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A Review of Bandwidth Spectrum Analysis of 4G and Relevant Technologies

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ABSTRACT : 4G means **fourth generation**. It is fourth generation of mobile telecommunications technology, succeeding 3G. A 4G system must provide capabilities defined by ITU in IMT Advanced. Potential & current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, & cloud computing. Two 4G candidate systems are commercially deployed: Mobile WiMAX standard first used in South Korea in 2007, & first-release Long Term Evolution (LTE) standard . This has however been debated if these first-release versions should be considered to be 4G or not, as discussed in technical definition section below. In United States, Sprint (previously Clearwire) has deployed Mobile WiMAX networks since 2008, while Metro PCS became first operator to offer LTE service in 2010. USB wireless modems were among first devices able to access these networks, with WiMAX smartphones becoming available during 2010, & LTE smartphones arriving in 2011. 3G & 4G equipment made for other continents are not always compatible because of different frequency bands. Mobile WiMAX is not available for European market as of April 2012.

1. INTRODUCTION TO WIRELESS COMMUNICATION

Wireless communication is transfer of information between two or more points that are not connected by an electrical conductor. most common wireless technologies use radio. With radio waves distances may be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. This encompasses various types of fixed, mobile, & portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), & wireless networking. Other examples of applications of radio *wireless technology* include GPS units, garage door openers, wireless computer mice, keyboards & headsets, headphones, radio receivers, satellite television, broadcast television & cordless telephones. Somewhat less common methods of achieving wireless communications include use of other electromagnetic wireless technologies, such as light, magnetic, or electric fields or use of sound.

The term *wireless* has been used twice in communications history, with slightly different meaning. This was initially used from about 1890 for first radio transmitting & receiving technology, as in *wireless telegraphy*, until new word *radio* replaced This around 1920. Term was revived in 1980s & 1990s mainly to distinguish digital devices that communicate without wires, such as examples listed in previous paragraph, from those that require wires. This is its primary usage today.

LTE, LTE-Advanced, Wi-Fi, Bluetooth are some of most common modern wireless technologies.

Meaning of G

Each of Generations has standards that must be met to officially use G terminology. Those standards are set by, you know, those people that set standards.

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Standards themselves are quite confusing but advertisers sure know how to manipulate them.

1G – A term never widely used until 2G was available. This was first generation of cell phone technology. Simple phone calls were all This was able to do.

2G – second generation of cell phone transmission. A few more features were added to menu such as simple text messaging.

3G – This generation set standards for most of wireless technology we have come to know. Web browsing, email, video downloading, picture sharing & other Smartphone technology were introduced in third generation. 3G should be capable of handling around 2Mbps.

4G – speed & standards of this technology of wireless needs to be at least 100 Megabits per second & up to 1 Gigabit per second to pass as 4G. This also needs to share network resources to support more simultaneous connections on cell. As This develops, 4G could surpass speed of average wireless broadband home Internet connection. Few devices were capable of full throttle when technology was first released. Coverage of true 4G was limited to large metropolitan areas. Outside of covered areas, 4G phones regressed to 3G standards. When 4G first became available, This was simply a little faster than 3G. 4G is not same as 4G LTE which is very close to meeting criteria of standards.

2. HISTORICAL EVOLUTION

History of G

The first cell phones could barely keep a call connected let alone send a text message & now we are streaming content across wireless spectrum while cruising web & talking to friends. A long way indeed. Where does it go from here & will wireless spectrum stand up to test? We will soon find out.

2G Rises to Challenge

When smart phones were first introduced, there was no texting as well as undoubtedly horrible connections. Then came 2G or 2nd Generation networks as well as by having them came capability to transfer & get information, although velocities were actually sluggish - 9.6 kb|s - slower than old, screechy, modems that we used to utilize in early days of Internet. Slowly technological innovation strengthened & information rates were raised, by having latter types of 2G getting to speeds of about 56kb|s & we thought that was fast!

3G is Introduced

3G or 3rd Generation of mobile technology innovations took us by storm with speeds of about 4 times quicker than old 2G standards. With initial speeds of around 200kb|s & steady transformation of technological innovations saw maximum speeds of up to 7.2 Mb|s & we were awed by things that could be accomplished. latter speeds were just numbers because highest rates were not achievable unless you were in right spot at right time. Still quite an improvement.

