

# Wimax technology essay



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## WIMAX TECHNOLOGY FOR TELE COMMUNICATION OVERVIEW: WiMAX

(Worldwide Interoperability for Microwave Access) is a telecommunications protocol that provides fixed and fully mobile internet access. The current WiMAX revision provides up to 40 Mbit/s with the IEEE 802. 16m update expected offer up to 1 Gbit/s fixed speeds. The name “ WiMAX” was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard. The forum describes WiMAX[3] as “ a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL”. pic] WiMAX base station equipment with a sector antenna and wireless modem on top [pic] A pre-WiMAX CPE of a 26 km (16 mi) connection mounted 13 metres (43 ft) above the ground (2004, Lithuania). WiMAX refers to interoperable implementations of the IEEE 802. 16 wireless-networks standard (ratified by the WiMAX Forum), in similarity with Wi-Fi, which refers to interoperable implementations of the IEEE 802. 11 Wireless LAN standard (ratified by the Wi-Fi Alliance).

The WiMAX Forum certification allows vendors to sell their equipment as WiMAX (Fixed or Mobile) certified, thus ensuring a level of interoperability with other certified products, as long as they fit the same profile. The IEEE 802. 16 standard forms the basis of ‘ WiMAX’ and is sometimes referred to colloquially as “ WiMAX”, “ Fixed WiMAX”, “ Mobile WiMAX”, “ 802. 16d” and “ 802. 16e. “[5] Clarification of the formal names are as follow: • 802. 16-2004 is also known as 802. 16d, which refers to the working party that has developed that standard.

It is sometimes referred to as “ Fixed WiMAX,” since it has no support for mobility. • 802. 16e-2005, often abbreviated to 802. 16e, is an amendment to 802. 16-2004. It introduced support for mobility, among other things and is therefore also known as “ Mobile WiMAX”. Mobile WiMAX is the WiMAX incarnation that has the most commercial interest to date and is being actively deployed in many countries. Mobile WiMAX is also the basis of future revisions of WiMAX. As such, references to and comparisons with “ WiMAX” in this Wikipedia article mean “ Mobile WiMAX”. Uses

The bandwidth and range of WiMAX make it suitable for the following potential applications: • Providing portable mobile broadband connectivity across cities and countries through a variety of devices. • Providing a wireless alternative to cable and DSL for “ last mile” broadband access. • Providing data, telecommunications (VoIP) and IPTV services (triple play). • Providing a source of Internet connectivity as part of a business continuity plan. Broadband Companies are deploying WiMAX to provide mobile broadband or at-home broadband connectivity across whole cities or countries.

In many cases this has resulted in competition in markets which typically only had access to broadband through an existing incumbent DSL (or similar) operator. Additionally, given the relatively low cost to deploy a WiMAX network (in comparison to GSM, DSL or Fiber-Optic), it is now possible to provide broadband in places where it may have not been economically viable. Backhaul WiMAX is a possible replacement candidate for cellular phone technologies such as GSM and CDMA, or can be used as an overlay to increase capacity.

Fixed WiMAX is also considered as a wireless backhaul technology for 2G, 3G, and 4G networks in both developed and developing nations. [6][7] In North America, backhaul for urban cellular operations is typically provided via one or more copper wire line T1 connections, whereas remote cellular operations are sometimes backhauled via satellite. In most other regions, urban and rural backhaul is usually provided by microwave links. (The exception to this is where the network is operated by an incumbent with ready access to the copper network, in which case T1 lines may be used. )

WiMAX is a broadband platform and as such has much more substantial backhaul bandwidth requirements than legacy cellular applications.

Therefore, traditional copper wire line backhaul solutions are not appropriate. Consequently the use of wireless microwave backhaul is on the rise in North America and existing microwave backhaul links in all regions are being upgraded. [8] Capacities of between 34 Mbit/s and 1 Gbit/s[citation needed] are routinely being deployed with latencies in the order of 1 ms. In many cases, operators are aggregating sites using wireless technology and then presenting traffic on to fiber networks where convenient.

Triple-play WiMAX supports the technologies that make triple-play service offerings possible (such as Quality of Service and Multicasting). As a result, it is possible for a WiMAX operator to not only provide high-speed broadband internet access, but also VoIP and IPTV services to customers with relative ease. This enables a WiMAX service to be a replacement for DSL, Cable and Telephony services. On May 7, 2008 in the United States, Sprint Nextel, Google, Intel, Comcast, Bright House, and Time Warner announced a pooling

of an average of 120 MHz of spectrum and merged with Clearwire to form a company which will take the name Clear.

