A Comprehensive Overview of different Wireless Networks

Ukkeshwar.V.S, Umesh Kumar Krishnan, Sibi.S, Waldar Richard Rajaiah.X, S.Sujindar

Abstract— The bond between us, was and is laid by various networks .For these things called networks they did not appear all of a sudden, they were found by humans and evolved with the help of humans.

As like the evolution of nomads to civilized, the networks evolved to wireless networks. Development of networks is a never-ending demand. More and more gadgets are finding their way into this world each day. This paper presents the foundations and necessity of networks and their development to the upcoming network systems.

Index Terms—1g , 2g , 3g , 4g , 5g , Bluetooth , Wi-Fi , blu-fi , nfc , wi-max.

I. INTRODUCTION

A. History of GSM

During the early 1980s, Analog cellular telephone systems were experiencing rapid growth in Europe, particularly in Scandinavia and the United Kingdom. Each country developed its own system, which was incompatible with everyone else's in equipment and operation. This undesirable situation was not only prevailing in mobile equipment's which are limited to operations within national boundaries, which particular stage was increasingly unimportant[1][4][5], but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized precisely. The Europeans realized this early on, and in 1982 the Conference of European Posts and Telegraphs (CEPT) formed a study group called the Group Special Mobile (known as GSM) to study and develop a pan-European public land mobile system. The proposed system had to meet certain criteria as:

- Good subjective speech quality
- Low terminal and service cost
- Support for international roaming
- Ability to support handheld terminals
- Support for range of new services and facilities
- Spectral efficiency
- ISDN compatibility

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In 1989, GSM responsibility was handed over to the European Telecommunication Standards Institute (ETSI), and phase I of the GSM specifications were published in 1990. Commercial service was commenced in mid-1991, and by 1993 there were 36 GSM networks in over 22 countries. Over 200 GSM networks (including DCS1800 and PCS1900) are operational in 110 countries around the world. In the beginning of 1994, there were 1.3 million subscribers worldwide [2] [3], which had grown to more than 55 million by October 1997 itself. With North America making a delayed entry into the GSM field with a derivative of GSM called PCS1900, GSM systems exist on every continent, and the acronym GSM now aptly stands for Global System for Mobile communications.

A. 1-Generation (IG)

The First generation of wireless telecommunication technology is known as 1G was introduced in 1980. The main difference between then existing systems and 1G was invent of cellular technology and hence it is also known as First generation of analog cellular telephone. In 1G or First generation of wireless telecommunication technology the network contains many cells and so same frequency can be reused many times which results in great spectrum usage and thus increased the capacity of the system i.e. large number of users at a time could be accommodated easily.

The First generation of wireless telecommunication technology used analog transmission techniques which were a basic phenomenon for transmitting voice signals. 1G or first generation of wireless telecommunication technology also consist of various standards among which most popular were Advance Mobile Phone Service (AMPS), Nordic Mobile Telephone (NMT), Total Access Communication System (TACS). All of the standards in 1G use frequency modulation techniques for voice signals and all the handover decisions were taken at the Base Stations (BS)[4]. The spectrum within cell was divided into number of channels and every call is allotted a dedicated pair of channels

I. Different standards of 1G were used worldwide like

In 1982 Advance Mobile Phone Service (AMPS) was employed in United States and later it was used in Canada, Central America, South America, Australia, Argentina, Brazil, Burma, Brunei, Bangladesh, China ,Cambodia, Georgia, Hong Kong, Indonesia, Malaysia, Kazakhstan, Mexico, Mongolia, Nauru, New Zealand, Pakistan, Guinea, Philippines, Russia, Singapore, South Korea, Sri lanka, Tajikistan, Taiwan, Thailand, Vietnam, Western Samoa .Nordic Mobile Telephone-900 (NMT-900) was employed in Cyprus, Denmark, Finland, France, Greenland, Netherlands, Norway, Switzerland and Thailand. C-NETZ (C-NETZ in German refers to C Network which was the first cellular wireless telephone network in Germany) was employed in

Germany, Portugal and South Africa. Radiocom2000 was employed in France. Radio Telephone Mobile System (RTMS) was employed in Italy. Nippon Telephone and Telegraph (NTT) was first employed in Japan and later NTACS (Narrowband Total Access Communications System) and JTACS (Japanese Total Access Communication System) were also employed [5].

