

Lecture 2: Network Protocols and Layering

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EE426: Communication Networks

What is a *Network Protocol*?

- A protocol is the set of rules that specify:
 - Format of **messages** exchanged in the network.
 - Appropriate **actions** required for each message.
- A protocol is executed by running distributed service scripts on remote communicating entities.
- The service scripts within communicating entities are typically **Layered**.
- Protocols are typically written in **standards** and implemented by software and/or hardware.

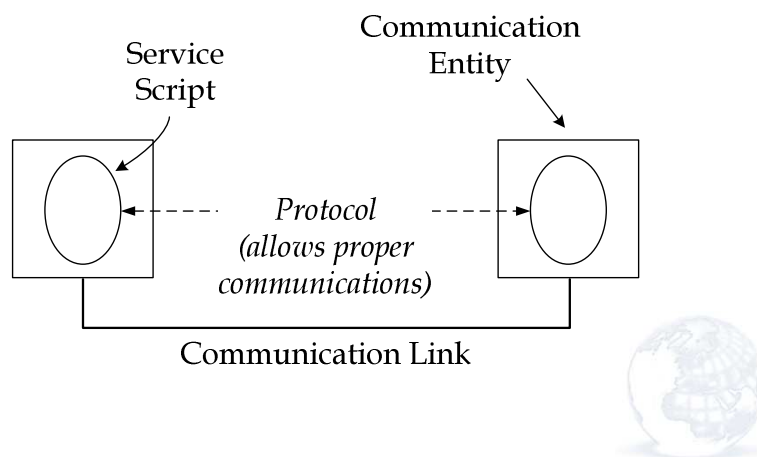


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What is a Network Protocol?



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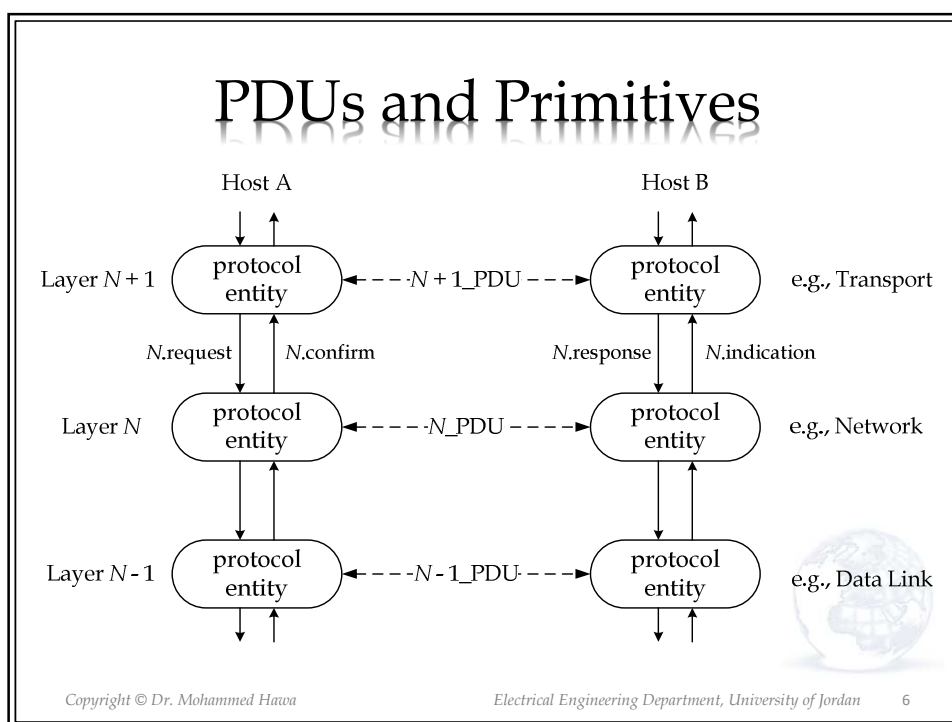
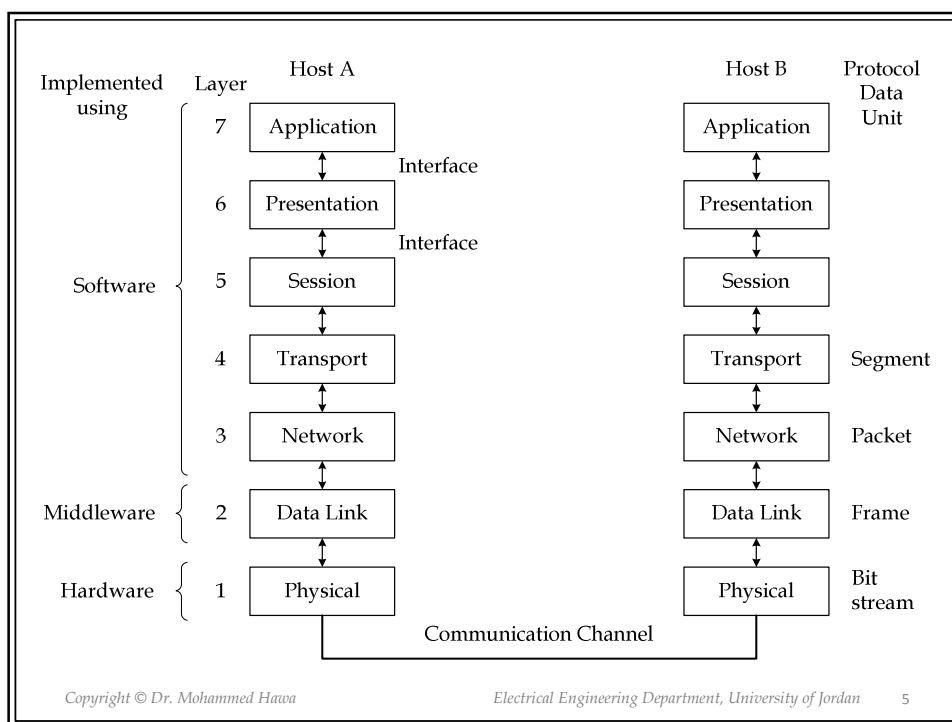
The OSI Model

