COMP90007 Internet Technology

Week3

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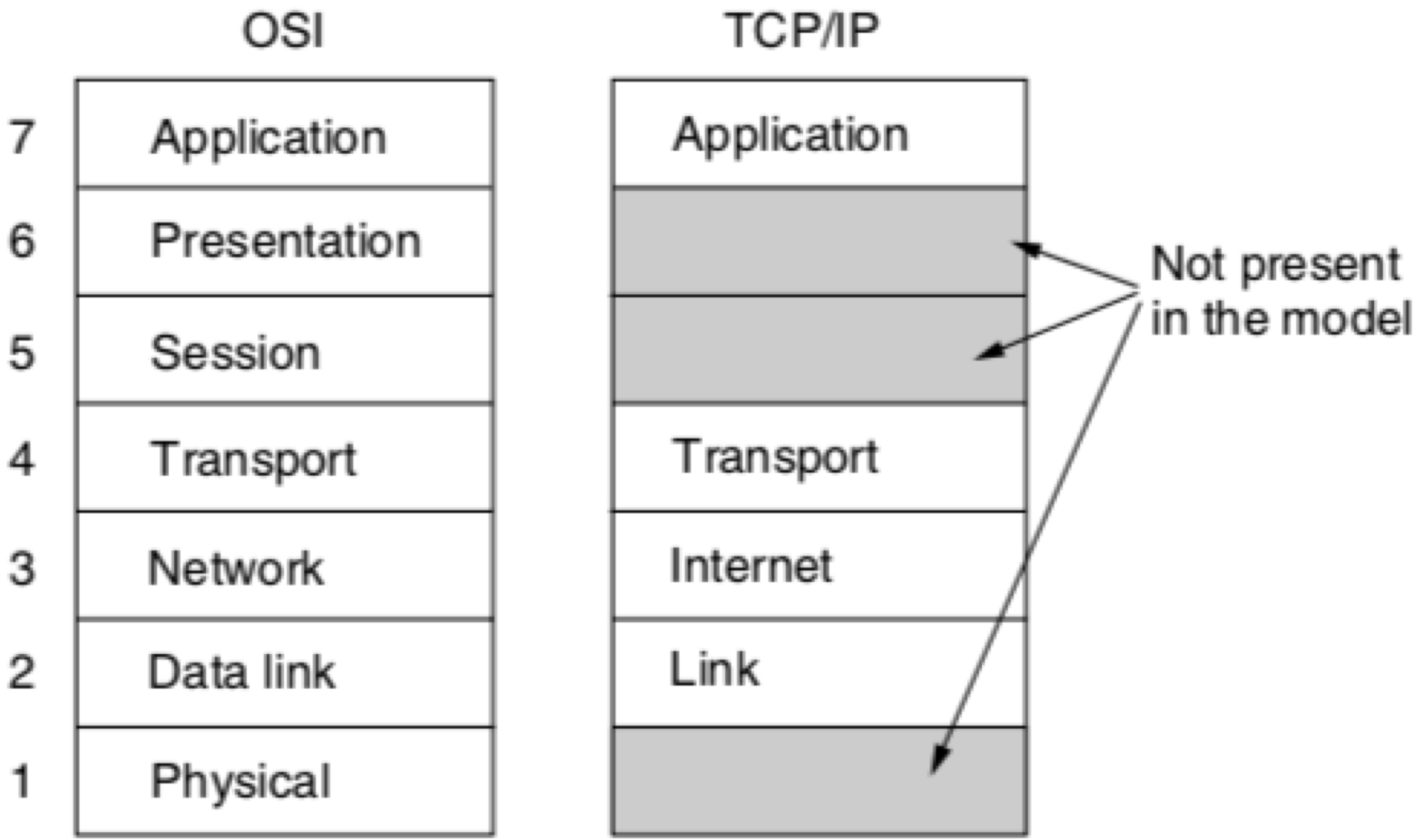
Question 1 (Layers)

- 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)


OSI
TCP/IP
7
Application
6
Presentation
5
Session
4
Transport
3
Network
2
Data link
1
Physical
Application
Transport
Internet
Link
Not present
in the model

