## Discussion Assignment

**1) Digital Transmission has become the preferred method of data transmission. Can you think of circumstances when analog transmission is still used? Where and why?**

Broadcast AM and FM radio are still using analog transmission, Because the use of analog transmission with analog data is relatively simple, the technology is more mature and the cost is lower.

**2) Given the rate of recent advances in technology, what kind of modems do you think will be available next year?**

Wifi7 modem will be available next year. Wifi7 is the next generation WiFi standard, corresponding to standard IEEE 802.11be. Qualcomm's Wi-Fi 7 chips have already begun shipping to customers, and final products are expected to be available by the end of this year, with large shipments expected in 2023.

**3) Two major techniques are used for re-transmission during error control: go-back-N; and selective-reject. Can you name a circumstance under which each would be more suitable?**

When the error rate is low, go-back-N is used to improve the efficiency of transmission. At the same time, the receiver does not need a buffer, which is simpler.

When the error rate is high, using GO-back-N will result in the overall retransmission of many buffers and reduce the transmission efficiency. In this case, using selective-reject is a better choice and only requires the retransmission of incorrect packets.

**4) Synchronous TDM and statistical TDM are two types of time-division multiplexing. Give areas of applications for which each is used.**

Connection oriented circuit switched network need use Synchronous TDM, Because this connection will reserve enough capacity for users to transmit continuous data streams at the maximum rate. Therefore, the synchronous TDM is selected to monopolize the slot in the line.

Packet switched network need use statistical TDM, Because all users can send packets at any time and no capacity is reserved for any particular communication, statistical TDM in this case allows users who use only part of the connection capacity to share the available bandwidth.

**5) X .25 was the standard for packet switching. Is it still used today? Why or why not?**

X.25 is an obsolete technology that is rarely used because it was developed on the basis of the early low speed, high error rate physical links and its characteristics are no longer suitable for the requirements of high-speed connections.

**6) Does your company use Ethernet, Fast Ethernet, or Gigabit Ethernet? Where is each being used: backbone, or desktop? If so, is it being used appropriately?**

We use Gigabit Ethernet on both backbone and desktop, Gigabit Ethernet can better meet the increasing bandwidth requirements of current network services, and Gigabit network devices such as switches, routers, and nics are the mainstream and relatively cheap.

**7) Does your company or organization use IPv4 or IPv6? Why has the deployment of IPv6 been very slow? How can we speed up its deployment?**

We use both IPv4 and IPv6.

Because IPv6 is completely incompatible with IPv4, which many web services currently rely on; NAT and other technologies solve the problem of lack of IPv4 address to a certain extent. The industrial chain lacks the impetus to upgrade, and the upgrade also needs a lot of costs.

With the development of the Internet of things such as vehicular networks, users have a growing demand for network addresses, and the use of IPv6 has become a necessary and cheap option to promote faster popularization.

## Module 1 Written assignment

##### Name the major hardware components and their functions in a data communications network. (10%)

* Source： Generates the data to be transmitted.
* Transmitter：Transforms and encodes the information in such a way as to produce electromagnetic signals that can be transmitted across some sort of transmission system.
* Transmission system：This can be a single transmission line or a complex network connecting source and destination.
* Receiver： Accepts the signal from the transmission system and converts it into a form that can be handled by the destination device.
* Destination：Takes the incoming data from the receiver.

##### Name the three cables most often used in data communications and networks. (10%)

* Twisted pair, coaxial cable, and optical fiber

##### State the differences between local area networks (LANs) and wide area networks (WANs). (10%)

* LANs are usually used within a single building or a group of buildings, WANs used over long distances.
* LANs are usually used by one organization, while WANs are usually owned by different organizations.
* LANs usually have high data transmission speed.

##### Define the term protocol as it relates to data communications. (10%)

* Syntax: Concerns the format of the data blocks  
  Semantics: Includes control information for coordination and error handling  
  Timing: Includes speed matching and sequencin

##### What are the reasons for using layered protocols? (10%)

* 1.Each layer is independent, simplify the function of each layer, easy to implement and maintain
* 2.Flexibility, changes to any layer will not cause problems in the system
* 3.Can promote standardization work

##### State the differences between circuit switching and packet switching in a WAN environment. (10%)

* In the process of source to destination, nodes switch information from one link to another link in different ways. There is a dedicated communication link between two nodes of circuit switching. Packet switching groups data and additional control information to make the packet forward in a certain route in the network.

