THE UNIVERSITY OF MELBOURNE

Week3

COMP90007 Internet Technology

Prepared by: Chenyang Lu (Luke)

Your Tutor

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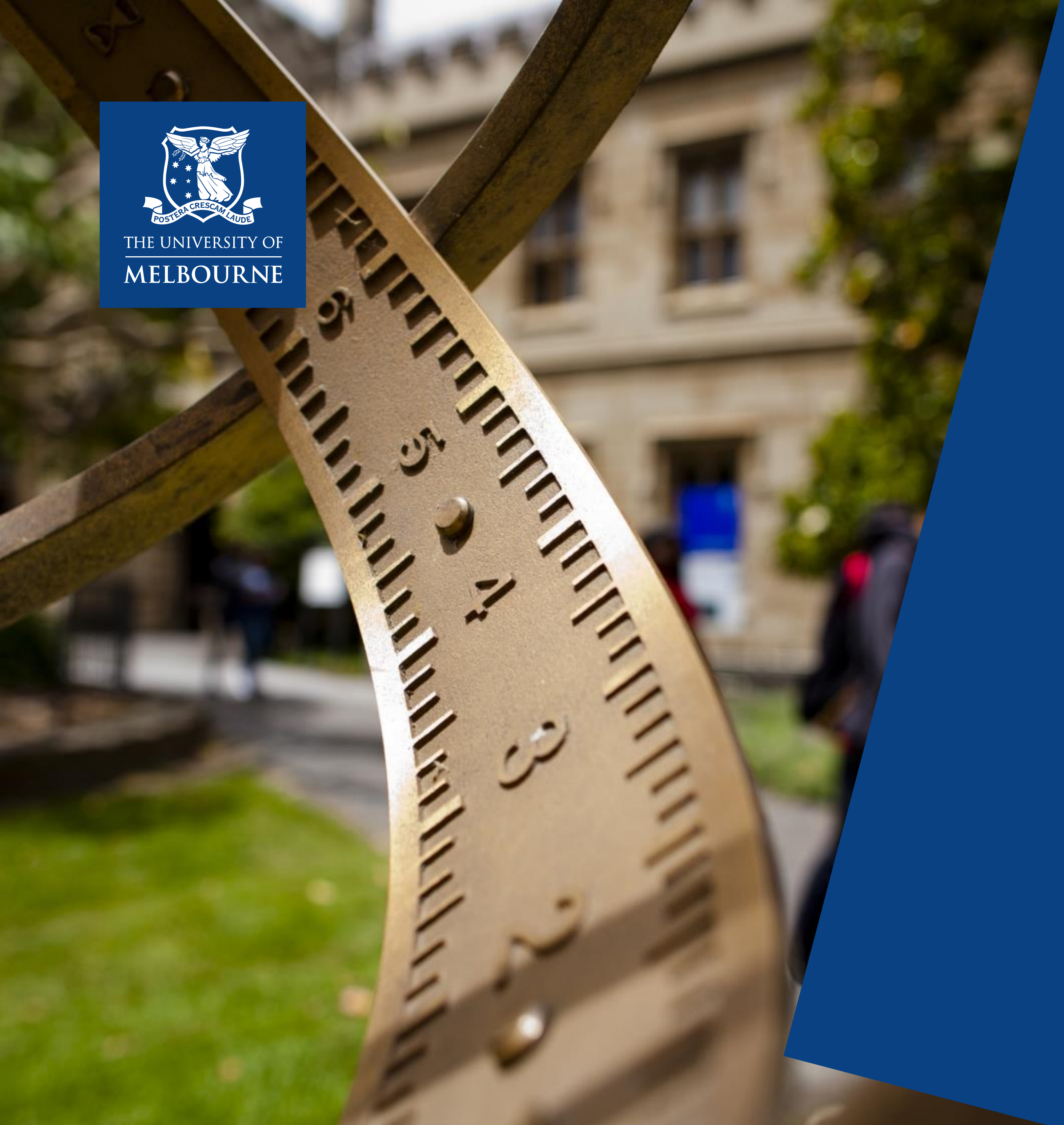
- Workshop Slides: https://github.com/LuChenyang3842/Internet-technology-teaching-material

Day	Time	Location
Tue	18:15	Bouverie st –B114
Wed	10:00	Elec Engineering -122
Wed	17:15	Bouverie-sr 132



Review

1. **What is Ip address?**

A numerical label assigned to each device connected to a computer network

3. What is TCP?

TCP is one of the main protocols in TCP/IP networks

Establish Connection between two hosts.

It manages flow control and handles retransmission.

