Biyani's Think Tank

Concept based notes

Wireless Technology

MCA

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Published by :
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Edition : 2012

Leaser Type Setted by :
Biyani College Printing Department

Preface

I am glad to present this book, especially designed to serve the needs of the students. The book has been written keeping in mind the general weakness in understanding the fundamental concepts of the topics. The book is self-explanatory and adopts the "Teach Yourself" style. It is based on question-answer pattern. The language of book is quite easy and understandable based on scientific approach.

Any further improvement in the contents of the book by making corrections, omission and inclusion is keen to be achieved based on suggestions from the readers for which the author shall be obliged.

I acknowledge special thanks to Mr. Rajeev Biyani, *Chairman &* Dr. Sanjay Biyani, *Director* (*Acad.*) Biyani Group of Colleges, who are the backbones and main concept provider and also have been constant source of motivation throughout this endeavour. They played an active role in coordinating the various stages of this endeavour and spearheaded the publishing work.

I look forward to receiving valuable suggestions from professors of various educational institutions, other faculty members and students for improvement of the quality of the book. The reader may feel free to send in their comments and suggestions to the under mentioned address.

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Unit I
Wireless Communication Fundamentals

Q1 How wireless communication is useful?

Ans. Wireless communication is used to meet many needs. The most common use is to connect laptop users who travel from location to location. Another common use is for mobile networks that connect via satellite. The following situations justify the use of wireless technology:

- Computers are integrated
  - small, cheap, portable, replaceable - no more separate devices
- Technology is in the background
  - computer are aware of their environment and adapt ("location awareness")
  - computer recognize the location of the user and react appropriately (e.g., call forwarding, fax forwarding, "context awareness"))
- Advances in technology
  - more computing power in smaller devices
  - flat, lightweight displays with low power consumption
  - new user interfaces due to small dimensions
  - more bandwidth per cubic meter
  - multiple wireless interfaces: wireless LANs, wireless WANs, regional wireless telecommunication networks etc. („overlay networks")

Q2 Give examples of various wireless common system?

Ans.

- Cellular phones and pagers: provide connectivity for portable and mobile applications, both personal and business
- Global Positioning System (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth
- Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless

- Cordless telephone sets: these are limited-range devices, not to be confused with cell phones
- Home-entertainment-system control boxes: the VCR control and the TV channel control are the most common examples; some hi-fi sound systems and FM broadcast receivers also use this technology
- Remote garage-door openers: one of the oldest wireless devices in common use by consumers; usually operates at radio frequencies
- Two-way radios: this includes Amateur and Citizens Radio Service, as well as business, marine, and military communications
- Baby monitors: these devices are simplified radio transmitter/receiver units with limited range
- Satellite television: allows viewers in almost any location to select from hundreds of channels
- Wireless LANs or local area networks: provide flexibility and reliability for business computer users.

  Wireless technology is rapidly evolving, and is playing an increasing role in the lives of people throughout the world. In addition, ever-larger numbers of people are relying on the technology directly or indirectly. (It has been suggested that wireless is overused in some situations, creating a social nuisance.) More specialized and exotic examples of wireless communications and control include:
- Global System for Mobile Communication (GSM): a digital mobile telephone system used in Europe and other parts of the world; the de facto wireless telephone standard in Europe
- General Packet Radio Service (GPRS): a packet-based wireless communication service that provides continuous connection to the Internet for mobile phone and computer users
- Enhanced Data GSM Environment (EDGE): a faster version of the Global System for Mobile (GSM) wireless service
- Universal Mobile Telecommunications System (UMTS): a broadband, packet-based system offering a consistent set of services to mobile computer and phone users no matter where they are located in the world
- Wireless Application Protocol (WAP): a set of communication protocols to standardize the way that wireless devices, such as cellular telephones and radio transceivers, can be used for Internet access
- i-Mode: the world's first "smart phone" for Web browsing, first introduced in Japan; provides color and video over telephone sets

Q3 What are the applications of wireless communication?

Ans Vehicles

- transmission of news, road condition, weather, music via DAB/DVB-T
- personal communication using GSM/UMTS
- position via GPS
- local ad-hoc network with vehicles close-by to prevent accidents, guidance system, redundancy
- vehicle data (e.g., from busses, high-speed trains) can be transmitted in advance for maintenance
- Emergencies
- early transmission of patient data to the hospital, current status, first diagnosis
- replacement of a fixed infrastructure in case of earthquakes, hurricanes, fire etc.
- crisis, war, ...
- Traveling salesmen
- direct access to customer files stored in a central location
- consistent databases for all agents
- mobile office
- Replacement of fixed networks
- remote sensors, e.g., weather, earth activities
- flexibility for trade shows
- LANs in historic buildings
- Entertainment, education, ...
- outdoor Internet access
- intelligent travel guide with up-to-date location dependent information
- ad-hoc networks for multi user games

Q.4 Differentiate wireless networks with fixed networks.

Ans. Wireless networks in comparison to fixed networks

- Higher loss-rates due to interference
- emissions of, e.g., engines, lightning
- Restrictive regulations of frequencies
- frequencies have to be coordinated, useful frequencies are almost all occupied
- Low transmission rates
  local some Mbit/s, regional currently, e.g., 53kbit/s with GSM/GPRS or about 150 kbit/s using EDGE

- Higher delays, higher jitter

- connection setup time with GSM in the second range, several hundred milliseconds for other wireless systems
- Lower security, simpler active attacking
- radio interface accessible for everyone, base station can be simulated, thus attracting calls from mobile phones
- Always shared medium
- secure access mechanisms important

Q.5 Describe following frequencies in short:

Ans. a)radio transmission: Radio is the transmission of signals by modulation of electromagnetic waves with frequencies below those of visible light.Electromagnetic radiation travels by means of oscillating electromagnetic fields that pass through the air & the vacuum of space.Information is carried by systematically changing(modulating) some property of the radiated waves,such as aplitude,frequency,p[hase,or pulse width.When radio waves pass an electrical conductor,the oscillating fields induce an alternating current in the conductor.This can be dected & transformed into sound or other signals that carry information..

Frequencies for Radio Transmission

Radio waves have frequencies between 10kHzs & 1Ghz.Radio waves can be categorized as below:

1) Short wave
2) Very High Frequency(VHF)television & FM radio
3) Ulra High Frequency(UHF)

Characteristics of Radio Transmission

1) Radio waves arev easy to generate.
2) They can travel long distances.
3) They can penetrate buildings easily so they are widely used for communications both indoors & outdoors.
4) Radio waves are omni-directional,meaning that they travel in all the directions from the sourse,so that the transmitter & receiver do not have to be carefully aligned physically.
5) The properties of radio waves are frequency dependent.At low frequencies ,radio waves pass thrugh obstacles well,but the power falls off sharply with distance from the source.
6) At high frequencies,radio waves are subject ti interference from motors & other electrical equipment.

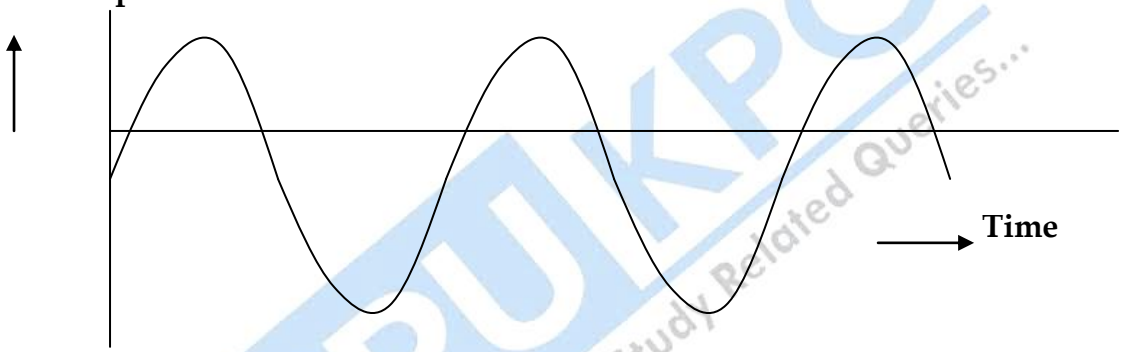
7) Low frequency & medium frequency range cannot be used for data transfer because of their very small bandwidth.

b)signals: A *signal* is a codified message, that is, the sequence of states in a communication channel that encodes a message. In a *communication system*, a *transmitter* encodes a *message* into a signal, which is carried to a *receiver* by the communications *channel*.

Electric signal can be in **analog** or **digital** form.

Analog Signal : In analog signal, the amplitude changes countinously with respect to time with no breaks or discontinuities .

Ex- Any music system conveys the songs in the analog form. Cassettes are recorded using analog recording system and playing the music gives you the analog sound waves.



Digital Signal : It is described as discrete. Their amplitude maintains a constant level for a prescribed period of time and then it changes to another level.

Digital signals are digital representations of discrete-time signals, which are often derived from analog signals.

- All binary signals are digital but all digital signal are not necessarily a binary signal.

c)Antennas: Antennas generally deal in the transmission & reception of radio waves,& are a necessary part of all radio equipment. Antennas are used in systems such as radio & television broadcasting, point to point radio communication, wireless LAN, cell phones & spacecraft communication. In air those signals travel very quickly & with a very low transmission loss. The signals are absorbed when moving through more conductive materials, such as concrete walls or rock. When encounting an interface, it he waves are partially reflected & partially transmitted through.

Q.6 Explain signal propagation.

Ans. In a wireless communication system, due to numerous obstacles in the propagation environment. RF signals usually travel along several different paths, arising from reflection, scattering & diffraction. The collective effect of the mechanism is random & complicated. Thus, usually, these different propagation mechanisms are combined & categorized as **path loss, shadowing** and **multipath fading**.

Q.7 What are the main problems of signal propagation?

Ans Problems: attenuation, scattering, diffraction, reflection, refraction. Except for attenuation all other effects can divert the waves from a straight line. Only in vacuum and without gravitational effects radio waves follow a straight line. Without reflection radio reception in towns would be almost impossible. A line.-of-sight almost never exists. However, reflection is the main reason for multipath propagation causing ISI.

- Signal can take many different paths between sender and receiver due to reflection, scattering, diffraction
- Time dispersion: signal is dispersed over time
- interference with "neighbor" symbols, Inter Symbol Interference(ISI)
- The signal reaches a receiver directly and phase shifted
- distorted signal depending on the phases of the different parts

Q.8 Define multiplexing.

Ans. Multiplexing is a techniques that permits the simultaneous transmission of multiple signals over a single data link. The aim is to share an expensive resource. For example, in telecommunication ,several phone calls may be transferred using one wire.

The multiplexed signal is transmitted over a communication channel, which may be a physical transmission medium. The multiplexing divides the capacity of the low-level communication channel into several higher-level logical channels, one for each message signal or data stram to be transferd. a reverse process, known as **demultiplexing**.

There are three basic multiplexing techniques:

a) Frequency-division multiplexing
b) Wavelength- division multiplexing
c) Time- division multiplexing

Figure *Dividing a link into channels*

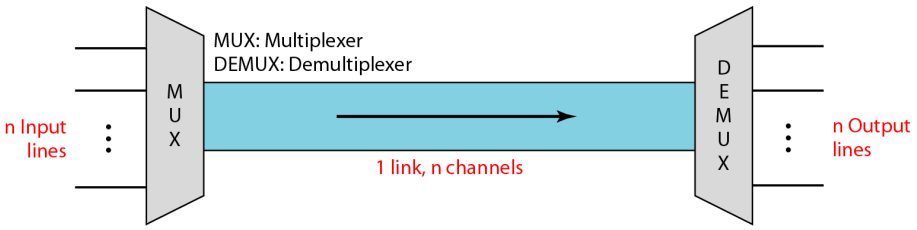
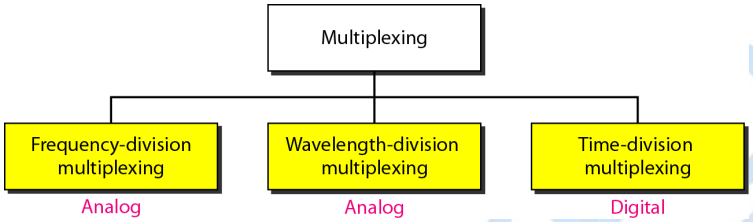


Figure : *Categories of multiplexing*



Q.9 Define Modulation.

