Introduction to Networking Protocols and Architecture

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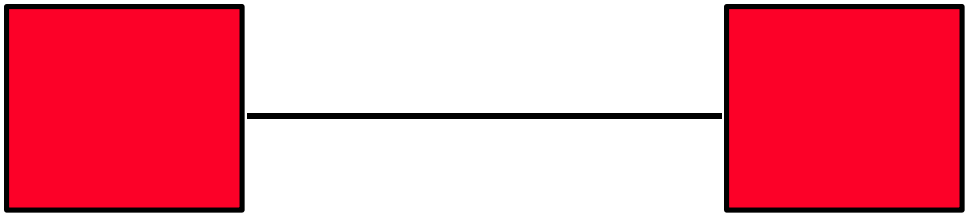
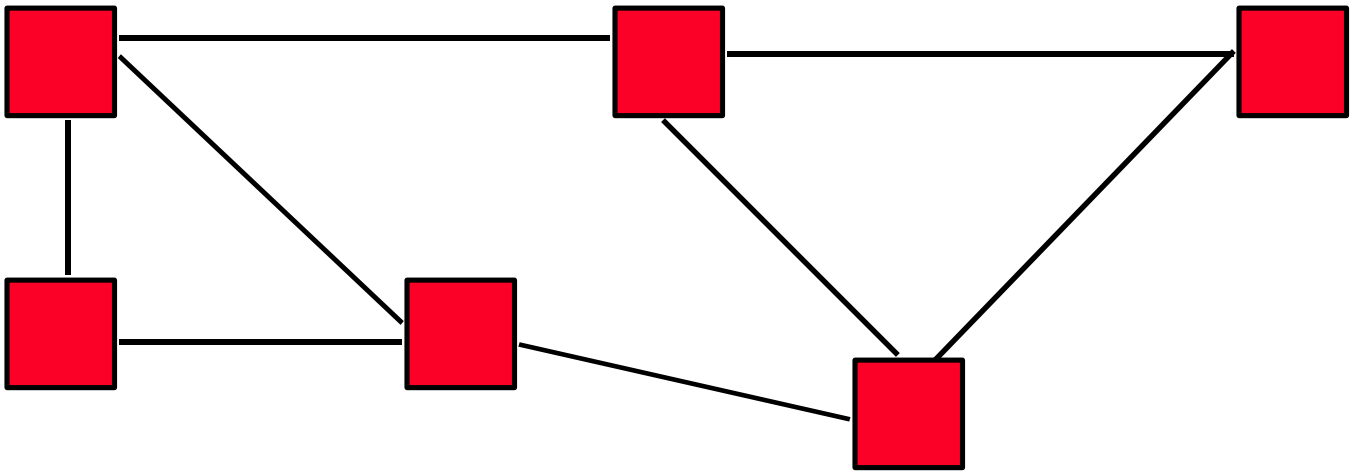
- Data Comm vs Networking vs Distributed Systems
- Types of Networks
- Protocol Layers: OSI and TCP/IP Models
- Connection-oriented vs connectionless
- Layered packet format

Data Communication vs Networking

- Communication: Two Nodes. Mostly EE issues.