##### What are the seven layers in the OSI reference model? (10%)

* Application, Presentation, Session, Transport, Network, Data link, Physical

##### Determine whether the following statements describe LAN or WAN environments: (30%)

##### You need to share network applications and printers with Karen, Mary, and Bob, whose desks are all within 100 feet of yours.

* + LAN

##### You need to exchange files and electronic mail with other employees in your office, which is spread over three buildings on one site.

* + LAN

##### You need to exchange electronic mail with John, who works for a different company and whose office is located in another city.

* + WAN

## Module 2 Written assignment

##### For each of the following communications devices, describe the transmission mode used (simplex, half-duplex, full-duplex). (10%):

##### 1.telephone

* full-duplex, Both parties can speak and hear at the same time.

##### 2.computer keyboard

* simplex, The keyboard sends information to the computer in one direction.

##### Television channels are 6MHz wide. How many bits/sec can be sent if four-level digital signals are used in a noiseless channel? (10%)

* C = 2BlogM = 2 \* 6M \* 2 = 24Mbps

##### What is "channel capacity"? How does it relate to transmission impairments? (10%)

* Channel capacity is the maximum rate at which data can be transmitted over a given communication path, or channel, under given conditions.
* Transmission impairments will distort and corrupt a signal, and then lead to retransmission and reduce the channel capacity.

##### Identify the type of data-transmission media described in af below: (30%)

##### 1.is generally most susceptible to electromagnetic interference and eavesdropping

* Unshielded Twist Pair

##### 2.inexpensive and well established but has relatively low bandwidth

* Twist Pair

##### 3.conducts signals of light

* Optical fiber

##### 4.surrounds the inner conductors with shielding to reduce electromagnetic interference

* Shielded Twist Pair

##### 5.is not susceptible to electromagnetic interference

* Coaxial cable

##### 6.is usually the least expensive

* Twist Pair

##### Which of the following devices should be positioned closer together: amplifiers being used for analog data transmission, or repeaters being used for digital data transmission? Explain why. (10%)

* Amplifiers, Because the signal will be attenuated during analog data transmission, it is necessary to amplify the signal before attenuation to ensure that the signal is not distorted.

##### Explain how to effectively propagate an analog signal that carries digital data over greater distances. Refer to Table 3.1 in the text. (10%)

* At appropriately points, the transmission system uses repeaters. The repeater recovers digital data from the analog signal and produces a new, clean analog signal. So that noise is not accumulated.

##### Describe the major components of optical fiber cable and its advantages over copper. (10%)

* Optical fiber strand (the core, the cladding, and the buffer coating ), Fiber optic cable and jacket.
* It has greater capacity, smaller size and lighter weight, lower attenuation, electromagnetic isolation, greater repeater spacing than copper.

##### Do problem 4.4 on page 146 of your textbook. (10%)

##### Coaxial cable is a two-wire transmission system. What is the advantage of connecting the outer conductor to ground?

* When the outer conductor is grounded, the external electric field will not affect the internal, and the internal electric field will not affect the external. The advantage is that the interference between internal and external signals is shielded, which can improve the signal quality and signal transmission rate.

## Module 3 Written assignment

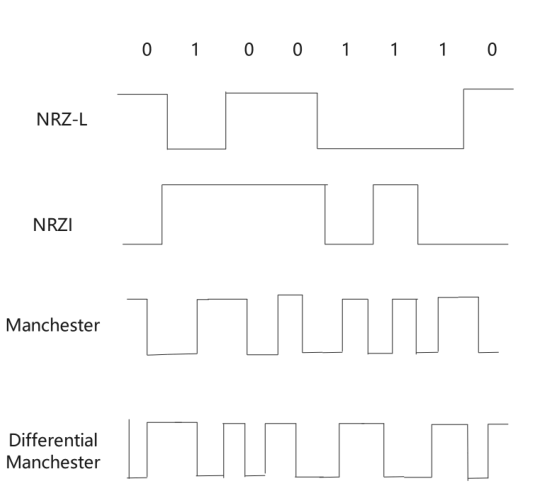
##### For the bit stream 01001110, sketch the waveforms for each of the following codes: (20%)

##### 1.Non-return to zero level (NRZ-L)

##### 2.Non-return to zero inverted (NRZI)

##### 3.Manchester

##### 4.Differential Manchester

* 

##### What does a modem actually do? (10%)

* The modem is to convert the digital data to analog signal for transmission over analog channel, or to restore the analog signal received from analog channel to digital data.