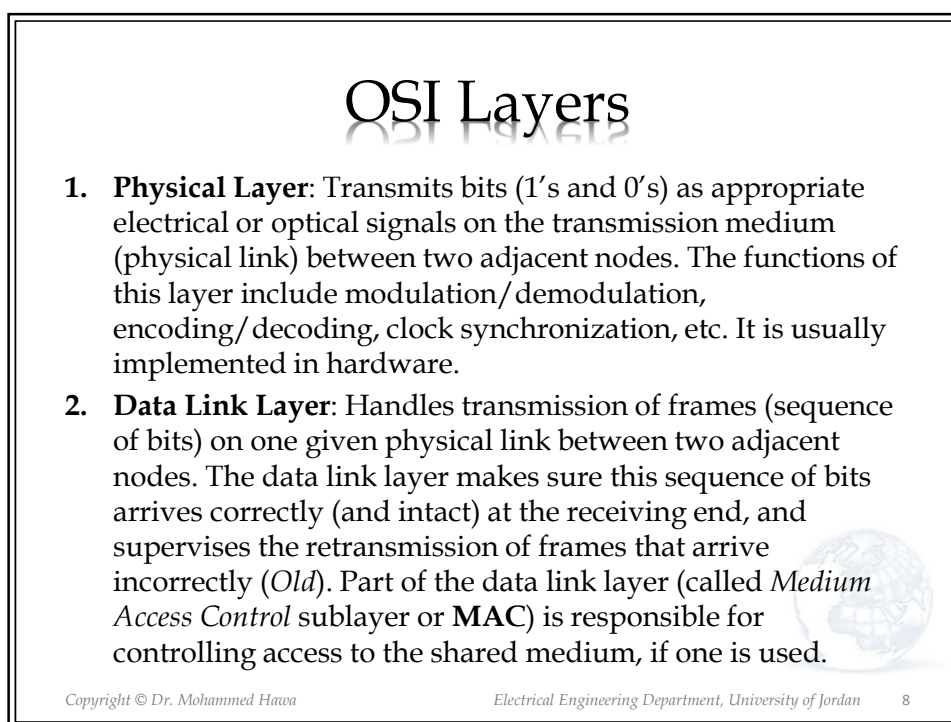
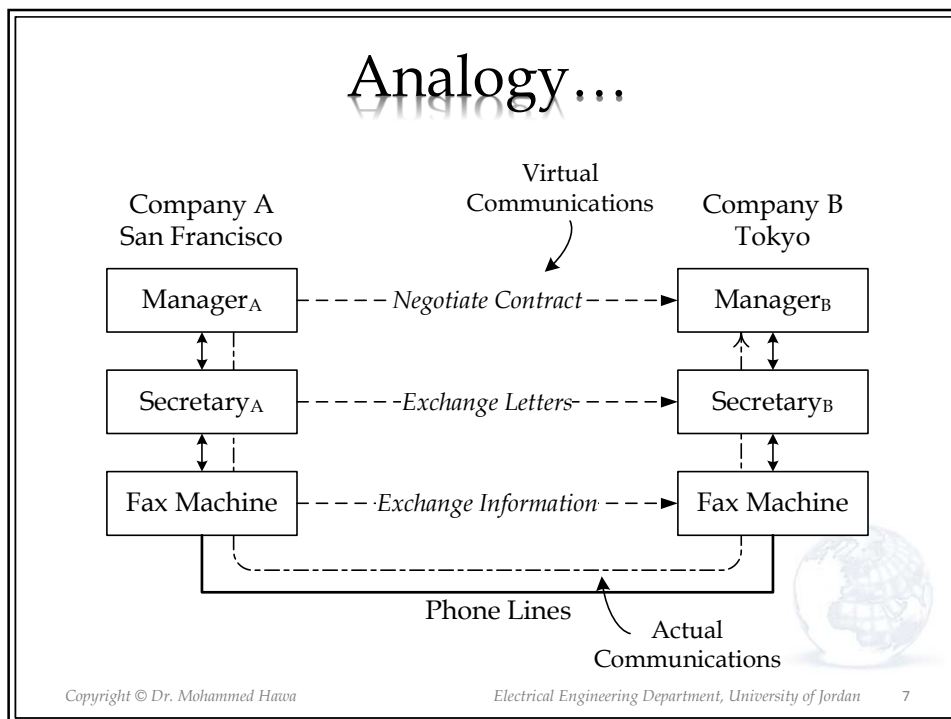
- One of the main layered models in computer networks is the “Open Systems Interconnection Reference Model” (OSI Model).
- It was developed by the International Organization for Standardization (ISO) in the late 1970s.
- The OSI model contains 7 layers.
- In a layered architecture, layer N uses only the services of layer N - 1 (so communication is valid only between adjacent layers, called *Interface*).