  - Networking: Two or more nodes. More issues, e.g., routing



Distributed Systems vs Networks

- Distributed Systems:
  - Users are unaware of underlying structure.
    E.g., trn instead of \n\bone\0\trn
  - Mostly operating systems issues.
  - Nodes are generally under one organization's control.
- Networks: Users specify the location of resources.
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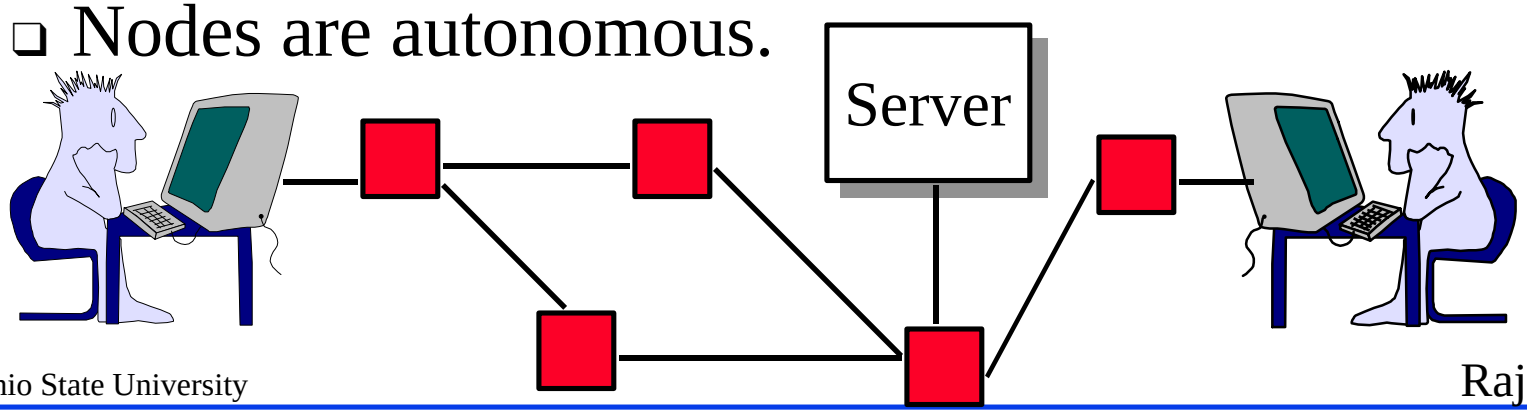
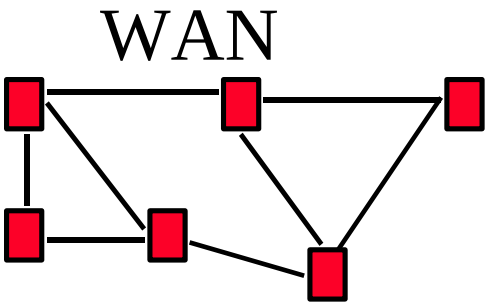
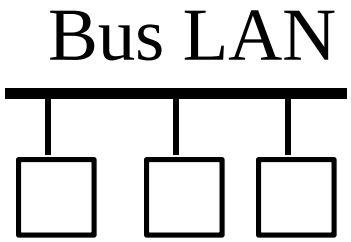
  - Nodes are autonomous.

