UNSW Business School
Information Systems and Technology Management

INFS2607 Networking and Infrastructure

Lecture 1
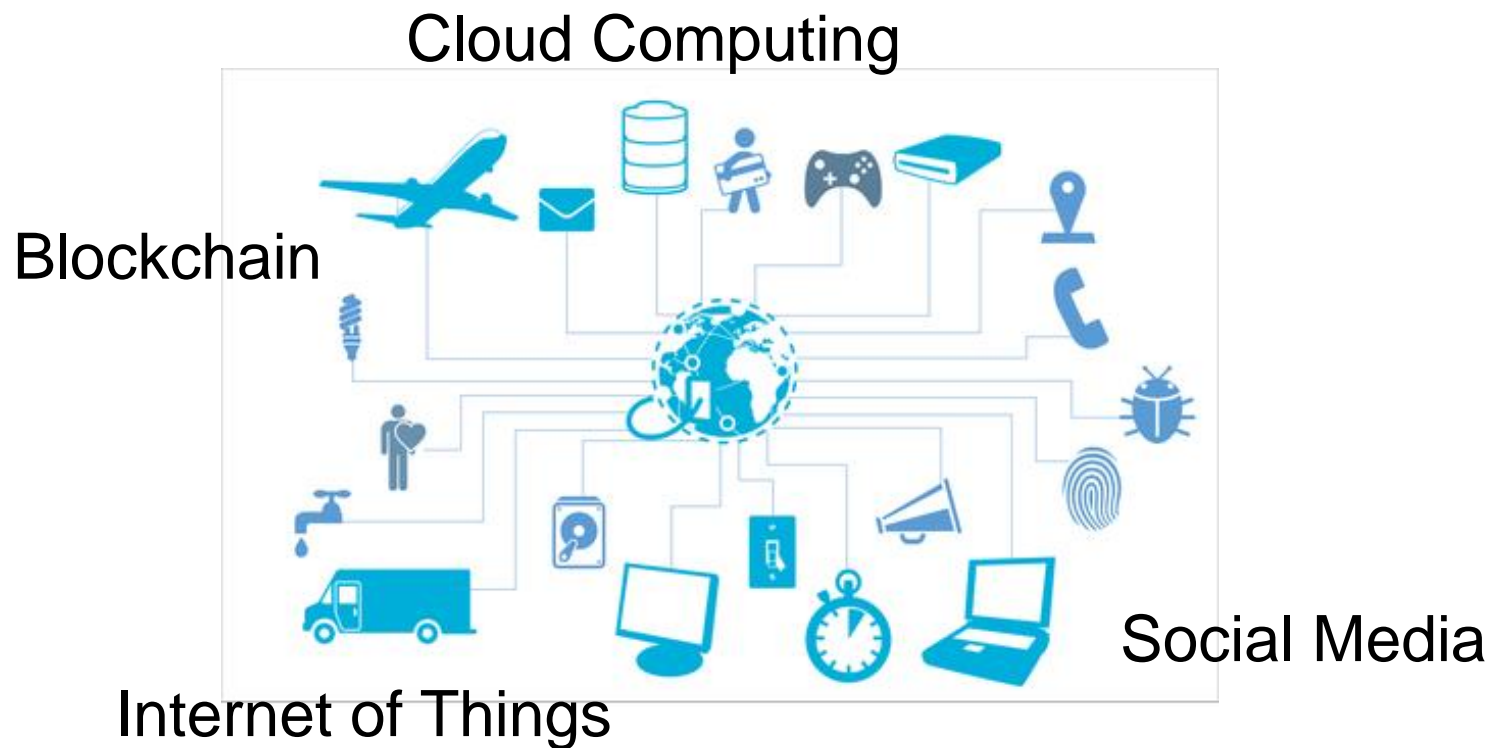# Introduction to Networking

yenni.tim@unsw.edu.au

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Objectives:

1. Introduction to networking

2. Introduction to the course

Why Networking?

