Slide 1

Curriculum Development
Centers Program

Awardee of The Office of the National Coordinator for
Health Information Technology

Component 9 – Networking and Health Information Exchange

Unit 1-1
ISO Open Systems
Interconnection (OSI)

This material was developed by Duke University, funded by the Department of Health and Human Services, Office of the National Coordinator for Health Information Technology under Award Number IU24OC000024.

_____

_____

_____

_____

_____

_____

Slide 2

Unit Objectives

- Explain the OSI representation of the various layers involved in networking, including the general functions of each layer and their interconnections
- Explain the concept of the Application Layer
- Explain the concept of the Presentation Layer
- Explain the concept of the Session Layer
- Explain the concept of the Transport Layer

Component 9/Unit 1-1   Health IT Workforce Curriculum
Version 2.0/Spring 2011   2

_____

_____

_____

_____

_____

_____

Slide 3

Terminology

A network is two or more devices that communicate with each other over some form of transmission media.

- Types of networks
  - Local Area Network (LAN)
  - Wide Area Network (WAN)
  - Internet
  - Intranet
  - Extranet

Component 9/Unit 1-1   Health IT Workforce Curriculum
Version 2.0/Spring 2011   3

_____

_____

_____

_____

_____

_____

Slide 4

Terminology Continued

For communication to take place on a
network we need
– Source
– Receiver
– Medium

Medium   Medium

Source   Receiver

Slide 5

Terminology Continued

Protocol – rules for communication

Examples:
• TCP/IP
• HTTP
• NETBEUI
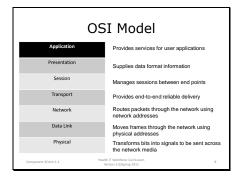• ICMP

Slide 6

TCP/IP Model

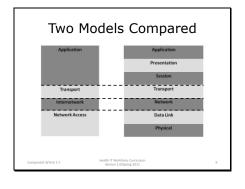Application

Transport

Internetwork

Network Access

Slide 7

OSI Model

| Application |
| Presentation |
| Session |
| Transport |
| Network |
| Data Link |
| Physical |

Component 9/Unit 1-1   Health IT Workforce Curriculum
Version 2.0/Spring 2011   7

_____

_____

_____

_____

_____

_____

_____

Slide 8

OSI Model

Application	Provides services for user applications
Presentation	Supplies data format information
Session	Manages sessions between end points
Transport	Provides end-to-end reliable delivery
Network	Routes packets through the network using network addresses
Data Link	Moves frames through the network using physical addresses
Physical	Transforms bits into signals to be sent across the network media

Component 9/Unit 1-1   Health IT Workforce Curriculum
Version 2.0/Spring 2011   8

_____

_____

_____

_____

_____

_____

Slide 9

Two Models Compared

Application		Application
		Presentation
		Session
Transport		Transport
Internetwork		Network
Network Access		Data Link
		Physical

Component 9/Unit 1-1   Health IT Workforce Curriculum
Version 2.0/Spring 2011   9

_____

_____

_____

_____

_____

_____

_____

Slide 10

Protocol Data Units (PDUs)

Application	Application	
	Presentation	Data
	Session	
Transport	Transport	Segments
Internetwork	Network	Packets
Network Access	Data Link	Frames
	Physical	Bits

_____

_____

_____

_____

_____

_____

Slide 11

Protocols/Technologies Covered

Application	Application	HTTP, SMTP, DHCP, FTP, Telnet, DNS
	Presentation	MIME, XDR, TLS, SSL
	Session	
Transport	Transport	TCP, UDP, MLLP
Internetwork	Network	IP, ICMP
Network Access	Data Link	LLC, MAC, SLIP, Ethernet, PPTP
	Physical	DSL, Bluetooth, T1