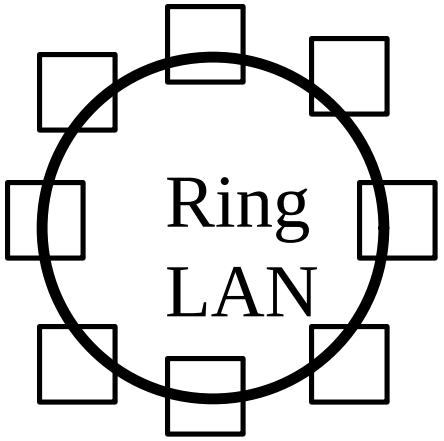


Types of Networks

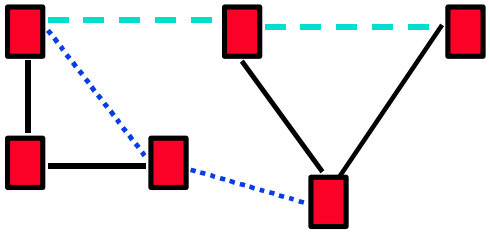
- Point to point vs Broadcast

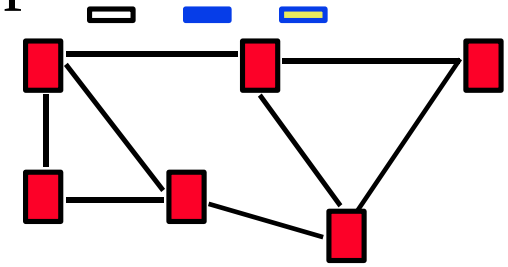






- Circuit switched vs packet switched

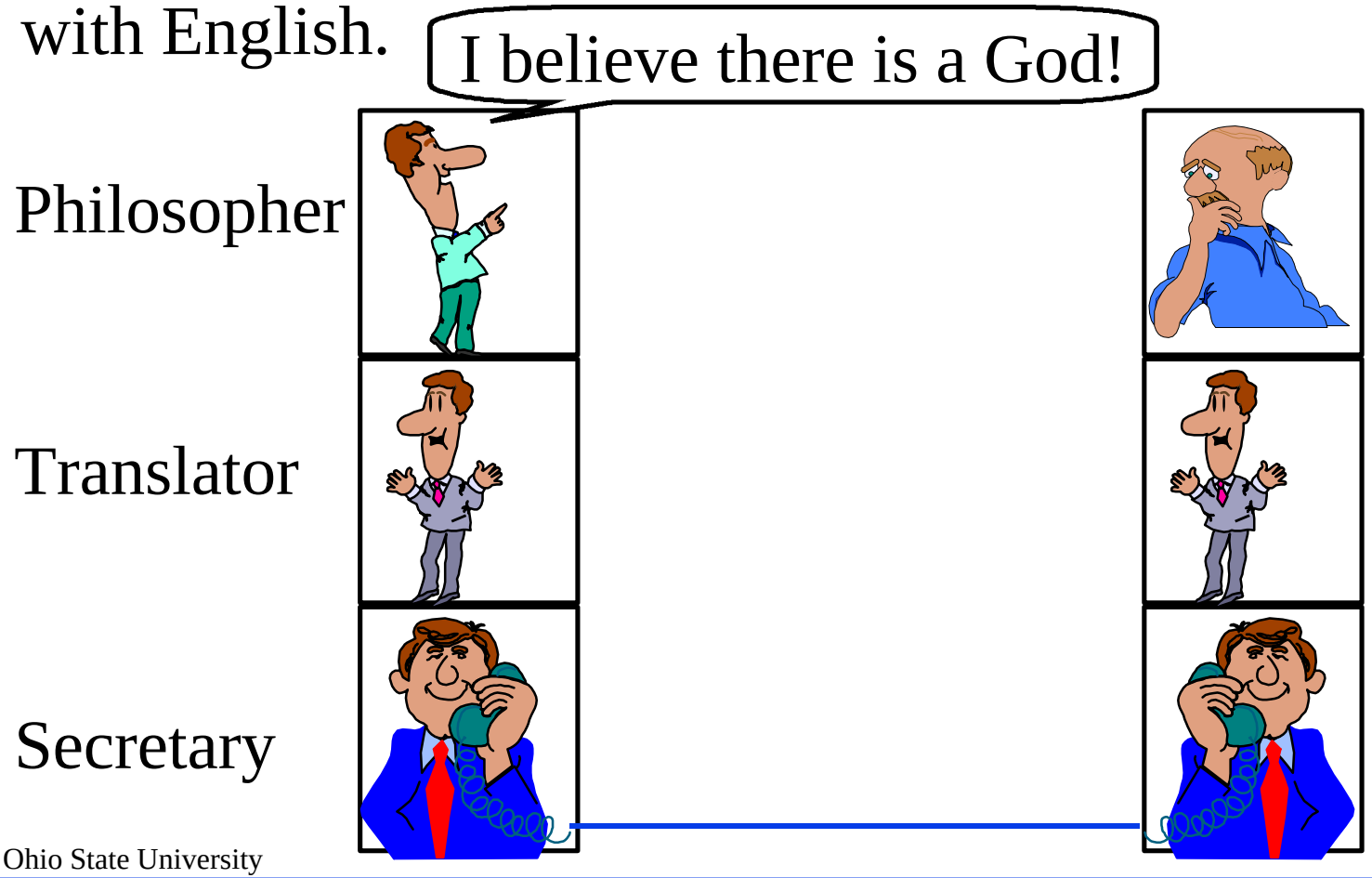




- Local Area Networks (LAN) 0-2 km, Metropolitan Area Networks (MAN) 2-50 km, Wide Area Networks (WAN) 50+ km

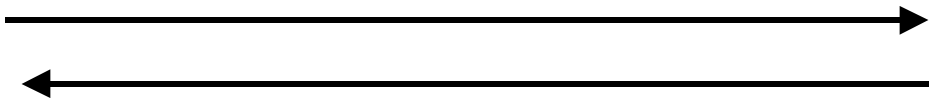
Protocol Layers

- Problem: Philosophers in different countries speak different languages. The Telex system works only with English.