Ans. Modulation is defined as the process whereby some characteristic (line amplitude, frequency, phase of a high frequency signal wave (carrier wave) is varied in accordance with the intensity of the signal. Modulation means to "change". In another word, it can be said that-"it is the process of combining an audio-frequency (AF) signal with a radio-frequency (RF) carrier wave". The audio-frequency (AF) signal is also called a modulating wave and the resultant wave produced is called modulated wave. During modulation, some characteristic of the carrier wave is varied in time with the modulating signal and accomplished by combining the two. Modulation is a process of converting a digital signal from a computer into an analog signal, the telephone system will accept or the process of changing some characterstic (amplitude, frequency or phase) of a carrier wave in accordance with the intensity of signal is known as ***Modulation.***

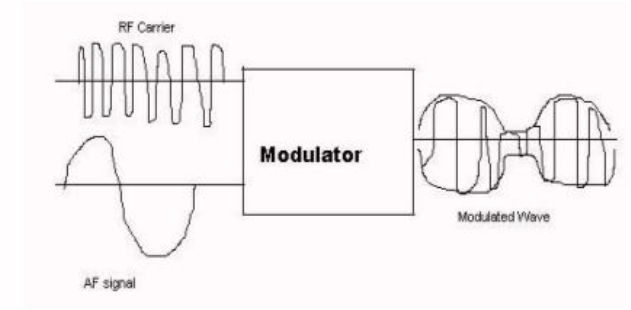


Fig: Modulation

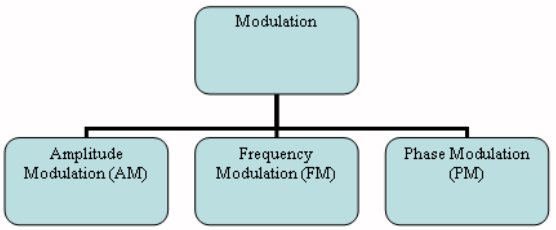


Fig: Basic types of modulation

Q.10 Explain Aloha.

Ans ALOHA is a random access protocol which is used for data transfer.A user access a channel as soon as a message is ready to be transmitted.After a transmission the user waits for an acknowledgement .In case of collisions,the terminal waits for a random period of time & retransmits the message.As the number of users increases,a greater delay occurs due to the probability of collision increases.

Q.11 What do you mean by Spread Spectrum?

Ans Spread spectrum means spreading the bandwidth needed to transmit data with the help of this technology ,several features can be implement ed .

a) security,without knowing thye spreading code3,the signal appears as noise.

b) it lays the basis for special medium access schemes using the code space.

c) it makes the transmission more robust against narrowband interference,as the signal is spread over a larger bandwidth so,the narrowband interference onll influences a small fraction of the signal.

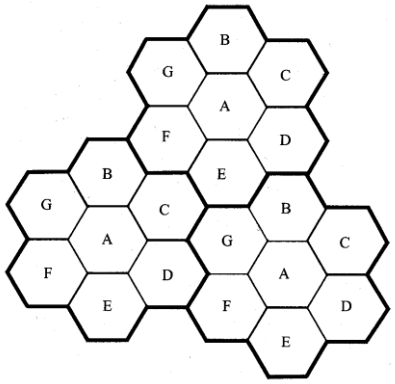
Q12 Explain any two techniques to spread the bandwidth.

Ans. Frequency-Hopping Spread Spectrum(FHSS)- With frequency hopping spreed spectrum, the signal is broadcast over a seemingly random series of radio frequencies,hopping from frequency at fixed intervals. A receiver, hopping between frequencies in synchronization with the transmitter, picks up the message.

Direct Sequence Spread Spectrum(DSSS)-With direct sequence spread spectrum,Each bit in the original is represented by multiple chips(or bits)in the transmitted signal, using a sprading code.The spreading code spreads the signal across a wider frequency band in direct proportion of the number of chips used.

Q.13 Describe cellular system.

Ans. Wireless communication technology in which several small exchanges (called cells) equipped with low-power radio antennas are interconnected through a central exchange. As a receiver moves from one place to the next, its identity, location, and radio frequency is handed-over by one cell to another without interrupting a call.



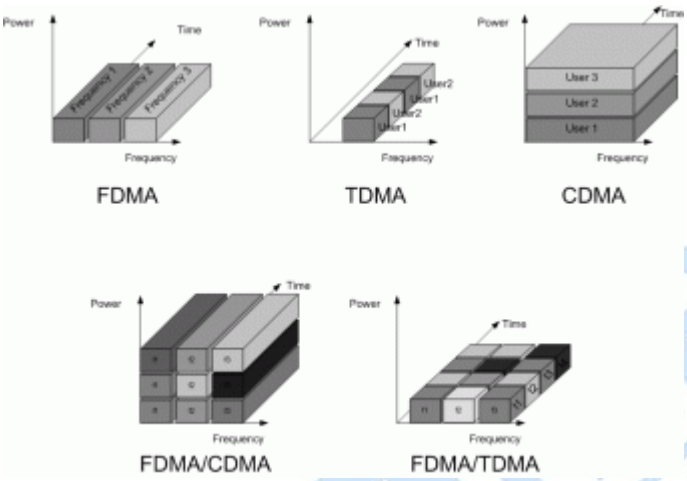
Q.14 What are the advantages & disadvantages of cellular system?

Ans.

- Solves the problem of spectral congestion and user capacity.
- Offer very high capacity in a limited spectrum without major technological changes.
- Reuse of radio channel in different cells.
- Enable a fix number of channels to serve an arbitrarily large number of users by reusing the channel throughout the coverage region.

Q.15 Describe various multiple access techniques.

Ans. The problem is each wireless system has to have its bandwidth that needs to be shared among several users. That is the reason that multiple access techniques have been designed.



FDMA – (Frequency Division Multiple Access)Each user has its part of overall frequency band i.e. the whole bandwidth is divided for many users.

TDMA – (Time Division Multiple Access)The whole bandwidth is reserved for particular user for only specified period of time.

CDMA - Code Division Multiple Access)User can use whole bandwidth for all time but has to use different code.

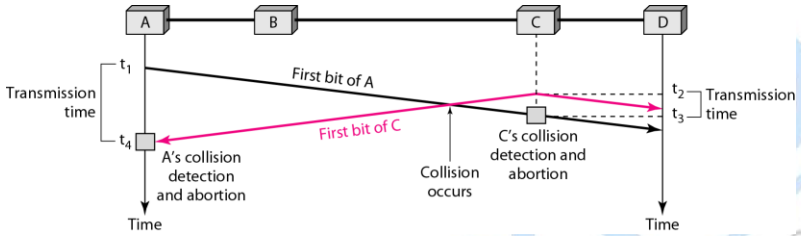
As for explanation of difference between these three multiple access technologies there is an example of room with people talking in pairs. When they would use FDMA the room (whole bandwidth) should be divided into smaller rooms and each room would represent one frequency. Walls would be the separation of these frequencies hence people in pairs would have a chance to talk at the same time without disturbing other pairs. As for TDMA each pair in the room would have some specific time to talk when other people should remain in silence. CDMA would allow to talk for all pairs but each of them would have to use different language (code).

Q.16 Explain CSMA/CA

Ans. The CSMA (Carrier Sense Multiple Access)/CA (Collision Avoidance) was developed to minimize the change of collision & increase the

performance. CSMA requires that each station first listen to the medium before sending.In other words, CSMA is based on the principle "sense before transmit" or "listen before talk". Unfortunately, this broadcasting of the intention to transmit data increases the amount of traffic on the cable and slows down network performance. This access method was once a popular method in the Macintosh environment and is now used with WLANs.

Figure ***Collision of the first bit in CSMA/CD***



Q.17 What is polling?

Ans. In the polling method, all data exchanges must be made through the primary device even when the ultimate destination is a secondary device. The primary device controls the link; the secondary devices follow its instructions.

Q.18 Explain CDMA.

Ans.

- CDMA (Code Division Multiple Access)
- all terminals send on the same frequency probably at the same time and can use the whole bandwidth of the transmission channel
- each sender has a unique random number, the sender XORs the signal with this random number
- the receiver can "tune" into this signal if it knows the pseudo random number, tuning is done via a correlation function
- Disadvantages:
- higher complexity of a receiver (receiver cannot just listen into the medium and start receiving if there is a signal)
- all signals should have the same strength at a receiver
- Advantages:
- all terminals can use the same
- frequency, no planning needed
- huge code space (e.g. 2^{32}) compared to frequency space
- interferences (e.g. white noise) is not coded

- forward error correction and encryption can be easily integrated

Q.19 Compare S/T/F CDMA techniques.

Ans.

Approach	SDMA	TDMA	FDMA	CDMA
Principle	Segment space into sectors/cells.	Message sending time into disjoint time-slots,fixed pattern/demand driven	Message is in different segments of frequency as disjoint sub-bands.	Spreads the spectrum using orthogonal codes.
Terminals	Only one terminal is active in one sector.	All the terminals are active for short time periods on same frequency.	Every terminal has its own frequency,which which is uninterruption.	All the terminls are active at same moment nwhich is uninterrupted.
Signal Separation	Directed antennas/cell structure.	Sychronization is done in time domain.	Filtering in frequency domain is done.	Code plus special receivers arrangement.
Channels per transponder	One or more	One	One or more	Many
Channel Spectrum		Sequentially used	Non-overlapping	Overlapped
Channel Separation Through	Spatial(beams,antenna orbits or polarization)	Guard time	Frequency spectrum	Orthogonal codes or frequency hopping.
Advantage	Simple,increases capacity	Full digital in nature,flexible,easy to establish.	Robust,easy establishment,simple.	Flexible,soft-handover,less planning is enough.
Disadvantages		Requires a guard space. Sychronization on is difficult	Not flexible. Resources are limited.	Receivers are complex in nature. Needs more complicated power control for senders.
Application	It is used onl;y in combination with TDMA,FDMA,CDMA secme for applications.	Used in mobile networks.	Combined with TDMA/SDMA for hopping & reuse mechanisms.	Integrated with TDMA/FDMA for application. This is a complex scheme.
Scheme	Segments the space in each sector.	Time slices are used.	Frequency slices are used.	Individual codes for each user.

Unit II
Telecommunication Networks/System

Q.1 Discuss 2G & 3G mobile network technology.

Ans. **Second Generation (2G) technology** was launched in the year 1991 in Finland. It is based on the technology known as global system for mobile communication or in short we can say GSM. This technology enabled various networks to provide services like text messages, picture messages and MMS. In this technology all text messages are digitally encrypted due to which only the intended receiver receives message. These digital signals consume less battery power, so it helps in saving the battery of mobiles.

The technologies used in 2G are either TDMA (Time Division Multiple Access) which divides signal into different time slots or CDMA (Code Division Multiple Access) which allocates a special code to each user so as to communicate over a multiplex physical channel.

2G networks are fairly basic in terms of functionality. They're intended to transmit voice data in real-time and not much else. Very lousy codecs are used to encode the voice data, compensating for the relatively low bandwidth of a 2G connection. As a direct result of this, it's hard to hear subtle intonation in someone's voice over a 2G cell phone connection. 2G networks can support other features but they're limited by low bandwidth and slow speeds; features like internet connectivity are typically reduced to slowly loading very basic content; and even with modern Smartphone level hardware, it would be a real pain to try and download large apps. 2G as a standard is largely obsolete in the United States, and realistically you won't be getting a 2G plan unless you have old hardware which you specifically want to use. However, 2G still sees substantial use in developing nations like India due to its much lower cost of operation and use.

Third Generation (3G) technology 3G generally refers to the standard of accessibility and speed of mobile devices. It was first used in Japan in the year 2001. The standards of the technology were set by the International Telecommunication Union (ITU). This technology enables use of various services like GPS (Global Positioning System), mobile television and video conferencing. It not only enables them to be used worldwide, but also provides with better bandwidth and increased speed.

This technology is much more flexible as it can support 5 major radio technologies that operate under CDMA, TDMA and FDMA. CDMA accounts for IMT-DS (direct speed), IMT-MC (multi carrier). TDMA holds for IMT-TC (time code), IMT-SC (single carrier). This technology is also comfortable to work with 2G technologies. The main aim of this technology is to allow much better coverage and growth with minimum investment.

3G networks are far more advanced mobile communication networks, featuring download speeds of up to 14.7 Mbps downstream at this point of time with room for improvement in the future. These considerable speeds can be used for advanced features which are either impossible or at least difficult to use on 2G networks. For telephony, a 3G connection's greater speed and bandwidth substantially improves the quality of voice communications. Furthermore, things like full-featured web browsers, streaming video, complex apps, movie and music downloads or real-time upload of photos taken to social media become possible.

Q.2 What are the performance characteristics of GSM?

Ans. Performance characteristics of GSM are:

- Communication
- mobile, wireless communication; support for voice and data services
- Total mobility
- international access, chip-card enables use of access points of different providers
- Worldwide connectivity
- one number, the network handles localization
- High capacity
- better frequency efficiency, smaller cells, more customers per cell
- High transmission quality
- high audio quality and reliability for wireless, uninterrupted phone calls at higher speeds (e.g., from cars, trains)
- Security functions
- access control, authentication via chip-card and PIN

Q.3 What are the disadvantages of GSM?

Ans. Disadvantages of GSM are:

- There is no perfect system!!
- no end-to-end encryption of user data
- no full ISDN bandwidth of 64 kbit/s to the user, no transparent B-channel
- reduced concentration while driving
- electromagnetic radiation
- abuse of private data possible
- roaming profiles accessible
- high complexity of the system
- several incompatibilities within the GSM standard

Q.4 What are the main services of GSM?

