

# Network Architecture Models

(September 7, 2016)

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## Learning Objectives

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- Discuss the OSI reference Model
- Discuss the Internet Model
- Compare OSI and Internet Models

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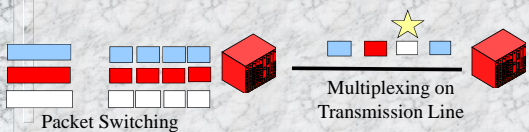
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## Data Networks operation

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- Packet Switching
  - Large messages are broken into small pieces called *packets* (or *frames*)
- Multiplexing
  - Packets from many conversations are mixed (*multiplexed*) over each trunk line



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## Why Packet Switching & Multiplexing? <sup>4</sup>

- Switches, routers, bridges handle short messages efficiently
- Sending a file all in one single string of data:
  - Other computers couldn't use the Network during transmission
  - Not be appreciated by other users
  - If error, the entire file has to be sent again



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## How computers make sense of incoming packets? <sup>5</sup>

- By using rules of operation defined through:
  - Network Architecture Models and their associated protocols, i.e.:

Protocols = rules for communications between 2 computers (or other networking devices) implemented in hardware or in software.

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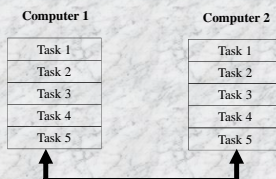
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## Network Architecture Model? <sup>6</sup>



- **Definition 1:** A communication model that defines specific tasks that together allow applications on different computers to communicate



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## Network Architecture Model? 7

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- **Definition 2:** A communication model that describes how data from a software application in one computer moves through a medium to a software application in another computer.

**Computer 1**

Task 1
Task 2
Task 3
Task 4
Task 5

Rules

Rules

Rules

Rules

**Computer 2**

Task 1
Task 2
Task 3
Task 4
Task 5

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## Network Architecture Model 8

- **Two main components:**
  - Layers (representing groups of tasks to be performed for data comm.)
  - Protocols (representing rules to be followed)
- ☆☆
- **Examples of network architecture models:**
  - OSI Reference Model
  - Internet Model (or TCP/IP Model)
  - Hybrid TCP/IP-OSI Model

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## OSI Reference Model 9

- **Deals with connecting Open Systems:**
  - Systems opened for communication with other systems
  - Non-proprietary systems (e.g. IBM's Systems Network Architecture) ☆
- **First step toward international standardization**
- **The other network architectures roughly follow the OSI structure**

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## Principles guiding OSI development

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- Create a layer when a different level of abstraction is needed
- Each layer should perform a well defined function
- Choose function of layers with an eye toward defining international protocols
- Choose layers' boundaries in order to minimize information flow across interfaces.



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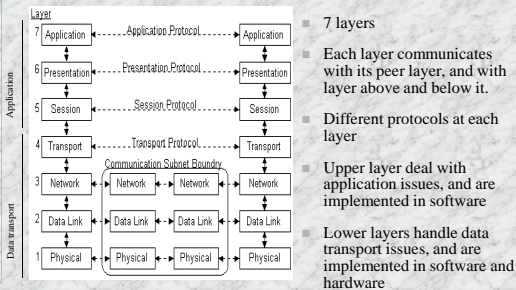
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## OSI Reference Model

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## OSI Reference Model

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

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## OSI Reference Model

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Layers	Role
7 Application	<ul style="list-style-type: none"><li>• Represent user interface between the application software (e.g. Eudora) and the Network</li><li>• Provides services like: Identification of the intended communication partner, determining resources availability for communication, etc.</li></ul>
6 Presentation	<ul style="list-style-type: none"><li>• Performs code conversion and data reformatting (syntax translation) including encryption and compression if required.</li><li>• Uses coding &amp; conversion schemes: Common Data Representation Formats, Common Data Encryption Schemes, EBCDIC, ASCII, etc.</li></ul>
5 Session	<ul style="list-style-type: none"><li>• Responsible for establishing, managing &amp; terminating communication sessions between computers.</li><li>• Communication sessions consist of service requests and service responses between applications</li><li>• Session layer's protocols coordinate request &amp; response sessions.</li></ul>

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## OSI Reference Model

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Layers	Role
4 Transport	<ul style="list-style-type: none"><li>• Makes sure the data arrives at the destination exactly as it left source (in case of connection-oriented communication)</li><li>• Provides error checking before transmission, and error recovery in case of failed delivery.</li></ul>
3 Network	<ul style="list-style-type: none"><li>• Responsible for creating, maintaining and ending network connections.</li><li>• Provides logical address (IP address) to messages</li><li>• Provides routing services: determining routes for sending. If router can't send large packets, break data into smaller units.</li></ul>
2 Data Link	LLC <ul style="list-style-type: none"><li>• Subdivided into 2 sublayers (Logical Link Control and Media Access Control)</li></ul>
	MAC <ul style="list-style-type: none"><li>• Provides physical address (MAC address) to messages</li><li>• Combines bits into bytes, bytes into a <i>frames</i> with header, address information, error detection code, and trailer</li></ul>

