IT- 6th Sem,
"Mobile Computing"

Unit-1 Notes

WHAT IS MOBILE COMPUTING:-

mobile computing एक ऐसी तकनीक है जिससे users एक mobile या किसी अन्य wireless device के द्वारा data, voice, तथा video का ट्रांसमिशन कर सकते हैं. दूसरे शब्दों में कहें तो, "मोबाइल कंप्यूटिंग एक ऐसी technology है जिसका प्रयोग data को किसी mobile device के द्वारा wireless network में transmit करने के लिए किया जाता है."

सामान्य रूप से, mobile computing को smartphones में प्रयोग की जाने वाली तकनीक के रूप में देखते है लेकिन यह इससे कही अधिक बड़ा topic है क्योंकि यह smartphones तक ही सिमित नहीं है यह हर उस devices में use होती है जो कि mobility को support करती है जैसे:- laptop, smart watch, tablet आदि. mobile computing के तीन मुख्य concepts है जिनपे यह आधारित रहता है:-

1. mobile communication
2. mobile hardware
3. mobile software

1:- mobile communication –

यहाँ मोबाइल कम्युनिकेशन का तात्पर्य एक ऐसे infrastructure से है जो कि wireless device के लिए विश्वसनीय (reliable) तथा बाधा रहित communication प्रदान करे. इसके अंतर्गत protocols, services, bandwidth तथा portals आते हैं जो कि devices को support करती है. data format भी इसी के अंदर define किया जाता है, यह सुनिश्चित करता है कि दूसरे systems के साथ collision ना हो. mobile communication में radio wave infrastructure का प्रयोग किया जाता है जिसमें signals को हवा (air) में भेजा जाता है (अर्थात् signals की sending तथा receive हवा के माध्यम से होती है.)

2:- mobile hardware –

mobile hardware का तात्पर्य उन devices या mobile devices से जो कि mobility की service को receive या access कर सकते हैं. इसके अंदर laptops, smartphones, tablet PC, smart watch तथा अन्य personal digital assistants (PDA) आते है. इन डिवाइसों के अंदर एक receptor लगा होता है जो कि signals को sense तथा receive करने के लिए डिजाईन किया होता है. तथा ये डिवाइस full duplex पर कार्य करती है अर्थात् ये एक ही समय पर signals को send भी कर सकती है तथा receive भी कर सकती है. मोबाइल हार्डवेयर, वायरलेस नेटवर्क पर कार्य करता है.

3:- mobile software –

मोबाइल सॉफ्टवेयर एक program होता है जो कि मोबाइल हार्डवेयर पर run होता है. इसे मोबाइल का operating system भी कह सकते है. यह डिवाइस के अंदर सभी कार्यों के लिए जिम्मेदार रहता है. इसे डिवाइस का engine भी कहते है. ये mobile applications के सभी विशेषताओं तथा जरूरतों को देखता है. ये camera, music player, cellular connectivity, WI-FI, Bluetooth, voice recorder, speech recognition, तथा video player आदि feature प्रदान करता है.

EVOLUTION OF MOBILE COMPUTING:-

mobile computing का idea 1990 के दशक से शुरू हुआ था और उसके बाद से अब तक इसमें बहुत बदलाव आ चूका है. क्या आपको पता है कि पहला portable laptop कौन सा था, अगर नहीं तो बताते है – पहले portable लैपटॉप का नाम Osborne था. यह 10.6 kg का था. और इसकी screen 5 इंच की थी. इसमें दो floppy disk drives तथा एक keyboard लगा होता था. और आजकल के laptop में 8GB की RAM, 14 इंच की display screen, तथा intel core i7 processor होता है एवं weight 1.5 kg तक होता है. आजकल हम घर बैठे सब कुछ काम कर सकते है. shopping, gaming, entertainment सब कुछ हमारे हाथों में होता है. पहले हमें game खेलने के लिए play-station, internet चलाने के लिए cyber cafe जाना पड़ता था. नेटवर्क 2G, 2.5G, 3G, 4G और अब कुछ देशों में 5G आ चूका है तो हम कह सकते है कि mobile computing का evolution बहुत तेज गति से हुआ है और भविष्य में भी नयी technology देखने को मिलेगी.

PRINCIPLES (CHARACTERISTICS) OF MOBILE COMPUTING:-

1:- portability – इसमें devices को एक स्थान से दूसरे स्थान पर ले जा सकते है. और wireless network में कहीं भी operate कर सकते हैं.

2:- connectivity – यह एक ability है जिसके द्वारा devices हमेशा नेटवर्क के साथ connect रहती है इसमें down time / lag time बहुत ही कम होता है, अगर हम डिवाइसों को दूसरी जगह पर ले भी जा रहें हो तो भी यह नेटवर्क के साथ connect रहती है.

3:- social interactivity – इसका मतलब है कि एक डिवाइस दूसरे डिवाइस से communication करने के लिए connect रहती है.

4:- individuality – जब कोई एक मोबाइल डिवाइस नेटवर्क से connect होती है तो उसे individual कहते है और यह डिवाइस अपनी जरूरत के लिए नेटवर्क को access कर सकती है.

ADVANTAGE OF MOBILE COMPUTING:-

1:- location flexibility – इसके द्वारा users कहीं से भी और कितनी दूरी से भी कार्य कर सकते हैं. location flexibility का मतलब है कि users किसी भी location से work कर सकता है. हम एक mobile device में एक समय में कई सारें tasks को पूरा कर सकते हैं.

2:- saves time – यह समय की बचत करता है जब भी हम कही travel करते है जैसे कि घर से office या कही और तो, हम travel करते वक्त भी अपने कार्यों को मोबाइल डिवाइस के द्वारा पूरा कर सकते है. जिससे travel में लगने वाले समय का भी उपयोग कर सकते हैं.

3:- enhanced productivity – यह productivity को बढाता है users अपनी मनचाही जगह से इसका प्रयोग कर सकते है तथा companies में client तथा कंपनी के कर्मचारी मोबाइल का प्रयोग करते है जिससे वे कार्य जल्दी खत्म कर लेते है जिससे उनकी productivity बढती है.

4:- entertainment – mobile devices का प्रयोग मनोरंजन के लिए किया जा सकता है. हम इसमें कोई भी movie, game खेल सकते है तथा social sites आदि चलाकर अपना मनोरंजन करते है. आजकल वैसे भी इन्टरनेट की high speed होती है इसमें कोई भी high quality videos तथा educational material देखा जा सकता है. भारत में जब से JIO आया है तब से ज्यादतर लोग entertainment के लिए ही प्रयोग करते हैं.

5:- Ease of Research – इसके द्वारा हम कोई भी research आसानी से कर सकते है. पहले जब मोबाइल कंप्यूटिंग नहीं थी तब लोगों को research करने के लिए उस field में जाना पड़ता था परन्तु अब हम इन्टरनेट के द्वारा google या अन्य sites में search करके data को collect कर सकते हैं.

6:- cloud computing –

यह एक सर्विस है इसके द्वारा हम अपने data को online servers (जिन्हें cloud कहते है) में save कर सकते हैं और जब भी हमारे पास इन्टरनेट कनेक्शन होता है हम उस data को access कर सकते है.

7:- social engagement – हम facebook, twitter, whatsapp आदि के द्वारा लोगों से जुड़ सकते है.

DISADVANTAGE OF MOBILE COMPUTING:-

1:- security (सुरक्षा)- इसका मुख्य नुकसान इसकी security है क्योंकि मोबाइल डिवाइसों को hack किया जा सकता है और इनमें स्टोर महत्वपूर्ण और संवेदनशील सूचना को चुराया जा सकता है. अगर हम किसी दूसरे का wi-fi प्रयोग करते है तो वह हमारे phone को easily हैक कर सकता है.