Ans. **GSM: Mobile Services**

- GSM offers
- several types of connections
- voice connections, data connections, short message service
- multi-service options (combination of basic services)
- Three service domains
- Bearer Services
- Telematic Services
- Supplementary Services

Bearer Services are:

- Telecommunication services to transfer data between access points
- Specification of services up to the terminal interface (OSI layers 1-3)
- Different data rates for voice and data (original standard)
- data service (circuit switched)
- synchronous: 2.4, 4.8 or 9.6 kbit/s
- asynchronous: 300 - 1200 bit/s
- data service (packet switched)
- synchronous: 2.4, 4.8 or 9.6 kbit/s
- asynchronous: 300 - 9600 bit/s

Today: data rates of approx. 50 kbit/s possible – will be covered later! (even more with new modulation

Telematic Services are:

- Telecommunication services that enable voice communication via mobile phones

- All these basic services have to obey cellular functions, security measurements etc.
- Offered services
- mobile telephony primary goal of GSM was to enable mobile telephony offering the traditional bandwidth of 3.1 kHz
- Emergency number common number throughout Europe (112); mandatory for all service providers; free of charge; connection with the highest priority (preemption of other connections possible)
- Multinumbering several ISDN phone numbers per user possible Supplementary Services are:
- Services in addition to the basic services, cannot be offered stand-alone
- Similar to ISDN services besides lower bandwidth due to the radio link
- May differ between different service providers, countries and protocol versions
- Important services
- identification: forwarding of caller number
- suppression of number forwarding
- automatic call-back
- conferencing with up to 7 participants
- locking of the mobile terminal (incoming or outgoing calls)

Q.5 Explain the architecture of GSM system.

Ans.

- GSM is a PLMN (Public Land Mobile Network)
- several providers setup mobile networks following the GSM standard within each country
- components
- MS (mobile station)
- BS (base station)
- MSC (mobile switching center)
- LR (location register)
- subsystems
- RSS (radio subsystem): covers all radio aspects
- NSS (network and switching subsystem): call forwarding, handover, switching
- OSS (operation subsystem): management of the network

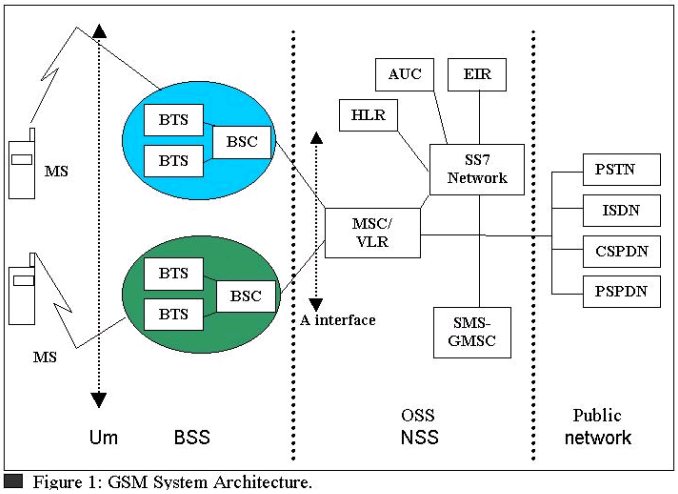


Figure 1: GSM System Architecture.

Q.6 Explain the following features of GSM.

Ans. Localization & calling: LOCALIZATION AND CALLING

One fundamental feature of GSM system is the automatic , worldwide localization of users. GSM perform periodic location updates even if a user does not use the MS.The HLR always contains information about the current location , and VLR currently responsible for the MS informs the HLR about location changes. As soon as an MS moves into the range of a new VLR , the HLR sends all user data needed to new VLR. Changing position of services is also called roaming. To locate an MS and to address the MS following number are required……..

Mobile station inter national ISDN number (MSISDN) :---------

The only important number for a user of GSM in is the phone number. Phone no is associated with SIM ,which is personalized for a user . This no consists of country code (CC) ,the national destination code(NDC) , and subscriber number (SN) .

International mobile subscriber identity(IMSI) :-------

GSM uses the IMSI for internal unique identification of a subscriber .it consists of mobile country code (MCC) ,the mobile network code(MNC) , and mobile subscriber identification identity(MSIN).

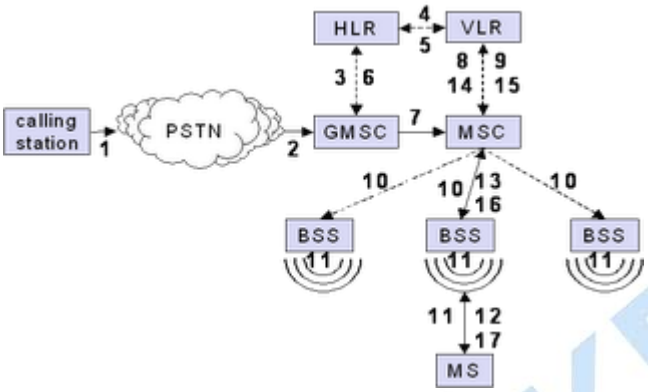
Temporary mobile subscriber identity(TMSI):

To hide the IMSI ,which would give the exact identity of the user signaling over the air interface ,GSM uses the 4 byte TMSI for local subscriber identification .TMSI is selected by the current VLR and is only valid temporarily and within the location area of VLR.

Mobile station roaming number(MSRN) :---Another temporary address that hides the location of a subscriber is MSRN. MSRN contains the current visitor country code(VCC) ,the visitor national destination code

(VNDC)

The steps involve in calling from a fixed network to a MS (MTC) , and from a MS to fixed network(MOC) is given below…..



MOBILE TERMINATED CALL(MTC)

1: calling a GSM subscriber

2: forwarding call to GMSC

3: signal call setup to HLR

4, 5: request MSRN from VLR

6: forward responsible MSC to GMSC

7: forward call to current MSC

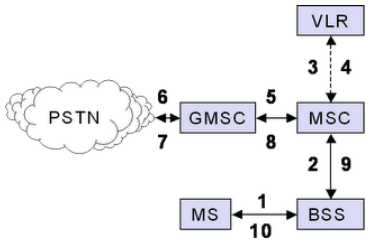
8, 9: get current status of MS

10, 11: paging of MS

12, 13: MS answers

14, 15: security checks

16, 17: set up connection



MOBILE OREGINATED CALL (MOC)

1, 2: connection request

3, 4: security check

5-8: check resources (free circuit)

9-10: set up call

b)**Handover**: Cellular system required handover procedure as single cells do not cover the whole service area. There are two basic reason for a handover ……

1. The station moves out of the range of BTS or a certain antenna of a BTS respectively .The received signal level decreases continuously until it falls below the minimal requirements for communication .The error rate may increase due to interface , the distance to the BTS may be too high etc. All these effect may diminish the quality of the radio link and make radio transmission impossible in near feature .

2. The wired infrastructure may decide that the traffic in one cell is too high and shift some MS to other cells with a lower load .Handover may be due to load balancing .

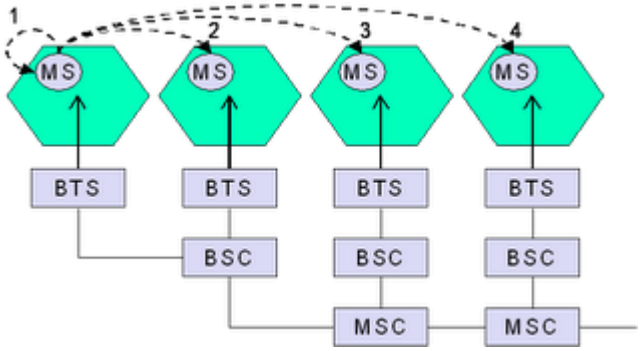
The handover are four type

1. Intra-cell handover

2. Inter-cell , Intra-BSC handover

3. Inter-BDC , intra-MSC handover

4. Inter-MSC handover



TYPES OF HANDOVER IN GSM SYSTEM

To provide all necessary information for a handover due to weak link , MS and BTS both perform periodic measurement of the downlink and uplink signal quality respectively. Measurement report are sent by the MS about every half-second and contain the quality of the current link used for information as well as the quality of certain channels in neighboring cells(BCCH). Handover is of two type Soft handover and hard handover. In hard handover MS can only talk with a single BTS at a time when changing from one cell to other . But in soft handover MS can talk old and new BTS simultaneously .Soft handover is used in CDMA technology while Hard handover is used in GSM technology.

Q.7 What are security services provided by the GSM?

Ans.

- Security services
- access control/authentication
- user ó SIM (Subscriber Identity Module): secret PIN (personal identification number)
- SIM ó network: challenge response method
- confidentiality
- voice and signaling encrypted on the wireless link (after successful authentication)
- anonymity
- temporary identity TMSI (Temporary Mobile Subscriber Identity)
- newly assigned at each new location update (LUP)
- encrypted transmission
- 3 algorithms specified in GSM

- A3 for authentication ("secret", open interface)
- A5 for encryption (standardized)
- A8 for key generation ("secret", open interface)

Q.8 Explain the satellite system.

Ans. A satellite communication system basically consists of a satellite in space & many earth stations on the ground which are linked with each other through the satellite.Baseband signal from the users is transmitted to the earth station through a terrestrial network & is modified by an RF carrier at the earth & transmitted to the satellite.The satellite receives the modulated RF carrier in its uplink frequency spectrum form all the earth in the downlink frequency spectrum,which is different from the uplink frequency spectrum.The bandwidth of a typical commercial satellite is 500 MHZ on both uplink & downlink.

Q.9 What are the applications of satellite system?

Ans. Radio&TV Broadcast satellites Broadband satellites transmit high-speed data and video directly to consumers and businesses. Markets for broadband services also include interactive TV & Radio programs .This technology c ompetes with cable in many places,as it is cheaper to install & in most cases ,no extra fees have to be paid for this service.

EnvironmentalMonitoring

Environmental monitoring satellites carry highly sensitive imagers and sounders to monitor the Earth's environment, including the vertical thermal structure of the atmosphere; the movement and formation of clouds; ocean temperatures; snow levels; glacial movement; and volcanic activity. Large-scale computers use this data to model the entire earth's atmosphere and create weather forecasts such as those provided by national weather services in the U.S. and abroad.

Military Satellites: Many communication links are managed via satellite because they are much safer from attack by enemies.

Satellites for navigation:The GPS(Global Positioning System) is nowadays well-known & available for everone.The system allows for precise localization worldwide,and some additional techniques,the precision is in the range of some metres.Almost all ships & aircraft rely on GPS as an additional to traditional navigation systems.Many trucks & cars come with installed GPS receivers.

Q.10 Define broadcast system.

Ans. Broadcasting is one of the most imported applications of radio systems.Radio is the most effective medium for broadcasting audio & video.Broadcasting for large areas is done through satellite ,but for local programs within a country or state,broadcasting is done through terrestrial radio.

The advantage of digital broadcasts is that they prevent a number of complaints with traditional analog

broadcast.For television,this includes the elimination of problems such as snowy pictures,ghosting & other distoration.These occur because of the nature of analog transmission,which means that perturbations due to noise will be evited in the final outpuit.Digital transmission overcomes this problem because digital signals are reduced to discrete values upon reception & hence small perturbations do not affect the final output.

Q.11 What do you mean by digital audio broadcasting?

Ans. Digital audio broadcasting (DAB) was first deployed in the United Kingdom in 1995, and has become common throughout Europe.Digital audio broadcasting (DAB), also known as digital radio and high-definition radio, is audio broadcasting in which analog audio is converted into a digital signal and transmitted on an assigned channel in the AM or FM frequency range. DAB is said to offer compact disc (CD)- quality audio on the FM (frequency modulation) broadcast band and to offer FM-quality audio on the AM (amplitude modulation) broadcast band.

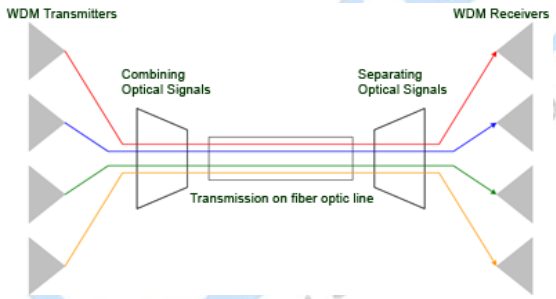
Q.12 What do you mean by digital video broadcasting?

Ans. Digital Video Broadcasting (DVB) is being adopted as the standard for digital television in many countries.. The DVB standard offers many advantages over the previous analogue standards and has enabled television to make a major step forwards in terms of its technology. DVB is now one of the success stories of modern broadcasting. The take up has been enormous and it is currently deployed in over 80 countries worldwide, including most of Europe and also within the USA. It offers advantages in terms of far greater efficiency in terms of spectrum usage and power utilisation as well as being able to affect considerably more facilities, the prospect of more channels and the ability to work alongside existing analogue services

Q.13 Explain WDM .