II. Use of Analog signals for data (in this case voice) transmission led to many problems as:

1. Analog Signals does not allow advance encryption methods hence security of data was at stake i.e. anybody could listen to the conversion easily by simple techniques. The user identification number could be stolen easily which could be used to make any call and the user whose identification number was stolen had to pay the call charges.[6]
2. Analog signals can easily be affected by interference and the call quality decreases.

B. 2G (Second Generation)

The main differentiator to previous mobile telephone systems, retroactively dubbed 1G, is that the radio signals that 1G networks use are Analog, while 2G networks are digital[7]. Note that both systems use digital signalling to connect the radio towers to the rest of the telephone system.

I. Flavours of 2G

2G technologies can be divided into TDMA-based standards and CDMA-based standards depending on the type of multiplexing annexures used. The main 2G standards are [7]:

1. GSM (TDMA-based), originally from Europe but used worldwide
2. iDEN (TDMA-based), proprietary network used in the United States and in Canada
3. IS-136 aka D-AMPS, (TDMA-based, commonly referred as simply TDMA in the US), used in the Americas
4. IS-95 aka cdma One, (CDMA-based, commonly referred as simply CDMA in the US), used in the Americas and parts of Asia
5. PDC (TDMA-based), used exclusively in Japan
6. 2G services are frequently referred as Personal Communications Service or PCS in the US.

II Capacities, Advantages, Disadvantages

Using digital signals between the handsets and the towers increases system capacity in two key ways:
Digital voice data can be compressed and multiplexed much more effectively than analog voice encodings through the use of various CODECs, allowing more calls to be packed into the same amount of radio bandwidth. The digital systems were designed to emit less radio power from the handsets. This meant that cells could be smaller, so more cells could be placed in the same amount of space. This was also made possible by cell towers and related equipment getting less expensive.

111. Advantages to 1G

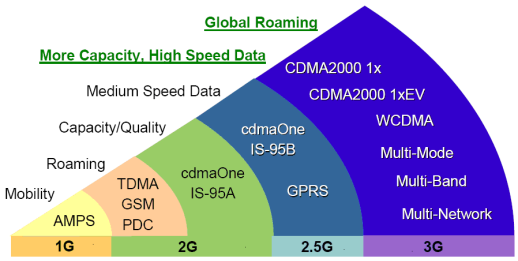
Digital systems were embraced by consumers for several reasons.

1. The lower powered radio signals require less battery power, so phones last much longer between charges, and batteries can be smaller
2. Less interference
3. The digital voice encoding allowed digital error checking which could increase sound quality by reducing static and lowering the noise floor.
4. The lower power emissions helped address health concerns.
5. Going all-digital allowed for the introduction of digital data services, such as SMS and email.

A key digital advantage not often mentioned is that the digital cellular calls are much harder to rely on by use of radio scanners. While the security algorithms used have proved to be not as secure as initially advertised, 2G phones are immensely more private than 1G phones, which have no protection whatsoever against eavesdropping.

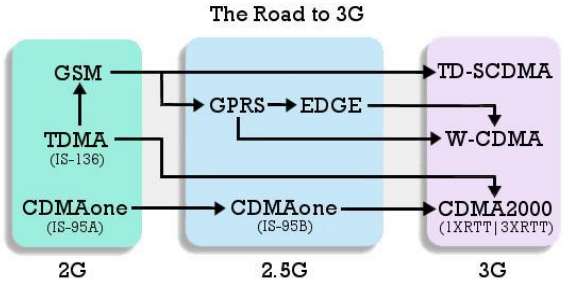
IV . Disadvantages

- In less populous areas, the weaker digital signal will not be sufficient to reach a cell tower.
- Analogue has a smooth decay curve, digital a jagged step one. This can be both an advantage and a disadvantage. Under good conditions, digital will have better depths of sound. Under slightly worse conditions, analogue will have annoying static, while digital has occasional dropouts. As conditions worsen, though, digital will start to completely fail, by dropping calls or being unintelligible, while analogue just slowly gets worse and worse, generally holding a call longer and allowing at least a few words to get through.
- Despite the coverage maps provided by major phone companies in many areas is spotty at best.
- With analogue systems it was possible to have two or more "cloned" handsets that had the same phone number. This was widely abused for fraudulent purposes. It was, however, of great advantage in many legitimate situations. One could have a backup handset in case of damage or loss, a permanently installed handset in a car or remote workshop, and so on. With digital systems, this is no longer possible.
- While digital calls tend to be free of static and background noise, the lossy compression used by the CODECs takes a toll; the range of sound that they convey is reduced. You'll hear less of the tonality and more clear dispersions of someone's voice talking on a digital cell phone.



