ECE230X Lectures 2-3
Supplementary Slides

Data and Computer Communications Eighth Edition
By William Stallings
Chapter 2 – Protocol Architecture, TCP/IP, and Internet-Based Applications

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Adapted from Prentice Hall instructor resources
Simplified Protocol Architecture
TCP/IP Protocol Architecture

- developed by US Defense Advanced Research Project Agency (DARPA)
- for ARPANET packet switched network
- used by the global Internet
- protocol suite comprises a large collection of standardized protocols
TCP/IP Five-Layer Model

- Not an official model but a working one
  - Application layer
  - Host-to-host, or transport layer
  - Internet layer
  - Network access layer
  - Physical layer
Operation of TCP and IP

Host A
- App Y
- App X
- TCP
- IP
- Network Access Protocol #1
- Physical

Host B
- App Y
- App X
- TCP
- IP
- Network Access Protocol #2
- Physical

Router J
- IP
- NAP 1
- NAP 2
- Physical

Network 1
- Physical

Network 2
- Physical

Port or service access point (SAP)
Logical connection (TCP connection)
Global network address
Subnetwork attachment point address
Logical connection (e.g., virtual circuit)
Addressing Requirements

- two levels of addressing required
- each host on a subnet needs a unique global network address
  - its IP address
- each application on a (multi-tasking) host needs a unique address within the host
  - known as a port
Physical Layer

- concerned with physical interface between computer and network
- concerned with issues like:
  - characteristics of transmission medium
  - signal levels
  - data rates
  - other related matters
Network Access Layer

- exchange of data between an end system and attached network
- concerned with issues like:
  - destination address provision
  - invoking specific services like priority
  - access to & routing data across a network link between two attached systems
- allows layers above to ignore link specifics
Internet Layer (IP)

- routing functions across multiple networks
- for systems attached to different networks
- using IP protocol
- implemented in end systems and routers
- routers connect two networks and relays data between them
Transport Layer (TCP)

- common layer shared by all applications
- provides reliable delivery of data
- in same order as sent
- commonly uses TCP
Application Layer

- provide support for user applications
- need a separate module for each type of application, e.g.
  - Simple Mail Transfer Protocol (SMTP)
  - Hyper text transfer protocol (HTTP)
  - File Transfer Protocol (FTP)
  - Telnet
  - SSH
  - Etc.
OSI

- Open Systems Interconnection
- developed by the International Organization for Standardization (ISO)
- has seven layers
- is a theoretical system delivered too late!
- TCP/IP is the de facto standard
OSI Layers

Application
Provides access to the OSI environment for users and also provides distributed information services.

Presentation
Provides independence to the application processes from differences in data representation (syntax).

Session
Provides the control structure for communication between applications; establishes, manages, and terminates connections (sessions) between cooperating applications.

Transport
Provides reliable, transparent transfer of data between end points; provides end-to-end error recovery and flow control.

Network
Provides upper layers with independence from the data transmission and switching technologies used to connect systems; responsible for establishing, maintaining, and terminating connections.

Data Link
Provides for the reliable transfer of information across the physical link; sends blocks (frames) with the necessary synchronization, error control, and flow control.

Physical
Concerned with transmission of unstructured bit stream over physical medium; deals with the mechanical, electrical, functional, and procedural characteristics to access the physical medium.

Figure 2.6 The OSI Layers
OSI v TCP/IP

<table>
<thead>
<tr>
<th>OSI</th>
<th>TCP/IP</th>
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</thead>
<tbody>
<tr>
<td>Application</td>
<td>Application</td>
</tr>
<tr>
<td>Presentation</td>
<td>Transport (host-to-host)</td>
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<tr>
<td>Session</td>
<td>Internet</td>
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<tr>
<td>Transport</td>
<td>Network Access</td>
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<tr>
<td>Network</td>
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<td>Data Link</td>
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<td>Physical</td>
<td>Physical</td>
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</tbody>
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Summary

- Protocol architecture: layering of functionality

- Advantages:
  - Simplifies design and analysis of communication networks
  - Increases flexibility (easier to upgrade parts of network, rather than the whole thing)

- Disadvantages:
  - Increased overhead
  - Lightweight protocols needed for multimedia applications

- Well-known layering models:
  - TCP/IP five-layer model
  - OSI seven-layer model