WWJMRD 2017; 3(9): 336-342
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
UGC Approved Journal
Impact Factor MJIF: 4.25
e-ISSN: 2454-6615

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Latest and top trends in current and Future Wireless Mobile Communication

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Abstract
Consumers demand more from their technology. With the advent of the Internet, the most-wanted feature is better, faster access to information. To support a powerful system, we need pervasive, high-speed wireless connectivity. A number of technologies currently exist to provide users with high-speed digital wireless connectivity; the goal is long-range, high-speed wireless, which for the purposes of this report will be called 4G, for fourth-generation wireless system. Fourth-generation wireless needs to be standardized due to its enticing advantages to both users' and providers. The first release of the 3GPP Long Term Evolution (LTE) standard does not completely fulfill the ITU 4G requirements called IMT-Advanced. First release LTE is not backwards compatible with 3G, but is a pre-4G or 3.9G technology, however sometimes branded "4G" by the service providers. Its evolution LTE Advanced is a 4G technology. WiMAX is another technology verging on or marketed as 4G.The proposal for 5G technologies aims to provide very high data-rates, massive number of devices connectivity, very high reliability and low latencies. Therefore, efforts are underway to consider beyond state of-the-art protocols and mechanisms for wireless communication. Thus, the next generation of wireless communication is expected to meet the demands of various challenging use cases that go far beyond distribution of voice, video and data. Therefore, this paper aims to present the solutions that address the challenges wireless communication systems are facing.

Keywords: CDMA: Code Division Multiple Access, TDMA: Time Division Multiple Access, MIMO: Multiple Input Multiple Output, QoS: Quality of Service, OFDMA Orthogonal Frequency Division Multiple Access, WiBro: Wireless Broadband MANET: Mobile Ad-Hoc Network

Introduction
Until the controversial spectrum scams were brought up many were ignorant of what 1G, 2G or 3G. Unlimited people own a mobile phone so we are going to analyze the various generations of cellular systems from 1st generation to 5th generation.Now almost all the service provider as well as the customers seek for availing 4G services. We can analyze that this could be due to increase in the telecoms customers day by day. In the present time, there are four generations in the mobile industry. These are respectively 1G the first generation, 2G the second generation, 3G the third generation, and then the 4G the fourth generation.

1G
(Or 1-G) refers to the first-generation of wireless telephone technology, mobile telecommunications. These are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital telecommunications. The main difference between two succeeding mobile telephone systems, 1G and 2G, is that the radio signals that 1G networks use are analog, while 2G networks are digital.

2G
(Or **2-G**) is short for second-generation wireless telephone technology. Second generation 2G cellular telecom networks were commercially launched on the GSM standard.Three primary benefits of 2G networks over their predecessors were that phone conversations were digitally encrypted; 2G systems were significantly more efficient on the spectrum allowing

for far greater mobile phone penetration levels; and 2G introduced data services for mobile, starting with SMS text messages.

3G

or 3rd generation mobile telecommunications is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. Application services include wide area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment.ITU has not provided a clear definition of the data rate users can expect from3G equipment or providers.

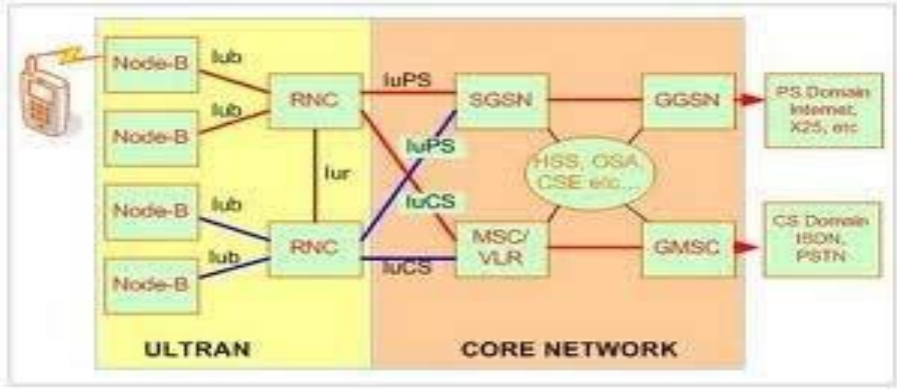


Fig. 1: 3G Network model

3G networks offer greater security than their 2G predecessors. By allowing the UE (User Equipment) to authenticate the network it is attaching to, the user can be sure the network is the intended one and not an impersonator. 3G networks use the KASUMI block crypto instead of the older A5/1 stream cipher. 3G can implement various network technologies such as UMTS, GSM, CDMA, WCDMA, CDMA200, TDMA and EDGE.

