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Subject: Data communication & networks

Question :1 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, take off/landing.

Ans: Before attempting to organize our thoughts on Internet architecture, let's look for a human analogy. Actually, we deal with complex systems all the time in our every day life. Imagine if someone asked *you* to describe, for example, the airline system. How would you find the structure to describe this complex system that has ticketing agents, baggage checkers, gate personnel, pilots and airplanes, air traffic control, and a worldwide system for routing airplanes? One way to describe this system might be to describe the series of actions you take (or others take for you) when you fly on an airline. You purchase your ticket, check your bags, go to the gate and eventually get loaded onto the plane. The plane takes off and is routed to its destination. After your plane lands, you de-plane at the gate and claim your bags. If the trip was bad, you complain about the flight to the ticket agent (getting nothing for your effort). This scenario is shown in Figure 1.7-1.

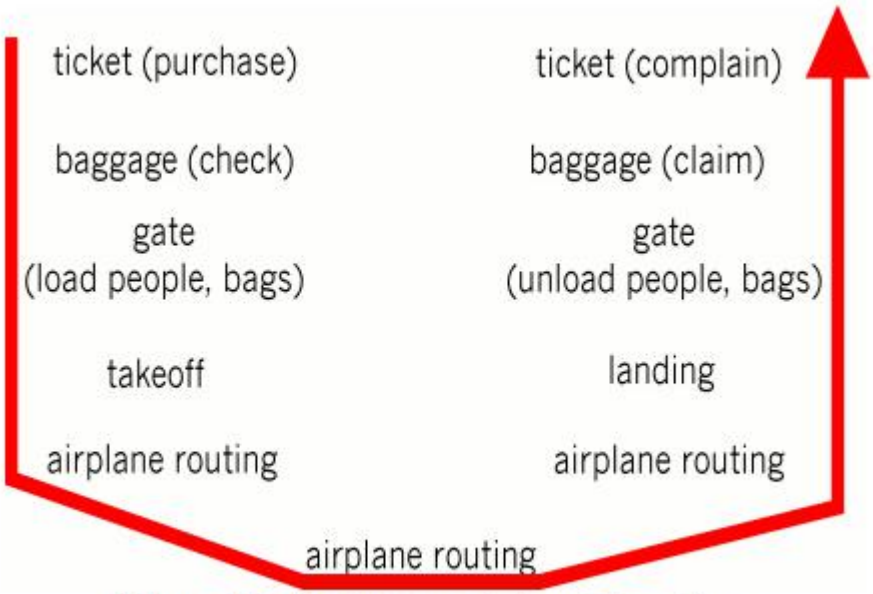


Figure 1.7-1: Taking an airplane trip: actions

Question :2 Give some advantages and disadvantages of combining the session, Presentation, and application layer in the OSI model in to one single application layer in the Internet (TCP/IP)?

Ans: Advantages of merging the presentation, session and application layer of the OSI in to 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.

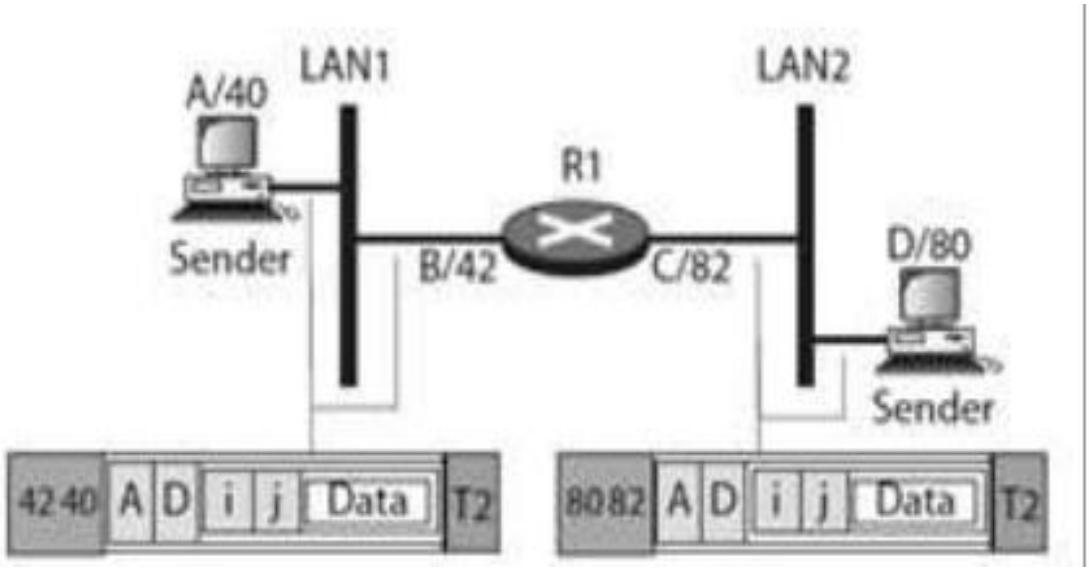
*It minimizes the efforts required to traverse the layers as fewer layers mean less traversal

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 by combing these layers.

Question:3 In Figure below, assume that the communication is between a process running at computer A with port address m and a process running at computer D with port address n. Show the contents of packets and frames at the network, data link, and transport layer for each hop.

Ans:



Question:4 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: 0.5MHz SNRdB =10

Ans: We can approximately calculate the capacity as

a. C = B × (SNRdB /3) = 15 KHz × (30 /3) = **150 Kbps**
b. C = B × (SNRdB /3) = 100 KHz × (2 /3) = **67 Kbps**
c. C = B × (SNRdB /3) = 0.5 MHz × (10 /3) = **1.7 Mbps**

Question :5 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?

Ans: Given:-

C=4800 bps

Log_2 M=8, because a signal element encodes an 8-bit word.

According to Nyquist's Equation:-

C= 2B LOG_2 M

C= 4800

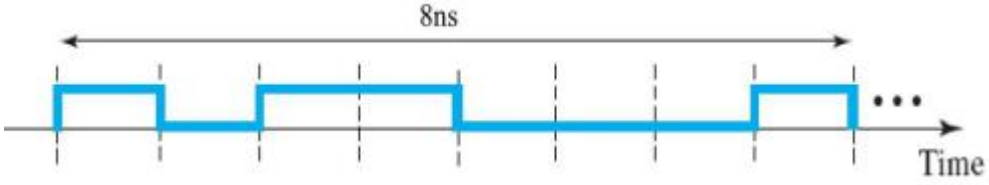
4800=2B*8

B=4800/2*8

=300 Hz (Ans)

~ The Minimum required band –width of the channel is 300 Hertz

Question :6 What is the bit rate for the signal given below?



Ans : There are 8 bits in 8 ns.

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

Question :7 A capacity of the channel is given as 40Mbps, the bandwidth of the channel is 6 MHz Assuming white thermal noise, what signal-to-noise ratio is required to achieve this capacity?

Ans : Given,

Capacity of the channel= 40Mbps= $40 * 10^6$bps

Bandwidth of the channel= 6MHz= $6 * 10^6$Hz

From Shannon capacity formula :-

Capacity = Bandwidth $\log_2 (1+SNR)$

$=> 40 * 10^6 = 6 * 10^6 \log_2 (1+SNR)$

$=> \log_2 (1+SNR) = 40 * 10^6/6 * 10^6 = 6.67$

$=>1+SNR = 2^{6.67}$

=>SNR=101.54 -1=100.54,

… Signal to noise ratio required =100.54

In db-> SNR/Indb = $10 \log_{10}(100.54) = 20.02$ db

Question:8 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?

Ans: 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