**King Saud University**

**College Of Computer & Information Sciences**

**Department Of Computer Sciences**

**Tutorial 4 Fall 15**

**(Computer Networks CSC 329)**

**Q1.**

1. **Explain the concepts of connection oriented and connectionless communication.**

**Connection-Oriented service:**The user first establishes a connection then uses the connection and then releases the connection. The sender transmits bits of information and the receiver takes them out in the same order as they were originally sent.

**Connectionless:**Each packet of information carries the full destination address and is routed independently from the others from the source to destination. Packets may take different routes to the destination and it is possible for two packets sent to the same destination the first one to sent can be delayed and the second one arrives first. So care must be taken in order for the all the bits arrive correctly and in the same order they were sent.

1. **Explain the concepts multiplexing.**

In order to take advantage of a single physical trunk to be used for many conversations, companies have developed elaborate schemes for multiplexing many dialogs over a single trunk. The multiplexing scheme is divided into two basic categories:

* ***FDM*** (Frequency Division Multiplexing) and
* ***TDM*** (Time Division Multiplexing)

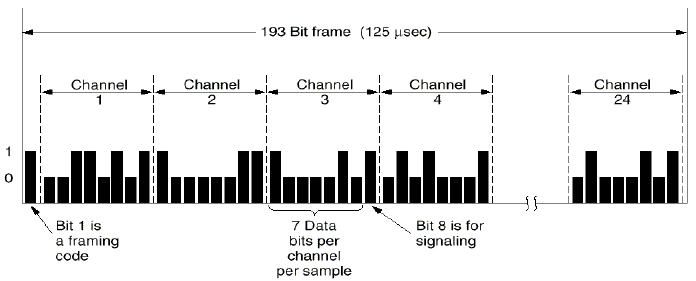
***Frequency Division Multiplexing***

With FDM is possible to simultaneously transmit multiple separate signals through a shared medium (such as a wire or optical fiber) by modulating, at the transmitter, the separate signals into a separable frequency bands and adding them within the medium,  allocating 4000Hz to each channel to keep them well separated. A graphical representation of FDM is shown in the next diagram stating a widespread standard  of 12 4kHz voice channels multiplexed into 60-108kHz band.

### http://www.ee.surrey.ac.uk/Projects/CAL/networks/Images/FDM.gif

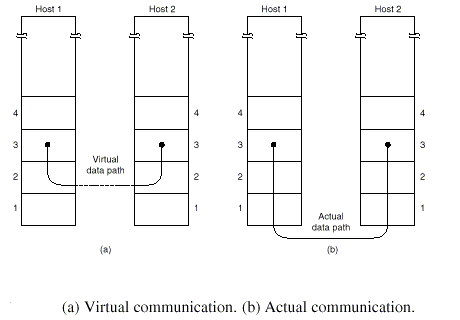
***Time Division Multiplexing.***

TDM is a technique used for digitize and combining analog signals onto a single outgoing digital trunk. As it was mentioned before (in the section discussing telephone systems) when a computer wishes to communicate with a remote one the signals sent from that computer alternate from digital to analog and vice versa in order to travel in the appropriate medium. Therefore in almost every **end office**the incoming data signals are digitized by a device called codec (coder- decoder), producing a 7 or 8 bit number. The codec makes 8000 samples per second which corresponds to 125 sec/sample. This sample rate was chosen intentionally because as Nyquist depicted this is sufficient to capture all the information from a 4kHz telephone channel bandwidth. Sampling the signal with a lower rate, information would be lost while sampling at higher rates no extra information would be gained. This method is called Pulse Code Modulation



1. **What is the flow-control applied at the data link layer**.

**Source machine:**Network Layer - Data Link Layer - Physical Layer - cable --> **Destination:**cable - Physical Layer - Data Link Layer - Network Layer) as shown in figure below.



**Question 4.A sender (S) wants to send a message M = 1010001101. It uses the CRC method to generate the Frame Check Sequence FCS. The used generator polynomial is given by**

1. Give the polynomial M(x ) that represent the message M
2. Determine the sequence of bits ( 5 bits ) that allows detecting errors.
3. Represent the binary whole message (T) send by the sender (S).
4. How does the receiver check whether the message T was transmitted without any errors

**Question 5: Consider a frame consisting of three characters of 4 bits each. Assume that the probability of a bit error is 10-3 , and the bit errors are independent of each other.**

**a. What is the probability that this received frame contains at least one error?**

**b. Now add even parity bit to each character, what is the probability?**

**c. Does adding parity bits reduce the error probability? Why?**

Answer:

By definition:

• Pb : Probability of single bit error (BER)

• P1 : Probability that a frame arrives with no bit errors

• P2 : While using error detection, the probability that a frame arrives with one or more undetected errors With no error detection:

P1 = (1 – Pb) F , P2 = 1 – P1 Where, F = Number of bits per frame

Here, Pb = 10-3 , F = 12

a. The probability that received frame contains at least one error is 1-( 1-Pb) F = 1-(1-10-3 ) 12

b. After added even parity bit to each character, the probability that received frame contains at least one error is F= 12+3 = 15 P2 = 1 - P1 = 1 – (1 – Pb) 15 = 1 – (1 – 10-3 ) 15

c. No, adding parity bit doesn’t reduce the error probability because it just does error detection does (no error corrections).