4G Fourth generation (4G) also called Next Generation Network (NGN) offers one platform for different wireless networks. A successor of 2G and 3G, 4G promises a downloading speed of 100Mbps and is yet to shower its wonders on. then with the case of Fourth Generation that is 4G in addition to that of the services of 3G some additional features such as Multi-Media Newspapers, also to watch T.V programs with the clarity as to that of an ordinary T.V. In addition, we can send Data much faster than that of the previous generations. A 4G system is expected to provide a comprehensive and secure all-IP based mobile broadband solution to laptop computer wireless modems, Smartphone's, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users. In 4G the integration of network and its applications is seamless therefore there is no risk of delay. While implementing 4G the cost issue needs to be taken into consideration so that users can benefit from this technological development fully

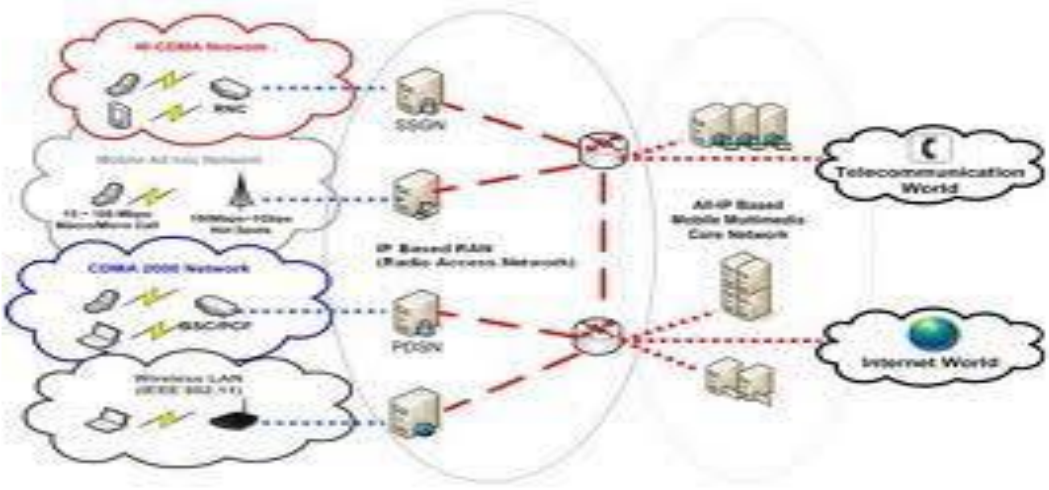


Fig-2: 4G mobile Networks

Applications of 4g

With the increase in the data rates, the mobile phones are made to perform higher performance applications. In 4G the mobile phone is not only for calling but it is an extraordinary device that can be used for variety of purposes. One such application in 4G is context awareness. For example if the mobile user is passing by an office where he/she is having an appointment to meet someone and they have forgotten the appointment. If the office location, address and geographical location matches, the

user who has already stored the details in the phone, he/she will receive information about the appointment and will be reminded that you need to perform this activity. Telemedicine is another application of 4G. Using telemedicine a patient can send general reading like temperature, glucose level and blood pressure to the doctor online. Or if someone needs to know about their family member's health continuously they can receive all the information through telemedicine by using 4G technology.

LTE

Long Term Evolution is an emerging technology for higher data rates. It is also referred as 3.9 G or super 3G technology. LTE is developed as an improvement to Universal Mobile Telecommunication System by 3G Generation Partnership Project (3GPP). LTE uses Orthogonal Frequency Division Multiple Access (OFDMA). The download rate in LTE is 150 Mbps and it utilizes the available spectrum in a very sophisticated way. In LTE the IP packet delay is less than 5 mille seconds which provides the experience of wired broadband internet access in wireless environment. The mobile TV broadcast is facilitated by LTE. LTE is a standard for wireless data communications technology and an evolution of the GSM/UMTS standards. The goal of LTE is to increase the capacity and speed of wireless data networks using new DSP (Digital Signal Processing) techniques and modulations that were developed in the beginning of the new millennium. Its wireless interface is incompatible with 2G and 3G networks, and so it must be operated on a separate wireless spectrum. The LTE specification provides down-link peak rates of 300 Mbit/s, uplink peak rates of 75 Mbit/s and QoS provisions permitting round-trip times of less than 10 ms.