2:- distractions – इन डिवाइसों के द्वारा एक तरफ तो productivity बढती है परन्तु दूसरी तरफ यह distraction का कारण भी बनती है. users अपने काम के समय भी इसका इस्तेमाल फ़ालतू की चीजों को देखने में लगा देते हैं. गाड़ी चलाते वक्त phone में बात करने से कई accidents हो चुके हैं.

3:- power consumption – मोबाइल डिवाइसों में लगी बैटरी की क्षमता बहुत ही कम होती है और ये batteries थोड़ी ही देर तक टिक पाती है. अगर आप कहीं ऐसी जगह में फंस जाए जहाँ बिजली नहीं है और आपकी battery खत्म हो गयी हो तो. (क्योंकि इनकी battery ज्यादा से ज्यादा 1 या 2 दिन तक ही टिक पाती है और इन्हें दूबारा charge करना पड़ता है.)

4:- quality of connectivity – आपने देखा होगा कि कभी कभी आपके phone में 4G नेटवर्क full आ रहे होते है परन्तु इन्टरनेट की speed बहुत ही कम होती है. तो यह इसका एक drawback है. 4g नेटवर्क में 2g की speed भी नहीं मिलती.

5:- cost – नयी technology तथा devices की कीमत महंगी होती है जिनको खरीद पाना थोडा मुश्किल हो जाता है.

6:- mobile devices की display स्क्रीन बहुत छोटी होती है.

7:- हम phones को अपने साथ ले जाते है तो चोरी होने का खतरा बना रहता है जिससे आपके phone का कोई दुरूपयोग कर सकता है.

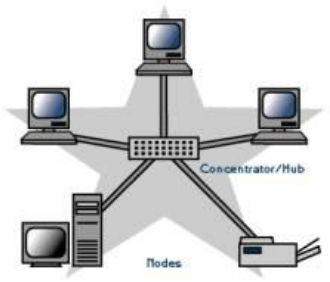
APPLICATIONS OF MOBILE COMPUTING:-

आजकल mobile computing का प्रयोग वैसे तो सभी जगहों पर किया जाता है फिर भी हम नीचे कुछ महत्वपूर्ण areas के बारें में बता रहे हैं जहाँ इसका प्रयोग किया जाता है.

- emergency services (आपातकालीन सेवाओं) में इसका प्रयोग किया जाता है जैसे- ambulance को call करना आदि.
- stock broker (दलाल) के द्वारा इसका प्रयोग stock की जानकारी प्रदान के लिए किया जाता है.
- vehicles में
- estate agents के लिए
- courts (अदालतों में)
- कंपनियों में
- credit card को verify करने के लिए
- e mail भेजने के लिए
- ola uber, ऑनलाइन hotel, flight तथा अन्य सेवाओं को ऑनलाइन book करने के लिए.

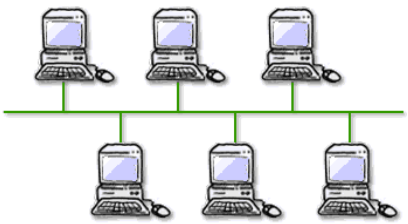
Wired Networks

Wired networks, also called Ethernet networks, are the most common type of local area network (LAN) technology. A wired network is simply a collection of two or more computers, printers, and other devices linked by Ethernet cables. Ethernet is the fastest wired network protocol, with connection speeds of 10 megabits per second (Mbps) to 100 Mbps or higher. Wired networks can also be used as part of other wired and wireless networks. To connect a computer to a network with an Ethernet cable, the computer must have an Ethernet adapter (sometimes called a network interface card, or NIC). Ethernet adapters can be internal (installed in a computer) or external (housed in a separate case). Some computers include a built-in Ethernet adapter port, which eliminates the need for a separate adapter (Microsoft). There are three basic network topologies that are most commonly used today. (Homenthelp.com)

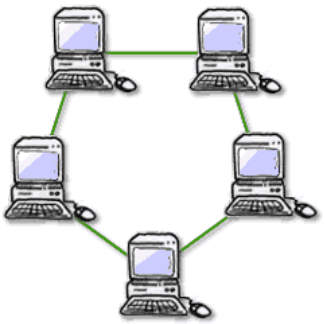


The star network, a general more simplistic type of topology, has one central hub that connects to three or more computers and the ability to network printers. This type can be used for small businesses and even home networks. The star network is very useful for applications where some processing must be centralized and some must be performed locally. The major disadvantage is the star network is its vulnerability. All data must pass through one central host computer and if that host fails the entire network will fail.

On the other hand the bus network has no central computer and all computers are linked on a single circuit. This type broadcasts signals in all directions and it uses special software to identify which computer gets what signal. One disadvantage with this type of network is that only one signal can be sent at one time, if two signals are sent at the same time they will collide and the signal will fail to reach its destination. One advantage is that there is no central computer so if one computer goes down others will not be affected and will be able to send messages to one another. (Laudon)



The third type of network is the ring network. Similar to the bus network, the ring network does not rely on a central host computer either. Each computer in the network can communicate directly with any other computer, and each processes its own applications independently. A ring network forms a closed loop and data is sent in one direction only and if a computer in the network fails the data is still able to be transmitted.

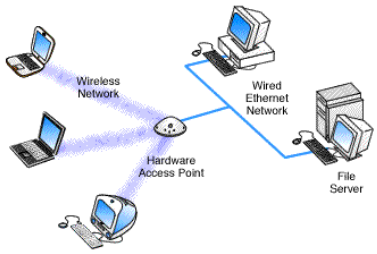


Typically the range of a wired network is within a 2,000-foot-radius. The disadvantage of this is that data transmission over this distance may be slow or nonexistent. The benefit of a wired network is that bandwidth is very high and that interference is very limited through direct connections. Wired networks are more secure and can be used in many situations; corporate LANs, school networks and hospitals. The biggest drawback to this type of network is that it must be rewired every time it is moved. (Laudon)

Wireless Networks

A wireless network, which uses high-frequency radio waves rather than wires to communicate between nodes, is another option for home or business networking. Individuals and organizations can use this option to expand their existing wired network or to go completely wireless. Wireless allows for devices to be shared without networking cable which increases mobility but decreases range. There are two main types of wireless networking; peer to peer or ad-hoc and infrastructure. (Wi-fi.com)

An ad-hoc or peer-to-peer wireless network consists of a number of computers each equipped with a wireless networking interface card. Each computer can communicate directly with all of the other wireless enabled computers. They can share files and printers this way, but may not be able to access wired LAN resources, unless one of the computers acts as a bridge to the wired LAN using special software.



An infrastructure wireless network consists of an access point or a base station. In this type of network the access point acts like a hub, providing connectivity for the wireless computers. It can connect or bridge the wireless LAN to a wired LAN, allowing wireless computer access to LAN resources, such as file servers or existing Internet Connectivity. (compnetworking.about.com)

There are four basic types of transmissions standards for wireless networking. These types are produced by the Institute of Electrical and Electronic Engineers (IEEE). These standards define all aspects of radio frequency wireless networking. They have established four transmission standards; 802.11, 802.11a, 802.11b, 802.11g.