2. What is HTTP used for?

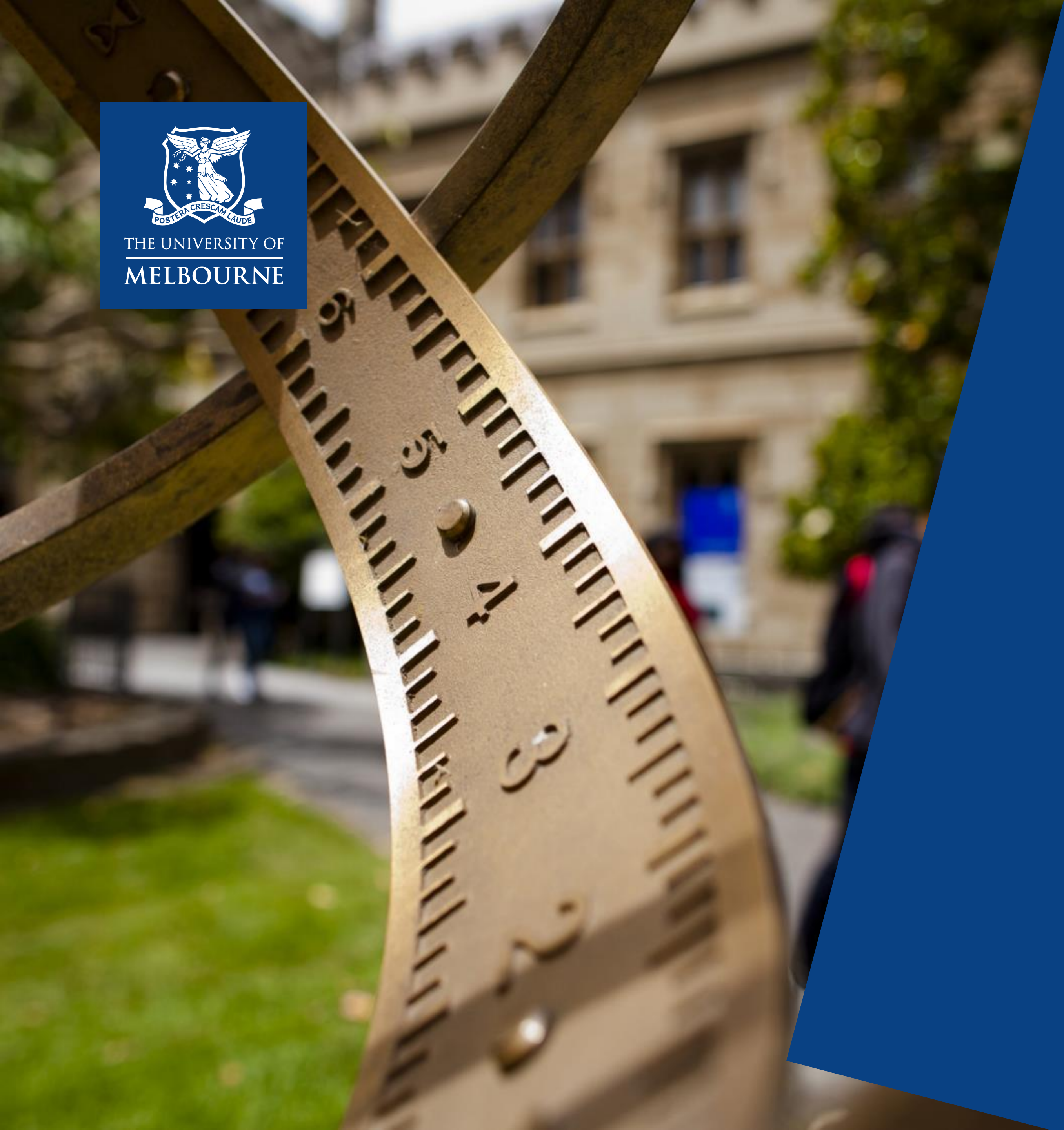
HTTP is the underlying protocol used by the World Wide Web and this protocol defines how messages are formatted and transmitted

1. How TCP establish a connection

3-way handshake

2. How TCP close a connection

4-way handshake



Workshop Questions

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.

TCP/IP Model

Application
Transport
Internet
Host-to-network

OSI Model

Application Layer
Presentation Layer
Session
Transport
Network
Data Link
Physical

Question 1

- 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.