Cloud Computing

Blockchain

Social Media
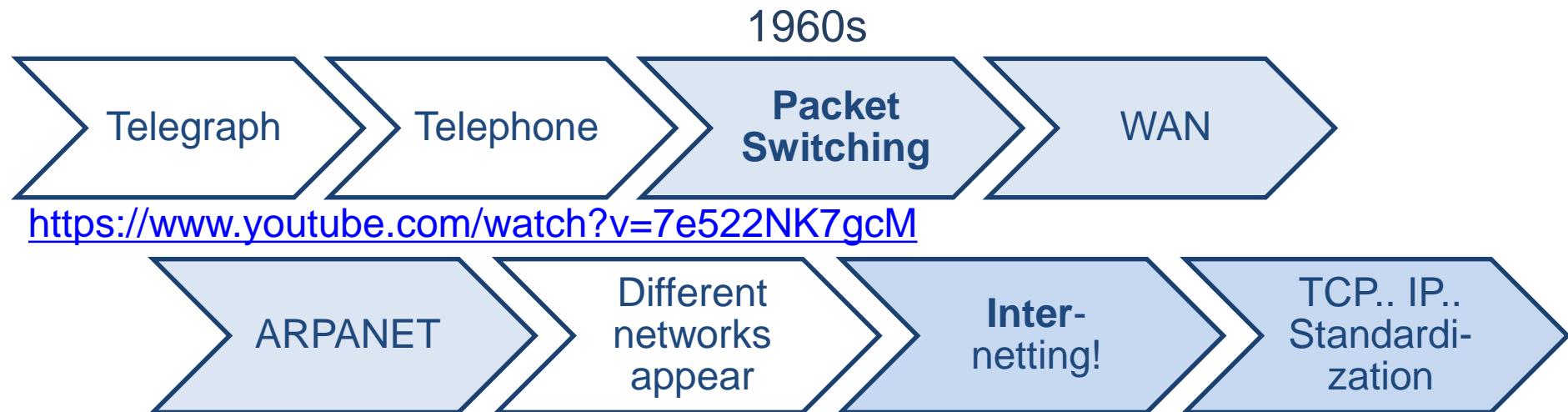
Internet of Things

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Why Networking?

- The key supporting element behind these technologies is _____

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What data communication was like… before the Internet came along?

1960s

Telegraph → Telephone → **Packet Switching** → WAN

ARPANET → Different networks appear → **Inter-** netting! → TCP.. IP.. Standardi-zation

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Why Networking?

Knowledge you are going to learn in this course will help you **understand, evaluate and design new technologies**

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In this course, you will learn:

The 3 faces of networking

- Fundamental Concepts

- Network Technologies

- Network Management

- …

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Lecturer-in-charge: Yenni Tim

E: yenni.tim@unsw.edu.au

Consultation time: **Monday 3-5pm** (by appointment)

Course Information

Your Lecture

- **Interactive**

- Learning concepts and fundamentals **with lots of illustrations (i.e., recording might not be as effective)**

- Peer instruction

Course Information

Assessment Task	Weighting	Length	Due Date
Tutorial Participation	20%	See below	Tutorials, Weeks 2 – 13
Mid Semester Quiz	20%	See below	Week 9 lecture time
Final Exam	60%	2 hours	University Exam Period
Total	100%		

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Course Information

Sandboxing Workshops start in Week 02

- Bi-weekly workshops (5 workshops in total)

- Each workshop = **4% (total 20%)**

- You have 2 hours in the sandbox to solve several challenges

- There are **questions to be answered prior to your workshop**

Course Information

Sandboxing Workshops start in Week 02

- IMPORTANT: you will be working in a group of 2, but marks will be awarded **individually**

- It is your responsibility to bring a **printed copy of your lab handout (along with answers to your homework)**