The basic differences between these four types are connection speed and radio frequency. 802.11 and 802.11b are the slowest at 1 or 2 Mbps and 5.5 and 11Mbps respectively. They both operate off of the 2.4

GHz radio frequency. 802.11a operates off of a 5 GHz frequency and can transmit up to 54 Mbps and the 802.11g operates off of the 2.4 GHz frequency and can transmit up to 54 Mbps. Actual transmission speeds vary depending on such factors as the number and size of the physical barriers within the network and any interference in the radio transmissions. (Wi-fi.com)

Wireless networks are reliable, but when interfered with it can reduce the range and the quality of the signal. Interference can be caused by other devices operating on the same radio frequency and it is very hard to control the addition of new devices on the same frequency. Usually if your wireless range is compromised considerably, more than likely, interference is to blame. (Laudon)

A major cause of interference with any radio signals are the materials in your surroundings, especially metallic substances, which have a tendency to reflect radio signals. Needless to say, the potential sources of metal around a home are numerous--things like metal studs, nails, building insulation with a foil backing and even lead paint can all possibly reduce the quality of the wireless radio signal. Materials with a high density, like concrete, tend to be harder for radio signals to penetrate, absorbing more of the energy. Other devices utilizing the same frequency can also result in interference with your wireless. For example, the 2.4GHz frequency used by 802.11b-based wireless products to communicate with each other. Wireless devices don't have this frequency all to themselves. In a business environment, other devices that use the 2.4GHz band include microwave ovens and certain cordless phones. (Laundon)

On the other hand, many wireless networks can increase the range of the signal by using many different types of hardware devices. A wireless extender can be used to relay the radio frequency from one point to another without losing signal strength. Even though this device extends the range of a wireless signal it has some drawbacks. One drawback is that it extends the signal, but the transmission speed will be slowed.

There are many benefits to a wireless network. The most important one is the option to expand your current wired network to other areas of your organization where it would otherwise not be cost effective or practical to do so. An organization can also install a wireless network without physically disrupting the current workplace or wired network. (Wi-Fi.org) Wireless networks are far easier to move than a wired network and adding users to an existing wireless network is easy. Organizations opt for a wireless network in conference rooms, lobbies and offices where adding to the existing wired

Wireless communication was a magic to our ancestors but Marconi could initiate it with his wireless telegraph in 1895. Wireless Communication can be classified into three eras.

- Pioneer Era (Till 1920)
- Pre Cellular Era(1920-1979)
- Cellular Era (beyond 1979)

The first commercial mobile telephone system was launched by BELL in St. Louis, USA, in 1946. Few lucky customers got the services. Early mobile systems used single high power transmitters with analog Frequency Modulation techniques to give coverage up to about 50 miles and hence only limited customers could get the service due to this severe constraints of bandwidth.

Cellular Era

To overcome the constraints of bandwidth scarcity and to give coverage to larger sections, BELL lab introduced the principle of Cellular concept. By frequency reuse technique this method delivered better coverage, better utility of available frequency spectrum and reduced transmitter power. But the established calls are to be handed over between base stations while the phones are on move.

Even though the US based BELL lab introduced the cellular principle, the Nordic countries were the first to introduce cellular services for commercial use with the introduction of the Nordic Mobile Telephone (NMT) in 1981.

First Generation Systems

All these systems were analog systems, using FDMA technology. They are also known as First Generation (1G) systems. Different systems came into use based on the cellular principle. They are listed below.

Year	Mobile System
1981	Nordic Mobile Telephone(NMT)450
1982	American Mobile Phone System(AMPS)
1985	Total Access Communication System(TACS)
1986	Nordic Mobile Telephony(NMT)900

Disadvantages of 1G systems

- They were analog and hence are were not robust to interference.
- Different countries followed their own standards, which were incompatible.

To overcome the difficulties of 1G, digital technology was chosen by most of the countries and a new era, called 2G, started.

Advantages of 2G

- Improved Spectral Utilization achieved by using advanced modulation techniques.
- Lower bit rate voice coding enabled more users getting the services simultaneously.
- Reduction of overhead in signaling paved way for capacity enhancement.
- Good source and channel coding techniques make the signal more robust to Interference.
- New services like SMS were included.
- Improved efficiency of access and hand-off control were achieved.

Name of the Systems	Country
DAMPS-Digital Advanced Mobile Phone System	North America
GSM-Global System for Mobile communication	European Countries and International applications
JDC - Japanese Digital Cellular	Japan
CT-2 Cordless Telephone–2	UK
DECT-Digital European Cordless Telephone	European countries

History of GSM

GSM standard is a European standard, which has addressed many problems related to compatibility, especially with the development of digital radio technology.

Milestones of GSM

- 1982 - Confederation of European Post and Telegraph (CEPT) establishes Group Special Mobile.
- 1985 - Adoption of list of recommendation was decided to be generated by the group.
- 1986 - Different field tests were done for radio technique for the common air interface.
- 1987 - TDMA was chosen as the Access Standard. MoU was signed between 12 operators.
- 1988 - Validation of system was done.
- 1989 - Responsibility was taken up by European Telecommunication Standards Institute (ETSI).
- 1990 - First GSM specification was released.
- 1991 - First commercial GSM system was launched.

Frequency Range of GSM

GSM works on four different frequency ranges with FDMA-TDMA and FDD. They are as follows

System	P-GSM (Primary)	E-GSM (Extended)	GSM 1800	GSM 1900
Freq Uplink	890-915MHz	880-915MHz	1710-1785Mhz	1850-1910MHz
Freq Downlink	935-960MHz	925-960MHz	1805-1880Mhz	1930-1990MHz

When we describe mobile communications, we refer to the overall technology, speed, frequency and system in numeric generations such as 3G, 4G or 5G. Each generation have unique technologies that define them. This blog explores and explains the differences throughout the evolution of mobile communications and what we can expect from the future generations of these technologies.

1G

The very first generation of commercial cellular network was introduced in the late 70's with fully implemented standards being established throughout the 80's. The radio signals used by 1G are analogue, meaning the voice of a call is modulated to a higher frequency rather than being encoded to digital signals.
Analogue signals degrade over time and space meaning that voice data can very often lack quality within a call. In comparison, digital is a representation of analogue stored as signals, meaning larger amounts of data can be carried more effectively.

2G

The second generation saw the introduction of GSM (Global System for Mobile Communication) technologies as a standard in the early 90's. It allowed for digital voice and data to be sent across the network and allowed users to roam for the first time.
2G also used Signalling and Data Confidentially and Mobile Station Authentication to ensure improved security and privacy of telephone calls.
The advance in technology from 1G to 2G introduced many of the fundamental services that we still use today, such as SMS, internal roaming, conference calls, call hold and billing based on services e.g. charges based on long distance calls and real time billing.

2.5G

Between the year 2000 and 2003, an upgrade in technologies introduced the packet network which provided high speed data transfer and internet and became known as 2.5G.
The standards included GPRS (General Packet Radio Service) and EDGE (enhanced Data Rates in GSM).
GPRS supports flexible data transmission rates and provides continuous connection with the network. It also allows for the service provider to charge for the amount of data that is sent rather than their connection time.

3G

Introduced commercially in 2001, the goals set out for third generation mobile communication were to facilitate greater voice and data capacity, support a wider range of applications, and increase data transmission at a lower cost.
For the first time, this generation supported high speed wide band internet access as well as fixed wireless internet access and allowed for video calls, chatting and conferencing, mobile TV, video on demand services, navigational maps, email, mobile gaming, music and digital services such as movies.
Significantly greater security features were introduced within 3G, including Network Access and Domain Security and Application Security.