Currently 4th Generation technologies are being presented around world & devices are being made available that may enjoy this brand-new mobile advancement in speeds & reliability.

1. In 2002, the strategic vision for 4G — which ITU designated as IMT Advanced— was laid out.
2. In 2005, OFDMA transmission technology is chosen as candidate for the HSOPA downlink, later renamed 3GPP Long Term Evolution (LTE) air interface E-UTRA.
3. In November 2005, KT demonstrated mobile WiMAX service in Busan, South Korea.
4. In April 2006, KT started the world's first commercial mobile WiMAX service in Seoul, South Korea.
5. In mid-2006, Sprint announced that it would invest about US$5 billion in a WiMAX technology buildout over the next few years ($5.87 billion in real terms). Since that time Sprint has faced many setbacks that have resulted in steep quarterly losses. On 7 May 2008, Sprint, Imagine, Google, Intel,

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Comcast, Bright House, & Time Warner announced a pooling of an average of 120 MHz of spectrum; Sprint merged its Xohm WiMAX division with Clearwire to form a company which will take the name "Clear".

6. In February 2007, the Japanese company NTT DoCoMo tested a 4G communication system prototype with 4×4 MIMO called VSF-OFCDM at 100 Mbit/s while moving, & 1 Gbit/s while stationary. NTT DoCoMo completed a trial in which they reached a maximum packet transmission rate of approximately 5 Gbit/s in the downlink with 12×12 MIMO using a 100 MHz frequency bandwidth while moving at 10 km/h, & is planning on releasing the first commercial network in 2010.
7. In September 2007, NTT Docomo demonstrated e-UTRA data rates of 200 Mbit/s with power consumption below 100 mW during the test.
8. In January 2008, a U.S. Federal Communications Commission (FCC) spectrum auction for the 700 MHz former analog TV frequencies began. As a result, the biggest share of the spectrum went to Verizon Wireless & the next biggest to AT&T. Both of these companies have stated their intention of supporting LTE.
9. In January 2008, EU commissioner Viviane Reding suggested re-allocation of 500–800 MHz spectrum for wireless communication, including WiMAX.
10. On 15 February 2008, Skyworks Solutions released a front-end module for e-UTRAN.
11. In November 2008, ITU-R established the detailed performance requirements of IMT-Advanced, by issuing a Circular Letter calling for candidate Radio Access Technologies (RATs) for IMT-Advanced.
12. In April 2008, just after receiving the circular letter, the 3GPP organized a workshop on IMT-Advanced where it was decided that LTE Advanced, an evolution of current LTE standard, will meet or even exceed IMT-Advanced requirements following the ITU-R agenda.
13. In April 2008, LG & Nortel demonstrated e-UTRA data rates of 50 Mbit/s while travelling at 110 km/h.
14. On 3 March 2009, Lithuania's LRTC announcing the first operational "4G" mobile WiMAX network in Baltic states.
15. In December 2009, Sprint began advertising "4G" service in selected cities in the United States, despite average download speeds of only 3–6 Mbit/s with peak speeds of 10 Mbit/s (not available in all markets)

[3] PROBLEM FORMULATION

A CPU networks or data networks is tele-communications networks which allows computers to exchange data. In CPU networks , networked computing devices exchange data with each other using data link. connections between nodes are established using either cables media or wireless media. best-known CPU networks is Internet. Network CPU devices that originate , route & terminate data are called networks nodes. Nodes could include hosts such as personal computers , phones , servers as well as networksing hardware. Two such devices could be said to be networked together when one device is able to exchange information with other device ,