Ans. Wavelength division multiplexing (WDM) and wavelength routing are rapidly becoming the technologies of choice in network infrastructure that must accommodate unprecedented, accelerating demand for bandwidth. *WDM Optical Networks: Concepts, Design, and Algorithms* provides practicing engineers, students, and researchers with a systematic, up-to-date introduction to the fundamental concepts, challenges, and state-of-the-art developments in WDM optical networks. The authors rely extensively on real-world examples and draw on the latest research to cover optical network design and provisioning in far greater depth than any other book. Coverage includes:

- WDM advantages: increased usable bandwidth, reduced processing cost, protocol transparency, and efficient failure handling



Unit III
Wireless LAN

Q.1 What are the advantages & disadvantages of wireless LAN?

Ans. **ADVANTAGES**

1. Degree of freedom for users within rooms,buildings etc.
2. Do not need cables ,wires.
3. Flexible for adhoc communication.
4. Allow for the design of small,indepentant devices such as small PDAs,notepads etc.
5. Wireless networks can survive disasters,eg, earthquakes or users pulling a plug.

DISADVANTAGES

1.Provide lower bandwidth due to limitation in radio transmission.
2. WLANs are limited to lower senders & certain licence-free frequency bands,which are not the same worldwide.
3.Air interface & higher complexity.

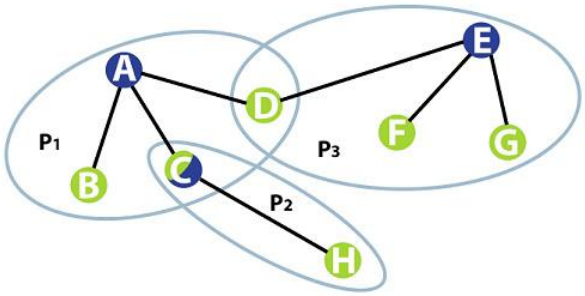
Q.2 Differentiate between Infrared & Radio transmission?

Ans.

INFRARED	RADIOTRANSMISSION
Uses uses IR diodes, diffuse light, multiple reflections (walls, furniture etc.)	Uses typically using the license free ISM band at 2.4 GHz
Advantages simple, cheap, available in many mobile devices no licenses needed simple shielding possible	Advantages experience from wireless WAN and mobile phones can be used coverage of larger areas possible (radio can penetrate walls, furniture etc.)
Disadvantages interference by sunlight, heat sources etc. many things shield or absorb IR light low bandwidth	Disadvantages very limited license free frequency bands shielding more difficult, interference with other electrical devices
Example IrDA (Infrared Data Association) interface available everywhere	Example Many different products

Q.3 What is Bluetooth?

Ans. Bluetooth is a wireless technology for the use of low-power radio communications to wirelessly link phones, computers and other network devices over short distances. The name Bluetooth is borrowed from Harald Bluetooth, a king in Denmark more than 1,000 years ago. Bluetooth technology was designed primarily to connect devices of different fuctions such astelephones,notebooks,cameras,printers including cell phones, PDAs, and wireless headsets. Wireless signals transmitted with Bluetooth cover short distances, typically up to 30 feet (10 meters). Bluetooth devices generally communicate at less than 1 Mbps.



Q.4 Explain the concept of Piconet & Scattenet.

Ans. Bluetooth defines two types of networks:piconets & scatternet.

Piconets : A Bluetooth network is called a piconet/small net.A piconet can have up to eight stations,one is called primary, the rest are called secondaries.

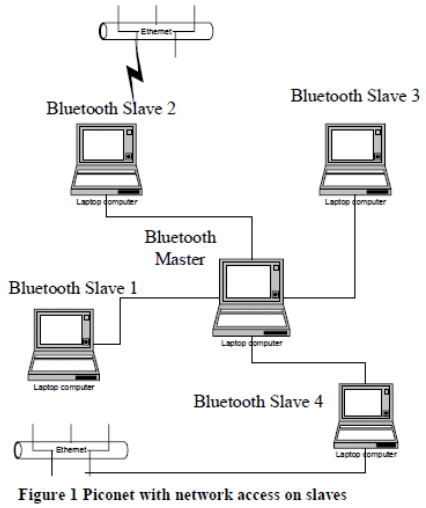


Figure 1 Piconet with network access on slaves

Scatternet: Piconets can be combined to form a scatternet.Asecondary in one piconet can be the primary in another piconet. This station can receive messages from the primary in the first piconet.A station can be a member of two piconets.

Q.5 Explain the following wireless standards:

a) IEEE 802.11 b

b) IEEE 802.11 a

c) IEEE 802.11 g

Ans. IEEE expanded on the original 802.11 standard in July 1999, creating the *802.11b* specification. 802.11b supports bandwidth up to 11 Mbps, comparable to traditional Ethernet.

802.11b uses the same *unregulated* radio signaling frequency (2.4 GHz) as the original 802.11 standard. Vendors often prefer using these frequencies to lower their production costs. Being unregulated, 802.11b gear can incur interference from microwave ovens, cordless phones, and other appliances using the same 2.4 GHz range. However, by installing 802.11b gear a reasonable distance from other appliances, interference can easily be avoided.

- **Pros of 802.11b** - lowest cost; signal range is good and not easily obstructed
- **Cons of 802.11b** - slowest maximum speed; home appliances may interfere on the unregulated frequency band

802.11a

While 802.11b was in development, IEEE created a second extension to the original 802.11 standard called *802.11a*. Because 802.11b gained in popularity much faster than did 802.11a, some folks believe that 802.11a was created after 802.11b. In fact, 802.11a was created at the same time. Due to its higher cost, 802.11a is usually found on business networks whereas 802.11b better serves the home market.

802.11a supports bandwidth up to 54 Mbps and signals in a regulated frequency spectrum around 5 GHz. This higher frequency compared to 802.11b shortens the range of 802.11a networks. The higher frequency also means 802.11a signals have more difficulty penetrating walls and other obstructions.

Because 802.11a and 802.11b utilize different frequencies, the two technologies are incompatible with each other. Some vendors offer hybrid **802.11a/b** network gear, but these products merely implement

the two standards side by side (each connected devices must use one or the other).

- **Pros of 802.11a** - fast maximum speed; regulated frequencies prevent signal interference from other devices
- **Cons of 802.11a** - highest cost; shorter range signal that is more easily obstructed

802.11g

In 2002 and 2003, WLAN products supporting a newer standard called *802.11g* emerged on the market. 802.11g attempts to combine the best of both 802.11a and 802.11b. 802.11g supports bandwidth up to 54 Mbps, and it uses the 2.4 Ghz frequency for greater range. 802.11g is backwards compatible with 802.11b, meaning that 802.11g access points will work with 802.11b wireless network adapters and vice versa.

- **Pros of 802.11g** - fast maximum speed; signal range is good and not easily obstructed
- **Cons of 802.11g** - costs more than 802.11b; appliances may interfere on the unregulated signal frequency

Q.6 Explain IEEE 802.16.

Ans. The IEEE developed the 802.16 in its first version to address line of sight (LOS) access at spectrum ranges from 10 GHz to 66 GHz. The technology has evolved through several updates to the standard such as 802.16a, 802.16c, the Fixed WiMAX 802.16d (802.16-2004) specification and lastly the mobile 802.16e set that are currently commercially available. The upcoming 802.16m standard is due to be ratified in 2010. The first update added support for 2 GHz through 11 GHz spectrum with NLOS capability. Each update added additional functionality or expanded the reach of the standard.

Q.7 Give an overview of Mobile IP.

Ans. In IP networks, routing is based on stationary IP addresses, similar to how a postal letter is delivered to the fixed address on the envelope. A device on a network is reachable through normal IP routing by the IP address it is assigned on the network.

The problem occurs when a device roams away from its home network and is no longer reachable using normal IP routing. This results in the active sessions of the device being terminated. Mobile IP was created to enable users to keep the same IP address while traveling to a different network (which may even be on a different wireless operator), thus

ensuring that a roaming individual could continue communication without sessions or connections being dropped.

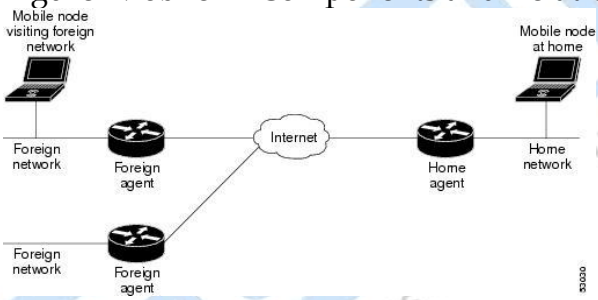
Because the mobility functions of Mobile IP are performed at the network layer rather than the physical layer, the mobile device can span different types of wireless and wireline networks while maintaining connections and ongoing applications. Remote login, remote printing, and file transfers are some examples of applications where it is undesirable to interrupt communications while an individual roams across network boundaries. Also, certain network services, such as software licenses and access privileges, are based on IP addresses. Changing these IP addresses could compromise the network services.

Components of a Mobile IP Network

Mobile IP has the following three components:

- Mobile Node
- Home Agent
- Foreign Agent

Figure Mobile IP Components and Relationships



The Mobile Node is a device such as a cell phone, personal digital assistant, or laptop whose software enables network roaming capabilities.

The Home Agent is a router on the home network serving as the anchor point for communication with the Mobile Node; it tunnels packets from a device on the Internet, called a Correspondent Node, to the roaming Mobile Node. (A tunnel is established between the Home Agent and a reachable point for the Mobile Node in the foreign network.)

The Foreign Agent is a router that may function as the point of attachment for the Mobile Node when it roams to a foreign network, delivering packets from the Home Agent to the Mobile Node.

The care-of address is the termination point of the tunnel toward the Mobile Node when it is on a foreign network. The Home Agent maintains an association between the home IP address of the Mobile

Node and its care-of address, which is the current location of the Mobile Node on the foreign or visited network

Q.8 Explain tunneling and encapsulation.

Ans. Encapsulation is required because each datagram we intercept and forward needs to be resent over the network to the device's care-of address. In theory, the designers might conceivably have done this by just having the home agent change the destination address and stick it back out on the network, but there are various complications that make this unwise. It makes more sense to take the entire datagram and wrap it in a new set of headers before retransmitting. In our mail analogy, this is comparable to taking a letter received for our traveling consultant and putting it into a fresh envelope for forwarding, as opposed to just crossing off the original address and putting a new one on.

The default encapsulation process used in Mobile IP is called *IP Encapsulation Within IP*, defined in RFC 2003 and commonly abbreviated *IP-in-IP*. It is a relatively simple method that describes how to take an IP datagram and make it the payload of another IP datagram. In Mobile IP, the new headers specify how to send the encapsulated datagram to the mobile node's care-of address.

In addition to IP-in-IP, two other encapsulation methods may be optionally used: *Minimal Encapsulation Within IP*, defined in RFC 2004, and *Generic Routing Encapsulation (GRE)*, defined in RFC 1701. To use either of these, the mobile node must request the appropriate method in its *Registration Request* and the home agent must agree to use it. If foreign agent care-of addressing is used, the foreign agent also must support the method desired.

The encapsulation process creates a logical construct called a *tunnel* between the device that encapsulates and the one that decapsulates. This is the same idea of a tunnel used in discussions of virtual private networks (VPNs), IPSec tunnel mode, or the various other tunneling protocols used for security. The tunnel represents a conduit over which datagrams are forwarded across an arbitrary internetwork, with the details of the encapsulated datagram (meaning the original IP headers) temporarily hidden.

In Mobile IP, the start of the tunnel is the home agent, which does the encapsulation. The end of the tunnel depends on what sort of care-of address is being used:

- **Foreign Agent Care-Of Address:** The foreign agent is the end of the tunnel. It receives encapsulated messages from the home agent, strips

off the outer IP header and then delivers the datagram to the mobile node. This is generally done using layer two, because the mobile node and foreign agent are on the same local network, and of course, the mobile node does not have its own IP address on that network (it is using that of the foreign agent.)

- **Co-Located Care-Of Address:** The mobile node itself is the end of the tunnel and strips off the outer header.

Unit IV
AD-HOC Networks

Q.1 What are the benefits & limitations of using mobile adhoc networks?

Ans. **ADVANTAGES**

1. New way of setting up wireless communication.
2. Do not need infrastructure.
3. Mobility.
4. Small, light equipment.
5. Application tailored adhoc-networks can offer a better solution.

DISADVANTAGES

1. Wireless communication
2. Mobility
3. Do not need infrastructure,but can use it, if available
4. Small, light equipment.

Q.2 What is difference between wired networks & adhoc wireless networks?

Ans. A adhoc network is typically a wireless connection between two or more computers without the use of a hub or switch, where as a wireless network generally has some piece network hardware running the network that is only meant to facilitate connections and not make them its self.
Mobile adhoc networks allow wireless connectivity directly between wireless nodes - without connecting through an access point (infrastructure mode networks).

Traditional wireless networks have at least one access point, which is usually connected to a wired network. The wireless nodes associate to the access point for their connectivity. Communication between wireless nodes occurs through the AP itself (if the AP allows peer-to-peer communications) or through the network that the AP is connected to. For the nodes to be able to communicate, they must remain within range of an AP.