_____

_____

_____

_____

_____

_____

Slide 12

Application Layer Protocols

- **Hypertext Transfer Protocol (HTTP)** is used by Web browsers and servers to communicate.
- **Domain Name Service (DNS)** is used for converting host names and domain names into IP addresses.
- **Simple Mail Transport Protocol (SMTP)** is used for email.
  - POP3
  - IMAP4

_____

_____

_____

_____

_____

_____

Slide 13

Application Layer Protocols Continued

- **Dynamic Host Configuration Protocol (DHCP)** is used to automatically configure network hosts with TCP/IP settings.
- **File Transfer Protocol (FTP)** is used to copy files from one host to another.
- **Telnet** allows a user to connect to a remote system and whatever action they perform on their local host happens on the remote system.

_____

_____

_____

_____

_____

_____

Slide 14

Presentation Layer Protocols

- **Multipurpose Internet Mail Extensions (MIME)** specifies how messages must be formatted so that they can be exchanged between different email systems.
- **External Data Representation (XDR)** is a standard for the description and encoding of data.

_____

_____

_____

_____

_____

_____

Slide 15

Presentation Layer Protocols Continued

- **Transport Layer Security** (**TLS**) and its predecessor, **Secure Socket Layer** (**SSL**) are used to encrypt/decrypt data.
- **Data Compression/Decompression** is also done at this layer.

_____

_____

_____

_____

_____

Slide 16

Session Layer

- Establishes connections
  - Authentication
  - Type of communication that will take place
  - Protocols that will be used by the lower layers
- Maintains connections
- Synchronizes communications

_____

_____

_____

_____

_____

_____

_____

Slide 17

Session Layer Continued

- Control dialogues
  - Keeps track of which device is making requests and which device is making responses
  - Determines whether acknowledgments are required
- Terminates connections
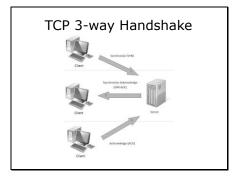
_____

_____

_____

_____

_____
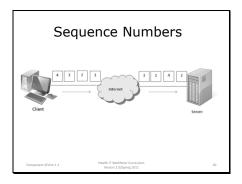
Slide 18

Transport Layer Protocols

- **Transmission Control Protocol (TCP)** maintains reliable, ordered delivery of segments.
  - **Connection-oriented**
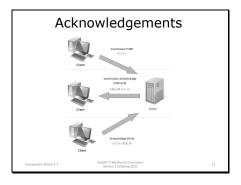 - **Sequence Numbers**
  - **Acknowledgements**
  - **Window Sizing**

_____

_____

_____

_____

_____

Slide 19

TCP 3-way Handshake

_____

_____

_____

_____

_____

_____

_____

Slide 20

Sequence Numbers

_____

_____

_____

_____

_____

_____

_____

Slide 21

Acknowledgements

_____

_____

_____

_____

_____

_____

_____

Slide 22

Window Sizing

_____

_____

_____

_____

_____

_____

_____

Slide 23

Transport Layer Protocols Continued

- **User Datagram Protocol (UDP)** provides best effort delivery of datagrams.
  - **Connectionless**
  - **Errors may be handled by higher level protocols.**
- **Minimal Lower Layer Protocol (MLLP)** is an interface between HL7 applications and TCP.

_____

_____

_____

_____

_____

_____

Slide 24

TCP/UDP Ports

- Assigned by the Internet Assigned Numbers Authority (IANA)
- Three different types of port numbers
  - Well-known ports (0 to 1023)
  - Registered ports (1024 to 49151)
  - Dynamic or private ports (49152 to 65535)

_____

_____

_____

_____

_____

Slide 25

TCP/UDP Ports

Application	Protocol	Port Number
HTTP	TCP	80
HTTPS	TCP	443
SMTP	TCP	25
DHCP	UDP	67
FTP	TCP	20 (data) 21 (control)
Telnet	TCP	23
DNS	TCP/UDP	53

_____

_____

_____

_____

_____

_____

_____