Solution 1 (Layers)

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

Solution 1 (Layers)

- Differences:
  - TCP/IP does not distinguish between **services**, **interfaces** and **protocols**
  - TCP/IP does not clearly separate physical and data link functions
  - OSI supports connectionless and connection-oriented communication at the network layer, while TCP/IP supports only connectionless communication at the IP layer *
  - OSI supports only connection-oriented communication at the transport layer, while TCP/IP supports both connection-oriented and connectionless communication at the transport layer *

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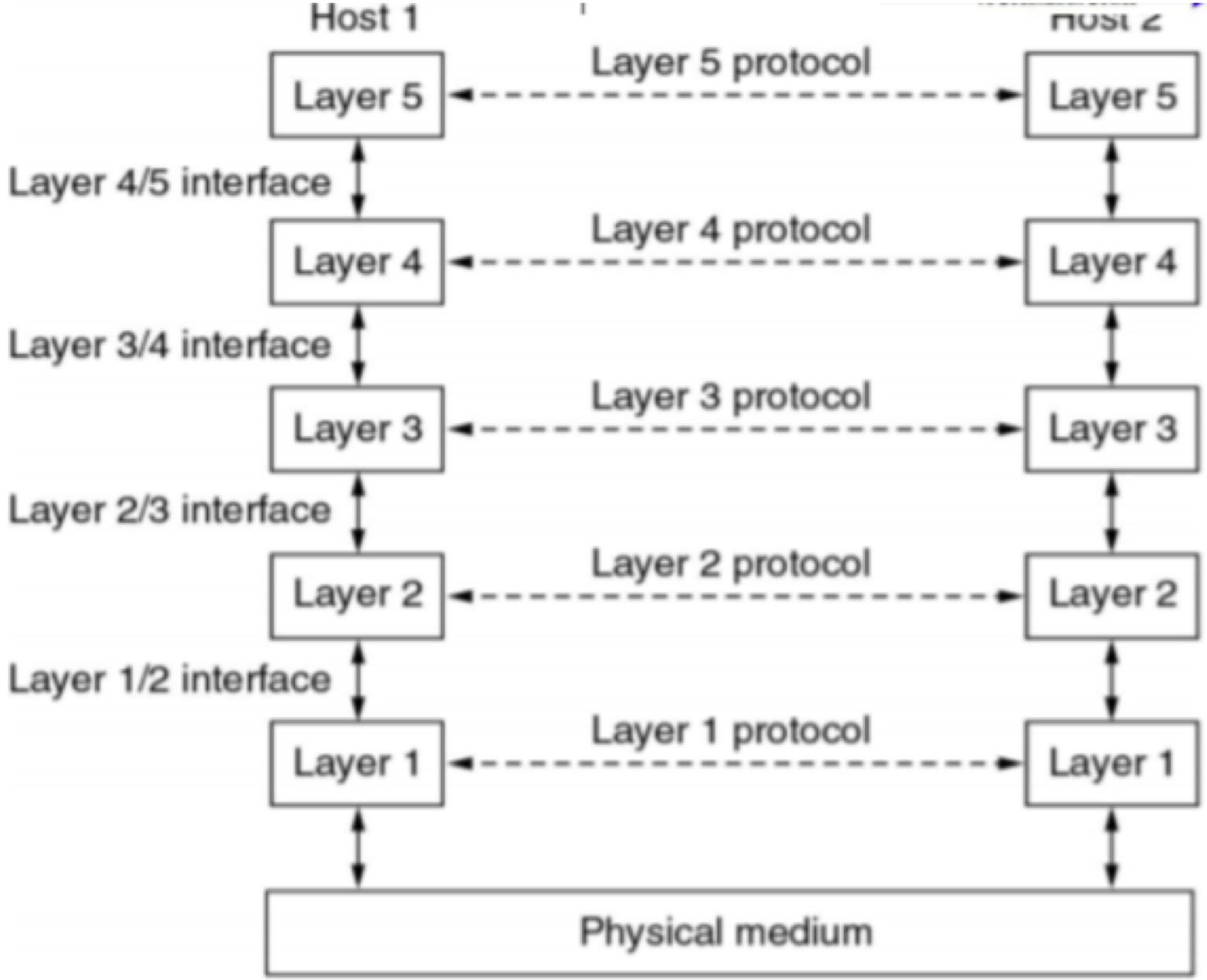
Solution 1 (Layers)

Services: Each layer performs some services for the layer above it. The service definition tells what the layer does, not how entities above it access it or how the layer works. It defines the layer's semantics.