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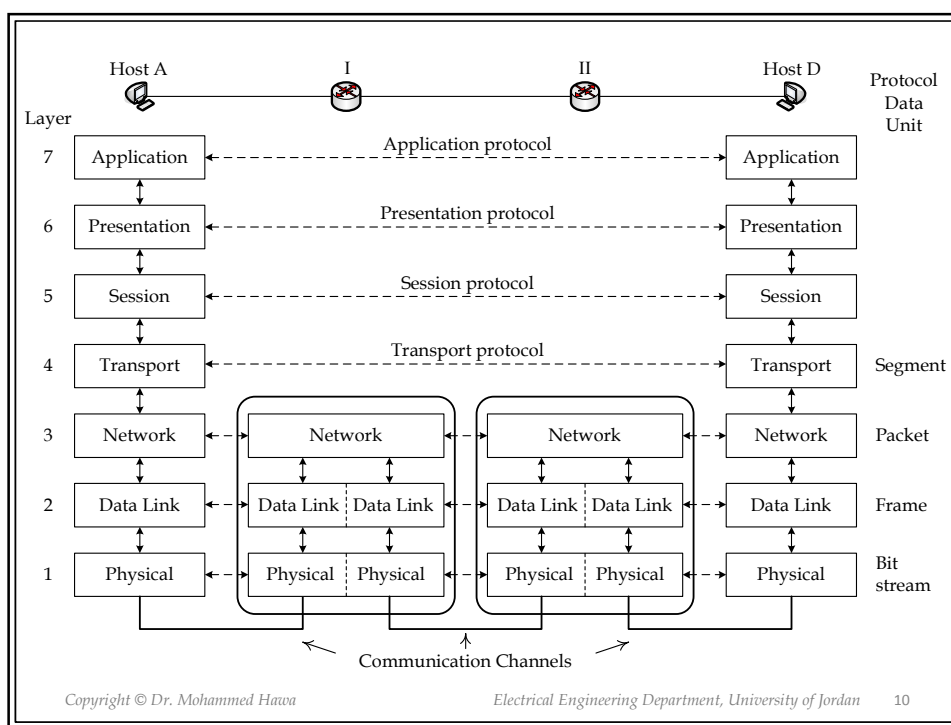
OSI Layers

3. **Network Layer:** Handles proper *end-to-end* transmission of packets. To do that, this layer collects information about the intermediate nodes in the network to find the *best path* through the network for packets to follow. It also deals with *global address assignment* of different nodes and controls the quality of service (QoS) issues (e.g., delay, jitter, bandwidth reservation, etc).
4. **Transport Layer:** Ensures the *reliable transfer* of messages between end nodes. It handles *dividing* the message into smaller segments, and uses *acknowledgements (ACKs)* to verify that the segments are received correctly by the destination. It supervises the *retransmission* of segments that arrive incorrectly. It also handles *numbering* of the transmitted segments and *rearranges out-of-order* segments at the receiving end. This layer also controls the *rate* at which segments are transmitted. It also allows end nodes to react to ease *congestions* in the network.

