**Unit-1**

**Introduction to wireless networks**

* A computer network is collection of several homogeneous/heterogeneous system, commonly used for resource sharing.
* Computer networks can be classified in many ways:
* Area wise:
  + - LAN
    - MAN
    - WAN
* As per medium used:
  + - Wired Computer Network
    - Wireless Computer Network

**Wireless Computer Network:**

* Which works without wires.
* System transmit data through radio waves.
* Users are mobile, They can access information within the range
* E.g. Wireless LAN i.e. ***“Wi-Fi”*** (Wireless Fidelity)

**Advantages of Wireless Network:**

* **Flexible**: Radio waves can penetrate the obstacles. Sender and receiver can be placed any where.
* **Mobility**: Data can be access from any location.
* **Robustness** : Can survive in disaster (Earthquake, military operations)
* **Scalable**: Can be configured in variety of topologies.
* **Easy Installation**
* **Less Cost**
* **Usage of ISM band**: ISM (Industrial, Scientific and Medical) band (2.40GHz to 2.484 GHz, 5.725 GHz to 5.850 GHz) is available for use by anyone.
* **No Planning**: Only Wireless Ad hoc not required any planning**.**

**Disadvantages of Wireless Network:**

* **Quality of Service:**
* Lower Bandwidth
* Lower Data Transmission Rate
* High Error Rates
* Interference
* Higher Delay

**Restrictions:** License-free frequency bands are not same worldwide.

* **Safety and Security**: Interference from other devices (e.g. Hospital. Eavesdropping is possible).

**WIRELESS-THE BEGINNING**

* In 1947 researchers in AT&T Bell Labs conceived the idea of cellular phones.
* They realized that by using small service areas or cells they can reuse the frequency.
* This in turn can enhance the traffic capacity of mobile phones.
* AT&T requested the Federal Communication Commission (FCC) to allocate a large number of radio-spectrum frequencies so that widespread mobile telephone service would become feasible.
* The first wireless network was commissioned in Germany in 1958. It was called A-Netz and used analog technology at 160 MHz. Only outgoing calls were possible in this network. That is to say that connection set-up was possible from the mobile station only.
* This system evolved into B-Netz operating at the same 160 MHz. It was possible to receive an incoming call from a fixed telephone network, provided that location of the mobile station was known.A-Netz was wireless but not a cellular network. Therefore, these systems (A-Netz and B-Netz) did not have any function, which permitted [handover](file:///H:\Mobile%20Computing%20Slides_Dr.Hasan\Important_Handover%20or%20handoff.doc) or change of base station.
* In 1968, in USA, the FCC reconsidered its position on Cellular network concept.FCC agreed to allocate a larger frequency band for more number of mobile phones provided the technology to build a better mobile service be demonstrated. AT&T and Bell Labs proposed a cellular system to the FCC with many small, low-powered, broadcast towers, each covering a hexagonal 'cell' of a few kilometers in radius.
* Collectively these cells could cover a very large area. Each tower would use only a few of the total frequencies allocated to the system. As the phones traveled across the area, calls would be passed from tower to tower.

**Cellular Telephony**

In 1996, there were over 75 million cellular customers worldwide. Predictions are that the number will increase to over 300 million by the year 2000. There are many reasons why cellular phones have so effectively captured the market. However, the most important factors are the continuing advancement of technology and competition, which enables the costs of wireless service to be decreased. There are two kinds of cellular phones available in today's market: analog and digital. Although digital cellular phones have more features and advantages than analog (such as preventing eavesdropping, clearer voice quality and the capacity for supporting more advanced services), analog cellular phones still dominate the market.

**TECHNOLOGY: CAPACITY EXPANSION**

Cellular phones use the radio frequency to transmit and receive voice and data information over the air. Due to the limited available frequencies, it was impossible to serve many customers at the same time, so technologies allowing expanded capacity were developed; one involves increasing the number of cells and the other has to do with multiplexing the frequencies.

Today's cellular systems consist of three basic elements: a mobile phone, cell sites, and a Mobile Switching Center (MSC). By dividing the former big cellular systems coverage into many small cells, frequencies can be reused in the non-adjacent cells, allowing for more customers to be served. If the customers roam to another cell, the MSC will automatically change the frequency to whichever is most suitable at that time.