Interfaces: A layer's interface tells the processes above it how to access it. It specifies what the parameters are and what results to expect.

Protocols: the peer protocols used in a layer are the layer's own business. It can use any protocols it wants to, as long as it gets the job done (i.e., provides the offered services). It can also change them at will without affecting software in higher layers. About how the layer works inside.


Host 1
Host 2
Layer 5
Layer 5 protocol
Layer 5
Layer 4/5 interface
Layer 4
Layer 4 protocol
Layer 4
Layer 3/4 interface
Layer 3
Layer 3 protocol
Layer 3
Layer 2/3 interface
Layer 2
Layer 2 protocol
Layer 2
Layer 1/2 interface
Layer 1
Layer 1 protocol
Layer 1
Physical medium

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.

Delay

- Delay = transmission delay + propagation delay
  - Time required for the first bit to travel from computer A to computer B.
  - **Transmission delay**: the amount of time required to **transmit** all of the packet's bits into the link.
  - **Propagation delay**: the time taken for a packet to reach from sender(A) to receiver(B).
  - ***Round-Trip Delay**:
    - Satellite
    - Altitude above the earth, round-trip delay
    - Round-trip distance, light speed

Solution 2 (Delay and bandwidth)

- *Transit time* = 2 × *distance* / *speed of light*, where c = 3.0×10^8 m/s
- GEO: $\frac{35800\times10^3\times2}{3.0\times10^8} = 0.239s$
  - 239 ms
- MEO: $\frac{18000\times10^3\times2}{3.0\times10^8} = 0.120s$
  - 120 ms
- LEO: $\frac{750\times10^3\times2}{3.0\times10^8} = 0.005s$
  - 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?

Bandwidth

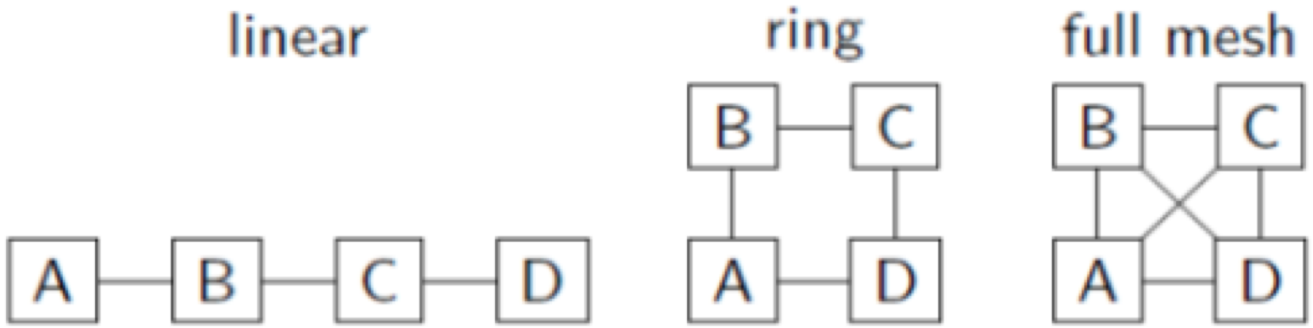
- 1. Bandwidth is treated as rate of transmission with the unit **bits/second.**
- 2. The second definition, commonly used in signal processing, is the range of frequencies an electronic signal uses on a given transmission medium (Hz)

Solution 3 (Delay and bandwidth)