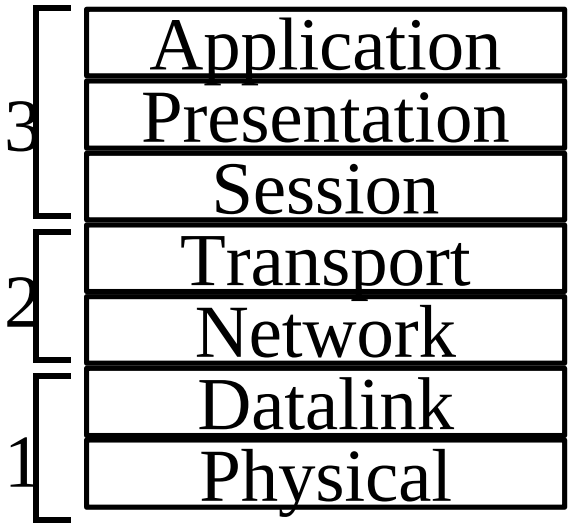
Design Issues for Layers

- Duplexity:
  - Simplex: Transmit or receive

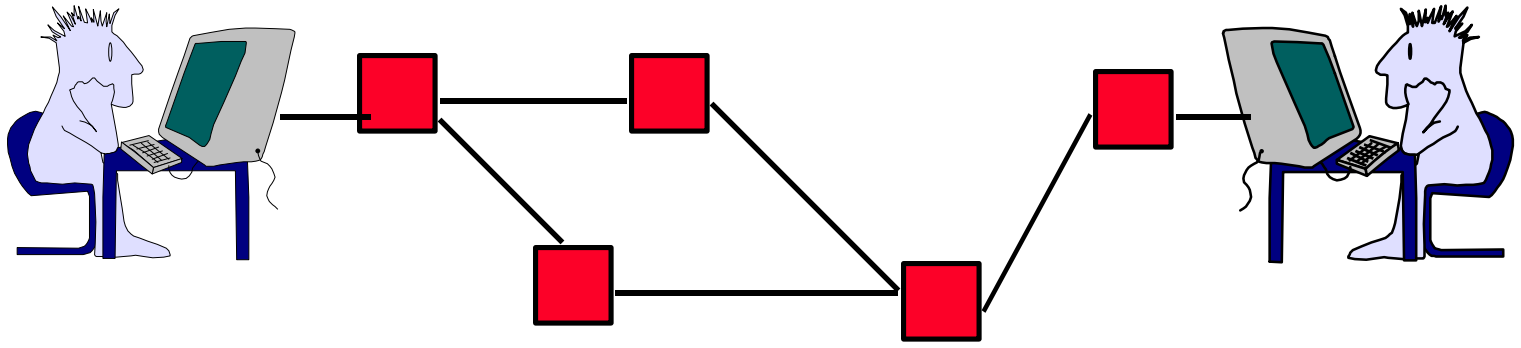


  - Full Duplex: Transmit and receive simultaneously
  - Half-Duplex: Transmit and receive alternately
- Error Control: Error detection and recovery
- Flow Control: Fast sender

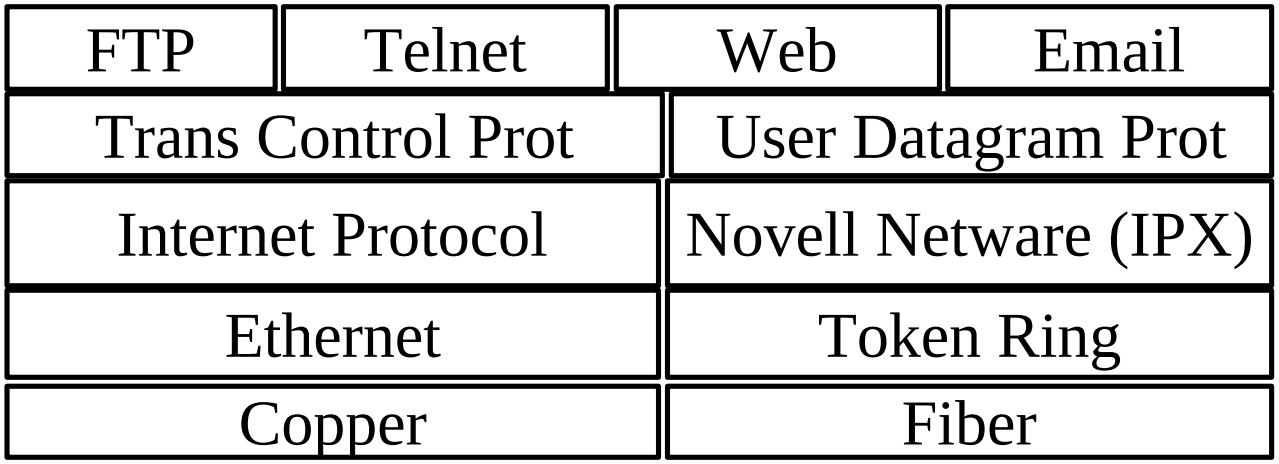
ISO/OSI Reference Model



File transfer, Email, Remote Login
ASCII Text, Sound
Establish/manage connection
End-to-end communication: TCP
Routing, Addressing: IP
Two party communication: Ethernet
How to transmit signal: Coding