WiMAX

WiMAX (**Worldwide Interoperability for Microwave Access**) is a communication technology for wirelessly delivering high speed Internet service to large geographical areas. It is a part of a "fourth generation," or 4G, of wireless-communication technology, WiMAX far surpasses the 30-metre (100-foot) wireless range of a conventional Wi-Fi local area network (LAN), offering a metropolitan area network with a signal radius of about 50 km (30 miles). WiMAX is based upon IEEE Std 802.16. supporting and significant solutions that help achieve progress towards 4G. In this section we are going to investigate and explain technological innovations such as MIMO (Multiple-Input Multiple-Output), OFDMA (Orthogonal Frequency Division Multiple Access) that could significantly increase security, mobility and throughput of 4G.

Security

Security in digital world means to protect the digital systems from criminal and unauthorized usage. In terms of computers and mobile communications the need for security has increased overwhelmingly with the improvement in technology. In attempting to avoid security problems like those that plagued the first-generation cellular systems, engineers must design security into any new technology. This is no easy task. Implementing good security requires that security be designed into every aspect of the system. There can be many attacks on digital data some of them are eavesdropping, man in the middle attack, denial of service (DOS) attack, spoofing.Before seeking to design and implement wireless security, however, one first needs to understand what this concept of security really means. In this case, wireless security is really a combination of wireless channel security (security of the radio transmission) and network security (security of the wired network through which the data flows). These collectively can be referred to as "wireless network security". 4G acts as a platform for heterogeneous networks. Therefore the need for security has become more dominant.

Services Provided By 4g

4G will likely become a unification of different wireless networks, including wireless LAN technologies public cellular networks (2.5G, 3G), and even personal area networks 4G needs to support a wide range of mobile devices that can roam across different types of networks. These devices would have to support Different networks. One solution to this "multi-network functional device" is a software defined radio. QoS assurance is important for real time traffics like Voice over IP (VoIP), online gaming, IP TV and video streaming etc. QoS enables network administrators to avoid network congestion and manage the network resources efficiently. The goal of the 4G is to provide the users the facility of Always Best Connected (ABC concept). Fourth generation of networks is a combination of different networks. It gives a platform for various technologies to be accessed. To provide QoS in 4G deals with different parameters in different technologies. If a user is moving and changing his coverage network, to provide service under QoS framework is challenging. While a mobile user is moving from one network to another network his communication session needs to be maintained irrelevant of the coverage network. Similar is the case with video conferencing and video streaming, the users like to receive the services seamlessly. There are some protocols designed to maintain the seamless communication of the users while moving or to minimize the latency and packet loss of the ongoing communication session. The mobility protocols are Mobile IPv6, Hierarchical MIPv6, Fast MIPv6 and some more (details of all these protocols are given in chapter Handovers). These protocols can help in improving the mobility management of mobile users. In order to provide QoS to the mobile users we propose a combination of mobility protocol Seamless Mobile IPv6 (SMIPv6) and Session Imitation Protocol (SIP). There are two types of losses when a mobile user switches network, one is called segment packet loss and the other is called edge packet loss. Segment packet loss is because of the undeterministic nature of the handoff while the edge packet loss is between the Mobility Anchor Point (MAP) and the MN. To minimize these losses different approaches are used, to minimize edge packet loss the MN is moved as close to the MAP as possible, whereas for the segmented packet loss two approaches are used one is synchronized packet simulcast (SPS) and hybrid simulcast mechanism are used. In SPS the packets are sent to both the current network as well the potential network the MN is approaching [14]. While hybrid simulcast mean that the mobile node informs the network about the handoff to be taken into effect but it is decided by the network to which AR the MN shall attach. This way the packet loss is

minimized (the detailed mechanism is given in chapter of handover). Session Initiation Protocol (SIP) is used to manage mobility of different entities such as session, terminal, service and personal mobility. It facilitates mobility and maintains the real time multimedia sessions. SIP is an application layer protocol therefore it can work both in IPv4 and IPv6. SIP work along with other protocols Such as Real Time Transport Protocol (RTP).