The new company hopes to benefit from combined services offerings and network resources as a springboard past its competitors. The cable companies will provide media services to other partners while gaining access to the wireless network as a Mobile virtual network operator to provide triple-play services. Some analysts have questioned how the deal will work out: Although fixed-mobile convergence has been a recognized factor in the industry, prior attempts to form partnerships among wireless and cable companies have generally failed to lead to significant benefits to the participants.

Other analysts point out that as wireless progresses to higher bandwidth, it inevitably competes more directly with cable and DSL, inspiring competitors into collaboration. Also, as wireless broadband networks grow denser and usage habits shift, the need for increased backhaul and media service will accelerate, therefore the opportunity to leverage cable assets is expected to increase. Rapid deployment • WiMAX access was used to assist with communications in Aceh, Indonesia, after the tsunami in December 2004.

All communication infrastructure in the area, other than amateur radio, was destroyed making the survivors unable to communicate with people outside the disaster area and vice versa. WiMAX provided broadband access that helped regenerate communication to and from Aceh. WiMAX hardware was donated by Intel Corporation to assist the Federal Communications Commission (FCC) and FEMA in their communications efforts in the areas

affected by Hurricane Katrina. [9] In practice, volunteers used mainly self-healing mesh, Voice over Internet Protocol (VoIP), and a satellite uplink combined with Wi-Fi on the local link.

Connecting to WiMAX [pic] A WiMAX Gateway which provides VoIP, Ethernet and WiFi connectivity [pic] A WiMAX USB modem for mobile internet There are numerous devices on the market that provide connectivity to a WiMAX network. These are known as the “ subscriber unit” (SU). There is an increasing focus on portable units. This includes handsets (similar to cellular smartphones); PC peripherals (PC Cards or USB dongles); and embedded devices in laptops, which are now available for Wi-Fi services.

In addition, there is much emphasis by operators on consumer electronics devices such as Gaming consoles, MP3 players and similar devices. It is notable that WiMAX is more similar to Wi-Fi than to 3G cellular technologies. The WiMAX Forum website provides a list of certified devices. However, this is not a complete list of devices available as certified modules are embedded into laptops, MIDs (Mobile internet devices), and other private labeled devices. WiMAX Gateways WiMAX gateway devices are available as both indoor and outdoor versions from several manufacturers.

Many of the WiMAX gateways that are offered by manufactures such as ZyXEL, Motorola, and Greenpacket are stand-alone self-install indoor units. Such devices typically sit near the customer’s window with the best WiMAX signal, and provide:

- An integrated Wi-Fi access point to provide the WiMAX Internet connectivity to multiple devices throughout the home or business.
- Ethernet ports should you wish to connect directly to your computer or DVR

instead. • One or two PSTN telephone jacks to connect your land-line phone and take advantage of VoIP.

Indoor gateways are convenient, but radio losses mean that the subscriber may need to be significantly closer to the WiMAX base station than with professionally-installed external units. Outdoor units are roughly the size of a laptop PC, and their installation is comparable to the installation of a residential satellite dish. A higher-gain directional outdoor unit will generally result in greatly increased range and throughput but with the obvious loss of practical mobility of the unit. WiMAX Dongles There are a variety of USB dongles on the market which provide connectivity to a WiMAX network.

Generally these devices are connected to a notebook or netbook whilst on the go. Dongles typically have omnidirectional antennae which are of lower-gain compared to other devices, as such these devices are best used in areas of good coverage. WiMAX Mobiles HTC announced the first WiMAX enabled mobile phone, the Max 4G, on Nov 12th 2008. [11] The device was only available to certain markets in Russia on the Yota network. HTC released the second WiMAX enabled mobile phone, the EVO 4G, March 23, 2010 at the CTIA conference in Las Vegas.

The device made available on June 4, 2010 is capable of both EV-DO(3G) and WiMAX(4G) as well as simultaneous data & voice sessions. The device also has a front-facing camera enabling the use of video conversations. A number of WiMAX Mobiles are expected to hit the US market in 2010. [14] Technical information [pic] Illustration of a WiMAX MIMO board WiMAX and the IEEE 802. 16 Standard The current WiMAX revision is based upon IEEE Std 802.