- Failure to bring a printed copy will result in **zero marks** for that particular workshop
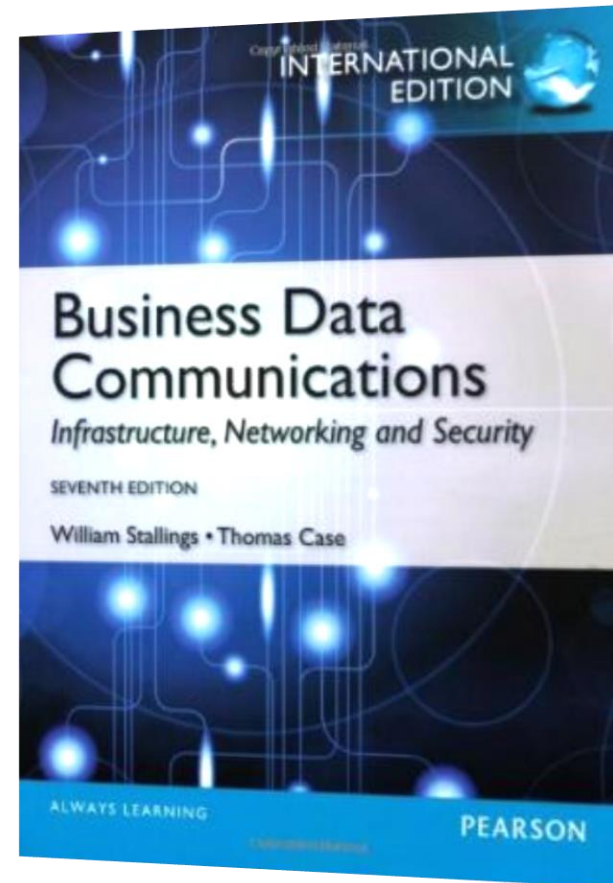
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Course Information

Main Reference Textbook

Business Data Communications: Infrastructure, Networking and Security

by Stallings W. and Case, T
7th ed., Prentice Hall

So, **what** exactly is **Networking**?

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Three components of Networking:

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Server

- Stores data or software to be accessed by the clients

Client

- Provides users with access to the data or software on the server

Medium

- Pathway through which the communication occurs
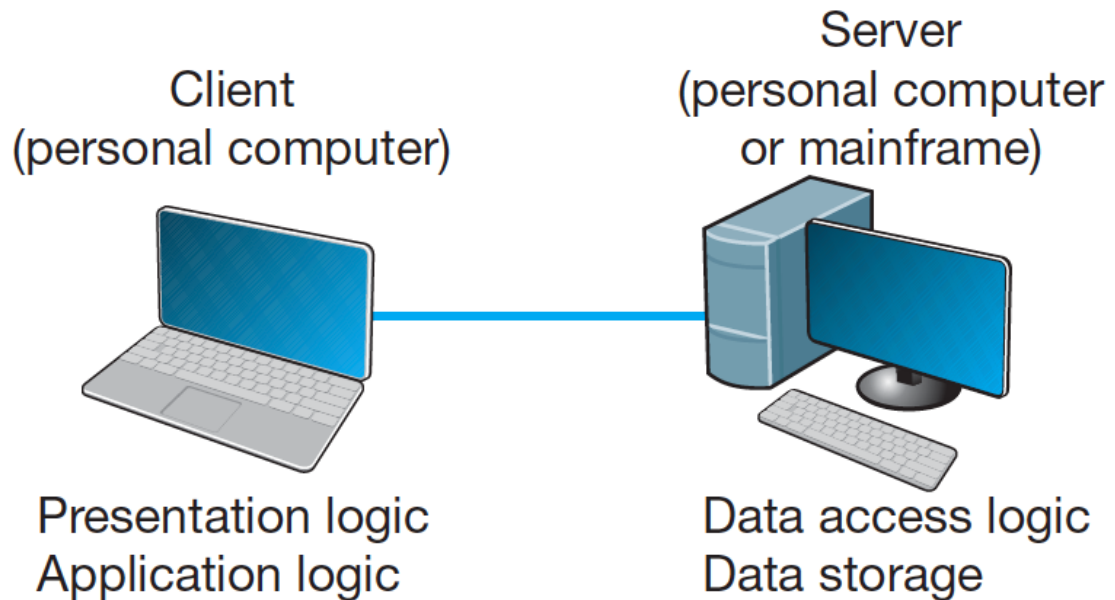- Could be a cable, or devices such as switches or routers

Client-server networks

- **Servers:**
  - **Mainframe**: large general-purpose computers that are capable of performing immense numbers of simultaneous functions and huge amounts of data
  - **Clusters**: group of computers linked together to serve as one server
  - **Virtual server**: one computer acts as several servers

Client-server networks

- **Clients:**
  - Personal computer, handheld computers, mobile phones etc.