As for the multiplexing of frequencies, two different schemes are now being used in the digital cellular phone. These different schemes are Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). TDMA is achieved by dividing a single frequency into a number of timeslots, with each user getting one out of every few slots. CDMA is a newly invented technology in which users may share the same time and frequency allocations, and are distinguished from each other by different assigned codes. Analog cellular phones use the Advanced Mobile Phone Service (AMPS) standard, in which each customer uses only one frequency. The capacity of digital cellular phones is significantly larger. Of course, there are still other technologies that can expand the capacity, such as Narrowband Advanced Mobile Phone Service (AMPS), which was introduced by Motorola in late 1991. It uses only a third of the size of AMPS channels -- 10 KHz bandwidth. Hence, NAMPS systems can serve more customers than AMPS systems without adding new cell sites. It is assumed that other new technologies will be invented to meet the increased market demand.

**MILLION-DOLLAR BUSINESS**

Analog cellular services in the United States (U.S.) were developed in the 1970s by AT&T, and service began in Chicago in October 1983. In the late 1990s, cellular telephony is a very competitive business, with numerous producers and service providers coexisting in the limited market. Motorola, Nokia and Samsung are the producers; MCI, Sprint and AT&T are the service providers; Qualcomm is the technology provider with a patent on CDMA chip. The costs of developing the cellular phone business are enormous, including development, production, patent royalty, marketing and post-sales service costs. Despite these high expenditures, the cellular phone business is still profitable. The main revenues of the producers and service/technology providers are naturally different. For example, the main revenue of the service provider is from the fee for telecommunications service. These costs are dropping due to increased competition between companies. The price of the analog phone has dropped from $307 in 1992 to approximately $104 in 1996, largely due to the threat of the digital cellular phone.

**APPLICATIONS**

Cellular phones were originally used primarily by businessmen for mobility and accessibility, but even teenagers now have them. The reason they buy phones now is for safety and status. In order to attract more customers, many features have been invented, such as caller ID, two-way paging, call waiting, and short message services. Cellular phones can also be used for data transmission (circuit switched data and packet switched data), accessing the Internet and faxing.

**DRIVING FORCES**

The strategy of cellular phone advertising is to emphasize convenience, mobility, and use in an emergency. People buy cellular phones for safety, instead of just for routine communication, such as enabling calls if you are out of gas or lost. In order to attract more customers, many different features and applications were invented to meet various user needs. The pre-paid cellular phone utilizes the pre-paid service to control the cellular airtime costs by users. Among all these new features, one of the most significant changes is in size and weight. The newly developed Motorola StarTAC 8600 weighs only 3.1 ounces. Although all of these changes affected the function and appearance of cellular phones, decreasing cost was the most important factor causing the market to successfully develop.

**POLICY: CATALYST OF BUSINESS AND TECHNOLOGY**

The Federal Communications Commission (FCC) established rules and procedures for licensing cellular systems in the U.S. and encouraged competition by creating two competing cellular licenses in every major market. This increasing competition drives prices down. In addition to government pressure, some industry associations have also facilitated the implementation and invention of new technologies. In 1988, the Cellular Technology Industry Association (CTIA) and Advanced Radio Technology Subcommittee (ARTS) were established to set and develop requirements for the next generation of cellular technology. They created a User Performance Requirement (UPR) document that provided goals for the new technology. These goals include a tenfold increase in system capacity compared to AMPS, dual mode during transition, new features, high quality service standards, etc. In order to reach these goals, many new technologies appeared one after the other, like TDMA and CDMA.

One problem that hinders the diffusion of cellular phones is the lack of a single standard. In Europe the cellular phones use the GSM standard; people can travel throughout Europe without worrying about phone usage problems. However, in the U.S., the different standards have caused an incompatibility problem. The FCC now requires all cellular systems to maintain AMPS service. In order to be able to roam in all the systems, some cellular phones have dual capacity, which can fit into both the analog and digital systems.