Similarities:

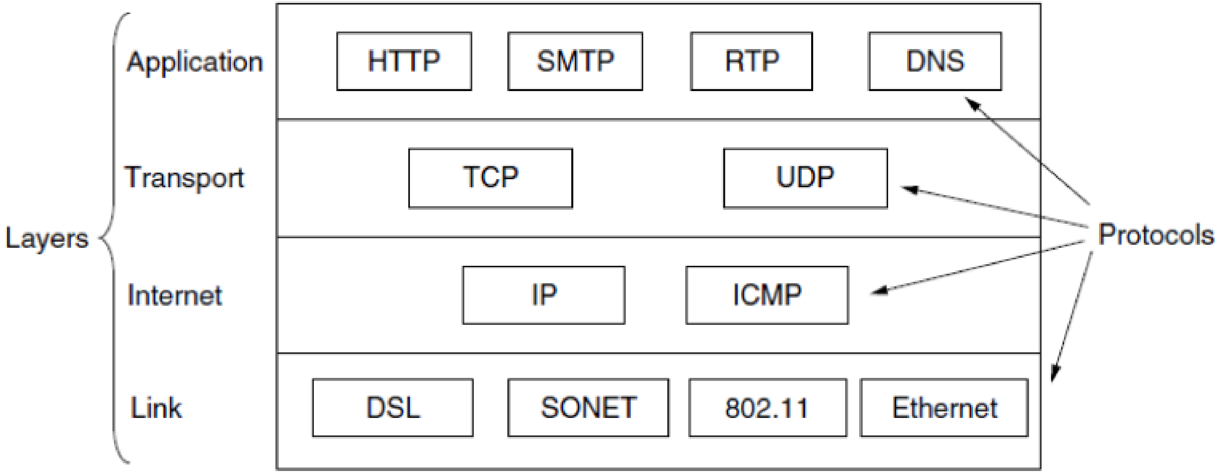
- stacking of layered protocols
- similar functionality in each of the layers
- layers above transport layer relate to applications

Differences:

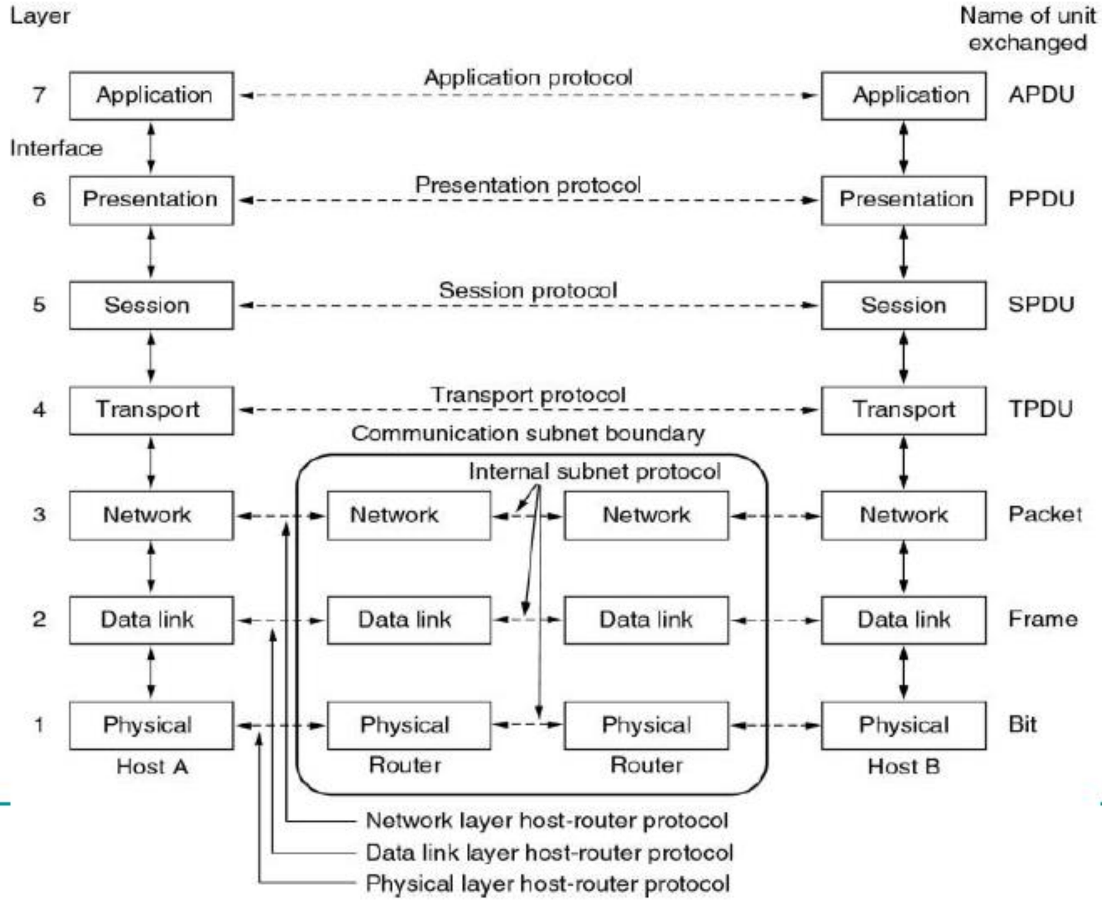
- TCP/IP does not distinguish between services, interfaces and protocols
- TCP/IP does not clearly separate physical and data link functions
- At the network layer, OSI supports connectionless and connection-oriented communication while TCP/IP supports only connectionless communication at the Internet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