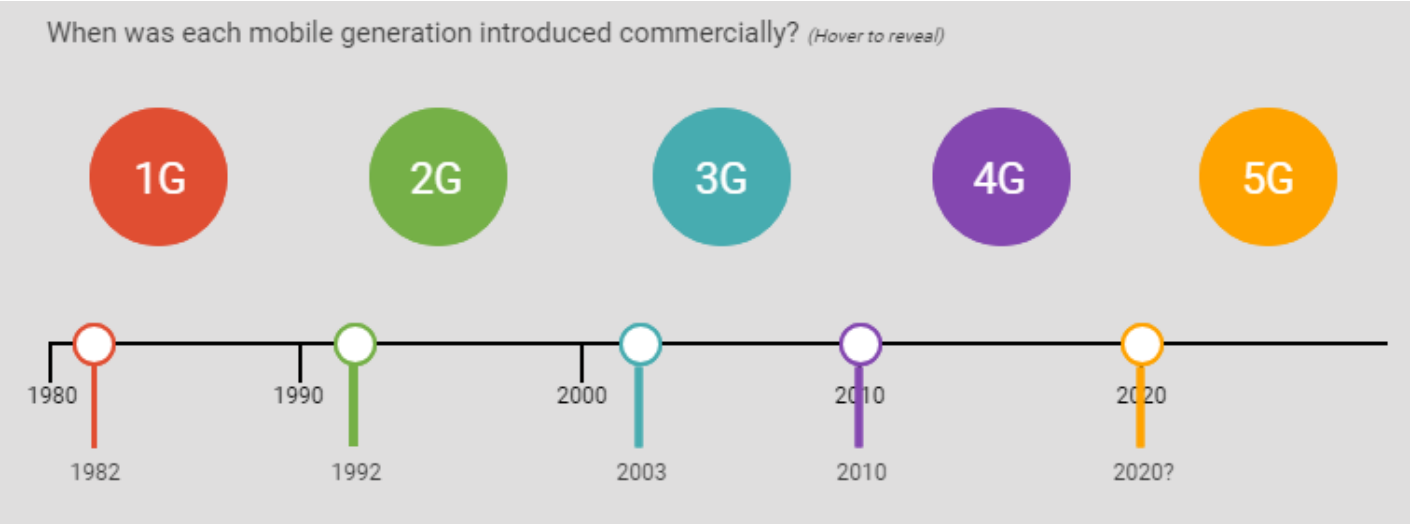
4G

Initiated in 2010, the fourth generation is an all IP based network system. Its purpose is to provide high speed, high quality and high capacity to users while improving security and lower the cost of voice and data services, multimedia and internet over IP.
The major benefit of an IP based network is that it is able to seamlessly handover, for voice and data to GSM, UMTS and CDMA2000 technologies from the previous different generations infrastructure.
4G introduced the LTE standard which only support packet switching and an all IP Network. There are a significant amount of infrastructure changes needed to be implemented by service providers

in order to supply because voice calls in GSM, UMTS and CDMA2000 are circuit switched, so with the adoption of LTE, carriers will have to re-engineer their voice call network.

5G

5G is the next generation of commercial cellular network, set to greatly increase internet connectivity speeds. At this time, there aren't any publicly agreed definitive standards that have been set as with previous generations so not a great deal of information is known about the specific technologies that are going to be used.
Different estimations have been made for the date of commercial introduction of 5G networks, but they are generally around the year 2020.
One of the main benefits of increased connectivity being plugged as the underlying selling point of 5G is IoT (Internet of Things), which would make the most of the higher speed of connectivity to allow for seamless integration of devices on a scale never been achievable before. You can read more about IoT and the details of the technology in our article 'Internet of Things: Explained' here.
Speed (data rates) = 1Gbps to 10Gbps (claimed by service providers in lab conditions)



1 PAGING SYSTEM

Paging Systems are wireless communication systems that are designed to send brief messages to a subscriber. It's a one-way messaging system in which Base Station send messages to all subscribers. The Paging System transmits the message also known as Page, along with Paging System access number, throughout the service area using Base Station, which broadcast the page on a radio link. Types of Paging SystemsThe Paging Systems can be of two types. Manual Paging System: In a manual paging system, a message is sent to the paging operator through telephone call by the caller. The message is then delivers to the pager through paging network by the operator. Automatic Paging System: In an automatic paging system, the incoming requests are automatically processed by the paging terminal and then this information is delivers to the pager. Automatic Paging Systems are mostly used.

2 Messages in Paging Systems

One of the following four types of information messages can be delivered in a Paging System.Alert Tone Message Voice Message Digital String Message Text String MessageAlert Tone Message: In the alert tone message, a dedicated telephone number is assigned to the receiver, which is also known as Tone Pager. The pager is triggered by dialing the number. To generate tone-type messages, the advantage of tone paging is that it utilizes a small amount of airtime. Voice Message: In the voice message, a voice message can be transmitted in some tone paging systems after the beep. Digital String Message: In digital string message, the receiver is a Numeric Pager. The string can be the telephone number of the caller or a coded message.

This coded message is generated on request of the caller by the paging center and is decoded by a codebook built into the pager. This type of paging takes less amount of airtime.

3 PSTN The public switched telephone network (PSTN) is the network of the world's public circuit-switched telephone networks. It consists of telephone lines, fiberoptic cables, microwave transmission links, cellular networks, communications satellites, and undersea telephone cables all inter-connected by switching centers which allows any telephone in the world to communicate with any other. Originally a network of fixed-line analog telephone systems, the PSTN is now almost entirely digital in its core and includes mobile as well as fixed telephones.The technical operation of the PSTN utilises standards created by the ITU-T. These standards allow different networks in different countries to interconnect seamlessly. There is also a single global address space for telephone numbers based on the E.163 and E.164 standards. The combination of the interconnected networks and the single numbering plan make it possible for any phone in the world to dial any other phone.

4 **CORDLESS TELEPHONE SYSTEM**
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.The base station on subscriber premises is what differentiates a cordless telephone from a mobile telephone. Current cordless telephone standards, such as PHS and DECT, have blurred the once clear-cut line between cordless and mobile telephones by implementing cell handover, various advanced features, such as data-transfer and even, on a limited scale, international roaming. In these models, base stations are maintained by a commercial mobile network operator and users subscribe to the service.Unlike a corded telephone, a cordless telephone needs mains electricity to power the base station. The cordless handset is powered by a rechargeable battery, which is charged when the handset sits in its cradle.

5 2G CELLULAR NETWORKS2G (or 2-G) is short for second-generation wireless telephone technology.Second generation 2G cellular telecom networks were commercially launchedon the GSM standard in Finland in 1991.Three primary benefits of 2G networks over their predecessors were that phoneconversations were digitally encrypted;2G systems were significantly more efficient on the spectrum allowing for far greatermobile phone penetration levels; and 2G introduced data services for mobile,starting with SMS text messages.After 2G was launched, the previous mobile telephone systems were retrospectivelydubbed 1G.While radio signals on 1G networks are analog, radio signals on 2G networksare digital.Both systems use digital signaling to connect the radio towers(which listen to the handsets) to the rest of the telephone system.2G has been superseded by newer technologies such as 2.5G, 2.75G, 3G, and 4G;however, 2G networks are still used in many parts of the world.

6 3G NETWORK SYSTEM International Mobile Telecommunications-2000 (IMT — 2000), better known as 3G or 3rd Generation, is a generation of standards for mobile phones and mobile telecommunications services fulfilling specifications by the International Telecommunication Union.[1] Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment. Compared to the older 2G and 2.5G standards, a 3G system must provide peak data rates of at least 200 kbit/s according to the IMT-2000 specification.

7 **Recent 3G releases, often denoted 3. 5G and 3**
Recent 3G releases, often denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to laptop computers and smartphones.The following standards are typically branded 3G:the UMTS system, first offered in 2001, standardized by 3GPP, used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by GSM 2G system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure:The original and most widespread radio interface is called W-CDMA.The TD-SCDMA radio interface, was commercialised in 2009 and is only offered in China.The latest UMTS release, HSPA+, can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink.the CDMA2000 system, first offered in 2002, standardized by 3GPP2, used especially in

North America and South Korea, sharing infrastructure with the IS-95 2G standard. The cell phones are typically CDMA2000 and IS-95 hybrids. The latest release EVDO Rev B offers peak rates of 14.7 Mbit/s downstreams.The above systems and radio interfaces are based on kindred spread spectrum radio transmission technology. While the GSM EDGE standard ("2.9G"), DECT cordless phones and Mobile WiMAX standards formally also fulfill the IMT-2000 requirements and are approved as 3G standards by ITU, these are typically not branded 3G, and are based on completely different technologies.

