COMP90007 Internet Technologies

Week 3 Workshop

Semester 2, 2024

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)

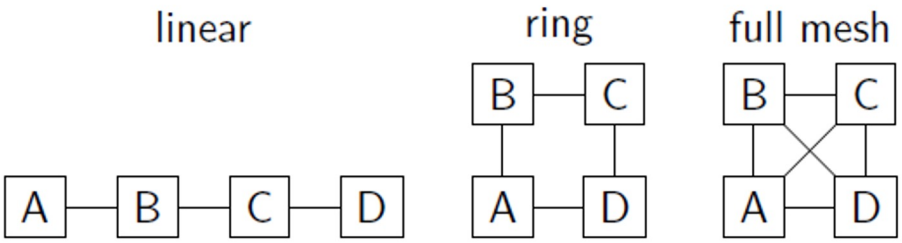
- An image is 1600 × 1200 pixels with 3 bytes/pixel. Assume the image is uncompressed.
  - How long does it take to transmit it over a 56-kbps modem channel, assuming zero propagation delay over the channel?
  - Over a 1-Mbps cable modem? Over a 10-Mbps Ethernet?
  - Over 100-Mbps Ethernet? Over gigabit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

- 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 (Multiplexing)

- 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 50-51 of physical layer.