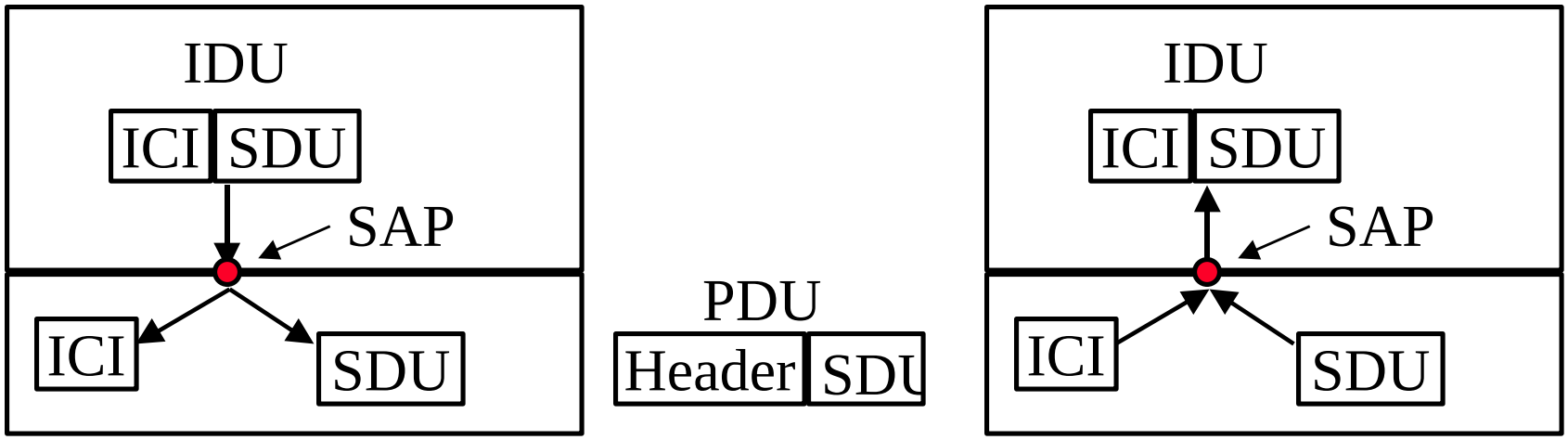


Layering



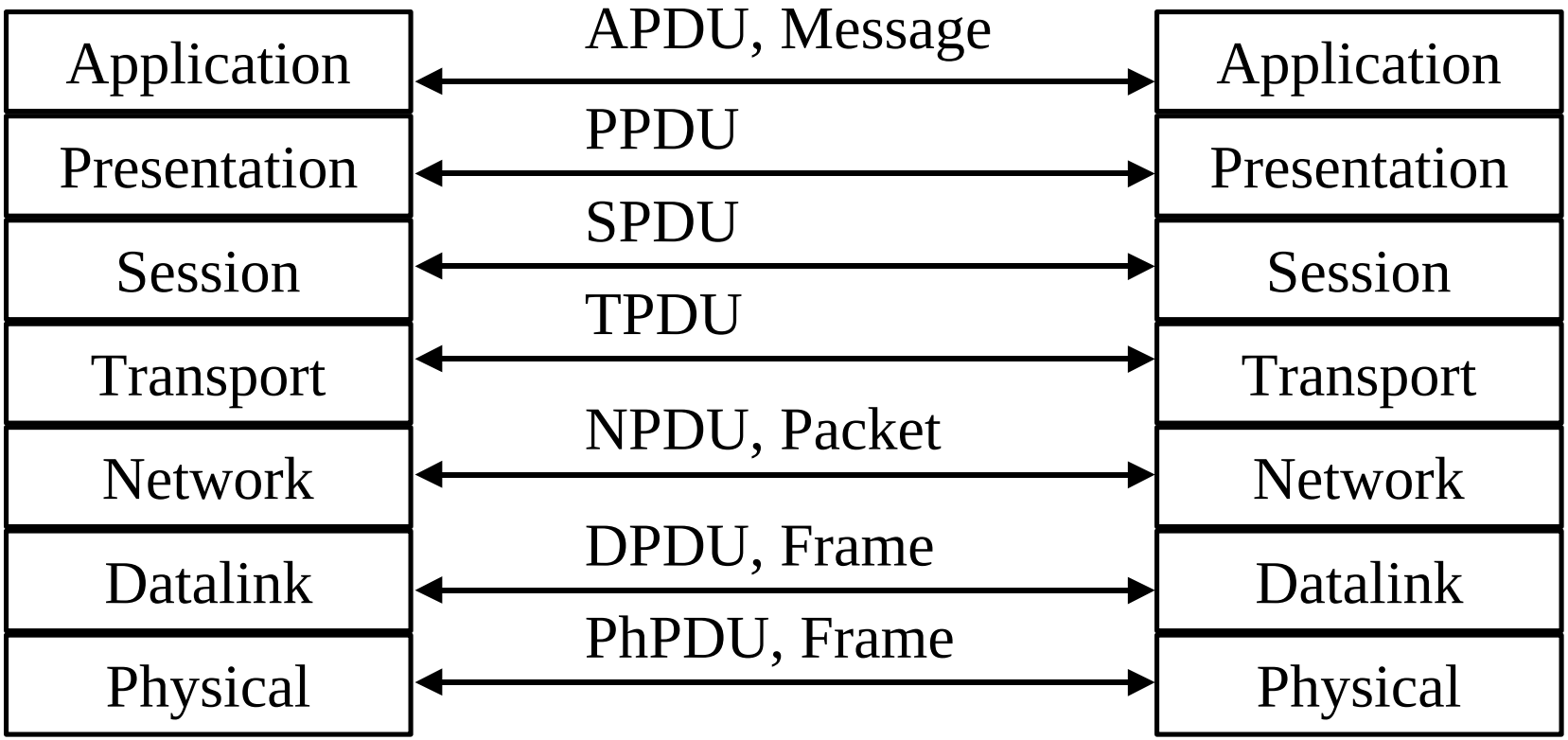
- Protocols of a layer perform a similar set of functions
- All alternatives for a row have the same interfaces
- Choice of protocols at a layer is independent of those of at other layers. E.g., IP over Ethernet or token ring
- Need one component of each layer ⇒ Null components