16e-2005,[15] approved in December 2005. It is a supplement to the IEEE Std 802. 16-2004,[16] and so the actual standard is 802. 6-2004 as amended by 802. 16e-2005. Thus, these specifications need to be considered together. IEEE 802. 16e-2005 improves upon IEEE 802. 16-2004 by:

- Adding support for mobility (soft and hard handover between base stations). This is seen as one of the most important aspects of 802. 16e-2005, and is the very basis of Mobile WiMAX.
- Scaling of the Fast Fourier transform (FFT) to the channel bandwidth in order to keep the carrier spacing constant across different channel bandwidths (typically 1. 25 MHz, 5 MHz, 10 MHz or 20 MHz).

Constant carrier spacing results in a higher spectrum efficiency in wide channels, and a cost reduction in narrow channels. Also known as Scalable OFDMA (SOFDMA). Other bands not multiples of 1. 25 MHz are defined in the standard, but because the allowed FFT subcarrier numbers are only 128, 512, 1024 and 2048, other frequency bands will not have exactly the same carrier spacing, which might not be optimal for implementations.

- Advanced antenna diversity schemes, and hybrid automatic repeat-request (HARQ)
- Adaptive Antenna Systems (AAS) and MIMO technology
- Denser sub-channelization, thereby improving indoor penetration
- Introducing Turbo Coding and Low-Density Parity Check (LDPC)
- Introducing downlink sub-channelization, allowing administrators to trade coverage for capacity or vice versa
- Adding an extra QoS class for VoIP applications.

SOFDMA (used in 802. 16e-2005) and OFDM256 (802. 16d) are not compatible thus equipment will have to be replaced if an operator is to move to the later standard (e. g. , Fixed WiMAX to Mobile WiMAX). Physical layer The original version of the standard on which WiMAX is based (IEEE 802. 6) specified a physical layer



operating in the 10 to 66 GHz range. 802. 16a, updated in 2004 to 802. 16-2004, added specifications for the 2 to 11 GHz range. 802. 16-2004 was updated by 802. 16e-2005 in 2005 and uses scalable orthogonal frequency-division multiple access (SOFDMA) as opposed to the fixed orthogonal frequency-division multiplexing (OFDM) version with 256 sub-carriers (of which 200 are used) in 802. 16d. More advanced versions, including 802. 16e, also bring multiple antenna support through MIMO (See WiMAX MIMO).

This brings potential benefits in terms of coverage, self installation, power consumption, frequency re-use and bandwidth efficiency. MAC (data link) layer The WiMAX MAC uses a scheduling algorithm for which the subscriber station needs to compete only once for initial entry into the network. After network entry is allowed, the subscriber station is allocated an access slot by the base station. The time slot can enlarge and contract, but remains assigned to the subscriber station, which means that other subscribers cannot use it.

In addition to being stable under overload and over-subscription, the scheduling algorithm can also be more bandwidth efficient. The scheduling algorithm also allows the base station to control Quality of service (QoS) parameters by balancing the time-slot assignments among the application needs of the subscriber stations. Deployment As a standard intended to satisfy needs of next-generation data networks (4G), WiMAX is distinguished by its dynamic burst algorithm modulation adaptive to the physical environment the RF signal travels through.

Modulation is chosen to be more spectrally efficient (more bits per OFDM/SOFDMA symbol). That is, when the bursts have a high signal strength and a high carrier to noise plus interference ratio (CINR), they can be more easily decoded using digital signal processing (DSP). In contrast, operating in less favorable environments for RF communication, the system automatically steps down to a more robust mode (burst profile) which means fewer bits per OFDM/SOFDMA symbol; with the advantage that power per bit is higher and therefore simpler accurate signal processing can be performed.

Burst profiles are used inverse (algorithmically dynamic) to low signal attenuation; meaning throughput between clients and the base station is determined largely by distance. Maximum distance is achieved by the use of the most robust burst setting; that is, the profile with the largest MAC frame allocation trade-off requiring more symbols (a larger portion of the MAC frame) to be allocated in transmitting a given amount of data than if the client were closer to the base station. The client's MAC frame and their individual burst profiles are defined as well as the specific time allocation.