A. V. 2G to 3G Network standardization

The International Telecommunication Union (ITU) has defined the demands for third generation mobile networks with the IMT-2000 standard. An organization called 3GPP has continued that work by defining a mobile system that fulfills the IMT-2000 standard. This system is called Universal Mobile Telecommunications System (UMTS). The evolution of the system will move forward with so called releases. In each release new features will be introduced. The following features are just examples of many others in these new releases.

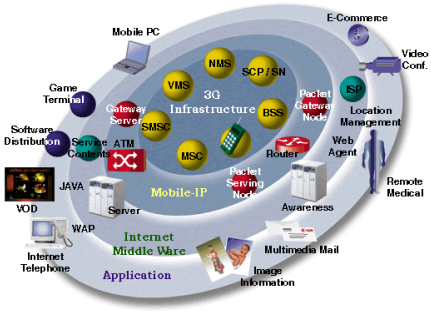


II. C. Evolution to 3G

The Evolution to 3G describes the updating of cellular mobile telecommunications networks around the world to use new 3rd generation technologies (3G) [8]. This process took an initiation by 1999 and finds millions of subscribers within 2010. Japan is the first country having introduced 3G nationally, and in Japan the transition to 3G has been largely completed during 2005/2006. 3G technologies enable network operators to offer users a wider range of quality and more advanced services, while achieving greater network capacity through improved spectral efficiency.

I. Operators and UMTS networks

As of 2005, the evolution of the 3G networks was on its way for a couple of years. The main reason for these changes is basically the limited capacity of the existing 2G networks. The second generation of networks were built mainly for telephone calls and slow data transmission. Due to the rapid changes in technology, these factors do not meet the requirements of today's wireless revolution. The developments of so-called "2.5G" technologies such as i-mode data services, camera phones, HSCSD and GPRS have been ways of bridging the oncoming change to 3G networks, but are not permanent solutions. They are merely stepping stones towards the new technology. These stepping stones were built to introduce the possibilities with the future wireless application technology to the end consumers. These procedures are necessary to ensure that the operators and the infrastructure itself have a healthy ground to operate on. The evolution of networks from the second generation of technologies to the third generation technologies could not be done without the help of network operators. In 2005 there were about 23 networks worldwide that operated on 3G technologies, the most advanced being KDDI in Japan. Some of these networks were only for test use but some were already in consumer based use[8].



II. Mobile technologies

The first new technology when going from GSM towards UMTS is General Packet Radio Service (GPRS). It is the trigger to 3G services. The main point is that the network connection is always on, so the subscriber is online all the time. From the operator's point of view, it is important that GPRS investments are re-used when going to UMTS. Also capitalizing on GPRS business experience is very important. From GPRS, operators could go directly to UMTS, but they could also invest in an EDGE system. One advantage of EDGE is that there is no new licence needed as in UMTS. The frequencies will also be re-used and no new antennas are needed. The main issue is that subscribers will have to buy new EDGE terminals.

III. From GPRS to UMTS

The key point when going to UMTS is the use of the existing mobile network. From GSM core network side, the following network elements are reused:

- MSC (Mobile switching centre) (vendor dependent)
- AUC (Authentication centre)
- HLR (Home location register)
- VLR (Visitor location register)
- EIR (Equipment identity register)
- BSC (base station controller)
- BTS (base transceiver station)

The UMTS network introduces new network elements that give functionality as given in the 3GPP specifications:

- Node-B (base station)
- RNC (Radio Network Controller)
- MGW (Media Gateway)

3G (or 3-G) is short for third-generation technology. It is usually used in the context of cell phones. The services associated with 3G provide the ability to transfer both voice data (a telephone call) and non-voice data (such as downloading information, exchanging email, and instant messaging).