Client
(personal computer)

Server
(personal computer
or mainframe)

Presentation logic
Application logic

Data access logic
Data storage

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Strictly speaking, a network **does not** necessary need a server

- **Peer-to-peer (P2P) networks** have computers sharing data and software with each other (computers function as equals**)**

- E.g., gossips ☺

CLIENT/SERVER

Central Server

Clients

PEER TO PEER

Distributed Clients
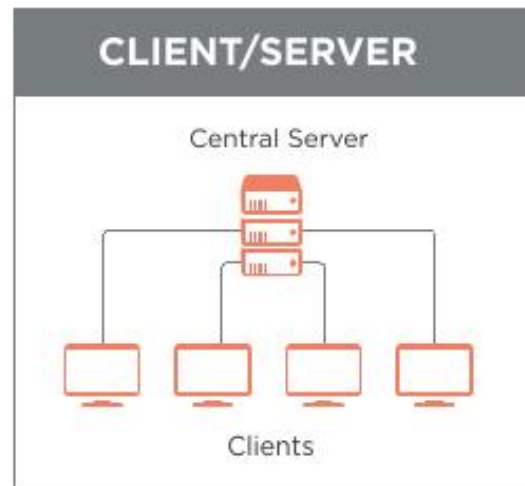
Discussion Question:

Why do we need Client-server networks?
Compare and contrast with P2P network

Skype, Whatsapp, WeChat?

This is an important thought question – we will come back to this when we discuss the blockchains

Data Transmission

Simplex

- Single direction (e.g., water flows from the pipe)

Half duplex

- Both stations can transmit but only one at a time

Full duplex

- Two-way, simultaneously (e.g., four-way highway cars travel in both directions)
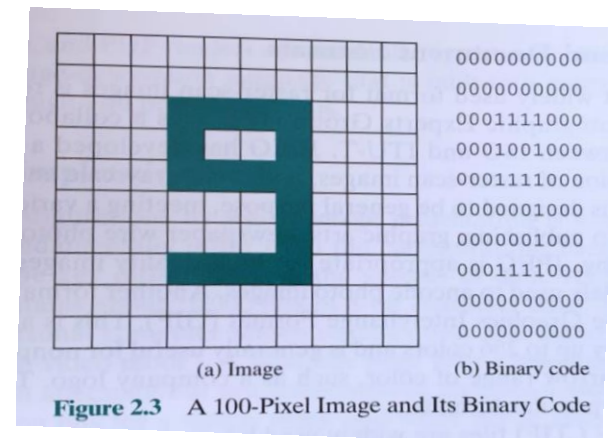
Data Transmission

- Fundamentally two different types of data: **digital and analog**

- **Analog transmission** – remember the history?
  - Telephone networks designed to carry **human sound waves** rather than **computer binary data**
  - Analog data takes on **a range of values**, not just 0 or 1
  - Analog transmission occurs when the signal sent over the transmission media **continuously varies from one state to another** in a wave-like pattern much like the human voice
  - A **modem** is used to translate analog signals to/from digital binary data

Data Transmission

Digital Data

- **Discrete binary data** represents two binary levels – 0 or 1 (e.g., voltage levels high vs low)

- Denoted by square waves (discrete and discontinuous)

- In most digital equipment, data is converted into binary code and then "reassembled" back into original form at reception point
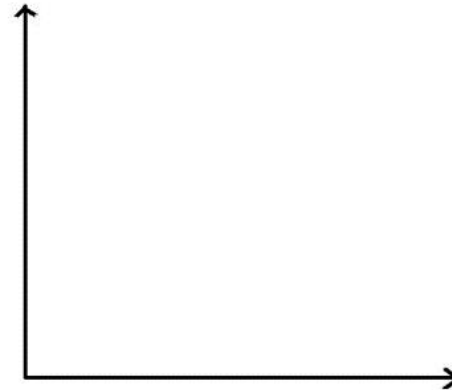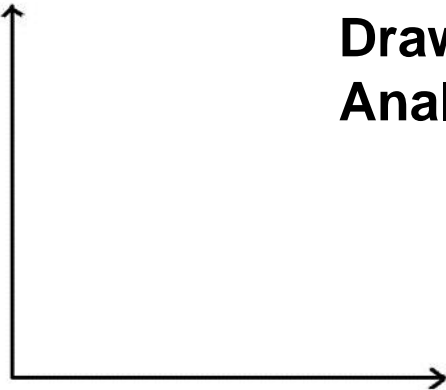

Figure 2.3   A 100-Pixel Image and Its Binary Code

Data Transmission

Digital Data

Draw:
Analog versus Digital

Data Transmission

Why bother to translate analog into digital?

