COMP90007 Internet Technologies

Week 3 Workshop

Semester 2, 2021

Suggested solutions

Question 1 (Layers)

- Identify 2 ways in which the OSI reference model and the TCP/IP reference model are the same.
- Identify 2 ways in which these models differ.

(*NB: You can use the textbook to solve this question*)

Similarities:

- stacking of layered protocols
- similar functionality in each of the layers
- layers above transport layer relate to applications

Differences:

- TCP/IP does not distinguish between services, interfaces and protocols
- TCP/IP does not clearly separate physical and data link functions

Question 2 (Delay and bandwidth)

- Calculate the end-to-end transit time for a packet for
  - GEO (*Geostationary orbit*) (altitude: 35,800 km),
  - MEO (*Medium Earth orbit*) (altitude: 18,000 km) and
  - LEO (*Low Earth orbit*) (altitude: 750 km) satellites.

- *Transit time* = 2 × *distance* / *speed of light*, where $c = 3.0 \times 10^8$ m/s
- GEO: 239 ms
- MEO: 120 ms
- LEO: 5 ms

Question 3 (Delay and bandwidth)

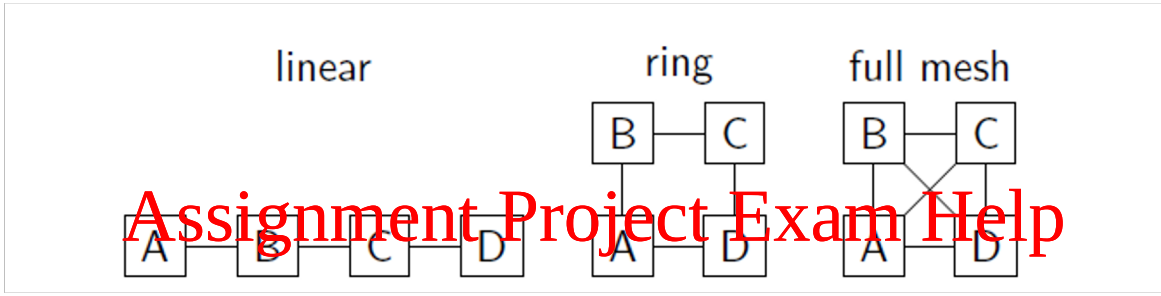
- An image is 1600 × 1200 pixels with 3 bytes/pixel. Assume the image is uncompressed.
  - How long does it take to transmit it over a 56-kbps modem channel, assuming zero propagation delay over the channel?
  - Over a 1-Mbps cable modem? Over a 10-Mbps Ethernet?
  - Over 100-Mbps Ethernet? Over gigabit Ethernet?

- Image size = 1600 × 1200 × 3 × 8 = 46.08 ×10^6 bits

- 56 kbps modem: 823 s
- 1 Mbps modem: 46.1 s
- 10 Mbps Ethernet: 4.61 s
- 100 Mbps Ethernet: 0.46 s
- 1 Gbps Ethernet: 0.046 s

Question 4 (Topology)

- Consider the following 3 network topologies for connecting N nodes. In the general case of an N node network:



  - (a) How many links are there in each network?
    Linear: *N − 1* links Ring: *N* links Full mesh: *N(N − 1)/2* links
  - (b) What is the maximum delay between any pair of nodes, assuming each link has a delay of 10ms, and the shortest path is used between nodes?
    Linear: *10(N − 1)* ms Ring: *10*N/2* ms Full mesh: *10* ms
  - (c) What is the minimum number of links that need to be cut in order to isolate one or more nodes?
    Linear: *1* link Ring: *2* links Full mesh: *N − 1* links
  - (d) Which topology would you use to connect military command centres?
    Full mesh – cost not important, but reliability is essential

Question 5 (Topology)

- Is an oil pipe a simplex system, a half-duplex system, a full duplex system or none of the above? Under which conditions?

  - Oil can flow in either direction, but not both ways at once, therefore it **cannot** be *full duplex*.

  - Depending on the situation at an oil refinery, for example, an oil pipe is *simplex*, as the oil only flows in one direction.

  - Theoretically oil can flow both ways, therefore it can be consider *half duplex*, similar to a single railroad track.

Question 6 (Topology)

- List two solutions that one can use for sharing a link between multiple senders and explain these solutions briefly.

Ans: Time division multiplexing and frequency division multiplexing. There are others but these are the key ones we saw in class in detail. The explanations are available from slides 48,49,50 of Week 2 – Physical Layer.