Mobile adhoc networks (MANETs) are designed so that the wireless peers can communicate directly to/from each other without going

through an AP. The peers form associations with, and validate each other directly. As long as the peers (nodes) are within range of each other, they can communicate.
in wireless network, a central node which is called "base station" or "access point" exists in the network that all the connections are done through this central node. But when we configure the network in ad hoc mode, every couple of nodes can communicate with each other independent of the central node.
mobile adhoc networks are the networks created in adhoc mode.. for ex: military applications... u can create it anywhere at anytime..
wireless network we normally use is INFRASTRUCTURE mode.. ex: cell phones with proper base station and mobile nodes around to access the network..
Both greatly differ in the protocols they use.. ad hoc method is a bit difficult to implement and is limited to lesser coverage area..

Q.3 Explain routing algorithm.
Or
What are the mechanisms of the TCP that influence the efficiency of TCP in a mobile environment?

Ans.

- Ans Transport protocols typically designed for
  - Fixed end-systems
  - Fixed, wired networks
- TCP congestion control
  - Packet loss in fixed networks typically due to (temporary) overload situations
  - Routers discard packets as soon as the buffers are full
  - TCP recognizes congestion only indirectly via missing acknowledgements
  - Retransmissions unwise, they would only contribute to the congestion and make it even worse

Slow-start

- Sender calculates a congestion window for a receiver
- Start with a congestion window size equal to one segment
- Exponential increase of the congestion window up to the congestion threshold, then linear increase
- Missing acknowledgement causes the reduction of the congestion threshold to one half of the current congestion window
- Congestion window starts again with one segment

Fast Retransmit/Fast Recovery

- ❑ TCP sends an acknowledgement only after receiving a packet
- ❑ If a sender receives several acknowledgements for the same packet, this is due to a gap in received packets at the receiver
- ❑ However, the receiver got all packets up to the gap and is actually receiving packets
- ❑ Therefore, packet loss is not due to congestion, continue with current congestion window (do not use slow-start)

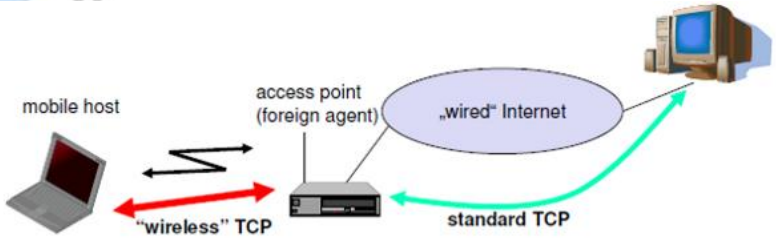
Influences of mobility on TCP

- ❑ TCP assumes congestion if packets are dropped
- ❑ typically wrong in wireless networks, here we often have packet loss due to *transmission errors*
- ❑ furthermore, *mobility* itself can cause packet loss, if e.g. a mobile node roams from one access point (e.g. foreign agent in Mobile IP) to another while there are still packets in transit to the wrong access point and forwarding is not possible
- ❑ The performance of an unchanged TCP degrades severely
- ❑ however, TCP cannot be changed fundamentally due to the large base of installation in the fixed network, TCP for mobility has to remain compatible
- ❑ the basic TCP mechanisms keep the whole Internet together

Q.4 Explain I-TCP.

Ans. Indirect TCP or I-TCP segments the connection

- o no changes to the TCP protocol for hosts connected to the wired Internet, millions of computers use (variants of) this protocol
- o optimized TCP protocol for mobile hosts
- o splitting of the TCP connection at, e.g., the foreign agent into 2 TCP connections, no real end-to-end connection any longer hosts in the fixed part of the net do not notice the characteristics of the wireless part



Q.5 What are benefits of using I-TCP?

Ans. **Benefits of using I-TCP**

1. It does not require any changes in the TCP protocol as used by the hosts.

2. Without partitioning retransmission of lost packets would take place between mobile host & correspond host across the whole network .
3. Different solutions can be used or tested at the same time without jeopardizing the stability of the internet.
4. It is easy to use different protocols for wired & wireless network.

Q.6 What are the disadvantages of using I-TCP?

Ans. **Disadvantages of using I-TCP**

- loss of end-to-end semantics, an acknowledgement to a sender does not any longer mean that a receiver really got a packet, foreign agents might crash
- higher latency possible due to buffering of data within the foreign agent and forwarding to a new foreign agent
- TCP proxy must be trusted obvious opportunities for snooping and denial of service End-to-end IP-level privacy and authentication (e.g., using IPSec) must terminate at the proxy

Q.7 Explain snooping TCP. Write its avantages & disadvantages also.

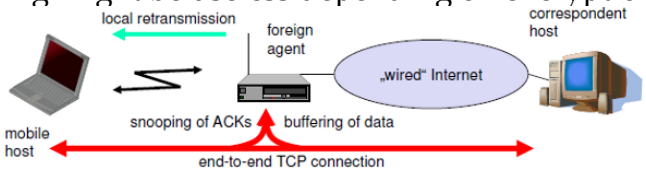
Ans. The main function of Snooping TCP is enhancement to buffer data close to the mobile host to perfor fast local retransmission in case of packet loss.A good place for the enhancement of TCP could be the foreign agent in the Mobile IP context.In this approach ,the foreign agent buffer all packets with destination mobile host & additionaly 'snoops' the packet flow in both directions to recognize acknowledgements.The reason for buffering packets toward the mobile node is to enable the foreign agent to perform a local retyransmission in case of packet loss on the wireless link.

Advantages:

- Maintain end-to-end semantics
- No change to correspondent node
- No major state transfer during handover

Problems:

- Snooping TCP does not isolate the wireless link well
- May need change to MH to handle NACKs
- Snooping might be useless depending on encryption schemes



Q.8 What do you mean by M-TCP?

Ans.

- Handling of lengthy or frequent disconnections
- M-TCP splits as I-TCP does
  - unmodified TCP for FH to BS
  - optimized TCP for BS to MH
- BS (Foreign Agent)
  - monitors all packets, if disconnection detected
- set advertised window size to 0
- sender automatically goes into persistent mode
  - no caching, no retransmission at the BS
- If a packet is lost on the wireless link, it has to be retransmitted by the original sender
- BS does not send an ack to FH, unless BS has received an ack from MH
  - maintains end-to-end semantics
- BS withholds ack for the last byte ack'd by MH
- When BS does not receive ACK for sometime, it chokes sender by setting advertise window to 0

Q.9 Write two advantages & two disadvantages of using M-TCP.

Ans. **Advantages of M-TCP**: (1) it maintains *end-to-end* TCP semantics and, (2) it delivers excellent performance for environments where the mobile encounters periods of disconnection.

(3)lost packets automatically retransmitted to the SH(Supervisory Host)

Disdvantages of M-TCP:

(1)M-TCP assumes low error bit rate, which is not always a valid assumption.

(2)A modified TCP on the wireless link not only requires modifications to MH protocol but also new network elements like the bandwidth manager.

Q.10 Explain TCP slow start algorithm.

Ans. TCP slow-start algorithm

- ❑ sender calculates a congestion window for a receiver
- ❑ start with a congestion window size equal to one segment
- ❑ exponential increase of the congestion window up to the congestion threshold, then linear increase

- missing acknowledgement causes the reduction of the congestion threshold to one half of the current congestion window
- congestion window starts again with one segment

Q.10 What do you mean by retransmission/recovery in a mobility?

Ans.

TCP fast retransmit/fast recovery

- TCP sends an acknowledgement only after receiving a packet
- if a sender receives several acknowledgements for the same packet, this is due to a gap in received packets at the receiver
- however, the receiver got all packets up to the gap and is actually receiving packets

therefore, packet loss is not due to congestion, continue with current congestion window (do not use slow start)

Unit V
Support For Mobility

Q.1 Explain file system in a mobile & wireless communication.

Ans. Goal

- efficient and transparent access to shared files within a mobile environment while maintaining data consistency

Problems

- limited resources of mobile computers (memory, CPU, ...)
- low bandwidth, variable bandwidth, temporary disconnection
- high heterogeneity of hardware and software components (no standard PC architecture)
- wireless network resources and mobile computer are not very reliable
- standard file systems (e.g., NFS, network file system) are very inefficient, almost unusable

Solutions

- replication of data (copying, cloning, caching)
- data collection in advance (hoarding, pre-fetching)

File systems - consistency problems

THE big problem of distributed, loosely coupled systems

- Are all views on data the same?
- How and when should changes be propagated to what users?

Weak consistency

- many algorithms offering strong consistency (e.g., via atomic updates) cannot be used in mobile environments
- invalidation of data located in caches through a server is very problematic if the mobile computer is currently not connected to the network
- occasional inconsistencies have to be tolerated, but conflict resolution strategies must be applied afterwards to reach consistency again

Conflict detection

- content independent: version numbering, time-stamps
- content dependent: dependency graphs

File systems for limited connectivity I

Symmetry

- Client/Server or Peer-to-Peer relations
- support in the fixed network and/or mobile computers

- one file system or several file systems
- one namespace for files or several namespaces

Transparency

- hide the mobility support, applications on mobile computers should not notice the mobility
- user should not notice additional mechanisms needed

Consistency model

- optimistic or pessimistic
  Caching and Pre-fetching
- single files, directories, subtrees, partitions, ...
- permanent or only at certain points in time

File systems for limited connectivity II

Data management

- management of buffered data and copies of data
- request for updates, validity of data
- detection of changes in data

Conflict solving

- application specific or general
- errors

Several experimental systems exist

- Coda (Carnegie Mellon University), Little Work (University of Michigan), Ficus (UCLA) etc.

Many systems use ideas from distributed file systems such as, e.g., AFS (Andrew File System)

File systems - Coda I

Application transparent extensions of client and server

- changes in the cache manager of a client
- applications use cache replicates of files
- extensive, transparent collection of data in advance for possible future use („Hoarding“)

Consistency

- system keeps a record of changes in files and compares files after reconnection
- if different users have changed the same file a manual reintegration of the file into the system is necessary

- optimistic approach, coarse grained (file size)

File systems - Coda II

Hoarding

- user can pre-determine a file list with priorities
- contents of the cache determined by the list and LRU strategy (Last Recently Used)
- explicit pre-fetching possible
- periodic updating

Comparison of files

- asynchronous, background
- system weighs speed of updating against minimization of network traffic

Cache misses

- modeling of user patience: how long can a user wait for data without an error message?
- function of file size and bandwidth

Q.2 Explain WWW.

Ans. The WWW(World Wide Web) is one of the latest & popular hypwertext based Internet tools.It allows users to access & display documents & graphics stored on any web server on the Internet.

The WWW also referred as the W3 or "The Web" is the universe of information available via hypertext transfer protocol(HTTP).The web is a large distributed system comprising of thousands of web servers connected to each other by the Internet.The key element in this system is the web document,also called a web page.The first page of a set of Web pages is called the home page.These document are written in a special "language" called the hypertext Markup Language(HTML).

Q.3 Define WAP.

Ans. WAP - Wireless Application Protocol

Goals

- deliver Internet content and enhanced services to mobile devices and users (mobile phones, PDAs)
- independence from wireless network standards
- open for everyone to participate, protocol specifications will be proposed to standardization bodies
- applications should scale well beyond current transport media and device types and should also be applicable to future developments

Platforms

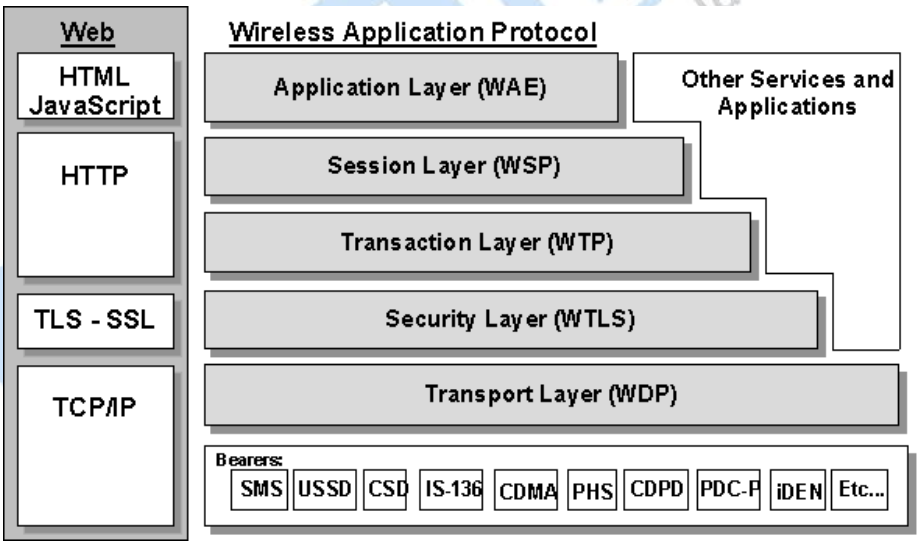
- e.g., GSM (900, 1800, 1900), CDMA IS-95, TDMA IS-136, 3rd generation systems (IMT-2000, UMTS, W-CDMA, cdma2000 1x EV-DO, …)

Forum

- was: WAP Forum, co-founded by Ericsson, Motorola, Nokia, Unwired Planet, further information www.wapforum.org
- now: **Open Mobile Alliance** www.openmobilealliance.org (Open Mobile Architecture + WAP Forum + SyncML + …)

Q.4 Explain the architecture of WAP.

