



THE UNIVERSITY OF  
MELBOURNE

# Workshop1

COMP90007 Internet Technology

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# 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

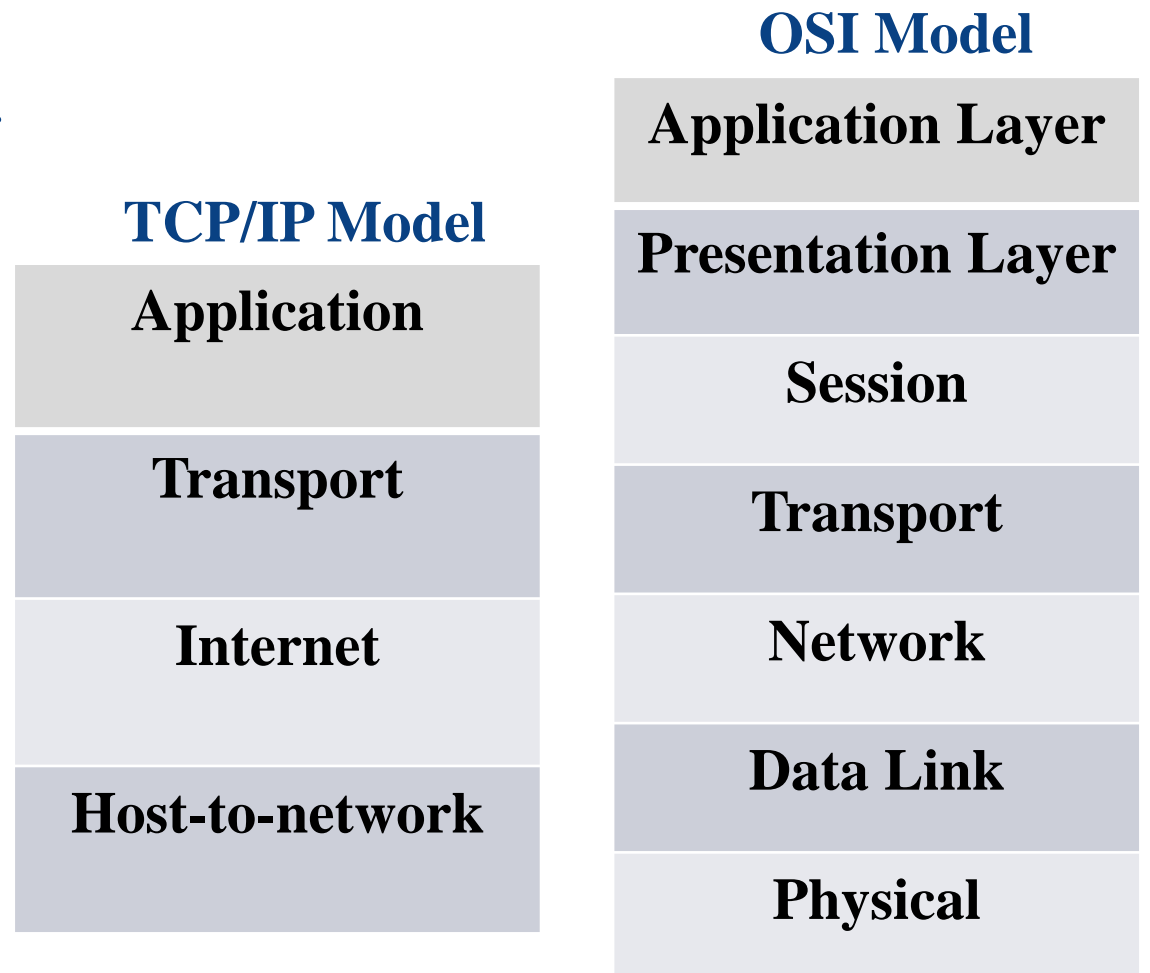




# Workshop Questions

# 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.



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- 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:

