MODULE 10: Networking

Lecture 10.2
Layered Models of Networks

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Lecture 10.2 Objectives

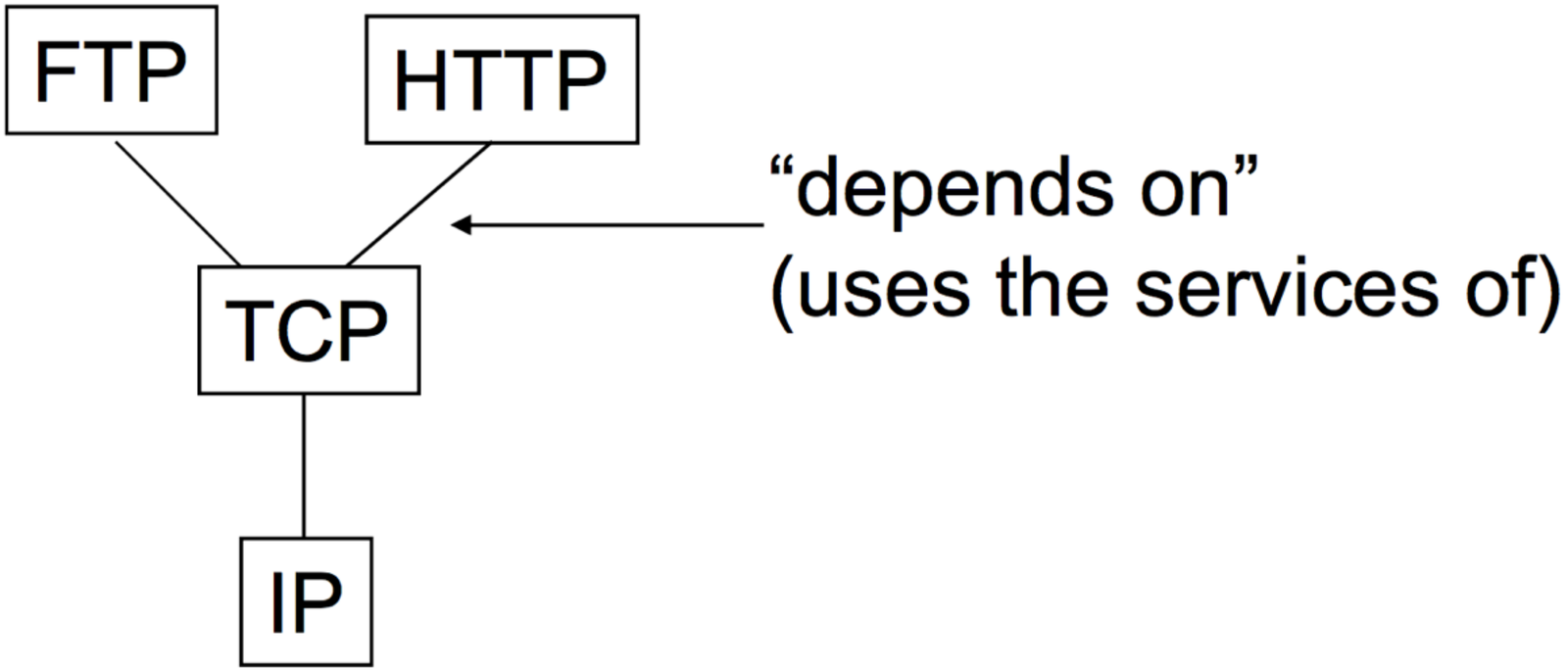
- Explain the motivation and benefits of a layered protocol model for networks
- Enumerate and describe the functions of each of the seven layers in the OSI model
- Describe how the OSI reference model maps to the Internet protocol architecture

Layering and Networks

- Start with services provided by the hardware, then add a sequence of layers, each providing a more abstract level of service
  - Services provided at higher layers implemented in terms of services at the lower layer
- Benefits
  - Decomposes the complex problem of building a network into manageable pieces
  - More modular design (easier to add a new service or modify the functionality of a layer)