- **Digital transmission** produces fewer errors. **Why**?
- Digital transmission permits higher transmission rates (e.g., the use of fiber optic cable)
- Digital transmission is more secure (easier to encrypt)
- Lastly…
  - Integrating different types of data (e.g., voice, video and data) on the same circuit is simpler with digital transmission. **Applications**?

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Checkpoint:

By now you should have some understanding on:

- Networking

- Computers, data, and communication

- Basic network structure (P2P etc.)

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Introducing the **OSI Reference Model** to help understanding networking:

- The OSI is the most referred to network model – tested in Microsoft, Cisco, etc. networking certification exams
- However, you will probably never use a network based on the OSI model

Wait what?

Why OSI?
Before OSI… Many different commercial networks were built by different vendors

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OSI Model
7. Application Layer
6. Presentation Layer
5. Session Layer
4. Transport Layer
3. Network Layer
2. Data Link Layer
1. Physical Layer

7 - **A**ll   7 - **A**cronyms

6 - **P**eople   6 - **P**ointless

5 - **S**eem   5 - **S**tudents

4 - **T**o   4 - **T**each

3 - **N**eed   3 - **N**ot

2 - **D**ominos   2 - **D**o

1 - **P**izza   1 - **P**lease

OSI Model – Overview
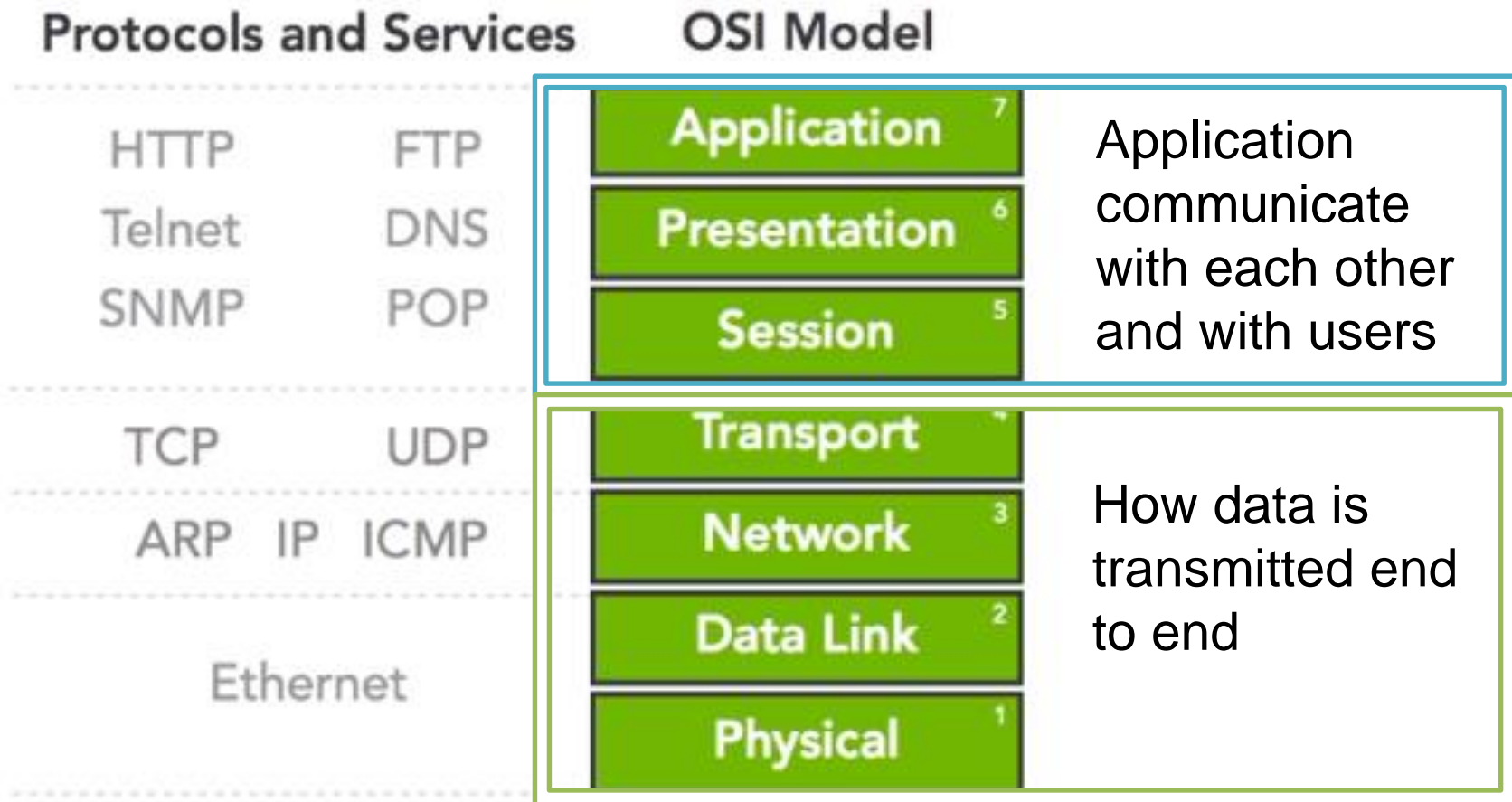
- Seven-layer theoretical model used as a **reference** to help understand how networks operate