**OPPORTUNITIES, PROBLEMS, AND PROSPECTS**

The cellular industry is one of the fastest growing businesses in the world. In the future, more multi-media capabilities will be added to cellular phones, which could allow them to effectively replace wired telephone systems or offer more cost-efficient data message transmission. The wireless marketplace is undergoing a change because of [Personal Communication Systems (PCS)](http://www-bcf.usc.edu/~wdutton/comm533/PCS-STEW.htm) and Specialized Mobile Radios (SMR). It's not difficult to imagine that competition in the cellular industry will become fiercer in the future. However, the final winner and beneficiary will be the customers.

Although cellular phones can benefit people a great deal, there are still many problems. The cellular industry estimates that it loses more than $400 million per year to cellular fraud. The effective prevention of piracy is vital to the success of the industry. Incompatibility raises additional concerns. Developing a universal standard in order to reach the goal of ‘global roaming’ is a challenge to the cellular industry and policy makers. Lastly, driving safety is another important issue arising from the use of cellular phones; some states prohibit the use of cellular phones while driving. In short, the successful resolution of these problems is essential to gain customer acceptance and keep the cellular industry growing.

**Cordless phones:**

A cordles telephone, also known as a portable telephone, act's just like a normal phone, except for the fact that it works without cords.

A wired base station, communicates with the wireless handset through radio waves, and this usually only works within a limited range (eg. within a house or office).

A cordless phone is different then a mobile phone, for this very reason, that it needs to communicate with a wired base station, unlike a mobile phone that doesn't need a base station, which allows it to communicate outside of its fixed area.

**"A cordless telephone or portable telephone is a telephone with a wireless handset that communicates via radio waves with a base station connected to a fixed telephone line, usually within a limited range of its base station (which has the handset cradle). The base station is on the subscriber premises, and attaches to the telephone network the same way a corded telephone does."**

DECT (Digital Enhanced Cordless Telephone) as the name suggests is a standard for digital and cordless communication of voice and multimedia traffic using frequencies in the 1.8 GHz - 1.9 GHz range.

DECT was developed by ETSI but has now been adopted by countries all over the world. In Europe the DECT frequency is 1880 MHz - 1900 MHz and outside Europe, in 2005 the channel was changed to 1920 MHz - 1930 MHz or 1.9 GHz.

These channels are reserved for voice communication applications and are therefore less likely to interfere with other wireless technologies, such as wireless networks.

DECT cordless phones work by connecting to a base station, which may support one or multiple handsets. DECT bridges the gap between cordless phones and wireless, cellular phones, as each base station in effect creates its own short range cell.

DECT handsets automatically search for the highest quality connection and switch to it, so the connection clarity is always high quality.

**"Digital Enhanced Cordless Telecommunications (DECT), known as Digital European Cordless Telephone[1] until 1995, is an ETSI standard for digital portable phones (cordless home telephones), commonly used for domestic or corporate purposes. It is recognized by the ITU as fulfilling the IMT-2000 requirements and thus qualifies as a 3G system. Within the IMT-2000 group of technologies, DECT is referred to as IMT-2000 Frequency Time (IMT-FT)."**

**SATELLITE COMMUNICATION SYSTEMS:**

A **satellite** is a body that moves around another body in a mathematically predictable path called an **Orbit**. A communication satellite is nothing but a microwave repeater station in space that is helpful in telecommunications, radio, and television along with internet applications.

A **repeater** is a circuit which increases the strength of the signal it receives and retransmits it. But here this repeater works as a **transponder**, which changes the frequency band of the transmitted signal, from the received one.

The frequency with which the signal is sent into the space is called **Uplink frequency**, while the frequency with which it is sent by the transponder is**Downlink frequency**.

The following figure illustrates this concept clearly.

Now, let us have a look at the advantages, disadvantages and applications of satellite communications.