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## OSI Reference Model

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Layers	Role
1 Physical	<ul style="list-style-type: none"><li>• Handles the transmission of bits over a communications channel.</li><li>• Defines characteristics such as voltage levels, connector types and maximum transmission distance.</li><li>• Places signal on the cable. Responsible to move bits between devices.</li></ul>

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## The Internet Model (TCP/IP Model)

- Created by the *Internet Engineering Task Force (IETF)*
- Named after its two most widely known protocols:
  - ★ TCP (Transmission Control Protocol) and
  - IP (Internet Protocol)
- TCP/IP refer to the model, while TCP and IP are individual protocols ★

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## The Internet Model

OSI	Internet	
Application	Application	<ul style="list-style-type: none"> <li>■ 4 layers ★★</li> <li>■ Interface layer - equivalent to the OSI's Physical and Data link layers</li> </ul>
Presentation		
Session	Transport	<ul style="list-style-type: none"> <li>■ Network layer - roughly equivalent to the OSI's Network layer</li> </ul>
Transport		
Network	Network	<ul style="list-style-type: none"> <li>■ Transport layer - performs same function as OSI Transport layer</li> <li>■ Application layer - equivalent to the OSI's Presentation and Application layers</li> </ul>
Data Link	Interface	
Physical		

Figure 1-14 (White 2007:20)

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## Applications/Protocols Use in Internet Model

Layers	Applications/Protocols
Application	<ul style="list-style-type: none"> <li>• Webservice: HTTP</li> <li>• E-mail: SMTP (Simple Mail Transfer Protocol), POP (Post Office Protocol), IMAP (Internet Message Access Protocol)</li> <li>• Telnet applications: Terminal Emulation Protocol</li> <li>• File transfer: FTP</li> </ul>
Transport	<ul style="list-style-type: none"> <li>• TCP (Transmission Control Protocol).               <ul style="list-style-type: none"> <li>• Required in webservice when HTTP is used</li> <li>• Required in Mailservice when SMTP is used. SMTP messages are encapsulated in TCP segments</li> <li>• Connection-oriented: Establishes and maintains connections before sending. Close connections after transmission. Correct errors in TCP segments.</li> </ul> </li> <li>• UDP (User Datagram Protocol)               <ul style="list-style-type: none"> <li>• Connectionless: Don't open connection. Simply sends. Discards incorrect UDP datagrams (no retransmission)</li> </ul> </li> </ul>
Network	<ul style="list-style-type: none"> <li>• IP (Internet Protocol)</li> </ul>
Interface	<ul style="list-style-type: none"> <li>• PPP (Point-to-Point Protocol)</li> <li>• V.90 for 56 Kbps modems</li> </ul>

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## IEEE's DL and Physical layer standards 19

- 802.2 defines Logical Link Control sublayer
- 802.3 is the standard for Ethernet networks
- 802.4 is the standard for Token Bus networks
- 802.5 is the standard for Token Ring networks

<http://grouper.ieee.org/groups/802/index.html>  
<http://standards.ieee.org/getieee802/802.3.html>

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## Protocols 20

OSI Model	TCP/IP Model	Protocols
Application	Application	FTP, Telnet, TFTP, NTP, PING, HTTP, POP, SMTP, ..
Presentation		
Session		
Transport	Transport	TCP, UDP
Network	Internet	IP, ARP, ICMP, IPX
Data Link	Network Interface	PPP, Ethernet, Token Ring, Voltage spec., etc.
Physical		

ICMP: an Internet layer protocol that reports on success or failure of data delivery. Can indicate when part of network is congested, when data failed to reach destination, and when data has been discard because of TTL expiration. (Dean 2004:165)

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## Protocols and webservices 21

TCP/IP Model	WWW	Email	File Transfer
Application	HTTP, HTTPS	IMAP, POP, SMTP	FTP
Transport	TCP	TCP	TCP
Internet	IP	IP	IP
Network Interface	PPP, Ethernet, Token Ring, Voltage spec., etc.	PPP, Ethernet, Token Ring, Voltage spec., etc.	PPP, Ethernet, Token Ring, Voltage spec., etc.

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## Summary Questions

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1. (a) Name the OSI layers that deal with application issues ? (b) Name the OSI layers that deal with data transport issue ?
2. Standardized applications used at the Application layer of the OSI Model include word processing. T/F
3. Upper layers of the OSI Model are usually implemented in physical devices. T/F
4. Compare OSI and Internet models in terms of layers

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## Internet and OSI Model compared

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TCP/IP Model      TCP/IP Protocols      OSI Ref Model

Application	FTP	Telnet	HTTP	Application
Transport	TCP		UDP	Presentation
Internetwork	IP			Session
Host to Network	Ethernet	Token Ring	Point-to-Point	Transport
				Network
				Datalink
				Physical

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