8 A new generation of cellular standards has appeared approximately every tenth year since 1G systems were introduced in 1981/1982. Each generation is characterized by new frequency bands, higher data rates and non backwards compatible transmission technology. 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. WiMAX is another technology verging on or marketed as 4G.

9 CDMA

Code division multiple access (CDMA) is a channel access method used by various radio communication technologies. It should not be confused with the mobile phone standards called cdmaOne and CDMA2000 (which are often referred to as simply CDMA), which use CDMA as an underlying channel access method.One of the basic concepts in data communication is the idea of allowing several transmitters to send information simultaneously over a single communication channel. This allows several users to share a band of frequencies (see bandwidth). This concept is called Multiple Access.

10 CDMA employs spread-spectrum technology and a special coding scheme (where each transmitter is assigned a code) to allow multiple users to be multiplexed over the same physical channel. By contrast, time division multiple access (TDMA) divides access by time, while frequency-division multiple access (FDMA) divides it by frequency. CDMA is a form of spread-spectrum signaling, since the modulated coded signal has a much higher data bandwidth than the data being communicated.An analogy to the problem of multiple access is a room (channel) in which people wish to talk to each other simultaneously. To avoid confusion, people could take turns speaking (time division), speak at different pitches (frequency division), or speak in different languages (code division). CDMA is analogous to the last example where people speaking the same language can understand each other, but other languages are perceived as noise and rejected. Similarly, in radio CDMA, each group of users is given a shared code. Many codes occupy the same channel, but only users associated with a particular code can communicate.

11 Uses of cdma

One of the early applications for code division multiplexing is in GPS. This predates and is distinct from cdmaOne.The Qualcomm standard IS-95, marketed as cdmaOne.The Qualcomm standard IS-2000, known as CDMA2000. This standard is used by several mobile phone companies, including the Globalstar satellite phone network.CDMA has been used in the OmniTRACS setellite system for transportation logistics.

12 GSMGSM (Global System for Mobile Communications: originally from Groupe Spécial Mobile) is the world's most popular standard for mobile telephony systems. The GSM Association estimates that 80% of the global mobile market uses the standard.[1] GSM is used by over 1.5 billion people[2] across more than 212 countries and territories.[3] This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system.

13 **The GSM standard has been an advantage to both consumers,** who may benefit from the ability to roam and switch carriers without replacing phones,and also to network operators, who can choose equipment from many GSMequipment vendors.[4] GSM also pioneered low-cost implementation of theshort message service (SMS), also called text messaging,which has since been supported on other mobile phone standards as well.The standard includes a worldwide emergency telephone

number feature (112).Newer versions of the standard were backward-compatible with theoriginal GSM system. .

14 GPRS

General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication systems global system for mobile communications (GSM). The service is available to users in over 200 countries worldwide. GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project (3GPP).It is a best-effort service, as opposed to circuit switching, where a certain quality of service is guaranteed during the connection. In 2G systems, GPRS provides data rates of kbit/second.[3] 2G cellular technology combined with GPRS is sometimes described as 2.5G, that is, a technology between the second (2G) and third (3G) generations of mobile telephony.It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system.

15 **GPRS usage charging is based on volume of data, either as part of a bundle or on** a pay as you use basis. An example of a bundle is up to 5 GB per monthfor a fixed fee. Usage above the bundle cap is either charged for permegabyte or disallowed. The pay as you use charging is typically per megabyteof traffic. This contrasts with circuit switching data, which is typically billedper minute of connection time, regardless of whether or not the user transfersdata during that period.

16 WLL & LMDS

Wireless local loop (WLL), is a term for the use of a wireless communications link as the "last mile / first mile" connection for delivering plain old telephone service (POTS) and/or broadband Internet to telecommunications customers. Various types of WLL systems and technologies exist.LMDS is a broadband wireless access technology originally designed for digital television transmission (DTV). It was conceived as a fixed wireless, point-to-multipoint technology for utilization in the last mile.[1] LMDS commonly operates on microwave frequencies across the 26 GHz and 29 GHz bands. In the United States, frequencies from 31.0 through 31.3 GHz are also considered LMDS frequencies.Throughput capacity and reliable distance of the link depends on common radio link constraints and the modulation method used - either phase-shift keying or amplitude modulation. Distance is typically limited to about 1.5 miles (2.4 km) due to rain fade attenuation constraints. Deployment links of up to 5 miles (8 km) from the base station are possible in some circumstances such as in point-to-point systems that can reach slightly farther distances due to increased antenna gain

17 W-CDMA

W-CDMA (Wideband Code Division Multiple Access), UMTS-FDD, UTRA-FDD, or IMT-2000 CDMA Direct Spread is an air interface standard found in 3G mobile telecommunications networks.It is the basis of Japan's NTT DoCoMo's FOMA service and the most-commonly used member of the UMTS family and sometimes used as a synonym for UMTS.[1] It utilizes the DS-CDMA channel access method and the FDD duplexing method to achieve higher speeds and support more users compared to most time division multiple access (TDMA) schemes used today.While not an evolutionary upgrade on the airside, it uses the same core network as the 2G GSM networks deployed worldwide, allowing dual-mode operation along with GSM/EDGE; a feat it shares with other members of the UMTS family.

1.6 MIDDLEWARE AND GATEWAYS

Any software layered between a user application and operating system is a middleware. Middleware examples are communication middleware, object-oriented middleware, message-oriented middleware, transaction processing middleware, database middleware, behavior management middleware, Remote Procedure Call (RPC) middleware, etc. There are some middleware components like behavior management middleware, which can be a layer between the client device and the application. In a mobile computing context we need different types of middleware components and gateways at different layers of the architecture (Fig. 1.2). These are:

1. Communication middleware.
2. Transaction processing middleware.
3. Behavior management middleware.
4. Communication gateways.

1.6.1 Communication Middleware

The application will communicate with different nodes and services through different communication middleware. Different connectors for different services will fall in this category. Examples could be TN3270 for IBM mainframe services, or Javamail connector for IMAP or POP3 services.

1.6.2 Transaction Processing Middleware

In many cases a service will offer session-oriented dialogue (SoD). For a session we need to maintain a state over the stateless Internet. This is done through an application server. The user may be using a device, which demands a sessionless dialogue (SlD) made of short sessionless transactions whereas the service at the backend offers a SoD. In such cases a separate middleware component will be required to convert a SoD to a SlD. Management of the Web components will be handled by this middleware as well.

1.6.3 Behavior Management Middleware

Different devices deliver differently. We can have applications which are developed specially to deliver in a certain manner. For example, we can have one application for the Web, another for WAP, and a different one for SMS. On the contrary, we may choose to have a middleware, which will manage device-specific rendering at run-time. This middleware will identify the device properly and handle all device-specific rendering independent of the application. The system may be required to have some context awareness, which will be handled by the behavior management middleware.