5G Future

Mobile and Wireless Communication systems will allow 5G support for the expected increase in data volumes and broadening in the range of application domains. 5G systems are built upon the evolution of existing technologies complemented by new radio concepts that are designed to meet the new and challenging requirements. Essential services such as e-banking, e-learning and e-health will continue to proliferate and become handier for pocket devices. Evolutionary research has been carried out on the development of interactive television (iTV), Video on Demand (VoD) and broad wireless internet contents, which will progressively be delivered over mobile and wireless systems. These developments will lead to an avalanche of mobile and wireless traffic volume, projected to increase a thousand-fold over the next decade. Furthermore, some applications will impose additional and very diverse requirements on mobile and wireless communication systems that 5G will have to support. Four generations of cellular communication systems have been adopted in the USA with each new mobile system generation emerging every 10 years or so since the 1980s: first generation analog FM cellular systems in 1981; second generation digital technology in 1992, 3G in 2001, and 4G LTE-A. Existing base station designs must service different bands with different cell sites, where each site has multiple base stations (one for each frequency or technology usage e.g. third generation (3G), fourth generation (4G), and Long Term Evolution-Advanced (LTE-A).

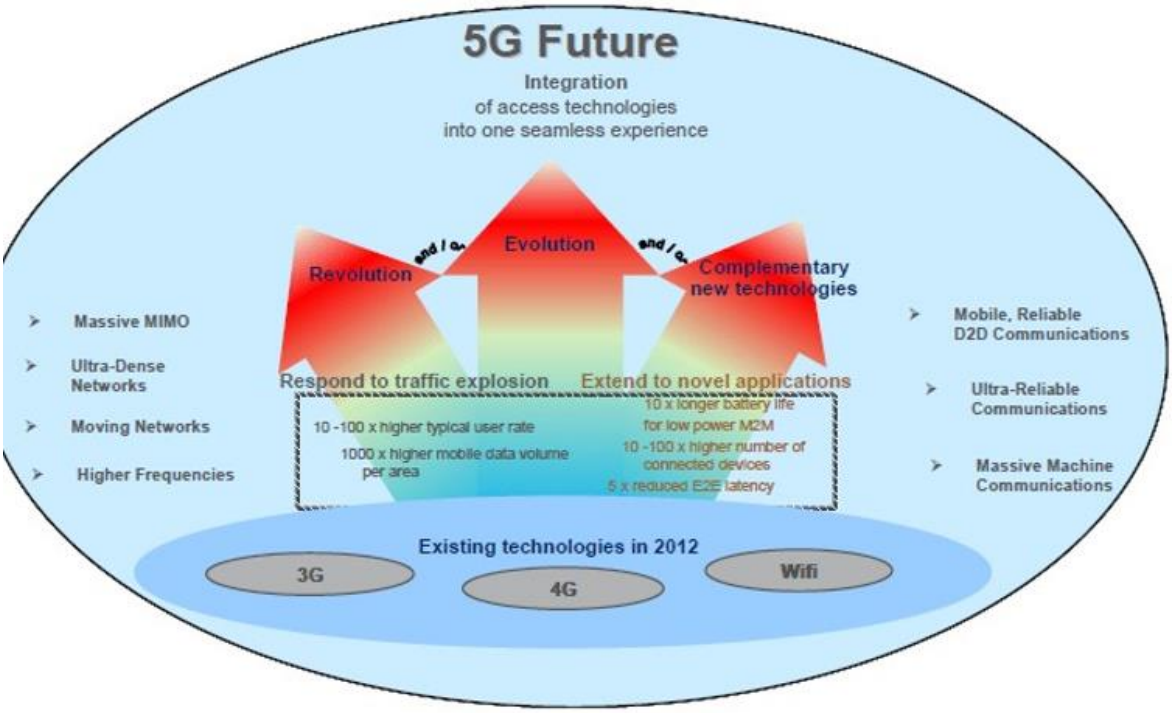


Fig-3*:* Evolution and New technologies of 5G (Originated from METIS project document)