In marketing 3G services, video telephony has often been used as the flagship killer application for 3G. Certain euphoria was created, which led to huge spectrum-licensing fees in many countries, especially in Europe, where spectrum auctions generated many billions of euros for the respective countries. Since these spectrum licensing fees were collected many years before any income could be expected from 3G business, and since enormous investments are necessary to

build the 3G networks, many telecommunication operators got into great financial difficulties, which greatly delayed 3G roll-out in all countries except Japan and South Korea, where such spectrum licensing fees were avoided since priority was set on national IT infrastructure development.

The first country which introduced 3G on a large commercial scale was Japan. In 2005 about 40% of subscribers use 3G networks only, and 2G is on the way out in Japan. It is expected that during 2006 the transition from 2G to 3G will be largely completed in Japan, and upgrades to the next 3.5G stage with 3 Mbit/s data rates is underway The successful 3G introduction in Japan shows that video telephony is not a killer application for 3G networks after all. Actually, the real-life usage of video telephony on 3G networks is only a small fraction of all services. Next generation (3G) wireless networks are not IEEE 802.11 networks. IEEE 802.11 networks are short range, primarily internet access, networks while 3G wireless networks are the evolution of wide area cellular telephone networks which hope to incorporate high-speed internet access and video telephony to these networks.

A. IV. Background

It is estimated that there are about 60 3G networks in 25 countries around the world. In Asia, European and the USA, telecommunication companies use WCDMA technology with the support of around 100 terminal designs to operate 3G mobile networks. The introduction of 3G services within Europe began in early 2003. The official 3G mobile network is the systems and services based on the ITU family of standards under the International Mobile Telecommunications program, 'IMT-2000'. A boost was given to 3G mobile networks in Europe when the EU council suggested that the 3G operators should cover 80% of the European national populations by the end of 2005. The most significant features offered by third generation (3G) mobile technologies are the momentous capacity and broadband capabilities to support greater numbers of voice and data customers - especially in urban centers - plus higher data rates at lower incremental cost than 2G. By using the radio spectrum in bands identified which is provided by the ITU for Third Generation IMT-2000 mobile services, it subsequently licensed to operators, 3G uses 5 MHz channel carrier width to deliver significantly higher data rates and increased capacity compared with 2G networks. The 5 MHz channel carrier provides optimum use of radio resources for operators who have been granted large, contiguous blocks of spectrum. On the other hand, it also helps to reduce the cost 3G networks while having the capable of providing extremely high-speed data transmission to users. Besides that, it also allows the transmitting 384kbps for mobile systems and 2Mbps for stationary systems. 3G users are expected to have greater capacity and improved spectrum efficiency which allow them to access the global roaming between different 3G networking.

International Telecommunications Unit (ITU): IMT-2000 consists of five radio interfaces

W-CDMA, CDMA2000, TD-CDMA / TD-SCDMA, UWC-136, DECT+

B. V. Issues

Even though 3G has successfully been introduced to the European mobile users, there are some issues that happened to be debated by the 3G providers and users.

1. The high input fees for the 3G service licenses;
2. The great differences in the licensing terms;
3. The current high debt of many telecommunication companies, making it more of a challenge to build the necessary infrastructure for 3G;
4. Member State support to the financially troubled operators;
5. Health aspects of the effects of electromagnetic waves;
6. 3G phones are expensive and bulky;
7. 2G mobile users still have not been convinced to use the 3G wireless service;
8. Lack of coverage because it is still new service;
9. High prices of 3G mobile services in some countries.

D. 4G (Fourth Generation)

4G (or **4-G**) is short for fourth-generation, the successor wireless access technology to 3G. It describes two different, but overlapping ideas[9]. The IEEE (Institute of Electrical and Electronics Engineers) official name for 4G is "3G and beyond".

- 4G technology stands to be the future standard of wireless devices. The Japanese company NTT DoCoMo is testing 4G communication at 100 Mbit/s while moving, and 1 Gbit/s while stationary. NTT DoCoMo plans on releasing the first commercial network in 2010. Despite the fact that current wireless devices seldom utilize full 3G capabilities, there is a basic attitude that if you provide the pipeline then services for it will follow.
- Pervasive networks. An amorphous and presently entirely hypothetical concept where the user can be simultaneously connected to several wireless access technologies and can seamlessly move between them. These access technologies can be Wi-Fi, UMTS, EDGE or any other future access technology. Included in this concept is also smart-radio aka cognitive radio technology to efficiently manage spectrum use and transmission power as well as the use of mesh routing protocols to create a pervasive network.