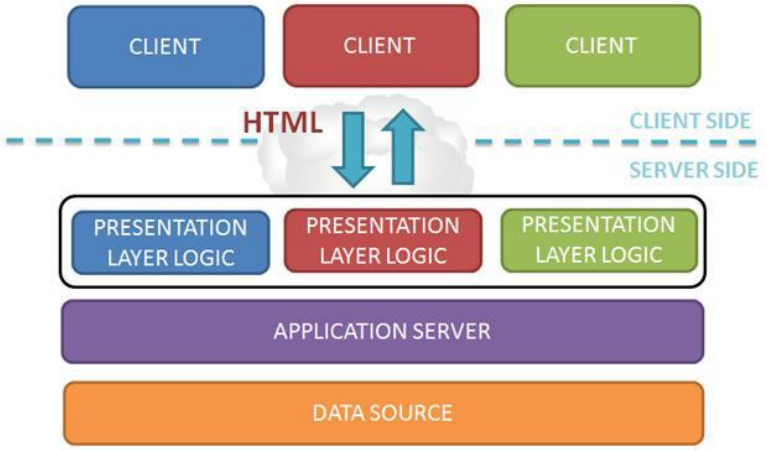
1.6.4 Communication Gateways

Between the device and the middleware there will be a system of networks. Gateways are deployed when there are different transport bearers or networks with dissimilar protocols. For example, we need an IVR gateway to interface Voice with a computer, or a WAP gateway to access Internet over a mobile phone.

Figure 1.2 presents a schematic diagram of services in a mobile computing environment with different devices providing different services.

UNIT- 2 Notes

THREE TIER MOBILE COMPUTING ARCHITECTURE:-



User Interface or Presentation tier

- This is the topmost level of the application. This is a layer of agent application and system. These applications runs on client device and offer all the user interface. This tier is responsible for representing the information to the end user. Presentation tier includes web browsers like Mozilla, Chrome, Internet Explorer and customised client programs. The presentation tier displays information related to such services as browsing merchandise, purchasing, and shopping cart contents. It communicates with other tiers by outputting results to the browser/client tier and all other tiers in the network.

Process Management or Application tier (business logic tier, data access tier or middle tier)

- It performs the business logic of processing users input, obtaining data and making decisions. In mobile computing environment in addition to business logic there are quite a few management function that need to be performed. These functions relates to decision on network management, security database access etc. Most of the these function implemented using different middleware software's.

Database Management or Data tier

- This tier consists of database servers. Here information is stored and retrieved. This tier keeps data neutral and independent from application servers or business logic. Giving data on its own tier also improves scalability and performance.

DESIGN CONSIDERATIONS FOR MOBILE COMPUTING:-

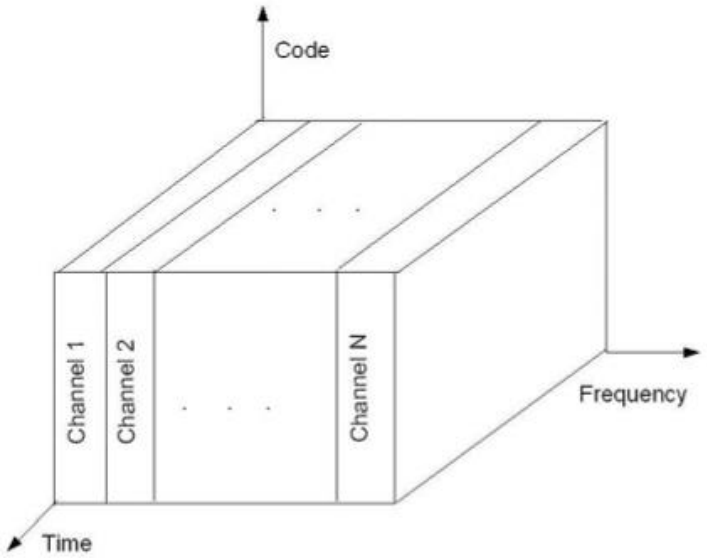
- The mobile computing environment needs to be context independent as well as context sensitive. Context information is related to the environment.
- The term context means all the information that helps to determine the state of the object.
- In a mobile computing environment the context data is captured so that decisions can be made about how to adapt content or behaviour to suit this context.
- Client context Manager:- We need a client context manager to gather & maintain information pertaining to the client device, user, network and the surrounding environment. Mobile computing applications are needs to operate in dynamic conditions which is due to different network conditions.
- Most applications developed for Web access by keeping large screen and browser in mind.
- So therefore a context manager is need to maintain the information pertaining to the client device (ie mobile phone)

FDMA, TDMA, CDMA & SDMA:-

Multiple access techniques (method). इसकी तकनीक 4 होती है जो कि निम्नलिखित है.

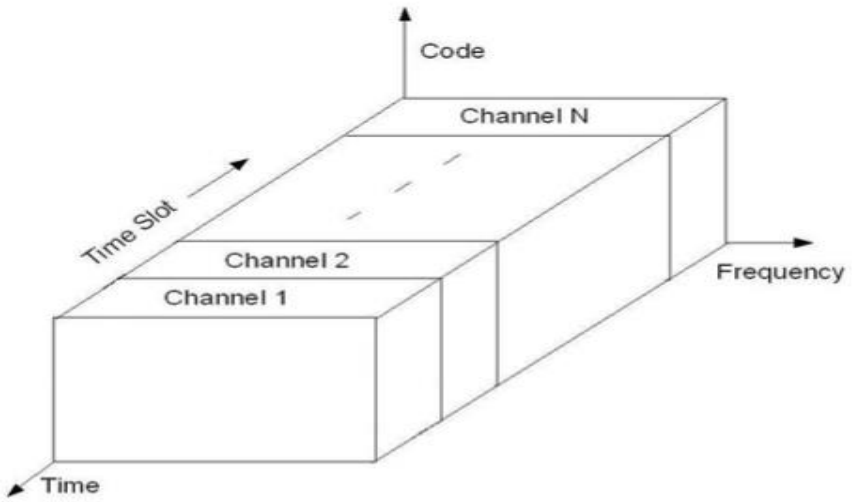
FDMA (FREQUENCY DIVISION MULTIPLE ACCESS)

FDMA का पूरा नाम फ्रीक्वेंसी डिवीज़न मल्टीप्ल एक्सेस है. यह cellular system के लिए एक multiple access techniques है जिसमें फ्रीक्वेंसी को विभाजित किया जाता है. इसमें लिंक की उपलब्ध bandwidth को विभिन्न नोड्स (स्टेशन) के मध्य फ्रीक्वेंसी बैंड्स के रूप में विभाजित किया जाता है. इसमें प्रत्येक स्टेशन को डेटा भेजने के लिए एक बैंड एलोकेट किया जाता है तथा प्रत्येक बैंड हमेशा एक स्टेशन के लिए रिज़र्व रहता है. इसमें प्रत्येक स्टेशन की ट्रांसमीटर फ्रीक्वेंसी को सिमित रखने के लिए एक बैंडपास फ़िल्टर का उपयोग किया जाता है. FDMA में एक स्टेशन से दुसरे स्टेशन के मध्य overlapping से बचने के लिए allocated बैंड्स के मध्य एक छोटा बैंड जिसे गार्ड बैंड कहते है स्थापित किया जाता है.



