Name: Aftab Khan ID: 12985 Subject: Data communication & networks

Q1: Protocol layering can be found in many aspects of our lives such as air travelling. Imagine you make a round-trip to spend some time on vacation at a resort. You need to go through some processes at your city airport before flying. You also need to go through some processes when you arrive at the resort airport. Show the protocol layering for the round trip using some layers such as baggage checking/claiming, boarding/off-boarding, takeoff/landing?

Answer: Protocol layering for the Round trip for the Vacation air travel.

Explanation:
Round trip means: Source ---> Destination -----> Source
Let us make the protocol layering for Source------> Destination first.
The layers at the Source Airport
1. Booking Tickets.
2. Passing Airport Security Check (In order to enter the Airport)
3. Checking in Baggage
4. Boarding the airplane from the Boarding gate.
5. Airplane Takeoff
6. Airplane take the route to destination. (This is an intermediate layer for both source and destination airport)
Layers at the Destination Airport
7. Airplane Landing
8. DE-boarding from a Gate
9. Claiming Baggage from the Baggage Carousel (The conveyor belt at the airport)
10. Filing Complain if any.
11. Exit the Airport.

This is for Source ---->Destination.
Now as for the round trip. We will follow the same layers but from destination to source. (We assume return tickets were already booked)
Layer at the Resort Airport:
1. Entering Airport gate (Passing security check)
2. Checking in the Baggage
3. Boarding flight from Gate
4. Airplane Takeoff

5. Airplane is routed to the source (By source i mean the source of the individual (City airport) as he/she is returning back)
Layers at the city airport:
6. Airplane Landing
7. DE-boarding flight from a gate.
8. Claiming baggage from the baggage carousel.
9. Filing Complain if any.
10. Exit Airport

Routing of the Flight will act as an intermediate layer which routes the flight from the source to destination after takeoff and till landing.

Q2: Give some advantages and disadvantages of combining the session, presentation,
and application layer in the OSI model into one single application layer in the Internet (TCP/IP) mode?

Answer:

Advantages of merging the presentation, session, and application layer of the OSI into a single application layer in TCP/IP:

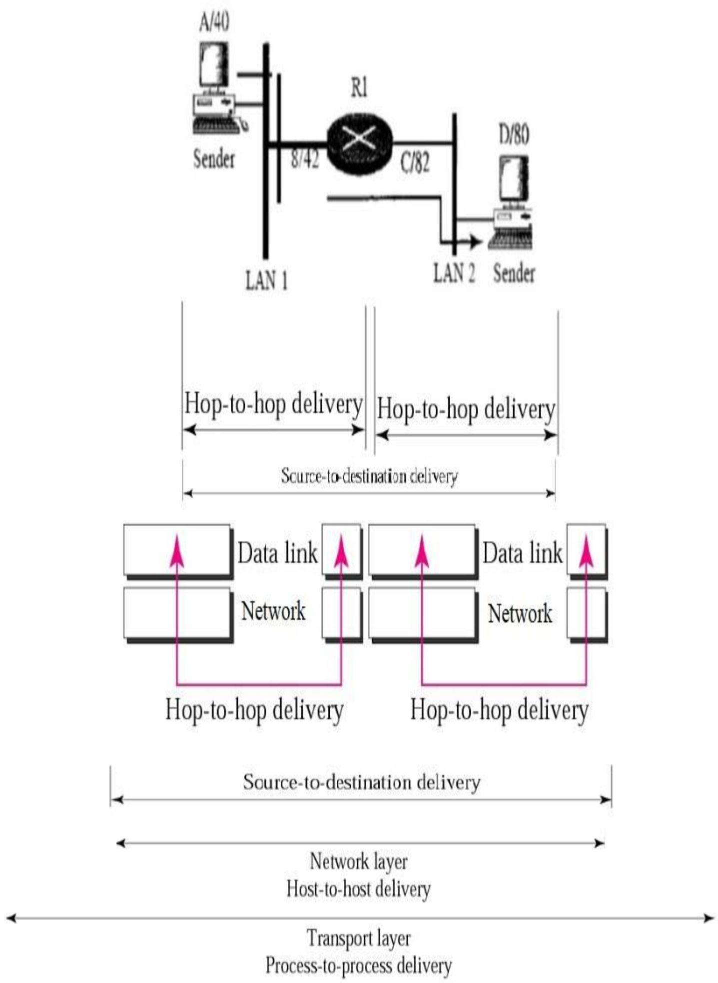
- TCP/IP is a practical protocol model that is commercially used. It shows the application layer which represents the functionalities of the session and presentation layer. OSI model has separate session, presentation and application but this model cannot be fully executed.
- It minimizes the efforts required to traverse the layers as fewer layers mean less traversal.