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whether or not they have direct connection to each other. Computer networks differ in transmission medium used to carry their signals , communications protocols to organize networks traffic , networks's size , topology & organizational intent. Computer networks support an enormous number of applications such as access to World Wide Web , video , digital audio , shared use of application & storage servers , printers , & fax machines , & use of email & instant messaging applications as well as many others. In most cases , application-specific communications protocols are layered (i.e. carried as payload) over other more general communications protocols. Computer communication links that do not support packets , such as traditional point-to-point tele-communication links , simply transmit data as bit stream. However , most information in CPU networks is carried in packets. A networks packet is formatted unit of data (a list of bits or bytes , usually few tens of bytes to few kilobytes long) carried by packet-switched networks. In packet networks , data is formatted into packets that are sent through networks to their destination. Once packets arrive they are reassembled into their original message. With packets , bandwidth of transmission medium could be better shared among users than if networks were circuit switched. When one user is not sending packets , link could be filled with packets from others users , & so cost could be shared , with relatively little interference , provided link isn't overused. Packets consist of two kinds of data: control information , & user data(payload). control information provides data networks needs to deliver user data , for example: source & destination networks addresses , error detection codes , & sequencing information. Typically , control information is found in packet headers & trailers , with payload data in between. Often route packet needs to take through networks is not immediately available. In that case packet is queued & waits until link is free. The transmission media used to link devices to form CPU networks include electrical cables (Ethernet , HomePNA,power line communication , G.hn) , opticalfiber (fiber-optic communication) , & radio waves (wireless networksing). In OSI model , these are defined at layers 1 & 2 — physical layer & data link layer. A widely adopted family of transmission media used in local area networks (LAN) technology system is collectively known as Ethernet. media & protocol standards that enable communication between networksed devices over Ethernet are defined by IEEE 802.3. Ethernet transmits data over both copper & fibers cables. Wireless LAN standards use radio waves , or others use infrared signals as transmission medium. Power line communication uses building's power cabling to transmit data.

4. APPLICATIONS OF WIRELESS TECHNOLOGY

Mobile telephones

One of best-known examples of wireless technology is mobile phone, also known as a cellular phone, with more than 4.6 billion mobile cellular subscriptions worldwide as of end of 2010. These wireless phones use radio waves from signal-transmission towers to enable their users to make phone calls from many locations worldwide. They may be used within range of mobile telephone site used to house equipment required to transmit & receive radio signals from these instruments.Wireless data communications Wireless data communications are an essential component of mobile computing. various available technologies differ in local availability, coverage range & performance, & in some circumstances, users must be able to employ multiple connection types & switch between them. To simplify experience for user,

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connection manager software may be used, or a mobile VPN deployed to handle multiple connections as a secure, single virtual network. Supporting technologies include:**Wi-Fi** is a wireless local area network that enables portable computing devices to connect easily to Internet. Standardized as IEEE 802.11 a,b,g,n, Wi-Fi approaches speeds of some types of wired Ethernet. Wi-Fi has become de facto standard for access in private homes, within offices, & at public hotspots. Some businesses charge customers a monthly fee for service, while others have begun offering it for free in an effort to increase sales of their goods. **Cellular data service** offers coverage within a range of 10-15 miles from nearest cell site. Speeds have increased as technologies have evolved, from earlier technologies such as GSM, CDMA & GPRS, to 3G networks such as W-CDMA, EDGE or CDMA2000. **Mobile Satellite Communications** may be used where other wireless connections are unavailable, such as in largely rural areas or remote locations.

[5] Result and discussion

GSMA Intelligence forecasts that an additional 1.6 billion citizens worldwide will become mobile Internet users over the next six years, bringing the total number to 3.8 billion, or around half of the world's expected population by 2020. "Our new findings underline how mobile is now the gateway to the Internet for billions of citizens across the world and will be responsible for connecting millions of currently 'offline' global citizens to the Internet in the years to 2020 and beyond," said Anne Bouverot, Director General of the GSMA. The GSMA (GSM Association) defines a mobile Internet subscriber as an individual who has accessed an Internet service on one or more of their mobile devices. Any activity that consumes mobile data is considered a mobile Internet service, including web browsing, mobile instant messaging, mobile social networking, email, app downloads and online gaming, video and music. Mobile Internet subscriber estimates and forecasts were based on primary research conducted by GSMA Intelligence. Overall, 42 markets have been surveyed worldwide with an equal split between developed (21) and developing countries (21). These 42 countries represent 74% of the global mobile market in terms of unique mobile subscribers. Almost all of the additional mobile Internet users expected over the next six years will come from the developing world. The number of mobile Internet users in the developing world will double from 1.5 billion in 2013 to 3 billion by 2020, rising from 25% of the developing world population to 45% over the period. In Sub-Saharan Africa, just 17% of the population were mobile Internet subscribers in 2013, but penetration is forecast to increase to 37% by 2020. Many users in the developing world still access the mobile Internet via 2G connections – over 60% do so in Sub-Saharan Africa, the GSMA said.

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