However, even if this is done automatically then the practical deployment should avoid high interference and multipath environments. The reason for which is obviously that too much interference causes the network function poorly and can also misrepresent the capability of the network. The system is complex to deploy as it is necessary to track not only the signal strength and CINR (as in systems like GSM) but also how the available frequencies will be dynamically assigned (resulting in dynamic changes to the available bandwidth. ) This could lead to cluttered frequencies with slow response times or lost frames.

As a result the system has to be initially designed in consensus with the base station product team to accurately project frequency use, interference, and general product functionality. Integration with an IP-based network [pic] The WiMAX Forum WiMAX Architecture The WiMAX Forum has proposed an architecture that defines how a WiMAX network can be connected with an IP based core network, which is typically chosen by operators that serve as Internet Service Providers (ISP); Nevertheless the WiMAX BS provide seamless integration capabilities with other types of architectures as with packet switched Mobile Networks.

The WiMAX forum proposal defines a number of components, plus some of the interconnections (or reference points) between these, labeled R1 to R5 and R8:

- SS/MS: the Subscriber Station/Mobile Station
- ASN: the Access Service Network[17]
- BS: Base station, part of the ASN
- ASN-GW: the ASN Gateway, part of the ASN
- CSN: the Connectivity Service Network
- HA: Home Agent, part of the CSN
- AAA: Authentication, Authorization and Accounting Server, part of the CSN
- NAP: a Network Access Provider
- NSP: a Network Service Provider

It is important to note that the functional architecture can be designed into various hardware configurations rather than fixed configurations. For example, the architecture is flexible enough to allow remote/mobile stations of varying scale and functionality and Base Stations of varying size – e. g. femto, pico, and mini BS as well as macros. Spectrum allocation There is no uniform global licensed spectrum for WiMAX, however the WiMAX Forum has published three licensed spectrum profiles: 2. 3 GHz, 2. 5 GHz and 3. 5 GHz, in an effort to drive standardisation and decrease cost.

In the USA, the biggest segment available is around 2.5 GHz,[18] and is already assigned, primarily to Sprint Nextel and Clearwire. Elsewhere in the world, the most-likely bands used will be the Forum approved ones, with 2.3 GHz probably being most important in Asia. Some countries in Asia like India and Indonesia will use a mix of 2.5 GHz, 3.3 GHz and other frequencies. Pakistan's Wateen Telecom uses 3.5 GHz. Analog TV bands (700 MHz) may become available for WiMAX usage, but await the complete roll out of digital TV, and there will be other uses suggested for that spectrum.

In the USA the FCC auction for this spectrum began in January 2008 and, as a result, the biggest share of the spectrum went to Verizon Wireless and the next biggest to AT. [19] Both of these companies have stated their intention of supporting LTE, a technology which competes directly with WiMAX. EU commissioner Viviane Reding has suggested re-allocation of 500-800 MHz spectrum for wireless communication, including WiMAX. [20] WiMAX profiles define channel size, TDD/FDD and other necessary attributes in order to have inter-operating products.

The current fixed profiles are defined for both TDD and FDD profiles. At this point, all of the mobile profiles are TDD only. The fixed profiles have channel sizes of 3.5 MHz, 5 MHz, 7 MHz and 10 MHz. The mobile profiles are 5 MHz, 8.75 MHz and 10 MHz. (Note: the 802.16 standard allows a far wider variety of channels, but only the above subsets are supported as WiMAX profiles. ) Since October 2007, the Radio communication Sector of the International Telecommunication Union (ITU-R) has decided to include WiMAX technology in the IMT-2000 set of standards. [21] This enables spectrum owners

(specifically in the 2.5-2.69 GHz band at this stage) to use WiMAX equipment in any country that recognizes the IMT-2000. Spectral efficiency

One of the significant advantages of advanced wireless systems such as WiMAX is spectral efficiency. For example, 802.16-2004 (fixed) has a spectral efficiency of 3.7 (bit/s)/Hertz, and other 3.5-4G wireless systems offer spectral efficiencies that are similar to within a few tenths of a percent. The notable advantage of WiMAX comes from combining SOFDMA with smart antenna technologies.

This multiplies the effective spectral efficiency through multiple reuse and smart network deployment topologies. The direct use of frequency domain organization simplifies designs using MIMO-AAS compared to CDMA/WCDMA methods, resulting in more effective systems. Inherent Limitations A commonly-held misconception is that WiMAX will deliver 70 Mbit/s over 50 kilometers. Like all wireless technologies, WiMAX can either operate at higher bitrates or over longer distances but not both: operating at the maximum range of 50 km (31 miles) increases bit error rate and thus results in a much lower bitrate.