In general, a generation is defined by the result of technology changes over a 10-15 year time frame. Thus, 4G would refer to whatever is deployed in the 2010-2015 period, assuming 3G deployment spans the 2000-2009 period. Typically, this means a new air-interface with higher data rates in the least, and some see change in the way data transport is handled end-to-end Ideally[9], 4G would provide users with on-demand high quality video and audio. The killer application of 4G is not clear, but video is one of the big differences between 4G and 3G. 4G may use OFDM (Orthogonal Frequency Division Multiplexing), and also OFDMA (Orthogonal Frequency Division Multiple Access) to better allocate network resources to multiple users. 4G devices may use SDR (Software-defined radio) receivers which allows for better use of available bandwidth as well as making use of multiple channels simultaneously Unlike the 3G networks which are a jumble of circuit switched and packet switched networks, 4G will be based on packet switching only. This will allow low-latency data transmission.

E. 5G(Fifth Generation)

5th generation mobile networks or 5th generation wireless systems is a network standard beyond the current 4G/IMT-advanced standards. It is the mobile communication

beyond 2020 Though 5G development projects have not been officially launched ,there is debate rising on what 5G might exactly turn out to be[10].

If 5G is to emerge soon then the question arises that what makes it better than 4G.The answer to this is that if 5G appears the major difference between it and 4G from user point must be something like higher system spectral efficiency (or)data volume per unit data , lower battery consumption , lower outage probability (better coverage) , [10]high bit rates in larger portions of the coverage area, lower latencies , higher number of supported devices , lower infrastructure deployment costs , higher versatility and scalability or higher reliability of communications .These are the objectives in several research papers which are going on.

I RESEARCH PROGRESSES:

In europe , Neelie Kroes (european commissioner) committed in 2013, 50 million euros for research to deliver 5G mobile technology by 2020.There is a project called METIS which aims to provide 1000 times higher mobile system spectral efficiency as compared with current LTE deployments . In 2013 , another project called 5GrEEn has started linked to the project METIS and focusing on designing of green 5G mobile networks . This new generation network comes with the plan of affordability aspects too.

III. SHORT RANGE COMMUNICATION

A. BLU-FI

A new and innovative technology called Blu-Fi has been launched in Bangalore services at the City Railway station. It is a unique combination of Bluetooth application and Wi-Fi connectivity which will allow passengers to receive a host of information, like videos, downloadable games, wallpapers etc and also Railway information so on by just switching on Bluetooth on their mobile phones[11]. The initiative has been taken by Bangalore Division in collaboration with RailTel and Telibrahma.

To use the connection passengers can send the request for internet access by sending their mobile number to which the password will be sent on SMS[11].

India has a very low population of internet users and initiatives like this should be taken in almost every Metro city of India to encourage the availability of internet in public places.

B .WiMAX

Wi-Max (**Worldwide Interoperability for Microwave Access**) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates, with the 2011 update providing up to 1 Gbit/s for fixed stations. 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 as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL"

III. C. WiMAX Wireless Network

In practical terms, WiMAX would operate similar to Wi-Fi but at higher speeds, over greater distances and for a greater number of users. WiMAX could potentially erase the suburban and rural blackout areas that currently have no broadband Internet access because phone and cable companies have not yet run the necessary wires to those remote locations.

A WiMAX system consists of two parts:

- A **WiMAX tower**, similar in concept to a cell-phone tower - A single WiMAX tower can provide coverage to a very large area -- as big as 3,000 square miles (~8,000 square km).
- A **WiMAX receiver** - The receiver and antenna could be a small box or PCMCIA card, or they could be built into a laptop the way WiFi access is today.

A WiMAX tower station can connect directly to the Internet using a high-bandwidth, wired connection (for example, a T3 line). It can also connect to another WiMAX tower using a line-of-sight, microwave link. This connection to a second tower (often referred to as a **backhaul**), along with the ability of a single tower to cover up to 3,000 square miles, is what allows WiMAX to provide coverage to remote rural areas.