Interfaces and Services

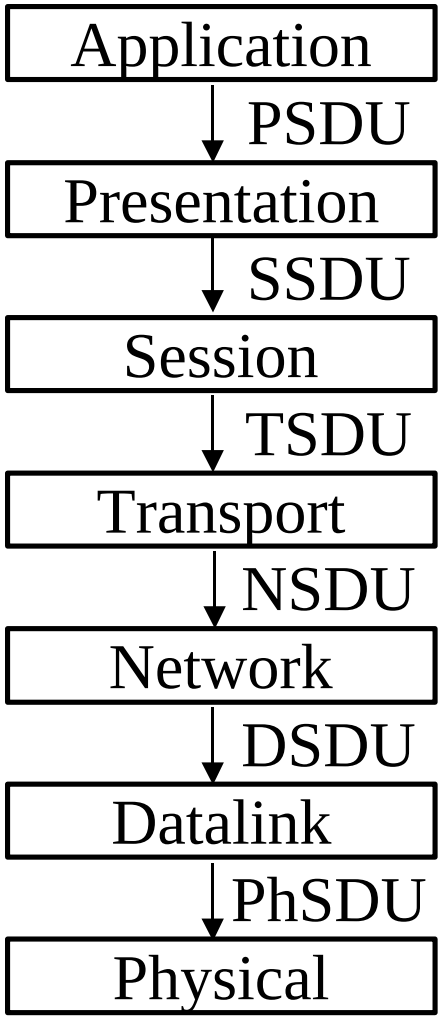


- IDU = Interface Data Unit = ICI + SDU
- ICI = Interface Control Information
- SDU = Service Data Unit
- PDU = Protocol Data Unit = Fragments of SDU + Header or Several SDUs + Header (blocking)
- SAP = Service Access Point

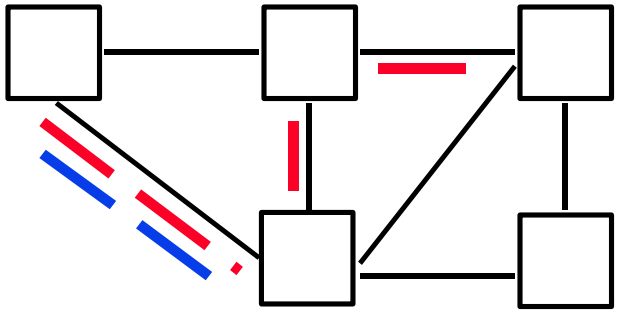
Protocol Data Unit (PDU)



Service Data Unit (SDU)