- Image size = 1600 × 1200 × 3 × 8 = 46.08 ×10^6 bits
- 56 kbps modem: $\frac{46.08\times10^6}{56\times10^3} = 823s$
- 1 Mbps modem: $\frac{46.08\times10^6}{1\times10^6} = 46.1s$
- 10 Mbps Ethernet: $\frac{46.08\times10^6}{10\times10^6} = 4.61s$
- 100 Mbps Ethernet: $\frac{46.08\times10^6}{100\times10^6} = 0.46s$
- 1 Gbps Ethernet: $\frac{46.08\times10^6}{1\times10^9} = 0.046s$

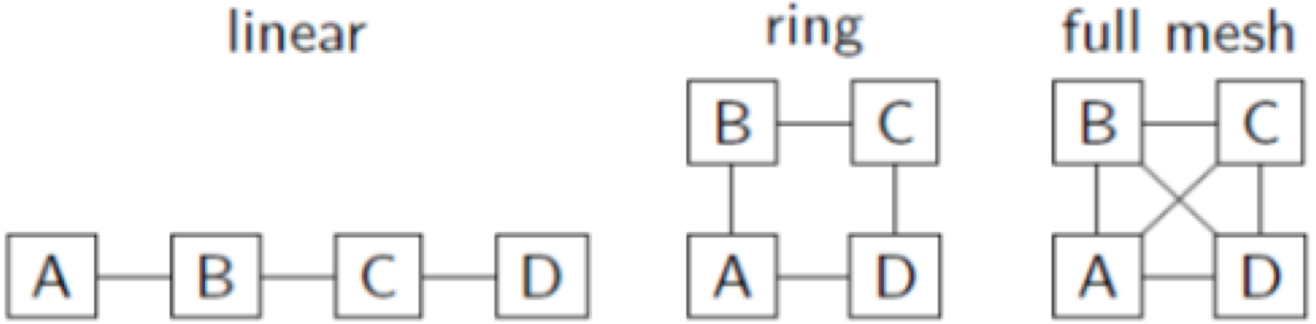
Question 4 (Topology)

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



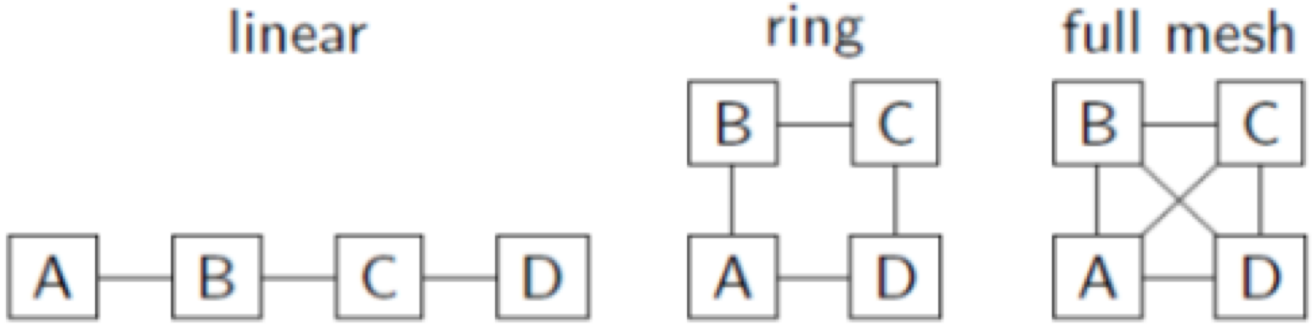
Question 4 (Topology)

- (a) How many links are there in each network?
- (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?
- (c) What is the minimum number of links that need to be cut in order to isolate one or more nodes?
- (d) Which topology would you use to connect <u>military command centres</u>?



Solution 4 (Topology)

- (a)



  - Linear: $N - 1$ links
  - Ring: N links
  - Full mesh: $N(N - 1)/2$ links

Question 4 (Topology)