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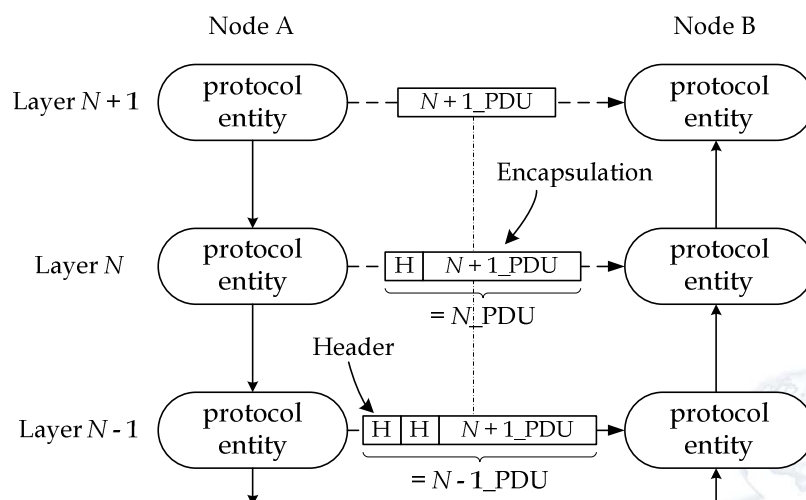
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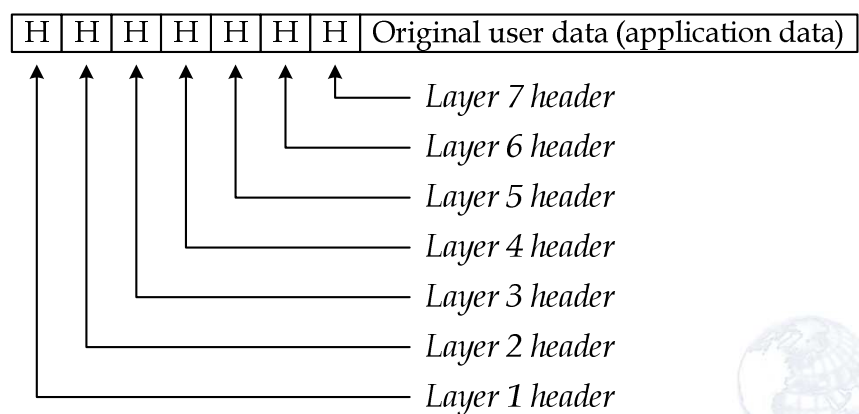
OSI Layers

5. **Session Layer:** Handles the *setup* and *management* of end-to-end sessions (or conversations). It handles *negotiating connection parameters* plus *authentication of users* using passwords.
6. **Presentation Layer:** Handles any necessary *formatting* to translate from the representation on one computer to the representation on another (e.g., ASCII vs. EBCDIC). This layer also handles any necessary *encryption* (for security) and *compression* of data (for faster transfer).
7. **Application Layer:** Those are the applications or services running on top of the network, such as file transfer, web browsing, VoIP and email. Part of the application layer program runs in node A and the other part runs in node B.

Encapsulation



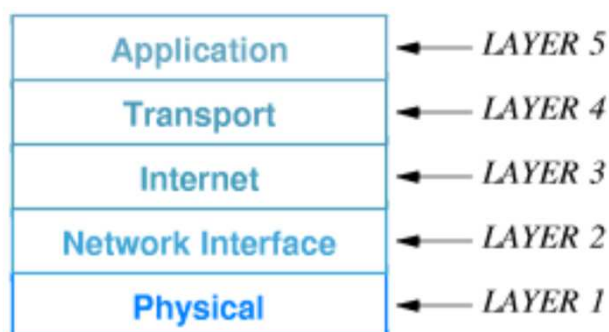
Encapsulation (Headers)



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TCP/IP Stack



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Standards & Standardization Bodies

- **ITU-T** (International Telecommunication Union – Telecommunications Sector), formerly CCITT: Mainly physical layer.
- **IEEE** (Institute of Electrical and Electronics Engineers): Mainly layer 2 such as Ethernet (IEEE 802.3) and Wi-Fi (IEEE 802.11).
- **IETF** (Internet Engineering Task Force): Mainly layer 3 and layer 4 such as IPv4 (RFC 791) and TCP (RFC 793).

