**Chapter 1:Introduction**

1. What are the major principles behind layering?

Layers created for different abstractions , Each layer performs a set of well-defined functions , The function of a layer is chosen with definition of international standard protocols in mind , Minimize information flow across interfaces between boundaries , Goal: optimizing the number of layers

1. What are the advantages of layered architecture?

The ability to change any given protocol without having to change all protocols; information hiding

Modification/upgrading of layers is easy, Modulation simplifies the overall design , Different layers can be assigned to different standards , Different mechanisms (packet-switching, circuit-switching) may be used independently , The relation between different control functions can be better understood , Common lower levels may be shared by different higher levels , Functions (especially at lower levels) may be removed from software to hardware and microcodes , Increases the compatibility of different machines

1. What are the disadvantages of layered architecture?

Too many layers can result in decreased throughput.

, Total overhead is higher , Two communicating machines may have to use certain functions which they could do without layers , As technology changes, the functions may not be in the most cost-effective layer

1. Briefly describe the major functionality of:
   1. Physical layer

how to transmit the signal

* 1. Data Link layer

purpose is to ensure the correct delivery of data and to ensure upper layer don’t notice when data is received incorrectly; makes sender send info in data frames

* 1. Network layer

determines how data is routed through the subnet

* 1. Transport layer

Accept data and split said data into smaller pieces and pass the pieces onto the network layer; end to end communication

* 1. Session layer

allows users on different machines to setup sessions with each other

* 1. Presentation layer

is concerned with the syntax and semantics of the information; manages an abstract version of the data structures and makes it possible to define high-level data structures

* 1. Application layer

contains a variety of protocols commonly used by the user(s)

1. What are the major differences between OSI protocol stack and TCP/OP (IETF) protocol stack?

The TCP/IP is mainly concerned with how do we transmit said data on a given network, while OSI also considerers the computers/ machines that said users are using to transmit

1. How do we measure quality of service?

quality of service is measured by bandwidth, latency and reliability

1. What are the major differences between circuit-switching and packet-switching?

circuit-switching sets up a physical connection that continuously transmits data, while packet-switching send packets of data when they are ready to the destination with no need to set up a physical connection

1. When we say a reliable connection, what do we mean by that? What is needed to make a reliable connection?

The ability to send data and ensure that said data makes it to its destination complete; with no dropped packets

1. Explain why TCP/IP has 4 layers and OSI has 7 layers.

TCP/IP combines the physical layer and the data link layers; and the session, presentation and application layers. TCP/IP only concerns itself with “how do we send said data from point A to point B” it is irrespective of the users hardware

**Chapter 2: Physical Layer**

1. Describe the major characteristics of a signal:
   1. Frequency

the rate of change of a signal

* 1. Period

time for one repetition of a signal

* 1. Phase

relative position of a signal in time

* 1. Wavelength

the distance occupied by once cycle

* 1. Spectrum

the range of frequencies contained within a given signal

1. What is the difference between analog and digital signals?

digital signals- discrete values of a signal within some interval

analog signals- continuous values of a signal within some interval

1. What is the difference between analog and digital transmissions?

digital transmissions- uses two signals, transmits using square waves, concerned with content

analog transmissions- uses waves such as cosine and sine, transmitted without regard to content, continuously variable

1. What is attenuation and how do we handle it?

the tendency of a signal to degrade over distance; we use amplifiers and repeaters

1. What is the major difference between an amplifier and a repeater?

amplifier- boosts an analogue signal, including noise,

repeater- boots a digital signal by regenerating the square wave; extract the bit pattern and retransmits said signal; more resilient to errors

1. What are the advantages/disadvantages of analog transmission?

advantages- cheaper

disadvantages- degrades over distance

1. What are the advantages/disadvantages of digital transmission?

advantages- low cost, better data integrity, more capacity, better security and privacy

disadvantages- bit errors

1. What are the major transmission impairment?

analog- degradation of signal over distance

digital- bit errors

attenuation, delay distortion and noise

1. What is delay distortion?

different frequency components travel at different speeds

1. How do we measure capacity?

data rate- rate at which data can be communicated, depends on channel frequency and modulation technique --> bits/sec

bandwidth- in terms of channel frequency --> cycles/sec

1. What is the major difference between Bandwidth and Data Rate?

data rate- the amount of data that can be transmitted in a given time

bandwidth- refers to the theoretical rate of speed that data on your network can travel, which is probably a speed you won't see very often.

