



# CSA2100: Techniques in OS

Part 1: Sockets and TCP/IP

Joseph Cordina

Rm203, Tel: 2340-2254

[joseph.cordina@um.edu.mt](mailto:joseph.cordina@um.edu.mt)

# Course Structure

- Networking Fundamentals
- Network and Internet Connectivity
- Socket Programming
- Textbooks:
  - A. Rodriguez, J. Gattrell, J. Karas and R. Peschke. TCP/IP Tutorial and Technical Overview. 7th Ed. IBM International Technical Support Organisation 2001 (downloadable) (up to Chap. 5)
  - W.R. Stevens. TCP/IP Illustrated, Volume I: The Protocols. Addison Wesley 1994
- Notes: [www.cs.um.edu.mt/~jcor1](http://www.cs.um.edu.mt/~jcor1)

# [ Requirements ]

- You need to be able to convert comfortably between decimal, binary and hexadecimal notation.
- Most networking operations are performed in binary
- Ability to reason in binary notations.
- Ability to research and read about topics on your own.
- Notes on their own are not complete

# [ Networking ]

- Computers need to communicate to share data.
- Stand-alone computers can only communicate using transfer of removable media that tends to be cumbersome
- Thus computers started being connected together allowing on the fly transfer of data: networks
- Many techniques exist that allow transfer of data from wired connections using electrical signals, wireless connections and even optical communication.
- Regardless of the type of computer being used, each computer needs a way to communicate: NIC
- A NIC allows data to be sent over a network.

# [ Network devices ]

- Each NIC has its own address called a MAC address
  - The form of this address depends on the networking technology being used ex: Ethernet, Token Ring, etc
- Any signal degrades the further it travels. Thus one uses several other devices:
  - Repeater
  - Bridges
- In addition several computers might want to communicate between each other
  - Switches
  - Routers

# Networking Topologies

- Computers might be connected in a variety of ways:
  - Bus, Ring, Star, Extended Star, Hierarchical or Mesh
- A network might span varying distances:
  - LAN – limited geographically, high bandwidth, full time connectivity
  - WAN – large geographical area, lower bandwidth and full or part-time connectivity
  - MAN – two or more LANs in a geographic area
  - SAN – Dedicated link to move data between servers and storage resources
- Another classification is by data access:
  - Intranet – only allowed users are given access
  - Extranet – provide services to the world

# [ Bandwidth ]

- Most important factor in networking is bandwidth
  - Flow of data per unit time
- Bandwidth is
  - Finite
  - Not free
  - Affects network design
  - More bandwidth is always required
- Units: bps, Kbps, Mbps, Gbps, Tbps
- Most fundamental restriction of bandwidth is
  - Type of media
  - LAN or WAN technology used
- Throughput is the actual bandwidth achieved

# [ Network Layers ]

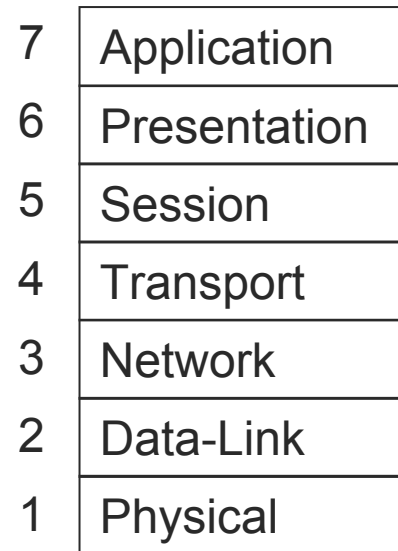
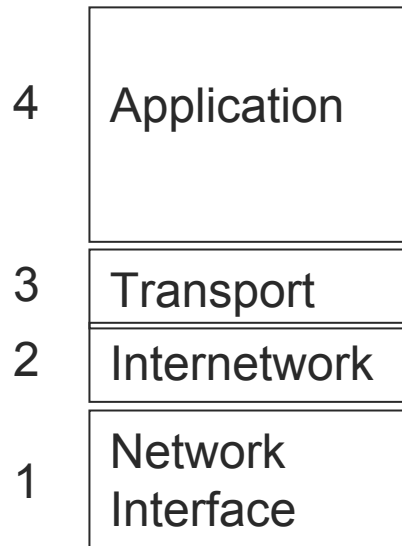
- For applications to be able to communicate, they need to communicate using one single language
- Thus data communication is split into layers
- Layer x will speak to Layer x on the other computer
- One layer will pass data to the layer underneath.
- The lowest layer will communicate directly with the lower layer on the other computer.

