Component 4: Introduction to Information and Computer Science

Unit 7: Networks & Networking
(Part 5 of 5)

Unit Objectives

- Understand the history of networks and their evolution.
- List and describe the various types of network communications.
- List and describe the various forms of network addressing, including DNS.
- List and define the different types of networks.
- Describe different network topologies.
- List and describe different network standards and protocols.
- Describe wireless communication.
- List and describe network hardware.
- Explain networking logical model concepts.

Networking Logical Models

- Devices and software mapped to logical model to use OS functionality.
  - Many OS programs load when computer boots.
  - Known as OS "services."
  - Services are applications that are always running in the background of the OS.
- Logical model not an actual program.
  - A series of "layers" that define functionality.
- OSI (Open Systems Interconnection) model defines how network hardware and software operate.

The OSI Model

- Model comprised of seven logical layers.
  - Application (7), Presentation (6), Session (5), Transport (4), Network (3), Data Link (2), Physical (1).
- Each layer's communication is standardized so adjacent layers know how to communicate with each other.
- Device and software communication is standardized using OS services.
  - Depending on device and/or software, one service calls on the functionality of another service to facilitate network functionality.

OSI Model Layer 7: Application Layer

- Software on a device calls on OS services to begin the network communication process by converting the software's communication into a format that can be readied for transmission.
  - You click "send" on an e-mail to start this process.
  - The communication is called <u>data</u> at this level.

OSI Model Layer 6: Presentation Layer

- Takes the converted message and further transforms it for electronic transmission.
- Also handles file compression and/or encryption if the file is or needs to be encrypted.
  - If you e-mail a compressed file, the compression type used, etc. is handled here.
  - The communication is still called <u>data</u> at this level.

OSI Model Layer 5: Session Layer

- Manages asynchronous application-to-application communication.
  - You send an e-mail to your friend. Services here record that an e-mail program needs to receive this communication (and vice-versa).
  - The communication is still called <u>data</u> at this level.

OSI Model Layer 4: Transport Layer

- Manages asynchronous device-to-device communication.
  - When sending an e-mail, services here indicate where a file (and communication) begins.
  - When receiving an e-mail, they indicate where a file ends and when the communication process should be considered complete.
  - Also ensures that pieces of the communication are put in the right order (sending and receiving).
  - The communication is called a <u>segment</u> at this level and is encoded with information about the communication and instructions.

OSI Model Layer 3: Network Layer

- Manages asynchronous network-to-network communication.
  - Services prepare the packet for traffic by adding a header and footer to each packet.
  - Services inform receiving devices as to the packet's source, destination, protocol, etc.
  - The communication is called a <u>packet</u> at this level since services split the segment into manageable sizes and further encode each packet with information to be used by Layer 3 devices (routers).

OSI Model Layer 2: Data Link Layer

- Determines applicable networking protocols for this packet and at the same time readies the packet for transport using whatever technology is supported by the NIC (Ethernet, wireless, fiber optic).
  - E-mail will be sent using the SMTP (Simple Mail Transfer Protocol).
  - The computer's NIC uses copper cable and expects the communication to be encoded according to the Ethernet standard.
  - The communication is called a <u>frame</u> at this level.

OSI Model Layer 1: Physical Layer

- NIC takes the computer's digital electronic signal and transforms it into a signal that can be put on the NIC's media.
  - The e-mail is translated into electronic impulses and moved from the NIC to the wires at the end of the RJ-45 and pushed across the entire cable length to the next device (which is usually a switch or router).
  - The communication is called <u>bits</u> at this level.

Acronyms Help to Memorize Layer Order

- Easy to remember OSI model layer order using acronyms. Review of order…
  - Application (7), Presentation (6), Session (5), Transport (4), Network (3), Data Link (2), Physical (1).
- Top to bottom:
  - <u>A</u>ll <u>P</u>eople <u>S</u>tanding <u>T</u>otally <u>N</u>aked <u>D</u>on't <u>P</u>erspire.
- Bottom to top:
  - <u>P</u>lease <u>D</u>o <u>N</u>ot <u>T</u>each <u>S</u>tudents <u>P</u>hony <u>A</u>cronyms.

Devices & the OSI Model

- Devices operate at specific layers:
  - Layer 3 – routers, and switches that also function as a router (known as a "L3 switch").
  - Layer 2 – switches and most NIC functionality.
  - Layer 1 – hubs, some NIC functionality, network cabling, wireless antennae.

OSI Model and the Medical World

- Many medical software and devices send network traffic adhering to a standard known as HL7 (Health Level 7), named after OSI model Layer 7.
  - An EKG image being transmitted from the machine to the patient's electronic health record (EHR) would be encoded in accordance with HL7 rules (expectations) so that the receiving EHR database can be informed of the image type, patient record number, equipment identification, supervising clinician, etc.

OSI Model and the Medical World (cont'd)

- EHR database software contains the HL7 encoding rules and is able to understand and act on the communication.
  - EHR program uses OS services just like any other network-enabled installed software.
- Note: other medical encoding standards exist.