Challenges and Prospects of 5G Wireless Technology

With the IMT-Advanced (IMT-A) standards ratified by the International Telecommunications Union in November 2010 and IMT-A, i.e., the fourth generation (4G), wireless communication systems being deployed in the world, the fifth generation (5G) mobile and wireless communication technologies are emerging into research fields. Based on the Internet Protocol Architecture of 4G communication systems, unprecedented numbers of smart and heterogeneous wireless devices will be accessing future 5G mobile and wireless communication systems with a continuing growth of Internet traffic. Therefore, compared to 4G communication systems, significantly higher wireless transmission rates are expected in 5G communication systems, such as 10 Gbps peak data rates with 8~10 bps/Hz/cell. Moreover, energy efficient concepts will be fully integrated into future wireless communication systems to protect the environment. To meet the above challenges, 5G mobile and wireless communication systems will require a mix of new system concepts to boost spectral efficiency, energy efficiency and the network design, such as massive MIMO technologies, green communications, cooperative communications and heterogeneous wireless networks. We expect to explore the prospects and challenges of 5G mobile and wireless communication systems combining all of the above new designs and technologies. Thus simultaneous management of multiple technologies in the same band limited spectrum is a challenge in 5G mobile communication which supports going beyond voice for newer smart phones and advanced mobile devices. Gathered data for meeting the requirements and satisfactory constraints are highly valuable for the development of 5G cellular communications at mm bands in the coming decade.

Ten Communications Technology Trends for 2017

5G sides safely off the Hype Curve and Makes a Nice Boring Landing

This is the year we hope to see 5G make a nice safe entry into commercial use. In the USA it is expected to be in the space of Wireless to the home or more generally WTTx.

Meanwhile Spectrum Allocation Becomes Not Boring

2017 has become the year talking about spectrum policy at parties is not boring. We have 5G and millimeter wave but that is not the most exciting part for the ordinary engineer. 2017 provides us all with an opportunity to think of new ways to manage spectrum beyond the simple split of shared or owned. The pressure on sub 6G spectral use in particular will force us to start thinking more creatively in our attempts to achieve that 1000X "perceived" capacity goal. Massive MIMO will allow us to manage interference spatially in a way we never have done before and allow new thinking in what it means to share spectrum in both frequency and space.

Internet of Things Takes Off and We All Become Part of the Borg Collective

We predict that this is the year when your aging grandmother becomes wired into the cloud, if only for health monitoring reasons. Google already knows more about your travel habits than you do and this year will bring this kind of monitoring to health. If the recent CES show is to be believed cloud will pretty soon be telling you when to exercise, what kinds of food you like and how to comb your hair. All of this will require wireless communications of course, so we like it!

Driverless Everything, Take Me I'm yours

By 2018 there will be several places in the world where being picked up by a driverless car will be unsurprising, if not commonplace. Drones delivering your packages also comes under this category and we may well be getting used to that by years end. Certain highway transport modes, such as truck platooning may appear in 2018 but there is a long way to go before your community scraps its traffic lights and there is a lot of cool R&D to be done in the meantime. This year we should all watch the DSRC versus LTE debate. Combining this with IoT and health monitoring and the joke is that eventually you will ask your driverless car to take you to the donut store and it will take you to the gym instead, or maybe drop you off a half mile from the donut store and tell you to walk, while a driverless drone delivers you a package of health food you didn't know you wanted. Maybe it is too close to New Years to be objective on this topic...

Security, Privacy and Hiding Bodies in the Cloud

We woke up this morning to read about certain governments hacking certain other governments elections, but the real security issue for the wireless network is in how we are going to make IoT, and in particular things like vehicle and drone automation, secure, and what security we should even expect if we are willing to stick sensors all over our bodies and appliances. As a sign of this, the New Year brought us a story about police in Arkansas requesting the data from an Amazon Echo so they could work out what was said in a house right before a suspected homicide. Amazon said no but they got something off another appliance in the house anyway. How will this all work when we have 20 recording devices pumping data to the cloud on our bodies? Security and Privacy are big issues in 2017 and so will the communications technology development surrounding them.

Distributed Ledgers, the End of Banks and the Beginning of a New Way to Run Networks

Bitcoin was 2015's best performing currency and crossed $1000 as we came into 2017. So apparently, we don't need a government to have a currency. The reason is, we don't need a "trusted" 3rd party any more. And the reason for that is, in Bitcoins case, something called blockchain that is an example of a distributed ledger. But you can use distributed ledgers for all sorts of transactions and some people are talking up a whole new economy as a result. We predict this will start to leak into how we use our communications networks both in terms of applications and how the networks themselves are managed (for example in making spectrum allocation way more interesting as we mentioned above). We feel this is a year where such technology will start to make a noticeable impact, especially perhaps in emerging economies.