- ~~(a) How many links are there in each network?~~
- (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?
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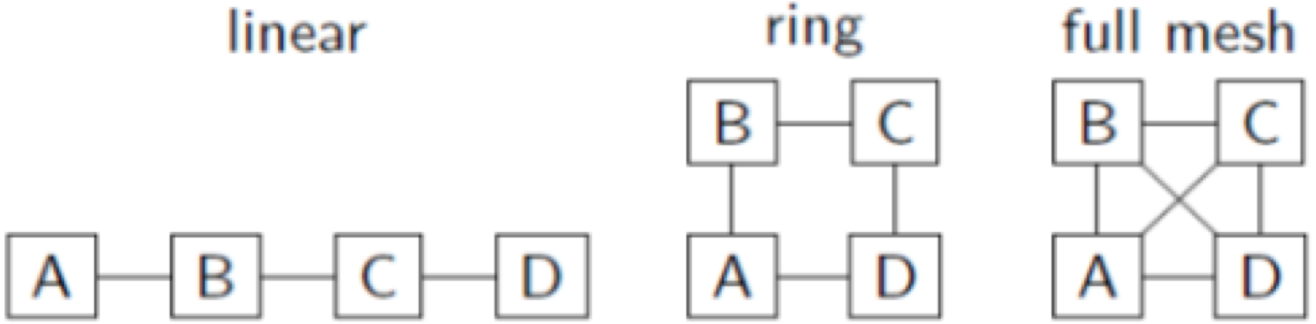
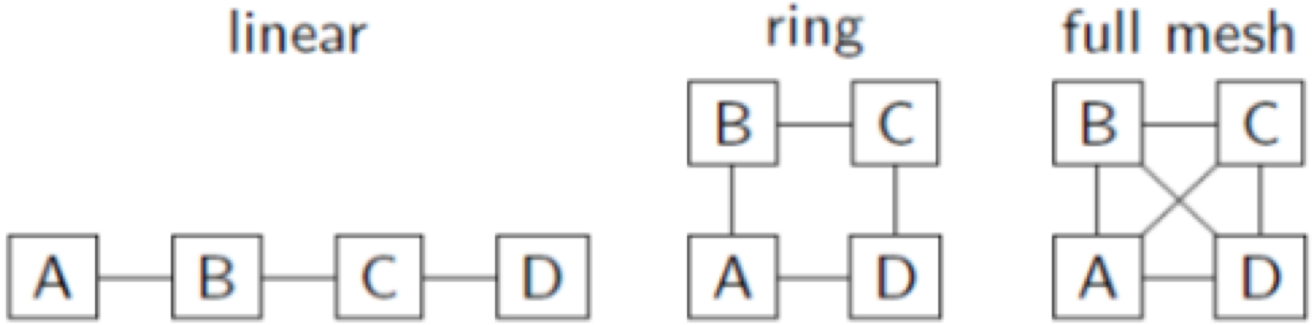


Solution 4 (Topology)

- (b)



  - Linear: *10(N – 1)* ms
  - Ring: *10*N/2* ms
  - Full mesh: *10* ms

Question 4 (Topology)

- ~~(a) How many links are there in each network?~~
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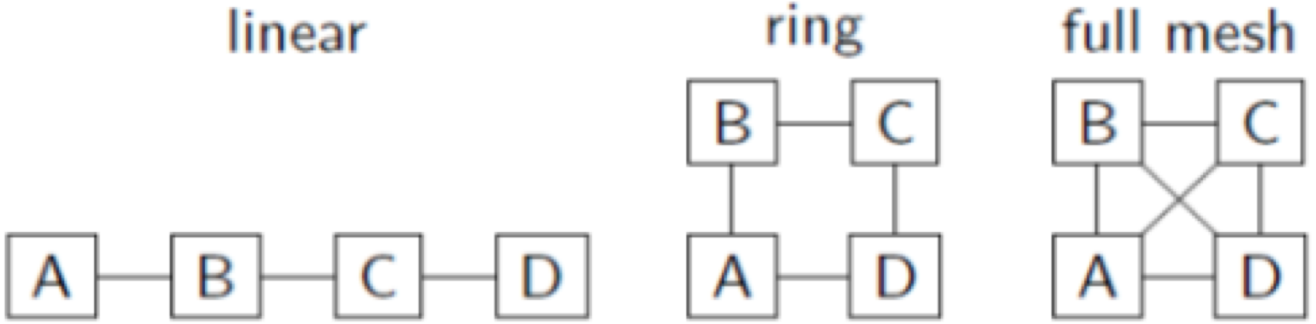
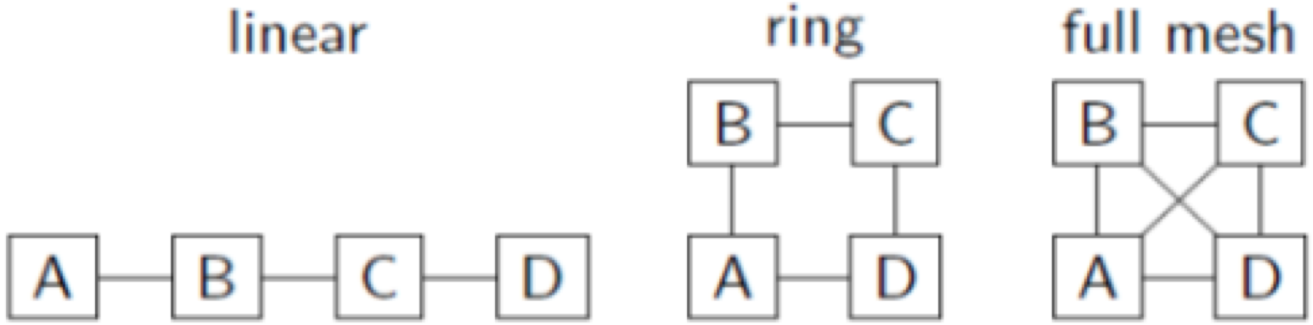