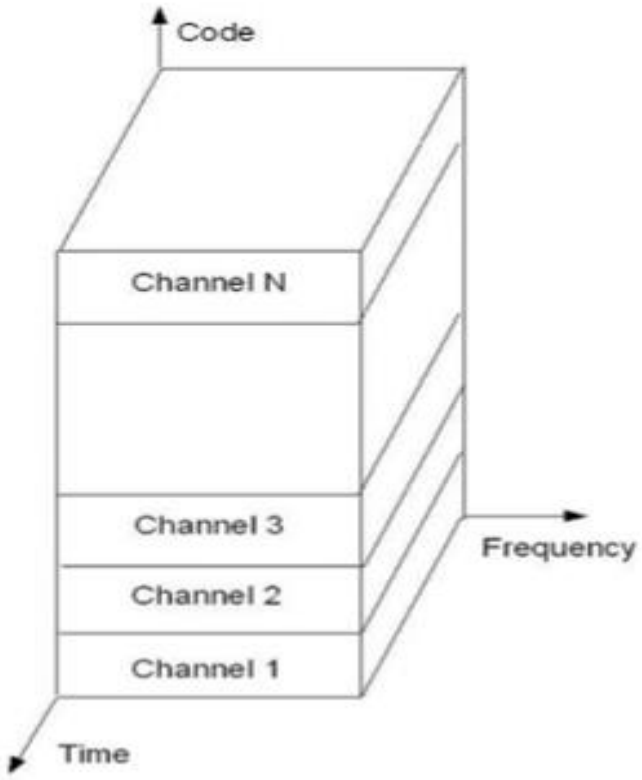
TDMA (TIME DIVISION MULTIPLE ACCESS)

TDMA का पूरा नाम टाइम डिवीज़न मल्टीप्ल एक्सेस है. यह एक multiple access techniques है, इसमें चैनल की bandwidth को विभिन्न नोड्स (स्टेशन) के मध्य time slots के रूप में विभाजित किया जाता है. TDMA में प्रत्येक चैनल की बैंडविड्थ समान होती है जो विभिन्न स्टेशन के मध्य time slots को share करते है. TDMA में विभिन्न स्टेशन के मध्य synchronization प्राप्त करना बहुत मुश्किल होता है.इसमें प्रत्येक स्टेशन को उसका प्रारंभिक time slot तथा अंतिम time slot की लोकेशन पता होनी जरुरी होता है. इसमें delay (देरी) को कम करने के लिए guard time को स्थापित किया जाता है



CDMA (CODE DIVISION MULTIPLE ACCESS)

CDMA का पूरा नाम कोड डिवीज़न मल्टीप्ल एक्सेस है यह भी एक मल्टीप्ल एक्सेस तकनीक है जो कि CDMA तथा TDMA से मिलकर बना हुआ है. तथा यह इन दोनों तकनीक से बेहतर है. इसका प्रयोग ज्यादातर 3G टेलीकम्यूनिकेशन तथा अन्य तकनीकों में किया जाता है.CDMA में एक ही चैनल सभी transmissions को एक साथ ले जाता है. इसमें लिंक की पूरी bandwidth एक ही चैनल काम में ले लेता है जबकि FDMA में चैनल bandwidth को बाँट लेते है. CDMA में सभी stations एक साथ डेटा भेज सकते है लेकिन इसमें time sharing नहीं होती है जबकि TDMA में time sharing होती है. CDMA में अलग-अलग कोड्स के द्वारा कम्युनिकेशन होता है.



SDMA (SPACE DIVISION MULTIPLE ACCESS)

SDMA का पूरा नाम स्पेस डिवीज़न मल्टीप्ल एक्सेस है. यह भी एक multiple access techniques है जिसका प्रयोग ज्यादातर वायरलेस (जैसे;- मोबाइल) तथा सेटेलाइट कम्युनिकेशन में किया जाता है. SDMA में सभी यूजर (स्टेशन) एक ही समय में एक ही चैनल का प्रयोग करके कम्यूनिकेट कर सकते है. SDMA की एक खासियत यह है कि इसमें कोई overlapping यानि कि हस्तक्षेप नहीं होता है. इसमें एक सेटेलाइट एक ही फ्रीक्वेंसी की बहुत सारीं सेटेलाइटो के साथ कम्यूनिकेट कर सकता है. SDMA सभी यूजरों के लिए विकर्णित (radiate) उर्जा को स्पेस में नियंत्रित करता है. इसमें users (स्टेशन) को serve करने के लिए यह spot beam antenna का प्रयोग किया जाता है.

MULTIPLE ACCESS TECHNIQUES- FDMA, TDMA, CDMA & SDMA:-

The access technologies are that allow multiple users to share a common communications channel. Access methods are multiplexing techniques that provide communications services to multiple users in a single-bandwidth wired or wireless medium. Communications channels, whether they are wireless spectrum segments or cable connections, are expensive. Communications services providers must engage multiple paid users over limited resources to make a profit. Access methods allow many users to share these limited channels to provide the economy of scale necessary for a successful communications business. In wireless communication systems, it is often desirable to allow the subscriber to send information simultaneously from the mobile station to the base station while receiving information from the base station to the mobile station.

A cellular system divides any given area into cells where a mobile unit in each cell communicates with a base station. The main aim in the cellular system design is to be able to increase the capacity of the channel, i.e., to handle as many calls as possible in a given bandwidth with a sufficient level of quality of service.

There are four basic access or multiplexing methods to allow access to the channel. These includes mainly the following –

- Frequency division multiple-access (FDMA)
- Time division multiple-access (TDMA)
- Code division multiple-access (CDMA)
- Space division multiple access (SDMA)

Depending on how the available bandwidth is allocated to the users, these techniques can be classified as narrowband and wideband systems.

Narrowband Systems

Systems operating with channels substantially narrower than the coherence bandwidth are called as Narrow band systems. Narrow band TDMA allows users to use the same channel but allocates a unique time slot to each user on the channel, thus separating a small number of users in time on a single channel.

Wideband Systems

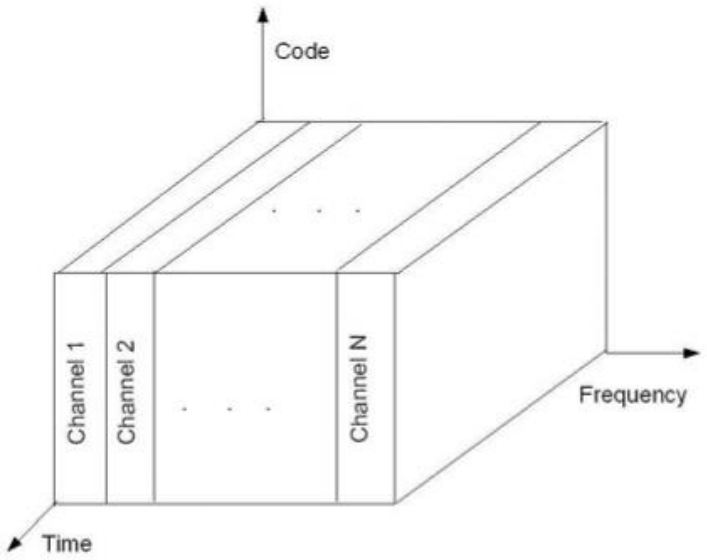
In wideband systems, the transmission bandwidth of a single channel is much larger than the coherence bandwidth of the channel. Thus, multipath fading doesn't greatly affect the received signal within a wideband channel, and frequency selective fades occur only in a small fraction of the signal bandwidth.

FDMA (FREQUENCY DIVISION MULTIPLE ACCESS)

FDMA is the process of dividing one channel or bandwidth into multiple individual bands, each for use by a single user. Each individual band or channel is wide enough to accommodate the signal spectra of the transmissions to be propagated. The data to be transmitted is modulated on to each subcarrier, and all of them are linearly mixed together. FDMA divides the shared medium bandwidth into individual channels. Subcarriers modulated by the information to be transmitted

occupy each sub channel. FDMA is the basic technology for advanced mobile phone services. The features of FDMA are as follows.

- FDMA allots a different sub-band of frequency to each different user to access the network.
- If FDMA is not in use, the channel is left idle instead of allotting to the other users.
- FDMA is implemented in Narrowband systems and it is less complex than TDMA.
- Tight filtering is done here to reduce adjacent channel interference.
- The base station BS and mobile station MS, transmit and receive simultaneously and continuously in FDMA.