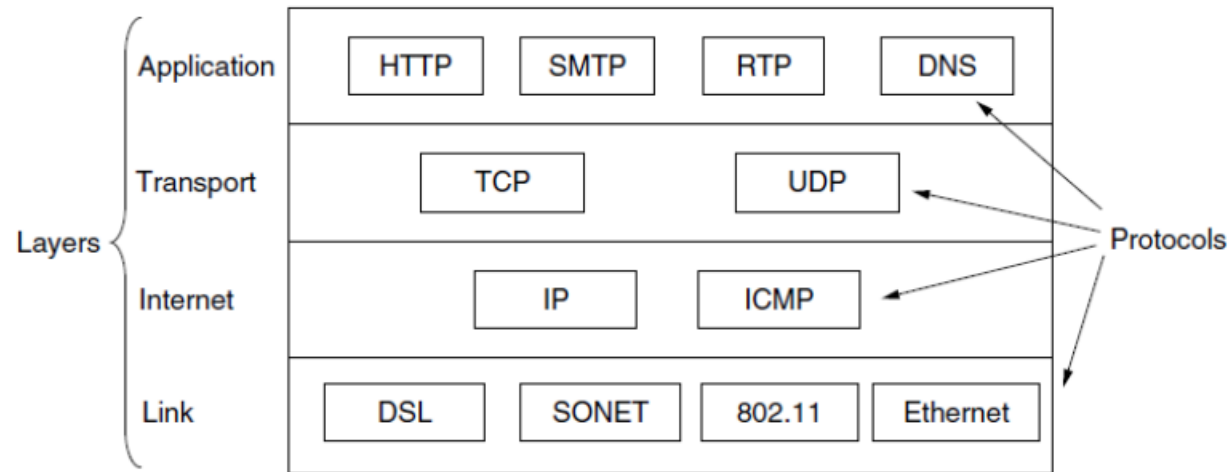
- stacking of layered protocols
- similar functionality in each of the layers
- layers above transport layer relate to applications

## Differences:

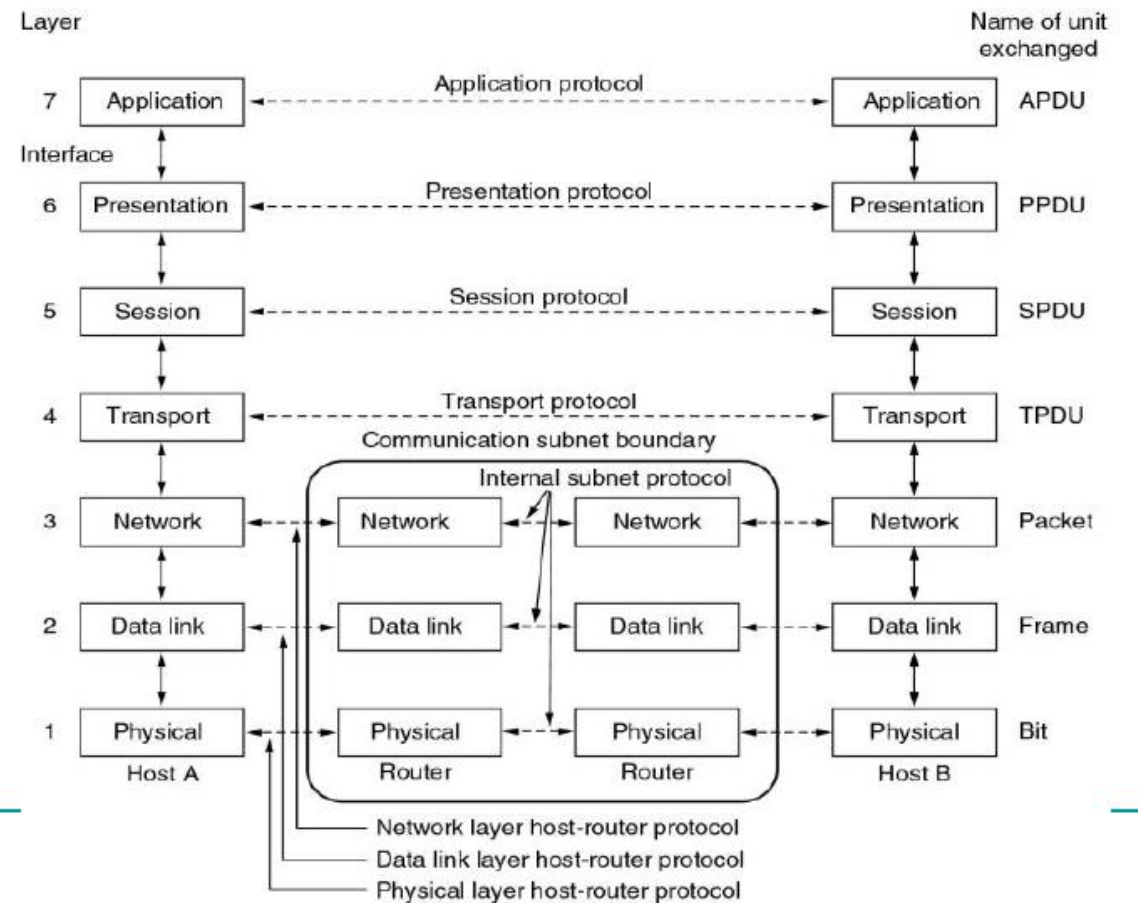
- TCP/IP does not distinguish between services, interfaces and protocols
- TCP/IP does not clearly separate physical and data link functions
- At the network layer, OSI supports connectionless and connection-oriented communication while TCP/IP supports only connectionless communication at the Internet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



