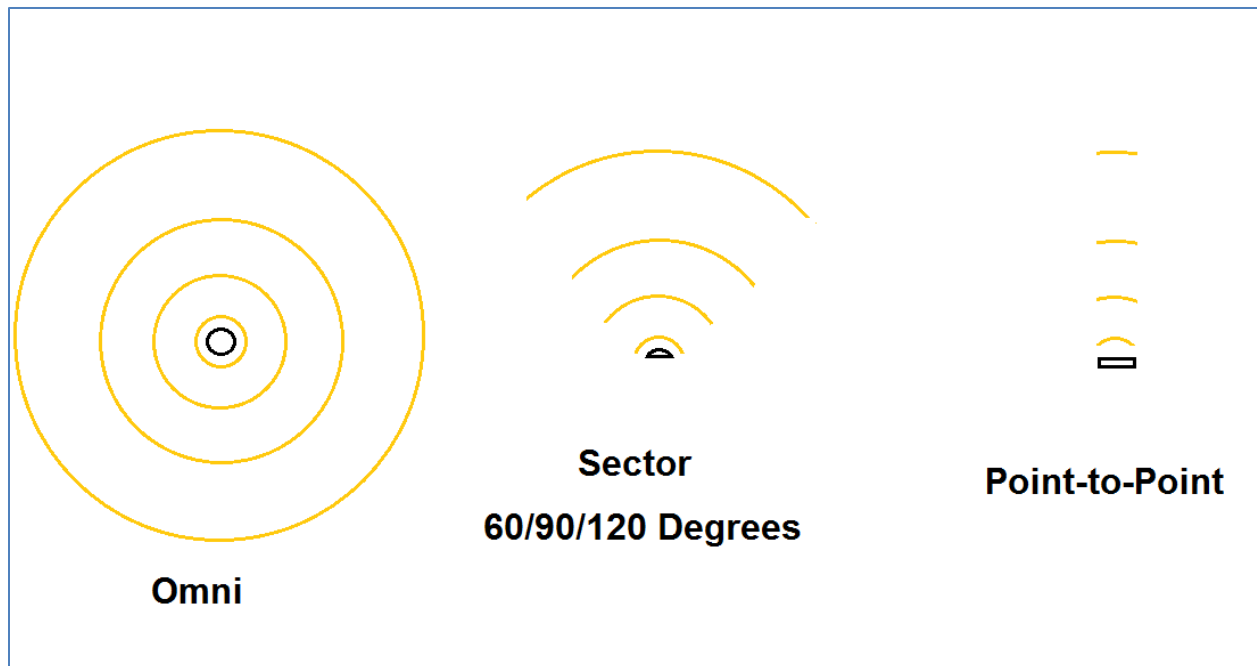
WiMAX can shape the broadcast pattern of the radio waves.

The data rates for WiMAX are approximately downlink 46 Mbps and uplink 7 Mbps but may vary according to interference, distance, location, number of users as well as other factors.

The assigned frequencies range from 2 GHz to 66 GHz, and the most commonly applied at this time are 3.5 MHz, 5 MHz, 7 MHz, 8.75 MHz, and 10 MHz. Other frequencies may be assigned by the FCC in the future because WiMAX is relatively new form of wireless broadband.

A very nice tutorial webpage is available at the following link
http://www.wimax.com/table/wimax-tutorial/

MIMO

MIMO Multiple in Multiple out (MIMO) is a method employed by many different wireless technologies. MIMO uses multiple radio channels to transmit and receive data to increase overall data rate. You can think of it as a device that uses two or more parallel channels to communicate thus doubling the data rate. When a device has multiple antennas is almost always a MIMO type of device. Look at the wireless router in the picture below.

A device with two or more antennas is always a sign of a MIMO enhanced device.

A device with two or more antennas is always a sign of MIMO technology being used, but not all devices have visible antennas. Many devices hide the antennas inside the case of the device to make it more aesthetically pleasing.

Summary Points

- o There is no one set frequency for or guaranteed data rate for Wireless broadband services.
- o WiMAX broadcast radio waves can be shaped as Omni, sector or point to point.
- o High Definition Video requires a data rate of 4 Mbps and higher.
- o Connecting a mobile device to another mobile device is called tethering.
- o Mobile hotspots are portable wireless routers that allow multiple devices to share a common wireless broadband Internet connection.
- o The acronyms 3G and 4G represent third generation (3G) and fourth generation (4G) when used in respect to wireless broadband services.
- o MIMO uses multiple radio channels to transmit and receive data to increase overall data rate.

Review Questions and Answers

1. How does MIMO technology incorporated into a wireless device affect data rates? MIMO doubles the data rate.

2. What configuration term is used describe connecting a mobile wireless device such as a smartphone to another device? Tethering.

3. What is another name for a mobile hotspot? Portable wireless router.

4. What factors affect the data rate of 3G and 4G services? Radio interference, distance from the service provider, and how many users are accessing the service at the same time.

5. Will data rates be consistent from city to city? No.

6. What data rate is needed for High Definition Video to perform successfully? 4 Mbps or higher.

7. What are two main difference when comparing WiMAX to Wi-Fi? Wi-Fi but has a much greater range, and the radio broadcast direction can be controlled.

8. How does WiMAX control the pattern of the broadcast area? The patterns are produced according to the type of antenna selected.