Conversely, reducing the range (to under 1 km) allows a device to operate at higher bitrates. A recent city-wide deployment of WiMAX in Perth, Australia, has demonstrated that customers at the cell-edge with an indoor CPE typically obtain speeds of around 1-4 Mbit/s, with users closer to the cell tower obtaining speeds of up to 30 Mbit/s. Like all wireless systems, available bandwidth is shared between users in a given radio sector, so performance could deteriorate in the case of many active users in a single sector.

However, with adequate capacity planning and the use of WiMAX's Quality of Service, a minimum guaranteed throughput for each subscriber can be put in place. In practice, most users will have a range of 4-8 Mbit/s services and additional radio cards will be added to the base station to increase the number of users that may be served as required. Silicon implementations A critical requirement for the success of a new technology is the availability of low-cost chipsets and silicon implementations.

WiMAX has a strong silicon ecosystem with a number of specialized companies producing baseband ICs and integrated RFICs for implementing full-featured WiMAX Subscriber Stations in the 2.3, 2.5 and 3.5GHz band (refer to 'Spectrum allocation' above). It is notable that most of the major semiconductor companies have not developed WiMAX chipsets of their own and have instead chosen to invest in and/or utilise the well developed products from smaller specialists or start-up suppliers. These companies include but not limited to Beceem, Sequans and PicoChip. The chipsets from these companies are used in the majority of WiMAX devices.

Intel Corporation is a leader in promoting WiMAX, but has limited its WiMAX chipset development and instead chosen to invest in these specialized companies producing silicon compatible with the various WiMAX deployments throughout the globe. Comparison with Wi-Fi Comparisons and confusion between WiMAX and Wi-Fi are frequent because both are related to wireless connectivity and Internet access. • WiMAX is a long range system, covering many kilometres, that uses licensed or unlicensed spectrum to deliver connection to a network, in most cases the Internet. • Wi-Fi uses unlicensed spectrum to provide access to a local network. Wi-Fi is

more popular in end user devices. • Wi-Fi runs on the Media Access Control's CSMA/CA protocol, which is connectionless and contention based, whereas WiMAX runs a connection-oriented MAC. • WiMAX and Wi-Fi have quite different quality of service (QoS) mechanisms: o WiMAX uses a QoS mechanism based on connections between the base station and the user device. Each connection is based on specific scheduling algorithms. o Wi-Fi uses contention access – all subscriber stations that wish to pass data through a wireless access point (AP) are competing for the AP's attention on a random interrupt basis.

This can cause subscriber stations distant from the AP to be repeatedly interrupted by closer stations, greatly reducing their throughput. • Both 802.11 and 802.16 define Peer-to-Peer (P2P) and ad hoc networks, where an end user communicates to users or servers on another Local Area Network (LAN) using its access point or base station. However, 802.11 supports also direct ad hoc or peer to peer networking between end user devices without an access point while 802.16 end user devices must be in range of the base station. Wi-Fi and WiMAX are complementary.

WiMAX network operators typically provide a WiMAX Subscriber Unit which connects to the metropolitan WiMAX network and provides Wi-Fi within the home or business for local devices (e. g. , Laptops, Wi-Fi Handsets, smartphones) for connectivity. This enables the user to place the WiMAX Subscriber Unit in the best reception area (such as a window), and still be able to use the WiMAX network from any place within their residence.

Conformance testing TTCN-3 test specification language is used for the purposes of specifying conformance tests for WiMAX implementations.

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The WiMAX test suite is being developed by a Specialist Task Force at ETSI (STF 252). [22] The WiMAX Forum is a non profit organization formed to promote the adoption of WiMAX compatible products and services. [23] A major role for the organization is to certify the interoperability of WiMAX products. [24] Those that pass conformance and interoperability testing achieve the “ WiMAX Forum Certified” designation, and can display this mark on their products and marketing materials.

Some vendors claim that their equipment is “ WiMAX-ready”, “ WiMAX-compliant”, or “ pre-WiMAX”, if they are not officially WiMAX Forum Certified. Another role of the WiMAX Forum is to promote the spread of knowledge about WiMAX. In order to do so, it has a certified training program that is currently offered in English and French. It also offers a series of member events and endorses some industry events. WiMAX Spectrum Owners Alliance [pic] WiSOA logo WiSOA was the first global organization composed exclusively of owners of WiMAX spectrum with plans to deploy WiMAX technology in those bands.