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



## 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  $c = 3.0 \times 10^8 \text{ m/s}$
  - 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),
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- 
- Transit Time =  $2 \times \text{distance} / \text{speed of light}$ , where  $c = 3.0 \times 10^8 \text{ m/s}$
  - 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  $1600 \times 1200$  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

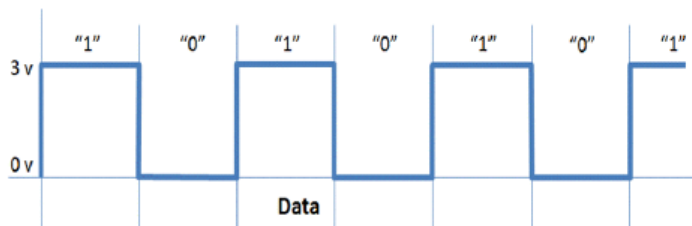
# Bonus: Maximum data rate of transmission

## Nyquist's theorem (Without noise)

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

How fast signal can change

Number of signal levels



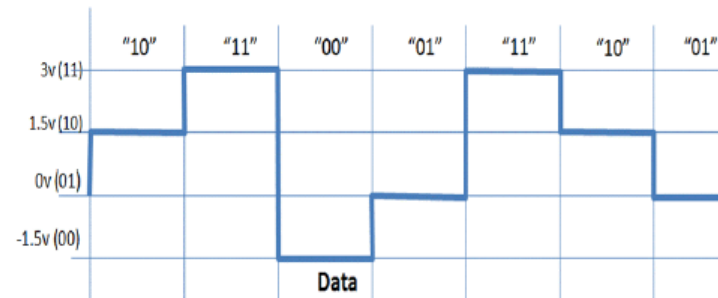
**Figure 1.** Data bits where logical "0" and "1" are represented by 0 volts and 3 volts respectively

## Shanon theorem (with Noise)

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

How fast signal can change

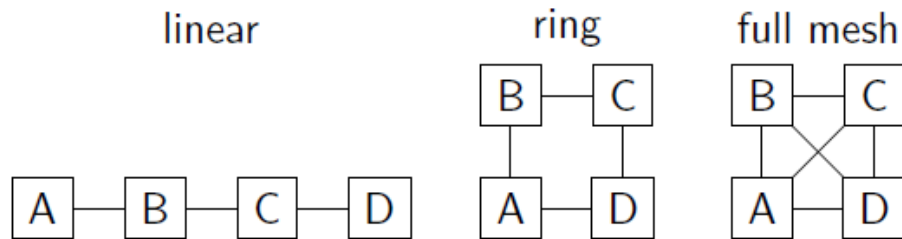
How many levels can be seen



**Figure 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(given  $n$  nodes, how many links 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

# 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 at 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.