For more Inormation , Text Book p38

TCP/IP Model



OSI Model



Hybrid Reference Model used in this semester

5	Application layer
4	Transport layer
3	Network layer
2	Data link layer
1	Physical layer

Delay (Latency)

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 <u>into the link</u>.
  - T-delay = Message in bit/ rate of transmission
- **Propagation delay**: the time taken for a packet to reach from sender(A) to receiver(B).
  - P-delay = length of channel/ speed of signals
- ***Round-Trip Delay**:
  - Satellite
  - Altitude above the earth, round-trip delay
  - Round-trip distance, light speed

Cite from: Yang, Lu, S 2018, Workshop3(physical layer), workshop notes, COMP90007 Internet Technology, University of Melbourne, delivered 19 Mar, 2018

Question2 (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.

- Assume speed of signal is speed of light , where $c = 3.0 \times 10^8$ m/s
- Calculate the round trip-delay

Question2 (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 / spead of light , where c = 3.0×10^8 m/s

- GEO: 239 ms
- MEO: 120 ms
- LEO: 5 ms

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)

Question3 (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 = $1600 \times 1200 \times 3 \times 8 = 46.08 \times 10^6$ 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

Bonus: Maximum data rate of transmission

Nyquist's theorem (Without noise)

$$\boxed{\text{Max. data rate} = 2B \log_2 V \text{ bits/sec}}$$

How fast signal can change

Number of signal levels

Shanon theorem (with Noise)

$$\boxed{\text{Max. data rate} = B \log_2(1 + S/N) \text{ bits/sec}}$$

How fast signal can change

How many levels can be seen

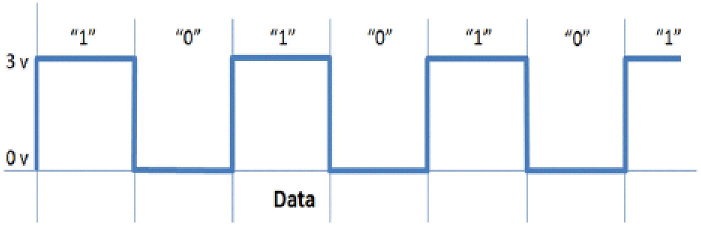


Figure 1. Data bits where logical "0" and "1" are represented by 0 volts and 3 volts respectively

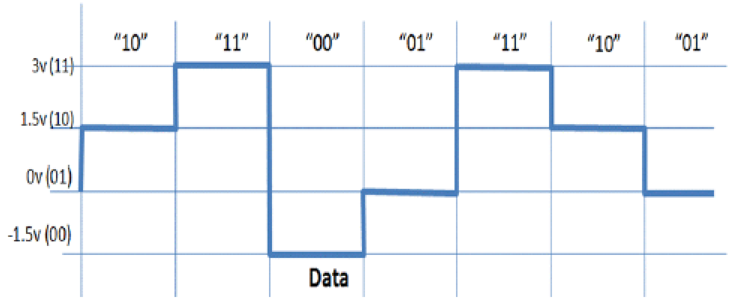
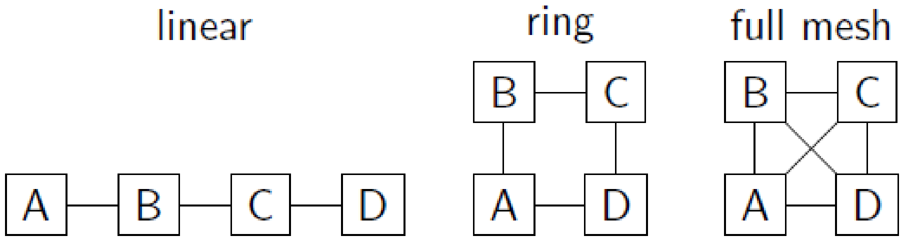


Figure 2. Four signaling levels per clock cycle can represent two data bits.

Question4 (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(<u>given n nodes, how many links in each network</u>)?

    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

Question5 (Topology)

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

Basis for Comparison	Simplex	Half Duplex	Full Duplex
Direction of Communication	Unidirectional	Two-directional, one at a time	Two-directional, simultaneously
Send / Receive	Sender can only send data.	Sender can send and receive data, but one a time.	Sender can send and receive data simultaneously.
Example	Keyboard and monitor	Walkie-talkie	Telephone

Question5 (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.