##### Describe the differences between data rate (bits/sec) and modulation rate (baud). (10%)

* Data rate is the number of bits transmitted per second. Baud is the modulation rate, which refers to the rate of the effective data signal modulating carrier, that is, the number of times the modulation state of the carrier changes per unit time. Data rate = baud x The number of bits corresponding to a single modulation state.

##### Which of the following types of modulation are used in higher-speed modems? (10%)

##### 1.Phase modulation

##### 2.Frequency modulation

##### 3.Phase and amplitude modulation

* Phase and amplitude modulation

##### Compare PCM and DM techniques for encoding analog signals. (20%)

##### 1.Which one is the preferred method?

* PCM is preferred

##### 2.Explain why.

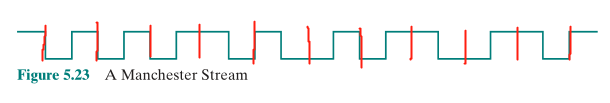
* The analog encoding of a digital signal has a more uniform spectral content over the bandwidth and therefore contains more high-frequency components. It has been shown that because of these higher frequencies, PCM-related techniques are preferable to DM-related techniques for digitizing analog signals representing digital data.

##### Which of the signals in Table 5.2 in your textbook use differential encoding? (10%)

* Differential Manchester

##### Do problem 5.7 on page 182 of your textbook. (10%)

##### The waveform of Figure 5.23 belongs to a Manchester-encoded binary data stream. Determine the beginning and end of bit periods (i.e., extract clock information) and give the data sequence.

* 
* The data is 1110011010

##### Do problem 5.19 on page 183 of your textbook. (10%)

##### Are the modem and the codec functional inverses (i.e., could an inverted modem function as a codec, or vice versa)?

* No, they are different.
* Modulation is to transform digital data into analog signals, take digital data as the key value, to modulate the frequency, phase or amplitude of periodic carrier, demodulation is to filter the modulated signal to extract digital data.
* The encoding is usually to sample the analog quantity according to the minimum sampling frequency defined by the sampling theorem, and then to encode the binary digital signal at some quantization level. Decoding is to generate continuously varying analog quantities according to the digital signal. The magnitude of the quantization value represented by the digital signal sequence controls the amplitude variation of the analog signal.

## Module 5 Written assignment

##### Identify the type of multiplexing (frequency-division, time-division, or statistical time-division) described below: (30%)

##### 1.Ten devices share a single high-speed line. Device 1 transmits, then Device 2 transmits, then Device 3 transmits, and so on. Each device is allowed the same amount of time.

* time-division

##### 2.Ten devices share a single high-speed line. Each device can transmit continuously over a portion of a high-speed line's bandwidth.

* frequency-division

##### 3.Ten devices share a single high-speed line. Device 1 transmits, then Device 2 transmits, then Device 3 transmits, and so on. Device 2, based on previous access, is given more access than the other devices.

* statistical time-division

##### Multiplexing technologies were developed to reduce congestion on existing telephone networks that could not expand. (10%)

* False

##### Statistical time-division multiplexers provide a much higher level of line utilization efficiency than time-division multiplexers. (10%)

* True

##### Multiplexing is a technique that enables more than one data source to share the use of a common line. (10%)

* True

##### Explain why cable TV currently chooses FDM over TDM. (10%)

* Cable TV can watch multiple channels at the same time, the bandwidth is divided into a variety of different frequency band of subchannels with FDM, each subchannel can transmit a signal in parallel, each subchannel can provide bandwidth is much wider than TDM provided.

##### Do problem 8.5 on page 267 of your textbook (10%)

##### Why is it that the start and stop bits can be eliminated when character interleaving is used in synchronous TDM?

* The Byte-Interleaving technique allows each byte to have a fixed time slot. In this way, The sending and receiving sides send or sample each bit synchronously at the same time according to the synchronization flag. It does not require the start and stop bit for asynchronous transmission. This will increase efficiency.