Satellite Communication − Advantages

There are many Advantages of satellite communications such as −

* Flexibility
* Ease in installing new circuits
* Distances are easily covered and cost doesn’t matter
* Broadcasting possibilities
* Each and every corner of earth is covered
* User can control the network

Satellite Communication − Disadvantages

Satellite communication has the following drawbacks −

* The initial costs such as segment and launch costs are too high.
* Congestion of frequencies
* Interference and propagation

Satellite Communication − Applications

Satellite communication finds its applications in the following areas −

* In Radio broadcasting.
* In TV broadcasting such as DTH.
* In Internet applications such as providing Internet connection for data transfer, GPS applications, Internet surfing, etc.
* For voice communications.
* For research and development sector, in many areas.
* In military applications and navigations.

The wireless arena has been experiencing exponential growth in the past decade. The advances in network infrastructures, growing availability of wireless applications, and the emergence of omnipresent wireless device such as portable or handheld computers, cell phones are all getting more powerful in their capabilities. A wireless network is an infrastructure to communicate ‗through the airwaves‘, in other words, no cables are needed to connect from one point to another. These connections can be used for speech, e-mail, surfing on the Web and to transmit audio and video. The most widespread use is mobile telephony. Wireless networks are also used to communicate between computers. The primary attraction is its ability to cross long distances without installing fixed lines and cables**.** These devices are now playing an ever increasingly important role in lives. Recently, industry has made significant progress in resolving some constraints to the widespread adoption of wireless technologies. Some of the constraints have included disparate standards, low bandwidth, and high infrastructure and service cost. Wireless technologies can both support the institution mission and provide cost effective solutions. Wireless is being adopted for many new applications: to connect computers, to allow remote monitoring and data acquisition, to provide access control and security, and to provide a solution for environments where wires may not be the best solution.

**EVOLUTION OF WIRELESS NETWORKs**

In February 1896, Guglielmo Marconi journeyed from Italy to England in order to show the British telegraph authorities what he had developed in the way of an operational wireless telegraph apparatus. His first British patent application was filling on June 2 of that year. Through the cooperation of Mr W.H. Preece, who was at that time the chief electrical engineers of the British Post-office Telegraphs, signals were sent in July 1896 over a distance of one-and-three-fourths miles on Salisbury Plain.

1946 First car-based mobile telephone set up in St. Louis, using ‗push-to-talk‘ technology

1948 Claude Shannon publishes two benchmark papers on Information Theory, containing the basis for data compression (source encoding) and error detection and correction (channel encoding)

1950 TD-2, the first terrestrial microwave telecommunication system, installed to support2400 telephone circuits

1960 Early in the decade, the Improved Mobile Telephone System (IMTS) developed with simultaneous transmit and receive, more channels, and greater

Power

1962 The first communication satellite,

Telstar, launched into orbit

1964 The International Telecommunications Satellite Consortium (INTELSAT) established, and in 1965launches the Early Bird geostationary satellite

1968 Defence Advanced Research Projects Agency – US(DARPA) selected BBN to develop the Advanced Research Projects Agency Network (ARPANET),

the father of the modern Internet

1970s Packet switching emerges as an efficient means of data communications, with the X.25 standard emerging late in the decade

1977 The Advanced Mobile Phone System

(AMPS),invented by Bell Labs, first installed in the US with geographic regions divided into ‗cells‘ (i.e. cellular

telephone)

1983 January 1, TCP/IP selected as the official protocol for the ARPANET, leading to rapid growth

1990 Motorola files FCC application for permission to launch 77 (revised down to 66) low earth orbit communication satellites, known as the Iridium System (element 77 is Iridium)