Artificial Intelligence, Deep Learning to Boldly Go Where No Machine Has Played Go Before

Google's Alpha Go won its big game in 2016, they released an open source AI package called Tensor Flow, and suddenly AI seems like big data used to be a couple of years ago. Now all sorts of people who don't know much about the theory of AI and Neural Networks are giving it a shot for all sorts of applications. The impression is that this enthusiasm will extend solidly into the wireless network management space, with AT&T saying in August of last year that AI was central to their Domain 2.0 management system. We are betting we will all be surprised by what some folks try to do with it.

Put it All Together and Let it Live in a Smart City

We hear a lot about smart cities in 2017. This is the catch all phrase, for those of you just back from sabbatical on the ocean floor, for all of the above cool technology applied to making life better for all us urban dwellers. Your car will park itself, the traffic system will closely monitor traffic flow to minimize stop and go time at traffic lights, perhaps using information from your vehicle about where you are planning to go, your cell phone will talk to your bus (or automated driverless shared use vehicle) or train to get you from point A to B with the minimum carbon footprint in the minimum time. In the US the department of transportation set up a "smart cities challenge" and got a pretty enthusiastic response. All of this will require masses of wireless communications and network management of course.

New Ways to Communicate I: Molecular Communication Smells Good

Armies of nanobots swarming through the air, our waterways, our bodies or even within individual cells for various reasons has long been the realm of science fiction. While developing the machinery for such nanobots is obviously daunting for a number of reasons, another perhaps even more important problem looms: how would such bots communicate? Getting small means the usual radiative methods (electromagnetic and acoustic) are difficult and inefficient owing both to impedance mismatch and medium absorption. Luckily, Nature has had eons to

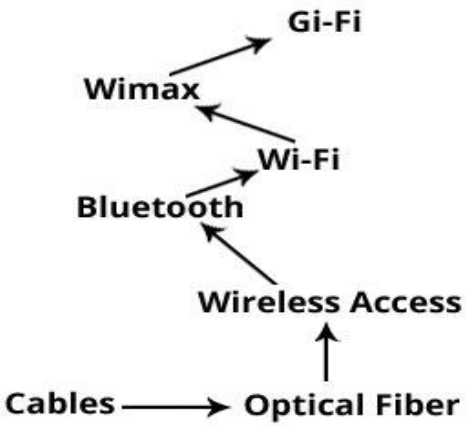
attack the problem of multi-body coordination at small sizes and provides a glimmer of hope -- release and sensing of signaling chemicals by cells and organelles, the original nanobots. The emerging field of Molecular Communication seeks to quantify not only all the usual How much? How far? and How fast? issues close to communication theorists hearts, but also the actual How? that will enable the design and control of envisioned nanobot armies. The field is growing rapidly and maybe 2017 will be the breakout year, so stay tuned. Of course, molecular communication is not frequency-based, so maybe instead, stay sniffing!

New Ways to Communicate II: LiFi Lights the Way

Everyone is talking about the lack of radio frequency spectrum. One of the solutions to this problem is right over our head – office lighting. Visible Light Communication, or LiFi as it is known, promises an additional avenue of data to your computer. The idea is that an LED can vary its intensity so quickly the human eye cannot see it, but a photo detector can detect it. LiFi is probably not suitable for uplink connections due to the clumsiness of having a light source projecting from your computer. But it can certainly supplement the vast amount of data we download in the forms of cat videos and other important documents. LiFi also has the advantage that it will not leak through walls, ensuring a fair amount of privacy to the intended user. How to integrate LiFi into existing WiFi connections is a compelling problem but its solution will promise more data to hungry customers. How to modulate, multiplex and handover LiFi data is still under debate in engineering circles and includes OFDM-based light intensity modulation schemes, though the IEEE standard 802.15.7 has defined a MAC layer as well as an On-Off Key physical layer. However, the light is modulated and received, the future promises a green technology where office lighting does double-duty as a transmission source. LiFi (Light Fidelity) an extension to Visible Light Communication is an emerging paradigm in the list of latest, emerging wireless technologies. Their speed, usability, flexibility and other advantages make them an excellent one. LiFi, Light Fidelity offers wireless communication using the visible light. It includes range of frequencies and wavelengths starting from the infrared to the ultraviolet. Just by using the light from the LED, LiFi as a wireless technology helps to transmit the data efficiently and securely. This wireless technology in its way is surely said to replace the WiFi routers thereby becoming the internet at the speed of light. It can use speeds upto 3.5Gbit/s per color.