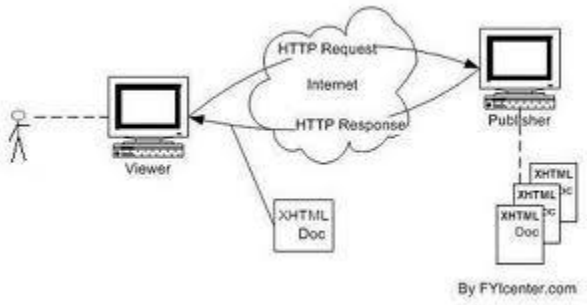
Ans. The Wap architecture provides and extensible evvironment for application development for mobile communication devices.This is achieved through a layered design of the entire protocol stack.Each of the layers of the architecture is accessible by the layers above it,as well as by other sevices & applications.



The WAP layered architecture enables other services applications to utilize the features of the WAP stack through a set of well-defined interfaces.External applications may acess the session,transaction,security & transport layers directly.

Q.5 Explain HTTP.

Ans. The Hypertext Transfer Protocol is a protocol used mainly to access data on the World Wide Web.The protocol transfers data in the form of plain text,hypertext,audio,video,and so on.However,it is called the hypertext transfer protocol because its feeiciency allows its use in a hypertext environment where ther are rapid jumps from one document to another.



Q.6 What do you mean by HTML?

Ans. HTML stands for Hyper Text Markup Language where each term can be described as:

1) Hypertext: It is ordinary text has extra features such as formatting,images,multimedia & links to other documents.
2) Markup:It can be be termed as process of taking ordinary text & adding extra symbols.each symbol usedvfor markup in HTML is a command that tells a browser how to display the text.
3) Language:Markup languages are the special type of computer language because they are solely concerned with classifying various parts of a document according to their fuctions.

Q.7 Define WML.

Ans. Wireless Markup Language (WML)is an XML(mark up language) language used to specify content **and user interface for WAP devices like PDA and Mobile Phones.** (WML), based on XML . It provides navigational support, data input, hyperlinks, text and image presentation, and forms, much like HTML(HyperText Markup Language).

Q.8 What do you mean by WML script?

Ans. WML (Wireless Markup Language)is a client-side scripting language that is very similar to JavaScript. Like javascript WML script is used for user input validation, generation of error message and other dialog

boxes etc A major difference between JavaScript and WMLScript is that JavaScript code can be embedded in the HTML markup, whereas WMLScript code is always placed in a file separated from the WML markup. URLs are used to refer to the actual WMLScript code in the WML document.

Q.9 Explain wireless telephony application

Ans. WTA is a collection of telephony specific extensions for call & features control mechanism,merging data networks & vice networks.The WTA framework integrates advanced telephony services using a consistent user interface(e.g,the WML
browser)and llows network operators to increase accessibility for various special services in their network.

Key Terms

1G
1st Generation wireless: first-generation wireless telephone technology, cellphones. These are the analog cellphone standards that were introduced in the 1980s and continued until being replaced by 2G digital cellphones.

2G
2nd Generation wireless telephone technology launched commercially in 1991. Unlike their predecessors 2G phone conversations were digitally encrypted, 2G systems were significantly more efficient on the spectrum allowing for far greater mobile phone penetration levels; and 2G introduced data services for mobile, starting with SMS text messages. After 2G was launched, the previous mobile telephone systems were retrospectively dubbed 1G. While radio signals on 1G networks are analog, and on 2G networks are digital, both systems use digital signaling to connect the radio towers to the rest of the telephone system.

2.5G
"Second and a half generation" is a term used to describe 2G-systems that have implemented a packet switched domain in addition to the circuit switched domain. 2.5G is a stepping stone between 2G and 3G cellular wireless technologies. Although the terms "2G" and "3G" are officially defined, "2.5G" is not. It was invented for marketing purposes.

3G
3rd Generation of mobile phone standards and technology, superseding 2.5G. It is based on the ITU family of standards under the IMT-2000. 3G networks make possible a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency. 3G services include wide-area wireless voice telephony, video calls, and broadband wireless data, all in a mobile environment.

4G

4th Generation wireless (also known as Beyond 3G): the next complete evolution in wireless communications that will a comprehensive solution allowing voice, data, and streamed multimedia to be provided on an "Anytime, Anywhere" basis at higher data rates than previous generations.

4G cannot be an incremental evolution of current 3G technologies, but rather the total replacement of the current 3G networks and handsets.

There is no formal definition for what 4G, but it is intended to be a fully IP-based integrated system capable of providing between 100 Mbit/s and 1 Gbit/s speeds with premium quality and high security.

Access point - (Also called AP.) A wireless network transceiver or "base station" hub, often used to connect a local area network to one or more wireless devices. An access point can also provide a communication link to a wired local area network.

Ad Hoc - A client setting for a wireless local area network that allows devices connected to the network to communicate with one another directly, independent of an access point or router.

B

B-to-B

Business-to-Business (also B2B): is a term commonly used to describe commerce transactions between businesses, as opposed to those between businesses and other groups, such as business-to-consumers (B2C) or business-to-government (B2G). B2B is often used to describe an activity, such as B2B marketing, or B2B sales, that occurs between businesses and other businesses. The volume of B2B transactions is much higher than the volume of B2C transactions.

Bandwidth

The difference between the highest and lowest frequencies of a transmission channel (the width of its allocated band of frequencies).

Basic Telecom Services

Communication services that relay information that relay information in real time from end-to-end without manipulating or enhancing the information.

Bottleneck
A point at which the performance or capacity of an entire system or network can be significantly influenced. Formally, a bottleneck lies on a network or system's critical path and provides the lowest throughput. Whoever controls the bottleneck can exert significant power over the system permitting it to increase its profits and competitive position.

Broadband
The term has different meanings in different contexts. Its meaning has undergone substantial shifts. It refers to a signaling method that includes or handles a relatively wide range of frequencies. Broadband is always relative term. The wider the bandwidth, the greater is the information-carrying capacity.

C

CCITT
ITU's International Telegraph and Telephone Consultative Committee: (now renamed The Telecommunication Standardization Sector (ITU-T)) coordinates standards for telecommunications on behalf of the International Telecommunication Union (ITU). It is based in Geneva.

ccTLD
country code Top-Level Domain: an Internet top-level domain generally used or reserved for a country or a dependent territory. All ccTLD identifiers are two letters long, and all two-letter top-level domains are ccTLDs. Creation and delegation of ccTLDs is performed by the Internet Assigned Numbers Authority (IANA

CDMA2000
Code division multiple access 2000: a hybrid 2.5G / 3G technology of mobile telecommunications standards that use CDMA, a multiple access scheme for digital radio, to send voice, data, and signalling data (such as a dialed telephone number) between mobile phones and cell sites.

Cheap Revolution
A term coined by Rich Kaarlgard that captures the consequences of the cumulative impact of (1) the price-performance dynamics
that resulted from a wide range of microelectronics innovations, (2) innovations in regard to fiber-optic and wireless bandwidth, (3)

changes in software design and costs, and (4) the emerging cost and delivery structure of digital content.

The Cloud
A metaphor for the Internet (based on how it is depicted in computer network diagrams). The Cloud is a style of computing in which IT-related capabilities are provided "as a service", allowing users to access technology-enabled services from the Internet ("in the cloud") without knowledge of, expertise with, or control over the technology infrastructure that supports them.

Client - An application on a computer or device connected to a network that requests services (files, print capability) from another connected computer or device on the network.

Commons
A resource over which a specific group has access and use rights.
Confederal structure
In modern political terms, usually takes the form of a permanent union

of sovereign states for common action in relation to other states Confederations usually are created by a treaty or a common constitution to deal with important issues such as foreign affairs or a common currency, with the central authority being required to provide support for all members.

D
DARPA
Defense Advance Research Projects Agency: an agency of the United States Department of Defense responsible for the development of new technology for use by the military. DARPA has been responsible for funding the development of many technologies, including computer networking and the first hypertext system. Its original name was simply Advanced Research Projects Agency (ARPA), but it was renamed DARPA (for Defense) on March 23, 1972, then back to ARPA on February 22, 1993, and then back to DARPA again on March 11, 1996.

Digital Divide
The gap between those people with effective access to digital and information technology and those without. It includes the imbalances

in physical access to technology as well as the imbalances in resources and skills needed to effectively participate in a dgitial world. It is the unequal access by some members of the society to information and communication technology, and the unequal acquisition of related skills. Groups often discussed in the context of a digital divide include gender, income, race and location. The term global digital divided refers to differences in technology access between countries.

DMCA

Digital Millennium Copyright Act: a 1998 United States copyright law that extended the reach of copyright, while limiting the liability of the providers of on-line services for copyright infringement by their users. The DMCA criminalizes production and dissemination of technology, devices, or services intended to circumvent measures (DRM) that control access to copyrighted works. It also criminalizes the act of circumventing an access control and heightens penalties for copyright infringement on the Internet.

DNS

Domain Name System: a hierarchical naming system for computers, services, or any resource participating in the Internet. It associates information assigned to participants with domain names. It also translates humanly meaningful domain names to the numerical (binary) identifiers associated with networking equipment to locate and address these devices worldwide. In essence, the DNS is the "phone book" for the Internet by translating human-friendly computer hostnames into IP addresses.

Domain Name

A symbolic representation of mostly numerically addressed Internet resources. This abstraction allows resources to be moved to a different physical location in the address topology of the network, globally or locally, in effect changing the IP address. This translation from domain names to IP addresses and vice versa is accomplished with the global facilities of Domain Name System (See DNS).

DRM

Digital Rights Management: a generic term that refers to access control technologies used by hardware manufacturers, publishers, and copyright holders to limit usage of digital media or devices. The term is used to describe technologies, which make the unauthorized use of

media or devices technically formidable. It can also refer to restrictions associated with specific instances of digital works or devices.

E

EC2

Elastic Compute Cloud: a commercial web service provided by Amazon.com which allows paying customers to rent computers on which to run their own computer applications. EC2 allows scalable deployment of applications by providing a web services interface through which customers can request any number of Virtual Machines, i.e. server instances, on which they can load any software of their choice. Current users are able to create, launch, and terminate server instances on demand, hence the term "elastic".

ENUM

Electronic Number Mapping system: a suite of protocols to unify the telephone numbering system with DNS, the Internet addressing system.

ERP

Enterprise Resource Planning: an enterprise-wide information system designed to coordinate all the resources, information, and activities needed to complete business processes such as order fulfillment or billing.

ETSI

European Telecommunications Standards Institute: an independent, non-profit, standardization organization of the telecommunications industry (equipment makers and network operators) in Europe, with worldwide projection.

EU

European Union: a political and economic union of 27 member states, located primarily in Europe. It was established by the Treaty of Maastricht in 1993 on the foundations of the pre-existing European Economic Community.

F

FCC

Federal Communications Commission: a US government agency established by the Communications Act of 1934 that regulates all non-

Federal Government use of the radio spectrum (including radio and television broadcasting), all interstate telecommunications (wire, satellite and cable), and all international communications that originate or terminate in the United States.

FTA
Free trade agreement (or area): An agreement by two or more countries to eliminate tariffs, quotas, and preferences on most (if not all) goods and services between them.

FTTH
Fiber to the home: a network architecture that uses optical fiber to replace all or part of the copper local loop used for telecommunications

G

GAC
Governmental Advisory Committee is an advisory committee of representatives of many national governments that exists within ICANN. It receives advice on governmental interests and needs

GATS
General Agreement on Trade in Services: a 1995 WTO treaty that emerged from Uruguay Round trade negotiations. GATS extended the multilateral trading system to the service sector. All members of the WTO are signatories to the GATS. The basic WTO principle of most favored nation treatment applies to GATS.

GATT
General Agreement on Tariffs and Trade: a treaty that emerged in 1950 when countries could not agree to establish an International Trade Organization. It reduced barriers to international trade through the reduction of tariff barriers, quantitative restrictions and subsidies on trade through a series of agreements. The functions of the GATT were taken over by the World Trade Organization (WTO), which was established during the final round of negotiations in early 1990s.

GDP
Gross domestic product: one measure of a country's national income and output. GDP is the total market value of all final goods and services produced within the country in a specified period of time. It is also considered the sum of a value added at every stage of production

of all final goods and services produced within a country in a given period of time.

GHz
Gigahertz: a measure of frequency, informally defined as the number of cycles occurring per second. Gigahertz are commonly used to describe radio and audio frequencies. 1 GHz is equal to one billion cycles per second. (See MHz)

Governance
The decisions that define expectations, grant power, or verify performance. It consists either of a separate process or of a specific part of management or leadership processes. Sometimes people set up a government to administer these processes and systems.