1. What does Nyquist's Theorem say?

the maximum bit rate without noise is

C= 2 B log2(M)

B= channel frequency is Hz; M= the level of said signal ie. binary, 8-bit; C= capacity in bits/sec

1. What does Shannon's Theorem say?

C= B log2(1+ (S/N))

B= channel frequency is Hz; S/N= the Signal to Noise ratio; C= capacity in bits/sec

Where 10 log10(S/N)= dB

1. What is the main difference between single mode and multi mode fiber optics?

Single mode: A small core , Support a single pathway of light , Realigns the light toward the center of the core

Multi mode: A large-diameter core that is much larger than the wavelength of light transmitted , Supports multiple pathways of several wavelengths of light , Less bandwidth per wavelength

1. What are advantages/disadvantages of satellite communications?

advantages- larger coverage area, very precise, higher bandwidth is available, transmission cost is independent of distance

disadvantages- launching satellite cost, bandwidth is gradually being used up, propagation delay

1. What is modulation? What are their classifications?

the process of encoding source data onto a carrier signal with frequency f

AM- amplitude modulation; two different amplitudes represent 0 and 1

FM- frequency modulation; two different tones represent 0 and 1

PM- phase modulation; two carrier wave shift to represent 0 and 1

1. What is modulation rate?

rate at which the signal level changes; measured in baud

1. What are the major components of a delay suffered by a packet? Which one is deterministic (predictable)? Which one is non-deterministic (probabilistic)?

propagation delay- depends on distance; deterministic

transmission delay-depends on modulation rate; deterministic

queuing delay-depends on queue/ buffer size; non-deterministic

access delay-depends on LAN access policy; both

1. How do we calculate the length of a packet in time?

1bit/ 100 Mbps= 1/(100\*2^20)sec.= .009 microsecond // in fiber

1. How do we calculate the length of a packet in meters?

(2\*10^8 m/sec)\* 1/(100\*2^20)sec= (2\*10^8)/(100\*2^20)m= 1.9 meters // in fiber

1. What is the major difference between Bandwidth, Throughput and efficiency?

Bandwidth refers to the theoretical rate of speed that data on your network can travel, which is probably a speed you won't see very often.

Throughput is the actual rate of speed that data on your network travels.

Efficiency is the ratio of throughput to bandwidth

1. Manchester and Differential Manchester coding are the two most popular data coding. Explain how they work

Manchester- 0’s are low to high voltage change, while 1’s are high to low; in the middle of the clock

Differential Manchester- 0’s are the absence of a transition and 1’s are the presence of a transmission; also in the middle of the clock // if a 1 is encountered the pattern changes ex. if it was low-to-high and a 1 is encountered it changes to high-to-low

1. What is the main difference between multiplexing and multi access?

multiplexing deals with how multiple signals can utilize a single resource i.e - sampling, modulation etc.

Multiple access on the other hand, deals with which signal can utilize which particular resource - frequency allocation/time slot allocation etc.

1. Discuss the difference between Frequency Hopping and Direct Sequence and show how they work?

Frequency Hopping- occurs when the sender and receiver change frequency and hopping code in time so it is difficult to eavesdrop if you don’t know the next frequency and code

Direct Sequence- spread the signal over a wider bandwidth and inserts a chipping code in order to secure a given data stream

1. What is Time-Division Multiplexing (TDM) and how it works

gives the full power and frequency to a given user but only for a limited amount of time, cycles through all users before restarting

1. What is Frequency-Division Multiplexing (FDM) and how it works

gives each user full power all the time but only on a given frequency

1. What is Code-Division Multiplexing (CDM) and how it works

Code division multiplexing (CDM) is a networking technique in which multiple data signals are combined for simultaneous transmission over a common frequency band.

1. What is Wave-Division Multiplexing (WDM) and how it works

a given user is given a specific wavelength to transmit and receive data on; ie. the color green

1. What is Spread Spectrum?

spread spectrum is when you take a given signal and spread is over a larger bandwidth in the frequency domain in order to make it more resilient to errors/ corruption

1. What is Frequency Hopping and how it works?

Frequency Hopping- occurs when the sender and receiver change frequency and hopping code in time so it is difficult to eavesdrop if you don’t know the next frequency and code

1. What is Direct Sequence and it works?

Direct Sequence- spread the signal over a wider bandwidth and inserts a chipping code in order to secure a given data stream