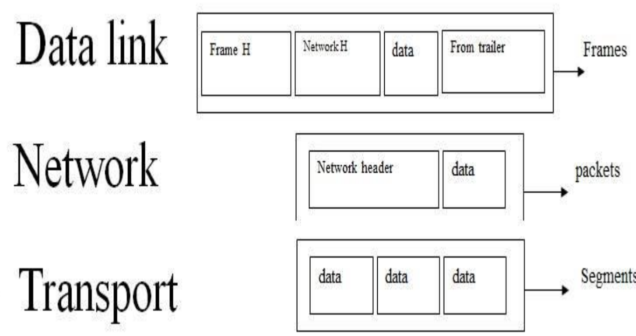
Disadvantages of merging the presentation, session and application layer of the OSI in to single application layer in TCP/IP:

- It can make the troubleshooting tough as the many errors may generate at a single moment.
- The security issues may generate by combining these layers.

Q3: In figure below, assume that the communication between a process running at computer A with port address m and a process running at computer D with port address n. Show the content of packets and frames at the network, data link and transport layer for each hop.

Answer:





Q4: What is the theoretical capacity of a channel in each of the following cases?

a) Bandwidth: 15 KHz SNRdb = 30

b) Bandwidth: 100 KHz SNRdb = 2

c) Bandwidth: 0.5 KHz SNRdb = 10

Answer: We can approximately calculate the capacity as

a. C = B x (SNRdb /3) = 15 KHz x (30/3) = 150 Kbps

b. C = B x (SNRdb /3) = 100 KHz x (2/3) = 67 Kbps

c. C = B x (SNRdb /3) = 0.5 MHz x (10/3) = 1.7 Mbps

Q5: A digitized system is operated at 4800 bps. If a signal element encodes an 8-bit word, what is the minimum required bandwidth of the channel?

Answer:

Using Nyquist's equation: $C = 2B \log_2 M$

We have C = 4800 bps and $\log_2 M = 8$,

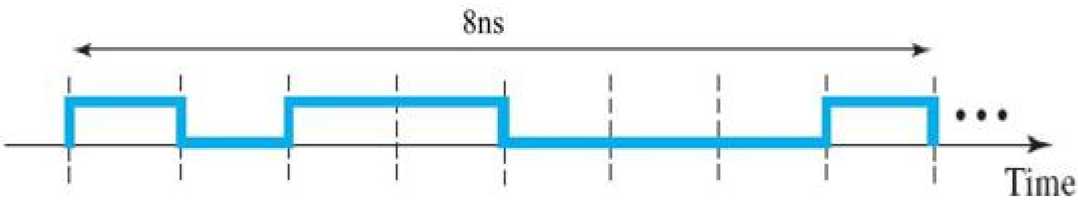
Because a signal element encodes a 8-bit word

Therefore, C = 4800 = 2B x 8, and

B = 300 Hz

The minimum required bandwidth of the channel = 300 Hz.

Q6: What is the bit rate for the signal given below?



Answer: There are 8 bits in 8ns

Bit rate is $8 / (8 \times 10^{-9}) = 1 \times 10^{-9} = 1000$ Mbps

Q7: A capacity of the channel is given as 40 Mbps, the bandwidth of the channel is 6 MHz. Assuming white thermal noise, what signal-to-noise ratio is required to achieve this capacity?

Answer: SNR = **101**
Explanation:
Given
Bandwidth (B) = 6 MHz = $6*10^6$ Hz
Channel capacity (c) = 40 Mbps = $4.0*10^7$ bps
Signal to noise ratio = SNR

$C = B \log_2(1 + SNR)$

$4.0*10^7 = 6*10^6 \log_2(1+SNR)$

6.0∗1064.0∗107 $= \log_2(1+SNR)$

$6.6667 = \log_2(1+SNR)$

$2^{6.6667} = 1+SNR$

SNR = 101.59 - 1

SNR = 100.59 ≈ **101**

Q8: A composite signal that is non-periodic contains frequencies from 20 to 40 kHz. The peak amplitude is 10 V for the lowest and the highest signals is 30 V for the 30-KHz signal. Assuming that the amplitudes change gradually from the minimum to the maximum, draw the frequency spectrum?

Answer: The non-periodic frequencies diagram is given in the explanation section

Explanation:
The maximum amplitude of 30 V is at 30 kHz as shown in the figure below where this is non-periodic contains frequencies