##### Do problem 8.6 on page 267 of your textbook. (10%)

##### Explain in terms of data link control and physical layer concepts how error and flow control are accomplished in synchronous time-division multiplexing.

* The multiplexer and demultiplexer can not consider the problem of traffic and error, the data link layer of the receiver and receiver can control the traffic and error between the bit stream before multiplexing and the bit stream after demultiplexing.

##### Do problem 8.13 on page 268 of your textbook. (10%)

##### Ten 9600-bps lines are to be multiplexed using TDM. Ignoring overhead bits in the TDM frame, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average TDM link utilization to 0.8, and assuming that each TDM link is busy 50% of the time, what is the capacity required for statistical TDM?

* TDM capacity = 9600bps \* 10 = 96kbps
* Statistical TDM capacity = aIR/p = 0.5 \* 10 \* 9600 / 0.8 = 60kbps

## Module 6 Written assignment

##### Circuit-switching is inefficient in line utilization. Another approach known as message switching has been explored to improve utilization by eliminating the use of end-to-end dedicated lines. In this approach, each transmitted message is stored at each node until traffic conditions permit it to be forwarded to the next node. Discuss the advantages and disadvantages

##### circuit-switching

The advantages are reliable and rapid data transmission, data will not be lost, and keep the original sequence. The communication line is dedicated to the users of both parties and the data is direct, so the delay of data transmission is very small.

The disadvantage is that in some cases the channel capacity when the circuit is idle is wasted, The average connection establishment time is long.

##### packet-switching

The advantage is that different data packets can be transmitted on the same link by dynamic sharing and reuse, and the utilization of communication resources is high, which greatly improves the capacity and throughput of the channel. When a transmission line is faulty, you can select other transmission lines to improve transmission reliability.

The disadvantages are delay jitter and high overhead. For digital signals only.

##### Consider a virtual circuit packet-switching network. Will the virtual circuit number associated with this packet change at each node when a packet traverses along its path to its destination? If so, Why? (10%)

Yes, Each link along the path of the virtual circuit has a different VC number, which greatly simplifies the establishment of the virtual circuit. Therefore, a virtual circuit may have a different VC number on each link. Each intermediate router must replace the VC number of each transmission packet with a new VC number, which is obtained from the forwarding table.

##### Consider a time-division switching network. Will this scheme introduce a minimum delay at each switching stage? If so, what is the delay? (10%)

Yes, Time division switching is to divide the time into a number of non-overlapping time slots, and establish different sub-channels by different time slots

The time slot switching network completes the time slot switching of data, and the process of channel partitioning and management introduces delays.

##### Which sentence do the following terms apply to? (Each term is not used more than twice.) (40%)

##### unswitched

##### circuit-switched

##### message-switched

##### packet-switched

##### In these connections, there are delays in transmission due to the time it takes to store and forward, messages.

message-switched, circuit-switched

##### These connections dedicate a connection between two points. Before the advent of automated switches, a telephone operator plugged in a path cord to connect two telephone circuits.

circuit-switched

##### These connections are not dedicated, but they provide smaller delays than message-switched connections.

packet-switched

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##### Consider a packet-switching network of N nodes, connected by the following topologies:

##### Star: One central node with no attached station; all other nodes attach to the central node.

##### Loop: Each node connects to two other nodes to form a closed loop.

##### Fully Connected: Each node is directly connected to all other nodes.

##### For each case, give the average number of hops between stations. (10%)s

Star: the avg number is 2, go to other nodes need to hop by central node.  
Loop:

if N is odd, the hop number is 1, 2, 3 ... (N-1)/2, (N-1)/2...3, 2, 1, the avg number = ((N-1)/2)\*((N+1)/2) / (N-1) = (N+1)/4

if N is even, the hop number is 1, 2, 3 ... N/2 - 1, N/2, N/2 - 1...3, 2, 1, the avg number = (N/2 + (N/2) \* (N/2 -1))/ (N-1) = N\*N/4(N-1)

Fully Connected: the avg number is 1, go to other nodes directly.

##### Do problem 9.9 on page 300 of your textbook. (10%)

##### Assuming no malfunction in any of the stations or nodes of a network, is it possible for a packet to be delivered to the wrong destination?

Yes, it is possible. Because the transmission medium is unreliable, large burst errors may occur in the transmission channel, resulting in the failure of the receiver to detect the error.