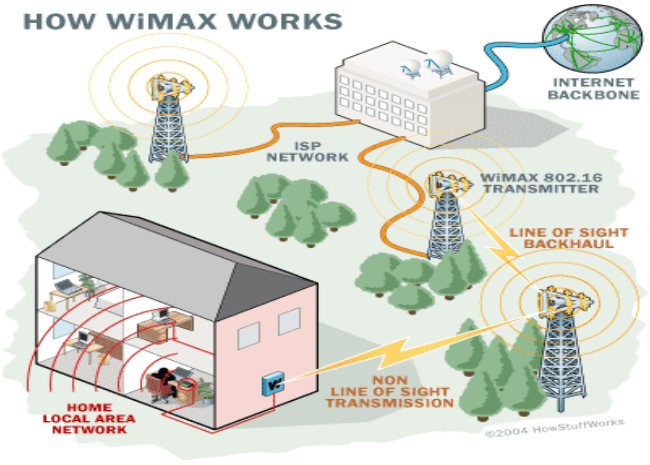


Fig 1.WiMax Working Process

D. BLUETOOTH

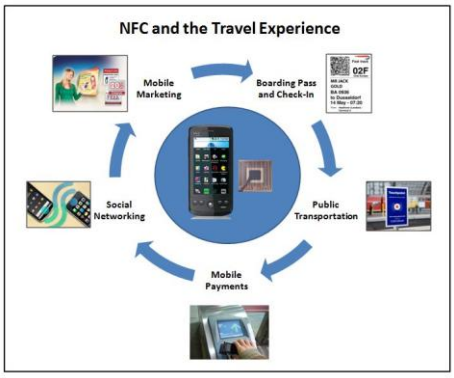
Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400–2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Created by telecom vendor Ericsson in 1994 it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

E. NFC TECHNOLOGY

Smartphones are no longer just fancy mobile devices that let you e-mail and surf the Web. A contemporary smartphone has more computing power than all of the computers that were at NASA's disposal back in 1969 when the United States first landed on the moon Although you probably won't use your phone to control your own lunar lander anytime soon, it will likely do all sorts of other nifty stuff, like replace your wallet, thanks to NFC (near-field communication) technology.

I. Advantages

Acting as a secure gateway to the connected world, tomorrow's NFC-enabled mobile devices will allow consumers to store and access all kinds of personal data – at home or on the move. Simply by bringing two NFC-enabled devices close together, they automatically initiate network communications without requiring the user to configure the setup. NFC-enhanced consumer devices can easily exchange] and store your personal data – messages, pictures, MP3 files, etc. Delivering ease of use, instant intuitive connectivity, zero configuration and smart key access, NFC meets all the needs of today's connected consumer and creates opportunities for new mobile services.



IV. CONCLUSION

A. We have described about the ranges of network systems and its development through ages. This paper explains about the evolution of wireless networks with its advantages, disadvantages and their applications in various fiels of the present world.

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REFERENCES

[1] Garret Kaur et al "A SURVEY ON COOPERATIVE DIVERSITY AND ITS APPLICATIONS IN VARIOUS WIRELESS NETWORKS International Journal of Computer Science & Engineering Survey (IJCSES) Vol.2, No.4, November 2011
[2]. Christhuraj et al "A Comprehensive overview on different network simulators" International Journal Engineering and Technology vol 5 issue 1
[3] Waqas Ikram et al Wireless Communication in Process Automation: A Survey of Opportunities, Requirements, Concerns and Challenges Presented at Control 2010, Coventry, UK, September 2010
[4] G hazisaidi, et al "N.Fiber-wireless (FiWi) access networks: A survey" Communications Magazine, IEEE (Volume:47 , Issue: 2)
[5]. http://www.howstuffworks.com/
[6] . http://en.wikipedia.org/wiki/1G
[7] . http://en.wikipedia.org/wiki/2G
[8] . http://en.wikipedia.org/wiki/3G
[9] . http://en.wikipedia.org/wiki/4G
[10] . http://en.wikipedia.org/wiki/5G
[11] http://articles.timesofindia.indiatimes.com/2012-02-04/bangalore/31024309_1_wi-fi-facility-bluetooth-access-point