Solution 4 (Topology)

- (c)



  - Linear: *1* link
  - Ring: *2* link
  - Full mesh: *N* − *1* links

Question 4 (Topology)

- ~~(a) How many links are there in each network?~~
- ~~(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?~~
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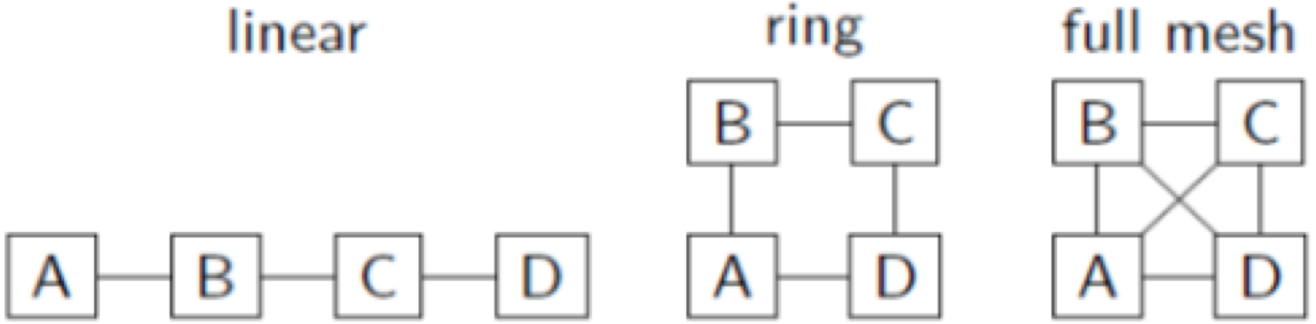
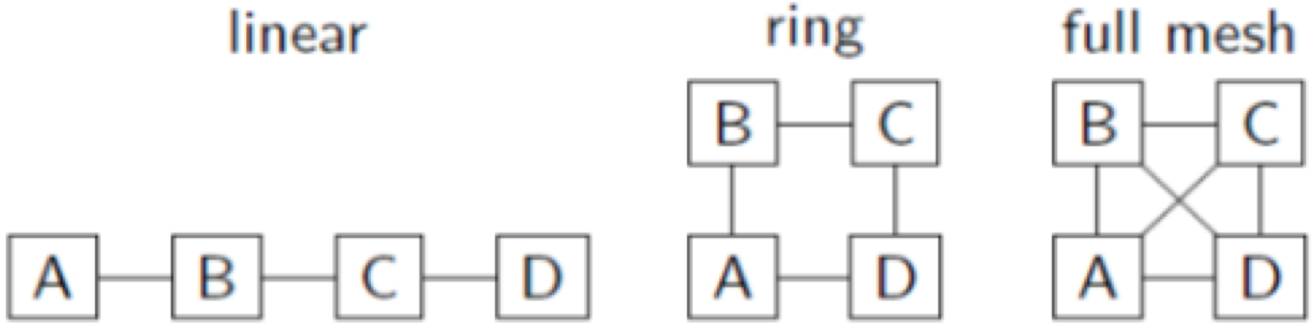