Grid computing
A form of distributed computing whereby a "super and virtual computer" is composed of a cluster of networked, loosely-coupled computers, acting in concert to perform very large tasks.

GSM
Global System for Mobile Communication: a popular standard for mobile phones. Its ubiquity made international roaming common between mobile phone operators, enabling subscribers to use phones in many parts of the world. GSM is a second-generation (2G) mobile phone system that made it easier to build data communications into the system.

H

HIPAA
Health Insurance Portability Accountability Act of 1996: protects health insurance coverage for workers and their families when they change or lose their jobs. It also requires the establishment of national standards for electronic health care transactions and national identifiers for providers, health insurance plans, and employers.

HTML
HyperText Markup Language: the predominant markup language for Web pages. It provides a means to describe the structure of text-based information in a document and to supplement that text with interactive forms, embedded images, and other objects

I

IANA

Internet Assigned Numbers Authority: the entity that oversees global IP address allocation, DNS root zone management, media types, and other Internet protocol assignments. It is operated by ICANN.

ICANN

Internet Corporation for Assigned Names and Numbers (pronounced eye-can): a non-profit corporation created in 1998 to oversee a number of Internet-related tasks previously performed directly on behalf of the U.S. government. ICANN manages the assignment of domain names and IP addresses. The technical work of ICANN is referred to as the IANA function. ICANN also helps preserve the operational stability of the Internet; promote competition, expand representation of the global Internet community; and develop policies through bottom-up, consensus-based processes.

ICT

Information and Communication Technology: an umbrella term that includes all technologies for the manipulation and communication of information. ICT is sometimes used in preference to Information Technology (IT), particularly in the education and government communities. In the common usage it is often assumed that ICT is synonymous, but ICT is broader. ICT encompasses any medium to record information and technology for broadcasting information. It includes the wide variety of computing hardware, the rapidly developing personal hardware market comprising mobile phones, personal devices, MP3 players, and more. Technologies such as broadcasting and wireless mobile telecommunications are explicitly included under ICT.

IETF

Internet Engineering Task Force: develops and promotes Internet standards, dealing in particular with standards of the TCP/IP and Internet protocol suite. It is an open standards organization, with no formal membership or membership requirements. All participants and leaders are volunteers, though their work is usually funded by their employers or sponsors.

IGF

Internet Governance Forum: a multi-stakeholder forum for policy

dialogue on issues of Internet governance. Its establishment was announced by the UN Secretary General in July 2006. It first convened in October/November 2006.

IM
Instant messaging: a technology (along with chat) that creates the possibility of real-time text-based communication between two or more participants over the Internet or some form of internal network/intranet.

Inflection point
The point at which the old strategic point dissolves and gives way to a new one.

Intellectual property
A legal field that refers to creations of the mind such as musical, literary, and artistic works; inventions; and symbols, names, images, and designs used in commerce, including copytights, patents, and trademarks. Under intellectual property law, the holder of one of these abstract properties has certain exclusive rights to the creative work, commercial symbol, or invention by which it is covered.

Interconnection
The physical linking of a carrier's network with equipment or facilities not belonging to that network. The term may refer to a connection between a carrier's facilities and the equipment belonging to its customer, or to a connection between two or more carriers.

Interoperability
A property referring to the ability of diverse systems and organizations to work together (inter-operate). In telecommunications, the ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services exchanged to enable them to operate effectively together.

IP
Internet protocol: a protocol used for communicating data across a packet-switched internetwork using the Internet Protocol Suite (TCP/IP). The first major version of addressing structure, Internet Protocol Version 4 (IPv4), remains the dominant protocol of the

Internet, although the successor, Internet Protocol Version 6 (IPv6) is actively deployed worldwide.

IPR
Intellectual Property Rights: a legal field related to creations of the mind such as musical, literary, and artistic works; inventions; and symbols, names, images, and designs used in commerce, including copyrights, trademarks, patents, and related rights. Under intellectual property law, the holder of one of these abstract properties has certain exclusive rights to the creative work, commercial symbol, or invention by which it is covered.

IPTV
Internet Protocol television: a system where a digital television service is delivered using Internet Protocol over a network infrastructure, which may include delivery by a broadband connection. IPTV is television content that is received by the viewer through the technologies used for computer networks, instead of being delivered through traditional broadcast and cable formats.

ISO
International Organization for Standards: an international-standard-setting body composed of representatives from various national standards organizations. ISO promulgates worldwide proprietary industrial and commercial standards.

ISP
Internet Service Provider: a company that offers their customers access to the Internet. The ISP connects to its customers using a data transmission technology appropriate for delivering Internet Protocol datagrams, such as dial-up, DSL, cable modem, or dedicated high-speed interconnects. ISPs may provide Internet e-mail accounts to users so that they can communicate with one another by sending and receiving electronic messages through their ISPs' servers.

IT
Information Technology: a term that encompasses many aspects of computing and technology. (See ICT)

ITU
International Telecommunication Union: founded as the International

Telegraph Union in 1865, its main tasks include standardization, allocation of the radio spectrum, and organizing interconnection arrangements between different countries to allow international phone calls. It is one of the specialized agencies of the United Nations.

J

JETRO

Japanese External Trade Organization: an independent government agency established in 1951 to consolidate Japan's efforts in export promotion. JETRO also provides information and support to foreign companies looking for successful entry and expansion in the Japanese market.

L

Light touch regulation

Regulation that does not involve imposing or maintaining unnecessary burdens.

LTE

Long Term Evolution: the 3G standardization work begun by the 3rd Generation Partnership Project in late 2004. The goal is to define a set of high-level requirements for mobile communications systems to compete with other emerging cellular broadband technologies, particularly WiMAX.

M

Managed entry

Megabit

When used to describe data storage a megabit is 1,024 kilobits. When used to described data transfer rates a megabit refers to 1 million bits. Often networks are measured in megabits per second (Mbps).

Megabyte

A megabyte is is a unit of information or computer storage equal to 1,048,576 bytes or 1,024 kilobytes. Large computer files are typically measured in megabytes.

MHz

Megahertz: a measure of frequency, informally defined as the number of cycles occurring per second. Megahertz are commonly used to

describe radio and audio frequencies. 1 GHz is equal to one million cycles per second. (See GHz).

Modularity
A continuum that describes the degree to which a system's components may be separated and recombined. It refers to the level of interoperability between components, and the degree to which the "rules" of the system architecture allow or prohibit the mixing and matching of components.

Moore's Law
In 1965 Gordon Moore, a co-founder of Intel, predicted with regard to semiconductor technology that "the number of transistors and resistors on a chip doubles every 18 months."

Multilateral
Involving or participated in by two or more nations or parties

Multisided Platform
A multi-sided platform serves two or more distinct types of customers that are mutually dependent and "whose joint participation makes the platform valuable to each.

N

NAFTA
North American Free Trade Area: a trilateral trade bloc in North America created by the governments of the United States, Canada, and Mexico. The agreements took effect on January 1, 1994. The trade bloc is the largest in the world and second largest by nominal GDP comparison. (See also FTA)

Network Infrastructure
The architecture, in terms of equipment and connections, that makes up a network.

Network Neutrality
A principle that is applied to residential broadband networks, and potentially to all networks. A neutral broadband network is one that is free of restrictions on the kinds of equipment that may be attached, on the modes of communication allowed, which does not restrict content,

sites or platforms, and where communication is not unreasonably degraded by other communication streams.

NGN
Next-Generation Network: a broad term to describe some key architectural evolutions in telecommunication core and access networks that will be deployed before 2020. The idea is that one network transports all information and services (voice, data, and all sorts of media such as video) by encapsulating these into packets, as on the Internet. NGNs are commonly built around the Internet Protocol, and therefore the term "all-IP" is sometimes used to describe the transformation towards NGN.

NGO
Non-governmental organization: a legally constituted organization created by private organizations or people with no participation or representation of any government. In the cases in which NGOs are funded totally or partially by governments, the NGO maintains its non-governmental status insofar as it excludes government representatives from membership in the organization.

NTT
Nippon Telegraph and Telephone: a telephone company that dominates the telecommunication market in Japan. NTT is the largest telecommunications company in Asia, and second in the world in terms of revenue.

O

ODM
Original Design Manufacturer: a company that manufactures a product that ultimately will be branded by another firm for sale. Such companies allow the brand firm to produce without having to engage in the organization or running of a factory. A primary attribute of this business model is that the ODM owns and/or designs in-house the products that are branded by the buying firm.

OECD
Organization of Economic Co-operation and Development: an international organisation of 30 countries that accept the principles of representative democracy and free-market economy. Most OECD

members are high-income economies and are regarded as developed countries.

OEM
Original Equipment Manufacturer: a company that uses a component made by a second company in its own product, or sells the product of the second company under its own brand.

OFDMA
Orthogonal Frequency-Division Multiple Access: a frequency-division multiplexing scheme used as a digital multi-carrier modulation method.

Open Source
A development methodology, which offers practical accessibility to a product's source goods and knowledge. Open source is one possible design approach. Others see open source as a critical strategic element of their operations. Open source gained popularity with the rise of the Internet, which provided access to diverse production models, communication paths, and interactive communities.

OS
Operating System: the software component of a computer system that is responsible for the management and coordination of activities and the sharing of the resources of the computer. The operating system acts as a host for applications that are run on the machine.

OSI
Open Systems Interconnection: an effort to standardize networking started in 1982 by the International Organization for Standardization along with the ITU-T.

P

PC
Personal Computer: any computer whose original sales price, size, and capabilities make it useful for individuals, and which is intended to be operated directly by an end user, with no intervening computer operator.

PDC
Personal digital cellular: a 2G mobile-phone standard developed and used exclusively in Japan.

Peering
Voluntary interconnection of administratively separate Internet networks for the purpose of exchanging traffic between the customers of each network. The pure definition of peering is settlement-free or "sender keeps all," meaning that neither party pays the other for the exchanged traffic, instead, each derives revenue from its own customers. Peering requires physical interconnection of the networks, an exchange of routing information and is often accompanied by peering agreements of varying formality, from "handshake" to thick contracts.

Peer-to-peer (or P2P)
P2P networks are typically used for connecting nodes via largely ad hc connections. P2P allows diverse connectivity between participants in a network rather than conventional centralized resources where a relatively low number of servers provide the core value to a service or application.

Platform
A computing hardware architecture or software framework (incldluing application frameworks) that allows software to run. Most platforms include a computer's architecture, operating system (see OS), programming languages, and runtime libraries or graphical user interface.

"Plug and Play"
A computer feature that allows the addition of a new device, normally a peripheral, without physical reconfiguration of device resources, or user intervention in resolving device conflicts.

Plurilateral
Referring to an agreement or a negotiation involving more than two countries, but not a great many, which would be multilateral.

PNP
Personal Network Platform: delivers core network functions to

individuals. PNP offers full flexibility, transparency, scalability, and expandability.

Principal/Agent Problem
In political science and economics this treats the difficulties that arise under conditions of incomplete and asymetric information when a principal employs an agent. Various mechanisms may be used to try to align the interests of the agent with those of the principal.

Property Rights
The exclusive authority to determine how a resource is used, whether that resource is owned by government or by individuals. All economic goods have a property rights attribute.

PTTs
Post, telegraph, and telephone authorities: are or were government agencies responsible for postal mail, telegraph, and telephone services. Such monopolies existed in many countries, but since the 1980s many of them have been partially or completely privatized.

R

R&D
Research and Development: creative work undertaken on a systematic basis to increase the stock of human knowledge and the use of this expanding stock of knowledge to devise new applications.

rBoc
regional Bell operating company: US telephone companies that were created on January 1, 1984, as a the result of the U.S. Department of Justice antitrust suit against AT&T. The original agreement created seven rBocs (Baby Bells): Ameritech — (acquired by SBC in 1999), Bell Atlantic — (acquired GTE in 2000 and changed its name to Verizon), BellSouth — (acquired by AT&T Inc. in 2006), NYNEX — (acquired by Bell Atlantic in 1996), Pacific Telesis — (acquired by SBC in 1997), Southwestern Bell — (changed its name to SBC in 1995; acquired AT&T Corp. in 2005 and changed its name to AT&T Inc.), and US West — (acquired by Qwest in 2000).

RFIDs
Radio frequency identification devices: A tag that can be applied to or incorporated into a product, animal, or person for the purpose of

identification and tracking using radio waves. It relies on storing and remotely retrieving data using radio frequency tags or transponders.

RSS
Really Simple Syndication: a family of Web feed formats used to publish frequently updated works – such as blog entries, news headlines, audio, and video – in a standardized format. An RSS includes full or summarized text, plus metadata such as publishing dates and authorship. A standardized XML file format allows the information to be published once and viewed by many different programs.

S

S3
Simple Storage System: an online storage web service offered by Amazon Web Services that first became available in the US in March 2006 and in Europe in November 2007.