Protocols

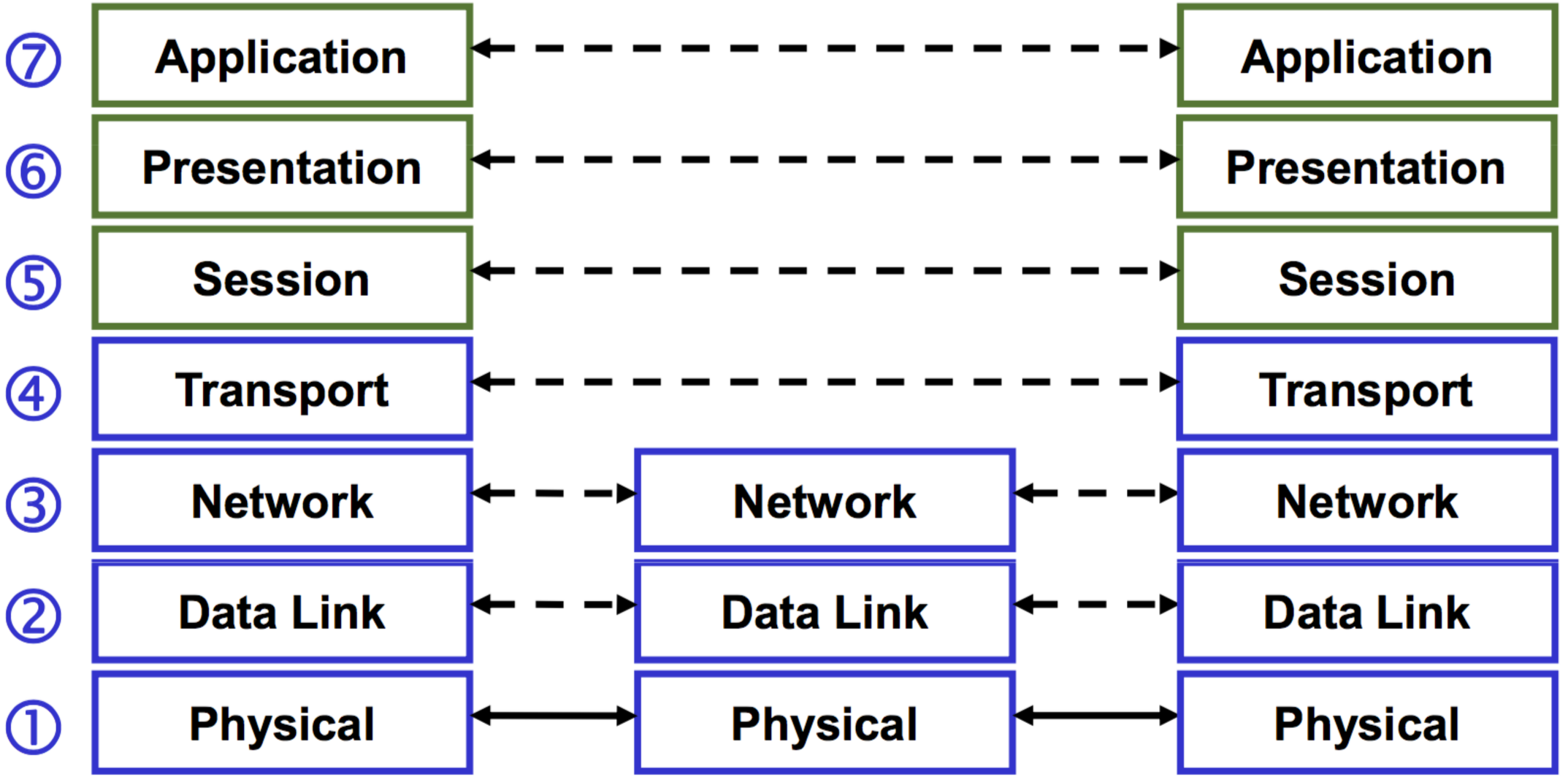
- A protocol defines the format and order of messages exchanged between 2 or more communicating entities, as well as the actions taken on the transmission and/or the receipt of messages