1992 One-millionth host connected to the Internet, with the size now approximately doubling every year

1993 Internet Protocol version 4 (IPv4) established for reliable transmission over the Internet .

**TYPES OF WIRELESS NETWORK**

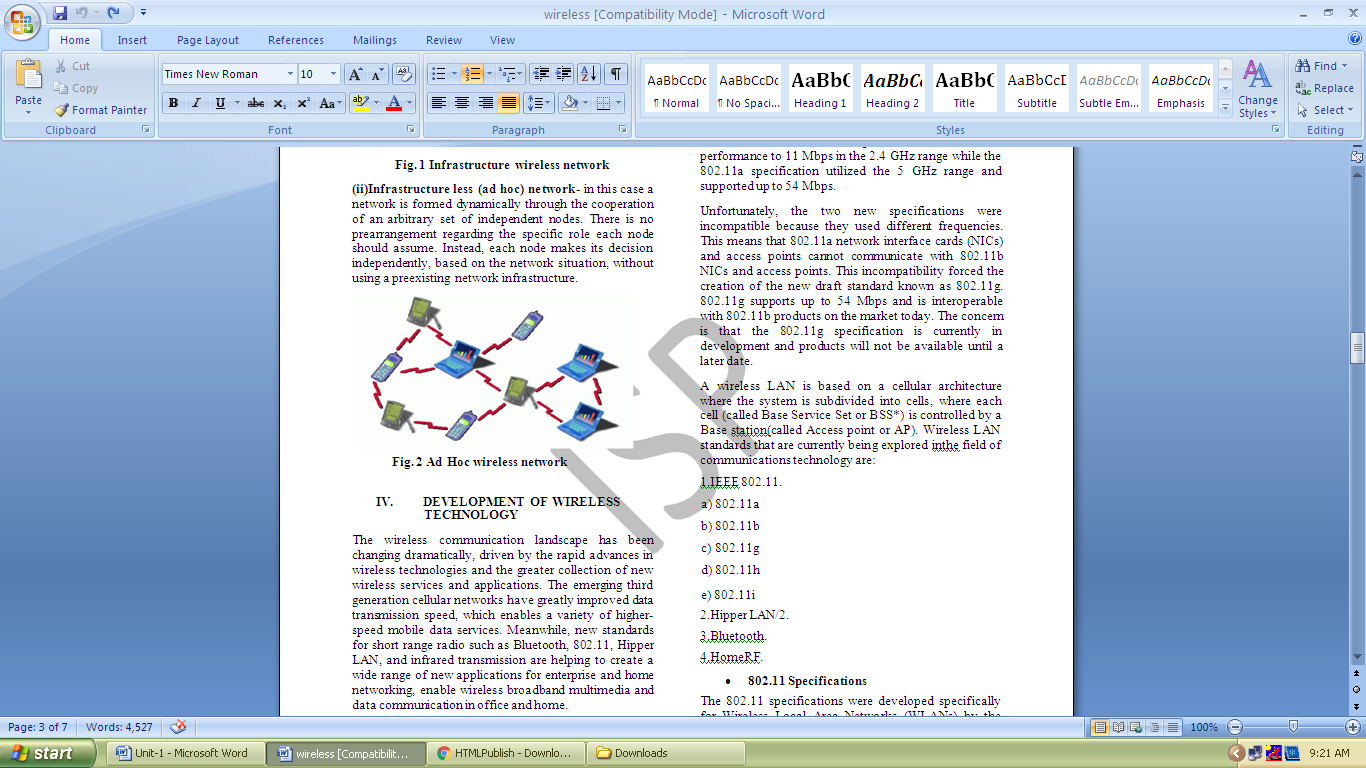
Wireless network gives user information access regardless of their location.

According to network formation and architecture the wireless network can be divided into two broad categories:

(i)**Infrastructure based network-** A network with reconstructed infrastructure that is made of fixed and wired network node and gateways with typically network services delivered via these preconfigured infrastructure.

**Fig: Infrastructure wireless network**

**(ii)Infrastructure less (ad hoc) network-** in this case anetwork is formed dynamically through the cooperation of an arbitrary set of independent nodes. There is no prearrangement regarding the specific role each node should assume. Instead, each node makes its decision independently, based on the network situation, without using a preexisting network infrastructure.

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**DEVELOPMENT OF WIRELESS TECHNOLOGY**

The wireless communication landscape has been changing dramatically, driven by the rapid advances in wireless technologies and the greater collection of new wireless services and applications. The emerging third generation cellular networks have greatly improved data transmission speed, which enables a variety of higher-speed mobile data services. Meanwhile, new standards for short range radio such as Bluetooth, 802.11, Hipper LAN, and infrared transmission are helping to create a wide range of new applications for enterprise and home networking, enable wireless broadband multimedia and data communication in office and home.