WiSOA focussed on the regulation, commercialisation, and deployment of WiMAX spectrum in the 2.3-2.5 GHz and the 3.4-3.5 GHz ranges. WiSOA merged with the Wireless Broadband Alliance in April 2008. Competing technologies [pic] Speed vs. Mobility of wireless systems: Wi-Fi, HSPA, UMTS, GSM Within the marketplace, WiMAX's main competition comes from existing, widely deployed wireless systems such as UMTS, CDMA2000, existing Wi-Fi and mesh networking.



In the future, competition will be from the evolution of the major cellular standards to so-called 4G, high-bandwidth, low-latency, all-IP networks with voice services built on top. The worldwide move to 4G for GSM/UMTS and AMPS/TIA (including CDMA2000) is the 3GPP Long Term Evolution effort. However, it has been noted that the likely performance difference between WiMAX as it stands today and LTE when it is eventually commercially available in 2-3 years time, will be negligible. [citation needed] LTE is expected to be ratified at the end of 2010, with commercial implementations becoming viable within the next two years..

End of 2009 TeliaSonera started commercial deployment in Oslo and Stockholm, In Denmark the 3 big telecoms are upgrading their network, and will make LTE available during 2010. In some areas of the world, the wide availability of UMTS and a general desire for standardization has meant spectrum has not been allocated for WiMAX: in July 2005, the EU-wide frequency allocation for WiMAX was blocked. Harmonization Early WirelessMAN standards, the European standard HiperMAN and Korean standard WiBro have been harmonized as part of WiMAX and are no longer seen as competition but as complementary.

All networks now being deployed in South Korea, the home of the WiBro standard, are now WiMAX. Comparison The following table should be treated with caution because it only shows peak rates which are potentially very misleading. In addition, the comparisons listed are not normalized by physical channel size (i. e. , spectrum used to achieve the listed peak rates); this obfuscates spectral efficiency and net through-put capabilities of the different wireless technologies listed below. v • d • e Comparison of Mobile

Internet Access methods | | Standard[pic] | Family[pic] | Primary Use[pic] |  
Radio Tech[pic] | Downlink | Uplink | Notes[pic] | | | | |(Mbit/s)[pic](Mbit/s)  
[pic| | | | | ] | | | | LTE | UMTS/4GSM | General 4G | OFDMA/MIMO/SC-FDMA |  
360 | 80 | LTE-Advanced update | | | | | | expected to offer peak| | | | | |  
rates of at least 1 | | | | | | | Gbit/s fixed speeds | | | | | | and 100 Mbit/s to |  
| | | | | | mobile users. | | WiMAX | 802. 16e | Mobile Internet | MIMO-SOFDMA  
| 144 | 35 | WiMAX update IEEE | | | | | | 802. 16m expected offer| | | | | |  
up to 1 Gbit/s fixed | | | | | | | speeds. | | Flash-OFDM | Flash-OFDM | Mobile  
Internet | Flash-OFDM | 5. 3 | 1. | Mobile range 18miles | | | | mobility up to | |  
10. 6 | 3. 6 |(30km) | | | | 200mph (350km/h) | | 15. 9 | 5. 4 | extended range  
34 | | | | | | miles (55km) | | HIPERMAN | HIPERMAN | Mobile Internet |  
OFDM | 56. 9 | 56. 9 | | | Wi-Fi | 802. 11 | Mobile Internet | OFDM/MIMO | 288.  
| Antenna, RF front end | | |(11n) | | |(Supports 600Mbps @ 40MHz|  
enhancements and minor| | | | | channel width) | protocol timer tweaks | | | |  
| | | | have helped deploy | | | | | long range P2P | | | | | networks  
compromising | | | | | on radial coverage, | | | | | throughput and/or | | | |  
| | | | spectra efficiency | | | | | |(310km & 382km). | | iBurst | 802. 0 |  
Mobile Internet | HC-SDMA/TDD/MIMO | 95 | 36 | Cell Radius: 3-12 km | | | | |  
| | Speed: 250kmph | | | | | | Spectral Efficiency: | | | | | | 13 bits/s/Hz/cell  
| | | | | | | Spectrum Reuse Factor:| | | | | |" 1" | | EDGE Evolution | GSM |  
Mobile Internet | TDMA/FDD | 1. 9 | 0. 9 | 3GPP Release 7 | | UMTS W-CDMA |  
UMTS/3GSM | General 3G | CDMA/FDD | 0. 384 | 0. 384 | HSDPA widely  
deployed. | HSDPA+HSUPA | | | | 14. 4 | 5. 76 | Typical downlink rates| |  
HSPA+ | | | CDMA/FDD/MIMO | 56 | 22 | today 2 Mbit/s, ~200 | | | | | | | kbit/s  
uplink; HSPA+ | | | | | | | downlink up to 56 | | | | | | | Mbit/s. | UMTS-TDD |  
UMTS/3GSM | Mobile Internet | CDMA/TDD | 16 | 16 | Reported speeds | | | | |  
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||| according to ||||| IPWireless using 16QAM| ||||| modulation similar to ||||| HSDPA+HSUPA | | 1xRTT | CDMA2000 | Mobile phone | CDMA | 0.144 | 0.144 | Succeeded by EV-DO | | EV-DO 1x Rev. 0 | CDMA2000 | Mobile Internet | CDMA/FDD | 2.45 | 0.15 | Rev B note: N is the || EV-DO 1x Rev.