- Important in troubleshooting

Protocols and Services		OSI Model
HTTP	FTP	Application 7
Telnet	DNS	Presentation 6
SNMP	POP	Session 5
TCP	UDP	Transport 4
ARP IP ICMP		Network 3
Ethernet		Data Link 2
		Physical 1

OSI Model – Overview

Protocols and Services

HTTP	FTP
Telnet	DNS
SNMP	POP
TCP	UDP
ARP IP ICMP	
Ethernet	

OSI Model

Layer	
Application	7
Presentation	6
Session	5
Transport	4
Network	3
Data Link	2
Physical	1

Application communicate with each other and with users

How data is transmitted end to end

Layer 1 – Physical layer (hardware)

- Deals with access to **physical** medium

- Transmitting **data bits** (zeros or ones) over a communication circuit

- Defines **rules** by which data bits are transmitted (e.g., as voltages of electricity? Number of bits sent per second? Physical format of cables?)

Layer 2 – Data Link layer (hardware)

- Because layer 1 transmits only the raw stream of bits without understanding, layer 2 needs to:
    - Recognize message boundaries
    - Combines **packets into bytes and bytes into frames**
- This layer also performs **error detection** (problems caused by damaged, lost or duplicate messages)

Layer 3 – Network layer (TCP/IP software)

- Perform **IP addressing and routing** - determines the next computer the message should be sent to

- Responsible for establishing, maintaining and terminating **connections** across intervening networks

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Layer 4 – Transport layer (TCP/IP software)

- Provides **reliable transfer** of data between end points

- Provides **end-to-end error recovery** and flow control

- Ensures the data are delivered error-free, in sequences, no losses and no duplications

Layer 5 – Session layer (application)

- **Session initiation and termination** (including security check - ensure correct party receives the message)

- Managing and structuring all sessions (e.g., logging onto equipment and transferring files)

- Performs recovery for any broken connections from the Transport layer

Layer 6 – Presentation layer (application)

- Formats the data for **presentation to the user**

- Concerned with the syntax of the data exchanged between application entities (accommodate different interfaces on different computers)

- Examples: data compression, encryption and decryption, translation between different fata formats and screen formatting

Layer 7 – Application layer (application)

- End user's access to the network
- Provide a set of utilities for application programs
- **User programs** determine the set of messages and action it might take on receipt of message
- Examples: sending emails, file transfers

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Think and share: Understanding how OSI model works

1. Leo sends an email to Alex…

?

?

?

…

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1. Email ready to be sent from an SMTP server
2. Data formatted in a way the receiving devices would understand (e.g., text: ASCII)
3. A session of receiving mail server is started
4. Should we use TCP or UDP?
5. IP address of the source and destination server are added to the data
6. MAC addresses of routers and host are added
7. Data is sent out of the network using Ethernet cable

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Questions? Feedback?

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What's next?

Your first workshop (starts in Week 02 or Week 03)
- Read and prepare for the questions in the lab handout
- **Print the lab handout** and be on time for your workshop

Next lecture
- **Physical layer**: communication media and data transmission