**IEEE Wireless Networking Specifications**

The IEEE (Institute of Electrical and Electronic Engineers) released the 802.11 specifications in June 1999. The initial specification, known as 802.11, used the 2.4 GHz frequency and supported a maximum data rate of 1 to 2 Mbps. In late 1999, two new addenda were released. The 802.11b specification increased the performance to 11 Mbps in the 2.4 GHz range while the 802.11a specification utilized the 5 GHz range and supported up to 54 Mbps.

Unfortunately, the two new specifications were incompatible because they used different frequencies. This means that 802.11a network interface cards (NICs) and access points cannot communicate with 802.11b NICs and access points. This incompatibility forced the creation of the new draft standard known as 802.11g. 802.11g supports up to 54 Mbps and is interoperable with 802.11b products on the market today. The concern is that the 802.11g specification is currently in development and products will not be available until a later date.

A wireless LAN is based on a cellular architecture where the system is subdivided into cells, where each cell (called Base Service Set or BSS\*) is controlled by a Base station(called Access point or AP). Wireless LAN standards that are currently being explored inthe field of communications technology are:

1.IEEE 802.11.

1. 802.11a
2. 802.11b
3. 802.11g
4. 802.11h
5. 802.11i 2.Hipper LAN/2. 3.Bluetooth. 4.HomeRF.

* **802.11 Specifications**

The 802.11 specifications were developed specifically for Wireless Local Area Networks (WLANs) by the IEEE and include four subsets of Ethernet-based protocol standards: 802.11, 802.11a, 802.11b, and 802.11g.

i)**802.11**

802.11 operated in the 2.4 GHz range and was the original specification of the 802.11 IEEE standard. This specification delivered 1 to 2 Mbps using a technology known as phase-shift keying (PSK) modulation. This specification is no longer used and has largely been replaced by other forms of the 802.11 standard.

**a) 802.11a**

802.11a operates in the 5 - 6 GHz range with data rates commonly in the 6 Mbps, 12 Mbps, or 24 Mbps range. Because 802.11a uses the orthogonal frequency division multiplexing (OFDM) standard, data transfer rates can be as high as 54 Mbps. OFDM breaks up fast serial information signals into several slower sub-signals that are transferred at the same time via different frequencies, providing more resistance to radio frequency interference. The 802.11a specification is also known as Wi-Fi, and though regionally deployed, it is not a global standard like 802.11b.

**b)802.11b**

The 802.11b standard (also known as Wi-Fi) operates in the 2.4 GHz range with up to 11 Mbps data rates and is backward compatible with the 802.11 standard. 802.11b uses a technology known as complementary code keying (CCK) modulation, which allows for higher data rates with less chance of multi-path propagation interference (duplicate signals bouncing off walls).

**U.S. Robotics 22 Mbps 802.11b**

Recent developments to 802.11b have seen numerous improvements to this well-established and widely-deployed wireless standard. New U.S. Robotics 22 Mbps products are designed to support Packet Binary Convolution Coding (PBCC) in addition to CCK modulation. This not only increases performance but also maintains complete 802.11b compatibility with both 11 Mbps and 22 Mbps products.

The overall benefits include:

* Up to twice the data rate of conventional

11 Mbps 802.11b standard products

* Greater WLAN coverage: up to 70% greater than standard 11 Mbps 802.11b products
* Full interoperability with all 802.11b products: works with 802.11b 11 Mbps, 802.11b 22 Mbps, and upcoming 802.11g products
* Improved security over standard 802.11b: 256-bit WEP encryption and MAC address authentication\*

**c)802.11g**

802.11g is the most recent IEEE 802.11 draft standard and operates in the 2.4 GHz range with data rates as high as 54 Mbps over a limited distance. It is also backward compatible with 802.11b and will work with both 11 and 22 Mbps U.S. Robotics wireless networking products.

802.11g offers the best features of both 802.11a and 802.11b, but as of the publication date of this document, this standard has not yet been certified, and therefore is unavailable.

**d)802.11h**

This standard is supplementary to the MAC layer to comply with European regulations for 5 GHz WLANs. radio regulations for the 5 GHz band require products to have transmission power control (TPC) and dynamic frequency selection (DFS). TPC limits the transmitted power to the minimum needed to reach the farthest user. DFS selects the radio channel at the access point to minimize interference with other systems, particularly

radar.

e)**802.11i**

It will apply to 802.11 physical standards a, b, and g. It provides an alternative to Wired Equivalent Privacy (WEP) with new encryption methods and authentication procedures. IEEE 802.1X forms a key part of 802.11i.