# OSI Model

7	Application	Network Services to Application - Data
6	Presentation	Data Representation, Format of Data, Readability of Data (XML) - Data
5	Session	Establish and maintain connection - Data
4	Transport	End-to-End Connections, Maintain virtual circuits, Data Reliability - Segments
3	Network	Network Address, Best Path Determination, Flow control (IP) - Packets
2	Data-Link	Access to Media, Physical Addressing, Reliable Transfer (Ethernet) - Frames
1	Physical	Wires, Connectors, Voltages, Binary Transmission - Bits

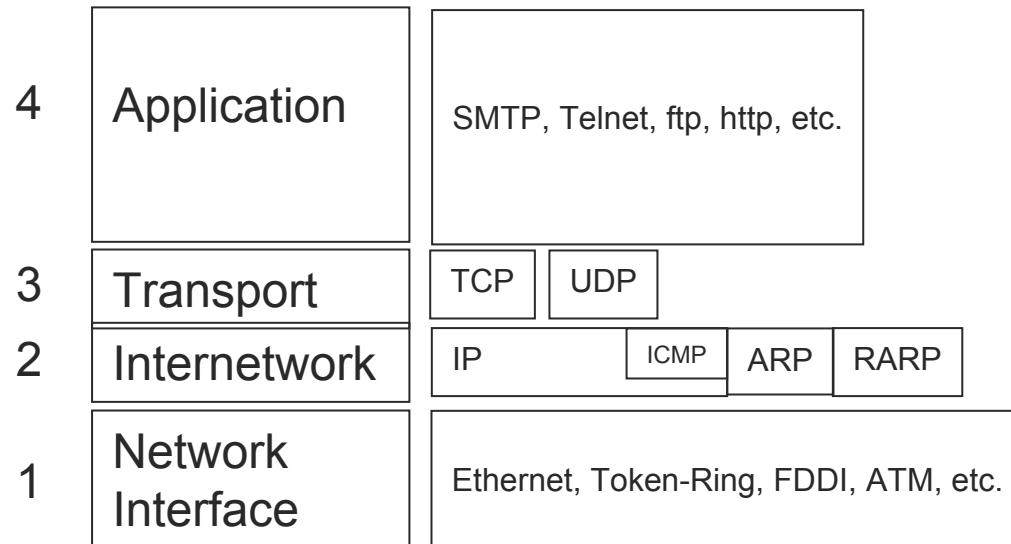
- This is a framework showing how data travels to the network and back.
- More accurate representation of networks.
- Each layer normally introduces a header in the data packet.

# [ TCP/IP Model ]



- Model used for internet connectivity.
- Note correspondence with OSI layer.

# TCP/IP Layer Implementations



- TCP/IP uses the Client/Server Model
  - The Server is an application that offers services and receives requests from clients
  - The Client is an application that requests services from servers.

# [ The Internet ]

- The internet is a collection of computers communicating with each other through the use of TCP/IP protocol suite
- It was a result from research in the American defence agency for a network to withstand nuclear holocaust
- No one owns the internet, people pay for connectivity
- The protocol suite evolved and still evolves through the use of approved standards ([www.ietf.org](http://www.ietf.org)).
  - The Internet Engineering Steering Group (IESG) decides on new standards
  - The IETF publishes RFCs containing new proposed standards
  - Anyone can forward RFCs to the IETF
  - An RFC passes through several states:
    - Standard, Draft Standard, Proposed Standard, Experimental, Informational, and Historic
  - Also an RFC has a status
    - Required, Recommended, Elective, Limited Use and Not Recommended

# [ Network Interfaces ]

- We will not cover physical layering since this is an Engineering domain.
- There are various widespread protocols:
  - Ethernet for LANs
  - ISDN, DSL, FrameRelay for WANs