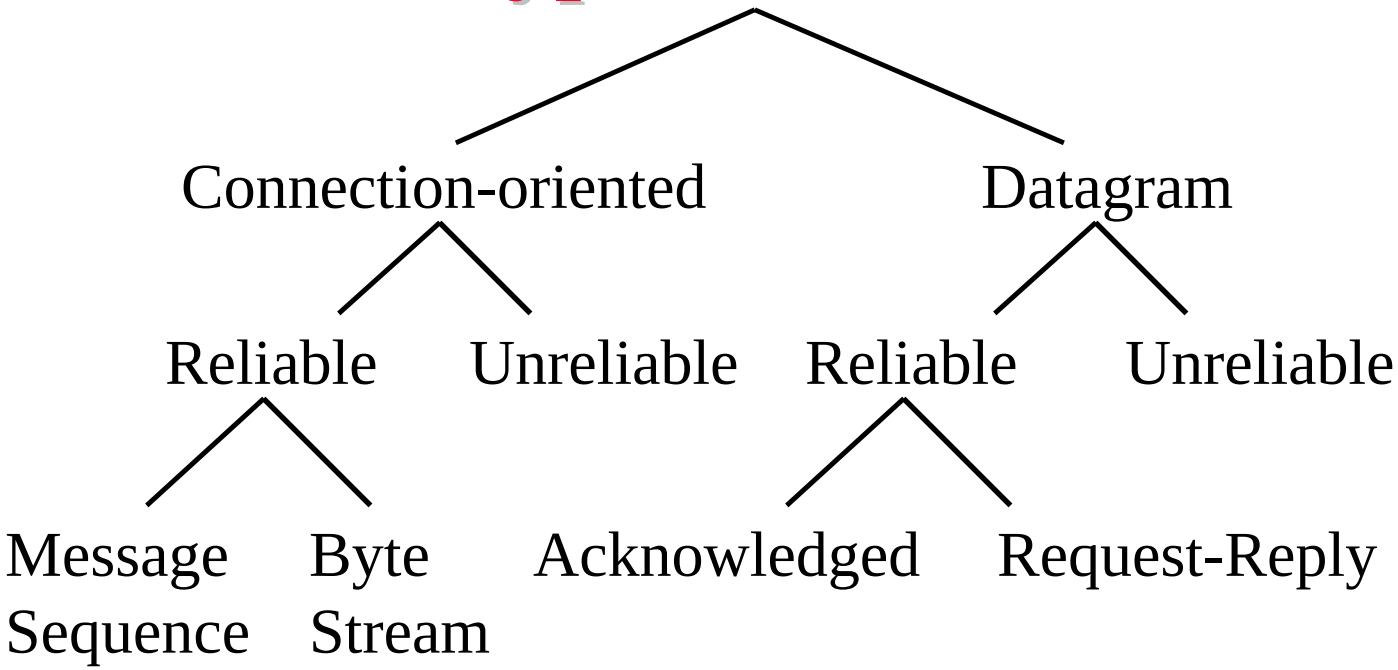


Connection-Oriented vs Connectionless



- Connection-Oriented: Telephone System
  - Path setup before data is sent
  - Data need not have address. Circuit number is used.
  - Virtual circuits: Multiple circuits on one wire.
- Connectionless: Postal System. Also known as datagram.
  - Complete address on each packet
  - The address decides the next hop at each routing point

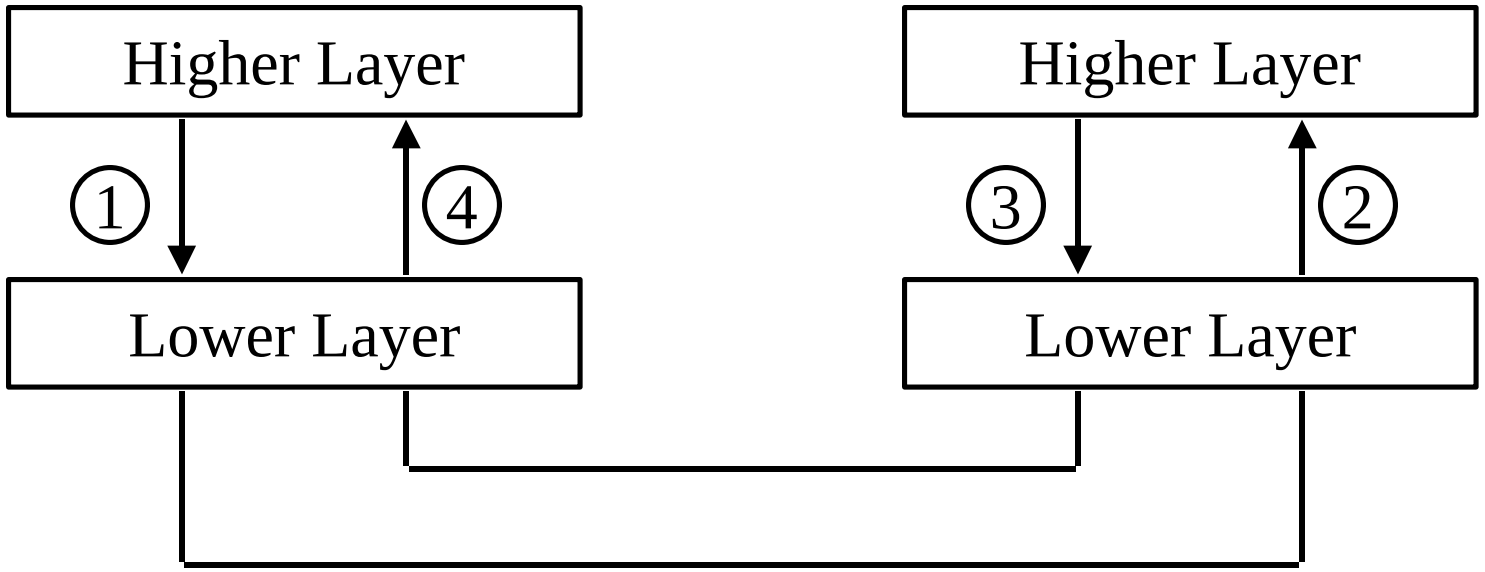
Types of Services



- Byte streams: user message boundaries are not preserved
- Request-reply: The reply serves as an acknowledgement also
- Message oriented or byte oriented approach can be used for unreliable connection-oriented communication