The best example of this is the cable television system. The medium is a single coax cable that is used to broadcast hundreds of channels of video/audio programming to homes. The coax cable has a useful bandwidth from about 4 MHz to 1 GHz. This bandwidth is divided up into 6-MHz wide channels. Initially, one TV station or channel used a single 6-MHz band. But with digital techniques, multiple TV channels may share a single band.

This technique is also used in fiber optic communications systems. A single fiber optic cable has enormous bandwidth that can be subdivided to provide FDMA. Different data or information sources are each assigned a different light frequency for transmission. Light generally isn't referred to by frequency but by its wavelength (λ).

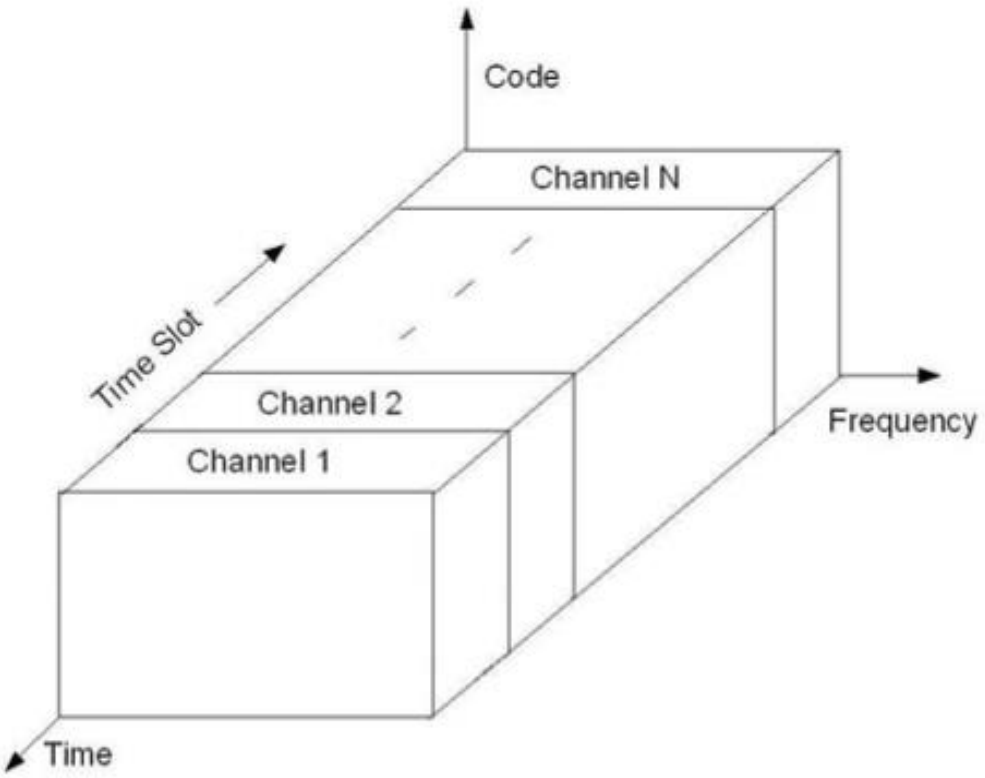
One of the older FDMA systems is the original analog telephone system, which used a hierarchy of frequency multiplex techniques to put multiple telephone calls on single line. At the receiving end of the system, the signals were sorted out and recovered with filters and demodulators.

TDMA (TIME DIVISION MULTIPLE ACCESS)

TDMA is a digital technique that divides a single channel or band into time slots. Each time slot is used to transmit one byte or another digital segment of each signal in sequential serial data format. This technique works well with slow voice data signals, but it's also useful for compressed video and other high-speed data. In the cases where continuous transmission is not required, there TDMA is used instead of FDMA. The features of TDMA include the following.

- TDMA shares a single carrier frequency with several users where each users makes use of non-overlapping time slots.
- Data transmission in TDMA is not continuous, but occurs in bursts. Hence handsoff process is simpler.
- TDMA uses different time slots for transmission and reception thus duplexers are not required.
- TDMA has an advantage that is possible to allocate different numbers of time slots per frame to different users.
- Bandwidth can be supplied on demand to different users by concatenating or reassigning time slot based on priority.

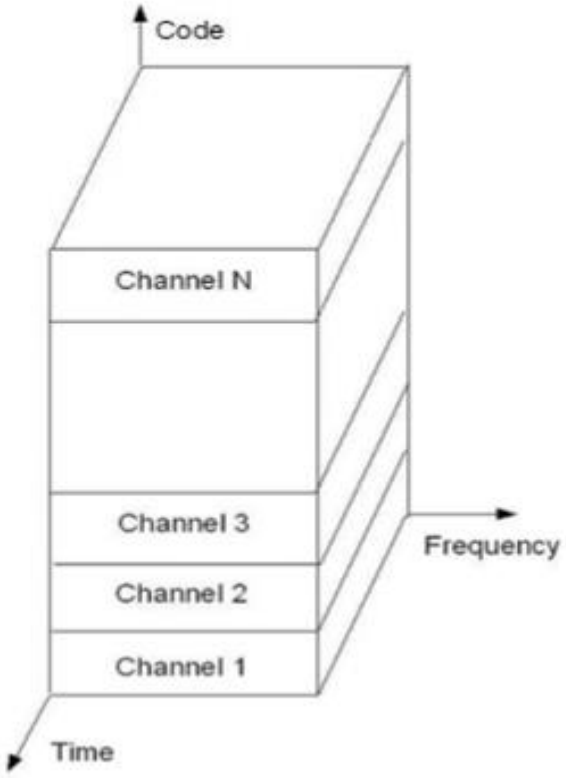
A good example is the widely used T1 transmission system, which has been used for years in the telecom industry. T1 lines carry up to 24 individual voice telephone calls on a single line . The basic GSM (Global System of Mobile Communications) cellular phone system is TDMA-based. It divides up the radio spectrum into 200-kHz bands and then uses time division techniques to put eight voice calls into one channel. The eight time slots can be voice signals or data such as texts or e-mails.



CDMA (CODE DIVISION MULTIPLE ACCESS)

CDMA is another pure digital technique. It is also known as spread spectrum because it takes the digitized version of an analog signal and spreads it out over a wider bandwidth at a lower power level. This method is also called direct sequence spread spectrum (DSSS). Spread spectrum is the technique of CDMA. The third generation (3G) cell-phone technology called wideband CDMA (WCDMA) uses a similar method with compressed voice and allow multiple users to share the same band. Code division multiple access technique is an example of multiple access where several transmitters use a single channel to send information simultaneously. Its features are as follows.

- In CDMA every user uses the full available spectrum instead of getting allotted by separate frequency.
- CDMA is much recommended for voice and data communications.
- While multiple codes occupy the same channel in CDMA, the users having same code can communicate with each other.
- CDMA offers more air-space capacity than TDMA.
- The hands-off between base stations is very well handled by CDMA.



SDMA (SPACE DIVISION MULTIPLE ACCESS)

Space division multiple access or spatial division multiple access is a technique which is MIMO (multiple-input & multiple-output) architecture and used mostly in wireless and satellite communication SDMA uses physical separation methods that permit the sharing of wireless channels. For instance, a single channel may be used simultaneously if the users are spaced far enough from one another to avoid interference. Known as frequency reuse, the method is widely used in cellular radio systems. Cell sites are spaced from one another to minimize interference.. It has the following features.

- All users can communicate at the same time using the same channel.
- SDMA is completely free from interference.
- A single satellite can communicate with more satellites receivers of the same frequency.
- The directional spot-beam antennas are used and hence the base station in SDMA, can track a moving user.
- Controls the radiated energy for each user in space.