**2. HipperLAN 1/2**

European Telecommunications Standards Institute, ETSI, ratified in 1996 with High Performance Radio LAN (Hipper LAN 1) [4] standard to provide highspeed communications (20Mbps) between portable devices in the 5GHz range. Similarly to IEEE802.11, Hipper LAN/1 adopts carrier sense multiple access protocol to connect end user devices together. On top of that, Hipper LAN/1 supports isochronous traffic fordifferent type of data such as video, voice, text, etc. Later, ETSI, rolled out in June 2000, a flexible Radio LAN standard called Hipper LAN 2, designed to provide high speed access (up to 54 Mbps at PHY layer) to a variety of networks including 3G mobile core networks, ATM networks and IP based networks, and also for private use as a wireless LAN system.

**3. Bluetooth**

Bluetooth is an industry specification for short-range RF-based connectivity for portable personal devices with its functional specification released out in 1999 by Bluetooth Special Interest Group [6]. Bluetooth communicates on a frequency of **2.45 gigahertz**, which has been set aside by international agreement for the use of industrial, scientific and medical devices (ISM). One of the ways Bluetooth devices avoid interfering with other systems is by sending out very weak signals of 1 mill watt. The low power limits the range of a Bluetooth device to about **10 meters**, cutting the chances of interference between a computer system and a portable telephone or television. Bluetooth makes use of a technique called spread-spectrum frequency hopping. In this technique, a device will use 79 individual, randomly chosen frequencies within a designated range, changing from one to another on a regular basis. Bluetooth devices essentially come in two classes, both using point to-point communication to speak. Class 3 devices operate at 0 dBm ranges and are capable of transmitting 30 feet, through walls or other objects and the other class are termed as class 1 product. These devices operate at 20 dBm, which allows for the signal to travel about 300 feet through walls or other solid objects. Both Bluetooth classes are rated at traveling at about 1 Mbps, with next generation products allowing anywhere from 2 to 12 Mbps, to be determined at a later date.

**TECHNICAL ISSUES IN WIRELESS NETWORKS**

Wireless networks have recently emerged as a premier research topic. They have great long term economic potential, ability to transform our lives, and pose many new system building challenges. Wireless networks also pose a number of new conceptual and optimization problems. Some, such as location, deployment, and tracking, are fundamental issues, in that many applications rely on them for needed information.

**[1]Coverage problem-**One of the fundamental issuesthat arises in wireless networks, in addition to location calculation, tracking, and deployment, is coverage. Due to the large variety of wireless network and applications, coverage is subject to a wide range of interpretations. In general, coverage can be considered as the measure of *quality of service* of a sensor network. For example, in the previous fire detection sensor networks example, one may ask how well the network can observe a given area and what the chances are that a fire starting in a specific location will be detected in a given time frame. Furthermore, coverage formulations can try to find weak points in a network field and suggest future deployment or reconfiguration schemes for improving the overall quality of service

**[2]Scheduling Problem-**In wireless networks theproblem of allocating transmission rights to subsets of network users at each time and under different channel qualities is known as the scheduling problem. It arises in wireless environments because of three main reasons related to the fundamental properties of the wireless medium.

Specifically, scheduling is mandatory since in wireless environments (i) communication resources are shared amongst geographically separated users, (ii) transmissions interfere with each other, and (iii) transmissions undergo impairments, such as fading, attenuation, etc.

**[3]Hidden Terminal problem-** Hidden nodes in awireless network refer to nodes that are out of range of other nodes or a collection of nodes[5]. Take a physical star topology with an access point with many nodes surrounding it in a circular fashion: Each node is within communication ion range of the AP, but the nodes cannot communicate with each other, as they do not have a physical connection to each other. In a wireless network, it is likely that the node at the far edge of the access point's range, which is known as **A**, can see the access point, but it is unlikely that the same node can see a node on the opposite end of the access point's range, **B**. These nodes are known as hidden .The problem is when nodes **A** and **B** start to send packets simultaneously to the access point. Since node **A** and **B** cannot sense the carrier, Carrier sense multiple access with collision avoidance (CSMA/CA) does not work, and collisions occur, scrambling data.