The OSI Reference Model

- The Open Systems Interconnect (OSI) Reference Model was developed under the auspices of the International Organization for Standards (ISO)
- The goal of the model was to delineate functionality that is the responsibility of different layers, with each layer being implemented by one or more distinct protocols
- While attempts have been made to implement a protocol stack that exactly matches the OSI model, its lasting value is in providing a framework for thinking about network architectures

The OSI Seven-layer Model



Physical Layer (Layer 1)

- The physical layer provides a virtual link for transmitting a sequence of bits between any pair of nodes joined by a physical communication channel — “virtual bit pipe”
- Defines physical interface, signaling, cabling, connectors, etc.
- There may be variations at the physical level for a basic data link protocol
  - IEEE 802.3 (Ethernet) offers an historical example: 10Base5 (thick wire), 10Base2 (thin wire), 10BaseT (twisted pair)

Data Link Layer (Layer 2)

- The data link layer is responsible for the error-free transmission of packets between “adjacent” or directly-connected nodes
- The medium access control (MAC) function is a sub-layer of the data link layer
  - Allows multiple nodes to share a common transmission media
  - Supports addressing of nodes
- The logical link control (LLC) function is another sub-layer
  - Provides functions such as error recovery

CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Explain the motivation and benefits of a layered protocol model for networks
- Enumerate and describe the functions of the Physical Layer and the Data Link Layer of the OSI model.

If you have any difficulties, please review the lecture video before continuing.

Network Layer (Layer 3)

- The network layer is responsible for getting a packet through the network from the source node to the destination node — routing to select network path
- In a wide area network, the network layer requires cooperation among peers at intermediate nodes
- Network layer function is minimal in a local area network

Transport Layer (Layer 4)

- The transport layer provides network-independent, end-to- end message transfer between pairs of ports or sockets
  - Ports are destination points for communication that are defined by software
- Transport layers typically provide one of two basic types of service:
  - Virtual circuit or connection-oriented service — Transmission Control Protocol (TCP)
  - Datagram or connectionless service — User Datagram Protocol (UDP)

Session Layer (Layer 5)

- The session layer is responsible for establishing and maintaining virtual connections between pairs of processes in different hosts, possibly including service location and access rights
- Multiple sessions may be multiplexed over a single connection (provided by a lower layer)
- One session may, in the event of failure, require multiple connections