Solution 4 (Topology)

- (d)

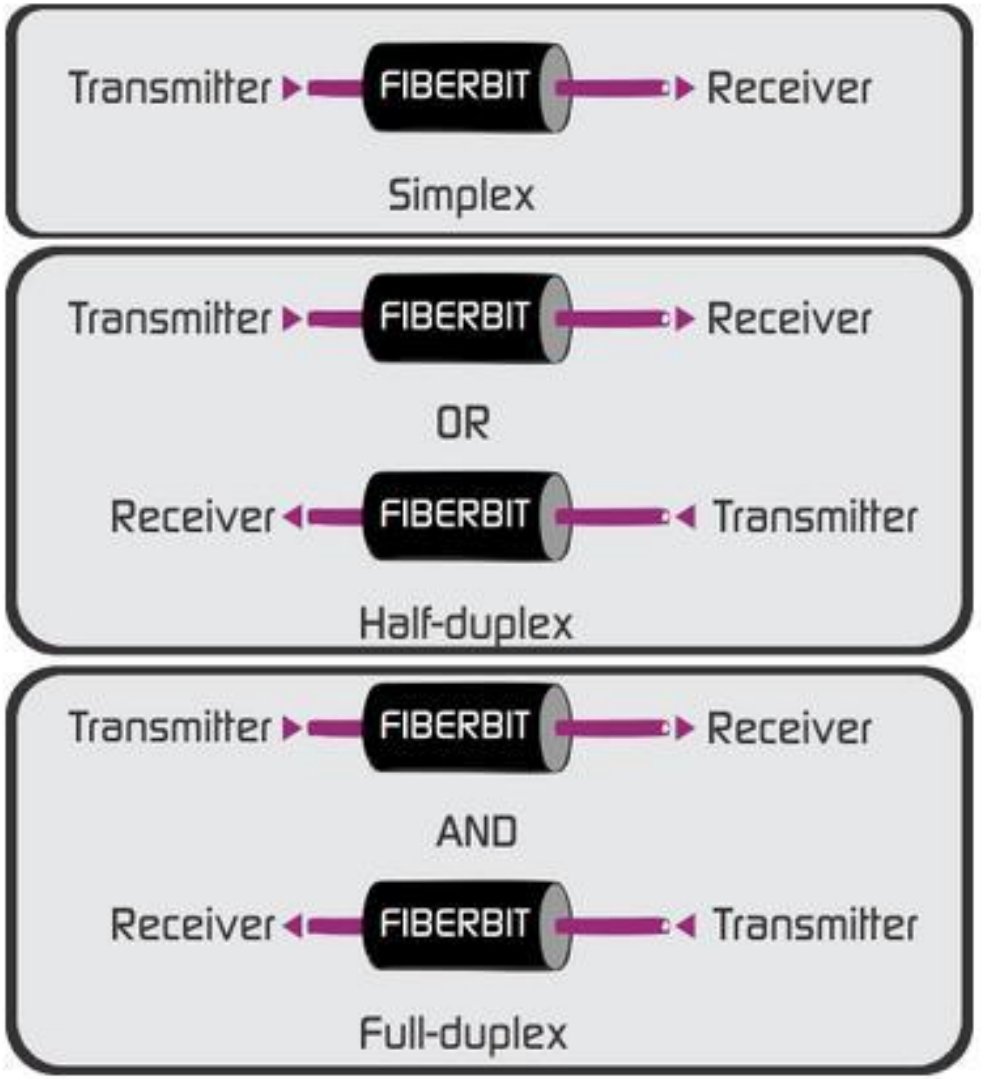


  - Full mesh – cost not important, but reliability is essential

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?

Solution 5 (Topology)



Solution 5 (Topology)

- 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.