Gigabit Wireless (GiFi)

Gigabit Wireless also known popularly by the names GiFi or Gi-Fi is a wireless communication providing a data rate of gigabits per second. Wi-Fi is used to get better connectivity and data exchange rates. This need leads us to an updated wireless technology that has standard data exchange rates, which we refer to as GiFi. GiFi as a wireless technology makes use of a very tiny antenna that can be used by mobile devices and it is a great tool for wireless home equipment. GiFi aims at solving the low data rate problems as it has an integrated receiver and transmitter on a single chip. If we make comparison between wireless technology, GiFi, Wi-Fi and Bluetooth, the Gi-Fi provides better data transfer rate with minimum power consumption.



Architecture of GiFi

GiFi wireless technology incorporates one subscriber station that is made available for different access points.The subscriber station basically comprises of a small antenna that is mounted on the top in order to support the light of sight operations. In order to avoid any interference, it transmits multiples signals across the path of transmission, at the same time having different frequencies.

Working of GiFi

Let us use time division duplex for receiving and transmission. The data files are converted to RF 60GHz range by making use of two mixers from an IF range. The output is then stored in a power amplifier, that stores a millimeter wave antenna within. The RF incoming data is first converted to IF signal at 5GHz and then converted to a normal data range. A heterodyne construction is used for this procedure to avoid any leakage because of direct conversion. With the availability of a 7GHz spectrum, the data gets transferred in a matter of seconds.

Main features of GiFi as a Wireless technology

1. **Better transfer rates-** The main reason for the invention of GiFi was to provide a better transfer rate in comparison to Wi-Fi and Bluetooth. It supports a 5 Gbps speed, which is approximately ten times better than the current rate of data transfer. Due to the high speed, audios, videos can be easily transferred in a matter of seconds. Due to a higher availability of 7 GHz spectrum, it results in high data rates.

2. **Lower power consumption**- The data is transmitted at a low rate of 2mwatts while other technologies make use of 5mwatts to 10mwatts, which is comparatively very high. Even though, it allows the transfer of a large amount of information it makes use of milli watts power only.
3. **Secure and Cost-Efficient**- The IEEE 802.15.3C offers more security, it offers both service level and link level security. Operating systems of 60GHz have been used for years by intelligence companies for security reasons and by the militants for satellite to satellite communications. The overall effects of narrow beams and O2 absorption lead in low interference and higher level of security. It makes use of mass-product and low cost chipsets, which drops down the rates dramatically and results in a **wireless technology** with high speed and low prices.
4. **Small sized**- Another feature of GiFi is the small size. The chip measures approximately 5mm on each side, incorporates a small antenna and makes use of a 60 GHz spectrum. Therefore, GiFi offers high mobility and portability. It provides better coverage area which allows the technology to go higher.
5. **Quick Positioning**- In comparison to the positioning of the present technologies, GiFi offers the deployment of service within a few minutes, which may take hours for other solutions.

Additional Features of GIFI wireless technology

- GiFi is highly –portable, which makes it very convenient to construct it wherever we need it.
- GiFi installs line of sight operations having a short coverage area, as it offers a versatile architecture.
- Re-use of high frequency levels is enabled which makes it easier to communicate with a wide range of customers within a specific geographic region. Hence, leaving them satisfied.

Applications of GiFi

1. **Household Appliance-** With the help of GiFi consumers can easily download their favorite movies in a matter of seconds and play it on their home theatres or store it wherever desired, so as to watch it later on. It offers a higher speed of internet, content streaming and download, wireless data and real time streaming.
2. **Office Appliance-** Due to its capability to transfer data within a few seconds, it is highly recommended to use for office purposes, as it provides information from the internet.
3. **Inter-vehicle communication-** It functions as an inter-vehicle communication system**,** enabling the vehicles to stay connected on the go.
4. **Transfer of Video Information-** With the current technologies, the transfer of videos may be a lengthy process as it may take hours, however, with the help of GiFi, videos can be transferred in a jiffy at Gbps speed. The rate of data transfer is same for both computers and mobile phones.

Conclusion

In this paper we are describing about the various wireless mobile technologies, and various applications of 4G mobile communication as well as the LTE (Long Term Evolution) and also we describe about various networks we are used in 4G Evolution. We also describes the Security, Quality of Service in 4G. We present the challenges that 4G faces and their up-to-date solutions. We also gave an idea about the latest communication technologies and also the use of 5G in future. Finally a feature called GiFi is been elaborately explained.

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