A |||| 3.1 | 1.8 | number of 1.25 MHz | | EV-DO Rev. B |||| 4.9xN | 1.8xN | chunks of spectrum | ||||| used. | Notes: All speeds are theoretical maximums and will vary by a number of factors, including the use of external antennae, distance from the tower and the ground speed (e. g. communications on a train may be poorer than when standing still). Usually the bandwidth is shared between several terminals.

The performance of each technology is determined by a number of constraints, including the spectral efficiency of the technology, the cell sizes used, and the amount of spectrum available. For more information, see Comparison of wireless data standards. See also Comparison of mobile phone standards, Spectral efficiency comparison table and OFDM system comparison table. Future development The IEEE 802.16m [1] standard is the core technology for the proposed WiMAX Release 2, which enables more efficient, faster, and more converged data communications. The IEEE 802.16m standard has been submitted to the ITU for IMT-Advanced standardization. IEEE 802.16m is one of the major candidates for IMT-Advanced technologies by ITU. Among many enhancements, IEEE 802.6m systems can provide four times faster data speed than the current WiMAX Release 1 based on IEEE 802.16e technology. WiMAX Release 2 will provide strong backward compatibility with Release 1 solutions. It will allow current

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WiMAX operators to migrate their Release 1 solutions to Release 2 by upgrading channel cards or software of their systems. Also, the subscribers who use currently available WiMAX devices can communicate with new WiMAX Release 2 systems without difficulty. It is anticipated that in a practical deployment, using 4X2 MIMO in the urban microcell scenario with only a single 20-MHz TDD channel available system wide, the 802. 16m system can support both 120 Mbit/s downlink and 60 Mbit/s uplink per site simultaneously.

It is expected that the WiMAX Release 2 will be available commercially in the 2011-2012 timeframe. Interference A field test conducted by SUIRG (Satellite Users Interference Reduction Group) with support from the U. S. Navy, the Global VSAT Forum, and several member organizations yielded results showing interference at 12 km when using the same channels for both the WiMAX systems and satellites in C-band. The WiMAX Forum has yet to respond. Deployments As example, Korea launched Wimax at 2nd quarter of 2006 and then launched HSPA one quarter after launched Wimax. At the end of 2008 there were 8. 4 million HSPA subscribers and 350, 000 Wimax subscribers in Korea.

Almost all of HSPA subscribers come from 2G and 3G users who have been tempted to upgrade to new devices by high subsidies, whereas Wimax subscribers almost all are newcomers. Deployment of Wimax is still limited (spotted), whereas there are well over 100 countries where HSPA networks are deployed, and even where there is no HSPA coverage there is backward compatibility (using HSPA devices) to pre-existing networks (GSM and WCDMA) with a roaming infrastructure already in place. As of April 2010, the <https://assignbuster.com/wimax-technology-essay/>

WiMAX Forum claims there are over 558 WiMAX (fixed and mobile) networks deployed in over 147 countries. [30] Yota is the largest WiMAX network operator in the world[31] but has announced that it will move new network deployments to LTE and, subsequently, change its existing networks as well.

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