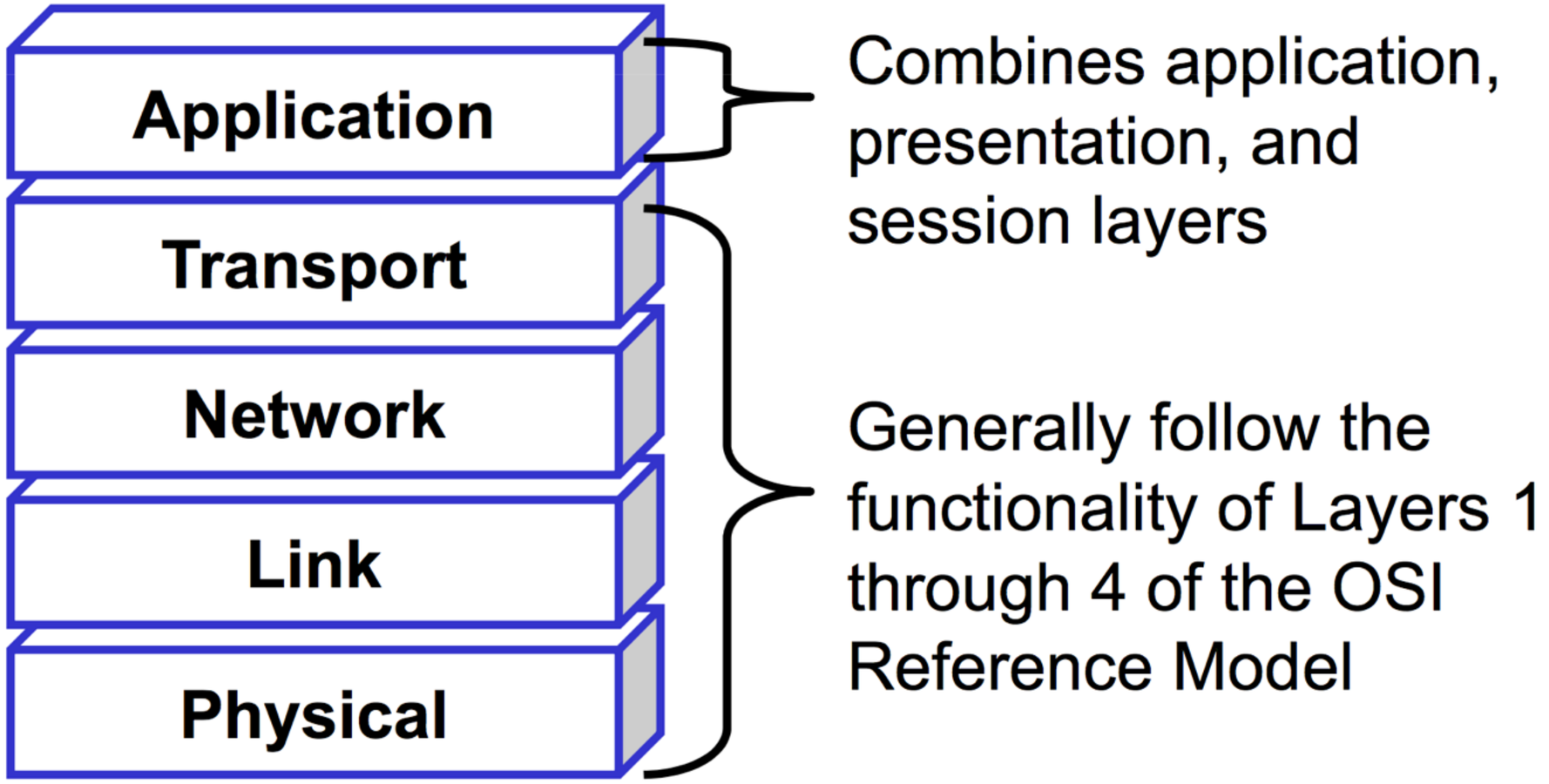
Presentation Layer (Layer 6)

- The presentation layer represents information to applications so as to preserve semantics (meanings or values) while resolving syntactic (representation) differences
- In open systems, heterogeneous computers result in heterogeneous representations
  - Characters: ASCII, EBCDIC, Unicode
  - Byte order: 01234567... or 67452301
- Presentation layer may provide encryption and/or compression may be used

Application Layer (Layer 7)

- Network applications make up the application layer
- Protocol specific to each particular application
- Certain applications, like HTTP, NFS, FTP, and Telnet have been standardized
- Standards do not provide a fixed model for applications, but models do exist
  - Client-server versus peer-to-peer
  - Remote procedure call (RPC) versus message passing

OSI Model and the Internet



CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:

- Enumerate and describe the functions of each of the Network, Transport, Session, Presentation, and Application layers.
- Describe how the OSI reference model maps to the Internet protocol architecture

If you have any difficulties, please review the lecture video before continuing.

Summary

- The layered model of networks decomposes the complex problem of building a network into manageable pieces
- The seven-layer OSI Reference Model is widely used to structure and define network functions
    - A useful model, but not widely implemented
- Each of the seven layers has defined functions that are to be realized by one or more protocols
- The Physical, Data Link, Network, and Transport layers are generally distinct
- In the Internet, the Session, Presentation, and Application layers are generally merged into the Application Layer

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