SaaS
Software as a Service: a model of software deployment where an application is hosted as a service provided to customers across the Internet. For a price, SaaS eliminates the need to install and run the application on the customer's own computer, SaaS alleviates the customer's burden of software maintenance, ongoing operation, and support.

SETI
Search of Extraterrestrial Intelligence: the collective name for a number of activities to detect intelligent extraterrestrial life. SETI projects survey the sky to detect the existence of transmissions from a civilization on a distant planet.

SME
Small and Medium Enterprise: companies whose headcount or turnover falls below certain limits. (SME is used more in the EU and in international organizations; in the US the term small and medium-sized businesses (SMBs) often is favored.) In the EU firms with fewer than 50 employees are categorized as "small", and those with fewer than 250 as "medium". In the US small business often refers to those with fewer than 100 employees, while medium-sized business often refers to those with fewer than 500 employees.

SMS

Short Message Service: a communications protocol allowing the interchange of short text messages between mobile telephone devices. The SMS technology has facilitated the development and growth of text messaging. SMS is so closely associated with text messaging and that in many countries it is used as a synonym for a text message or the act of sending a text message, even when a different protocol is being used.

SNA

Systems Network Architecture: IBM's proprietary networking architecture created in 1974. It is a complete protocol stack for interconnecting computers and their resources. SNA describes the protocol and is, in itself, not actually a program. The implementation of SNA takes the form of various communications packages.

SOA

Service-Oriented Architecture: In computing, SOA provides methods for systems development and integration where systems group functionality around business processes and package these as interoperable services. SOA also describes IT infrastructure that allows different applications to exchange data with one another as they participate in business processes.

Spectrum

The "electromagnetic spectrum" (usually just spectrum) is the range of all possible electromagnetic radiation frequencies. The electromagnetic spectrum extends from below the frequencies used for modern radio (at the long-wavelength end) through gamma radiation (at the short-wavelength end), covering wavelengths from thousands of miles down to a fraction the size of an atom.

Stack

In computer science, an abstract data tupe and data structure based on the principle of Last in First Out (LIFO). Stacks are used extensively at every level of a modern computer system. The stack is ubiquitous. A stack-based computer system is one that stores temporary information primarily in stacks, rather than hardware CPU registers.

Standard

A technical standard is an established norm or requirement. It is usually a formal document that establishes uniform engineering or

technical criteria, methods, processes and practices. (A custom, convention, company product, or corporate standard, which becomes generally accepted and dominant is often called ade facto standard.) A technical standard may be developed privately or unilaterally by a corporation, regulatory body, or military. Standards can be developed by groups such as trade unions, and trade associations.

Supply chain
The system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer.

T

TCP/IP
Transmission Control Protocol (TCP) and the Internet Protocol (IP) (also known as The Internet Protocol Suite): two early two networking protocols used for the Internet and other similar networks. TCP/IP, like many protocol suites, may be viewed as a set of layers. Each layer solves a set of problems involving the transmission of data, and provides a well-defined service to the upper layer protocols based on using services from some lower layers. Upper layers are logically closer to the user and deal with more abstract data, relying on lower layer protocols to translate data into forms that can eventually be physically transmitted. The TCP/IP model consists of four layers. From lowest to highest, these are the Link Layer, the Internet Layer, the Transport Layer, and the Application Layer.

TD-SCDMA
Time division synchronous code division multiple access: an alternate 3G mobile telecommunications standard, being pursued in China by the Chinese Academy of Telecommunications Technology, Datang, and Siemens AG, in an attempt not to be dependent on Western technology. (See TDMA and CDMA2000)

TDMA
Time division multiple access: a channel access method for shared medium (usually radio) networks. It allows several users to share the same frequency channel by dividing the signal into different time slots.

TLDs
Top-level domains: the last part of an Internet domain name; that is,

the letters that follow the final dot of any domain name. Management of most top-level domains is delegated to responsible parties or organizations by the Internet Corporation for Assigned Names and Numbers (see ICANN), which operates the Internet Assigned Numbers Authority (IANA) and is in charge of maintaining the Domain Name System (see DNS) root zone.

Trading Rights

Transparency

The extent to which laws, regulations, agreements, and practices affecting international trade are open, clear, measurable, and verifiable

U

UMB

Ultra Mobile Broadband: the brand name for the project to improve the CDMA2000 mobile phone standard for next generation applications and requirements.

Unbundling

Usually associate with local loop unbundling, it is the regulatory process of allowing multiple telecom operators to connect to the telephone exchange's central office to the customer's's premises.

USTR

Office of the United States Trade Representative: the US agency responsible for developing and recommending US trade policy, conducting trade negotiations at bilateral and multilateral levels, and coordinating trade policy within the US is part of the Executive Office of the President.

V

VAN

Value-Added Network: VANs are public networks that add value to the basic communication provided by common carriers by offering specialized services such as access to commercial data bases, E-mail and video conferencing. A VAN is where an ISP provides an extra service as well as the Internet line.

VoIP

Voice over Internet Protocol: a family of transmission technologies for delivery of voice communications over the Internet or other packet-

switched networks. Other terms frequently encountered and synonymous with VoIP are IP telephony and Internet telephony, as well as voice over broadband, broadband telephony, and broadband phone. VoIP systems usually interface with the traditional public switched telephone network to allow for transparent phone communications worldwide. Skype and Vonage are notable service provider examples.

W

Web 2.0

The changing trends in the use of Web technology and web design that aim to enhance creativity, secure information sharing, collaboration and functionality of the web. Web 2.0 concepts have led to the development and evolution of web-based communities and hosted services, such as social-networking sites, video sharing sites, wikis, and blogs. Web 2.0 does not refer to an update to any technical specifications, but rather to changes in the ways software developers and end-users make use of the Web.

W-CDMA

Wideband code division multiple access: a type of 3G cellular network follow-on to the 2G GSM networks deployed worldwide. (See also CDMA2000 and TD-SCDMA).

WiFi

Wireless Fidelity: the wireless technology used in home networks, mobile phones, video games, and other electronic devices that require some form of wireless networking capability.

WiMAX

Worldwide Interoperability for Microwave Access: a telecom technology that provides for wireless transmission of data using a variety of transmission modes, from point-to-point links to full mobile cellular-type access. The technology provides up to 70 Mb/sec symmetric broadband speed without the need for cables. Its creators describe WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL.

WRC

World Radiocommunication Conference: organized by the ITU to

review, and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum, and the geostationary-satellite and non-geostationary-satellite orbits. It is held every two to four years. Prior to 1993 it was called the World administrative radio conference (WARC).

WSIS

World Summit on Information Society: two UN-sponsored conferences about information, communication and the information society that took place in 2003 in Geneva and in 2005 in Tunis. Its advocates aimed to bridge the "global digital divide" separating rich countries from poor countries by spreading access to the Internet in the developing world.

WTO

World Trade Organization: an international organization designed to supervise and liberalize internetaional trade. The WTO came into being on 1 January 1, 1995, and is the successor to the GATT. The WTO deals with the rules of trade between most nations nations; it is responsible for negotiating and implementing new trade agreements, and is in charge of policing member countries' adherence to WTO agreements. The WTO has 153 members, which represents more than 95% of total world trade.

WWW

World Wide Web: a system of interlinked hypertext documents accessed via the Internet. Web browsers are used to view Web pages that may contain text, images, videos, and other multimedia and navigate between them using hyperlinks. The World Wide Web was created in 1989 by Tim Berners-Lee and released in 1992.

MCQs

1. If an FDMA network has eight stations, the medium bandwidth has _____ bands.
a1
b.2
c.**8**
d.16

2. In the _____ random-access method there is no collision.
a.CSMA/CD
b.**CSMA/CA**
c.ALOHA
d.Token-passing

3. _____ is a random-access protocol.
a. FDMA
b. CDMA
c. **MA**
d. Polling

4. _____ is a controlled-access protocol.
a. FDMA
b. TDMA
c. CSMA
d. **Reservation**

5. _____ is (are) a channelization protocol.
a. FDMA
b. TDMA
c. CDMA
d. **All the above**

6. _____ is the access protocol used by traditional Ethernet.
a. Token ring
b. CSMA
c. **CSMA/CD**
d. CSMA/CA

7. The most primitive random access method is _____.
a. Channelization
b. ALOHA
c. CSMA
d. Token passing

8. When a collision is detected in a network using CSMA/CD, _____.
a. The frame is immediately resent
b. The backoff value is decremented by 1
c. **A jam signal is sent by the station**
d. The backoff value is set to 0

9. In the _____ random-access method, stations do not sense the medium.
a. CSMA/CA
b. **ALOHA**
c. CSMA/CD
d. Ethernet

10. When a primary device asks a secondary device if it has data to send, this is called _____.
a. Backing off
b. **Polling**
c. Selecting
d. Reserving

11. If a TDMA network has eight stations, the medium bandwidth has _____ bands.
a. **1**
b. 2
c. 8
d. 16

12. If a CDMA network has eight stations, the medium bandwidth has _____ bands.
a. **1**
b. 2
c. 8
d. 16
13. Before data can be transmitted, they must be transformed to _____.
a. **Electromagnetic signals**
b. Periodic signals

c. Aperiodic signals
d. Low-frequency sine waves

14. When one of the components of a signal has a frequency of zero, the average amplitude of the signal _____.
a. Is less than zero
b. **Is greater than zero**
c. Is zero
d. (a) or (b)
The correct **answer** is b

15. A periodic signal can always be decomposed into _____.
a. Exactly an odd number of sine waves
b. A set of sine waves, one of which must have a phase of 0°
c. **A set of sine waves**
d. None of the above

16. In a frequency-domain plot, the horizontal axis measures the _____.
a. **Frequency**
b. Peak amplitude
c. Phase
d. Slope

17. In a time-domain plot, the vertical axis is a measure of _____.
a. Frequency
b. Phase
c. **Amplitude**
d. Time

18. In a time-domain plot, the horizontal axis is a measure of _____.
a. Signal amplitude
b. **Time**
c. Frequency
d. Phase

19. As frequency increases, the period _____.
a. **Decreases**
b. Increases

c. Remains the same
d. Doubles

20. When propagation speed is multiplied by propagation time, we get the _____.
a. Throughput
b. Wavelength of the signal
c. **Distance a signal or bit has traveled**
d. Distortion factor

21. Propagation time is _____ proportional to distance and _____ proportional to propagation speed.
a. Inversely; directly
b. Inversely; inversely
c. **Directly; inversely**
d. Directly; directly

22. Wavelength is _____ proportional to propagation speed and _____ proportional to period.
a. **Directly; directly**
b. Inversely; directly
c. Directly; inversely
d. Inversely; inversely

23.Modulation refers to _____.
1. the distance between the uplink and downlink frequencies
2. the separation between adjacent carrier frequencies
3. the process of changing the characteristics of a carrier frequency
4. the number of cycles per unit of time

24 .Which of the following are not telephony services supported by GSM?
1. dual-tone multifrequency
2. voice mail
3. fax mail
4. call waiting

25.What is the basic service unit of cellular telephony?
1. location area
2. cell
3. PLMN service area

4. MSC/VLR service area

26.The first cellular systems were _____.
1. analog
2. digital
3. semi analog
4. None of the above

27.The location area is the area in which a _____ can be paged.
1. subscriber
2. BTS
3. tower
4. None of the above

28.The _____ is a database used for storing and managing subscriptions.
1. HLR
2. VLR
3. EIR
4. AuC

29.The _____provides authentication and encryption parameters that verify the users identity and ensure the confidentiality of each call.
1. HLR
2. VLR
3. EIR
4. AUC

30.The _____ consists of both hardware and software that provides an interface to various networks for data communications
1. GIWU
2. AUC
3. MSN
4. MXE

31.The _____ is a node that provides integrated voice, fax, and data messaging.
1. AUC
2. GMSC

3. MXE
4. MSN

32.Modulation technique used in DECT is
1. **GFSK**
2. QPSK
3. BPSK
4. None of the above

33.The broad spectrum of the transmitted signal gives rise to
1. Fadiing
2. Noise
3. **Spread Spectrum**
4. All Of the above

34. All communication systems involve
a. analogue data
b. digital data
c. audio data
d. **information**

35. The term POTS stands for
a. Public Orientated Telephone System
b. **Plain Old Telephone System**
c. Packet Orientated Text System
d. Packet Orientated Telephone System

36. Conventional TV and Radio is transmitted using:
a. Digitally encoded signals
b. **Radio waves**
c. Digitally modulated signals
d. Base band signals

37.Which of the following is a low cost wireless technology:
a. RedHat
b. Conventional Ethernet
c. Bluetooth
d. Firewire

38.Wi-Fi is a standard for:
a. Commercial radio communications
b. Wireless speakers for Home Cinemas
c. Connecting peripherals to a mobile
d. **Mobile computing**

39. The Formula for Power is:
a. **P = I times V**
b. P = V divided by R
c. P = I times R
d. P = R times I

40. 4. Advanced TCP window control is especially relevant
a.On circuit switching optical networks
b. On wireless networks
c.**On TDM multiplexers**

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