**[4]Security-**Security is a big concern in wirelessnetworking, especially in m-commerce and e-commerce applications. Mobility of users increases the security concerns in a wireless network. Current wireless networks employ authentication and data encryption techniques on the air interface to provide security to its users. The IEEE 801.11 standard describes wired equivalent privacy (WEP) that defines a method to authenticate users and encrypt data between the PC card and the wireless LAN access point. In large enterprises, an IP network level security solution could ensure that the corporate network and proprietary data are safe. Virtual private network (VPN) is an option to make access to fixed access networks reliable. Since hackers are getting smarter, it is imperative that wireless security features must be updated constantly.

**[5]Quality of Service-** Next generation wirelesscommunications will have to meet the demands of multimedia applications such as steaming video, IP telephony, teleconferencing, interactive games, distance learning etc. and it would be challenging due to constraints and heterogeneities such as power constraint, bandwidth limitation, different protocols and standards, fading effects and stringent quality of service (QoS) requirements. Provisioning of QoS is a key problem in next generation wireless communication systems. Provisioning of end-to-end QoS would be challenging due to major difficulties of IP based multimedia communication in mobile networks. QoS refers to the set of those quantitative and qualitative characteristics which are necessary in order to achieve the desired functionality/ performance of an application or service. From a user‘s perspective, it is the perceived quality such as picture quality of a video, or the quality of a voice conversation. For cellular data networks, QoS mechanisms have been proposed in the literature in the form of medium access control (MAC) enhancement, scheduling and admission control schemes.

**[6]Fading-** Multipath fading has a distinct impact onthe fragility of wireless links. It is considered a small-scale phenomenon in the sense that the level of attenuation of the signal changes substantially if the position of the receiver or the transmitter is varied by about half a wavelength. One of the most common features of wireless sensor networks is the fact that the nodes are usually static; static multipath fading is therefore of particular interest. Another physical phenomenon of interest is shadowing; it is considered a large scale effect, as it corresponds to substantial deviations of the RF signal from its mean due to large obstacles, which create shadow zones that cause deep fades if a receiver happens to enter them. Although the impact of multipath fading is particularly strong in rich scattering environments such as offices and other indoor locales, outdoor deployments of wireless sensing nodes are not immune to it. Radio waves still get reflected off buildings and other landscape features. Multipath fading and shadowing contribute to the volatility of wireless links and must be accounted for when modeling the wireless channel. When the analysis of a higher-layer scheme (typically medium access and routing algorithms) is carried out, realistic assumptions must be made about the physical layer.

**ADVANTAGES OF WIRELESS NETWORK**

1. It is very flexible within the reception area.
2. Ad-hoc networks arepossible without previous planning.
3. There is no difficulty of wiring. E.g.historic buildings, firewalls.
4. More robust against disasters. E.g., earthquakes, fire - or users pulling a plug

v)Economical networking infrastructures possible.

vi) Within radio coverage, nodes can communicate without further restriction. Radio waves can penetrate walls.

1. Wireless ad hoc networks allow for communication without planning. Wired networks need wiring plans.
2. Wireless networks can survive disasters, if the wireless devices survive people can still communicate.

**DRAWBACKS**

1. Very low bandwidth compared to wire networks 1-10 Mbit/s and error rates of about 10-4 instead of 10-12.
2. Many proprietary solutions, especially for higher bit-rates.

• Standards take their time, e.g., IEEE 802.11

1. Products have to follow many national restrictions if working wireless
2. It takes a very long time to establish global solutions like, e.g., IMT-2000
3. Lack of security, ―open‖ air interface, War driving.

vi)WLANs offer typically lower QoS. Lower bandwidth due to limitations in radio transmission (1-10 Mbit/s) and higher error rates due to interference.

vii) Safety and security: using radio waves for data transmission might interfere with other high-tech equipment.