Service Primitives

- Indication = Interrupt

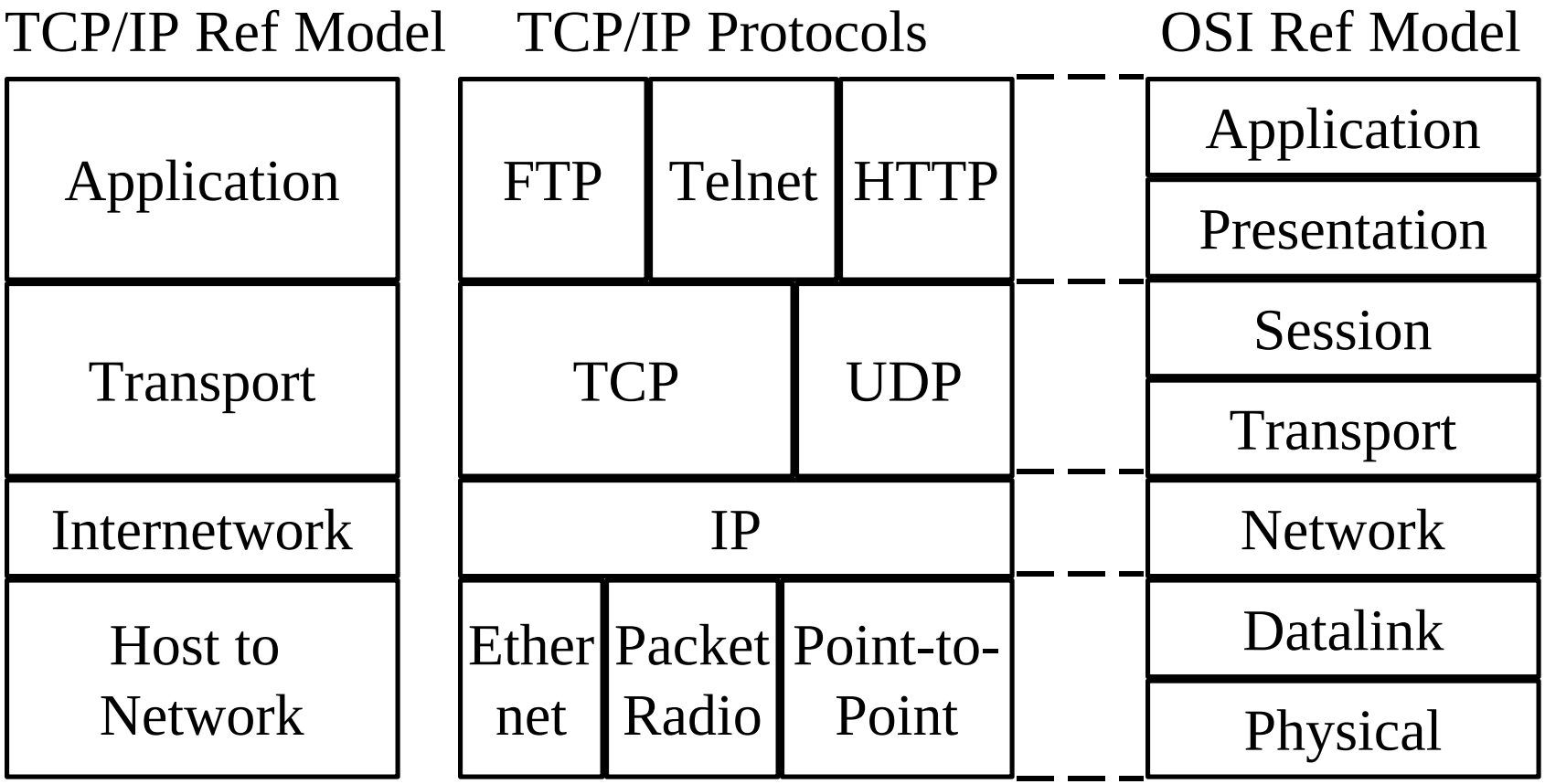


1. Request
2. Indication
3. Response
4. Confirm

Unconfirmed service: No confirmation or response

TCP/IP Reference Model

- TCP = Transport Control Protocol
- IP = Internet Protocol (Routing)

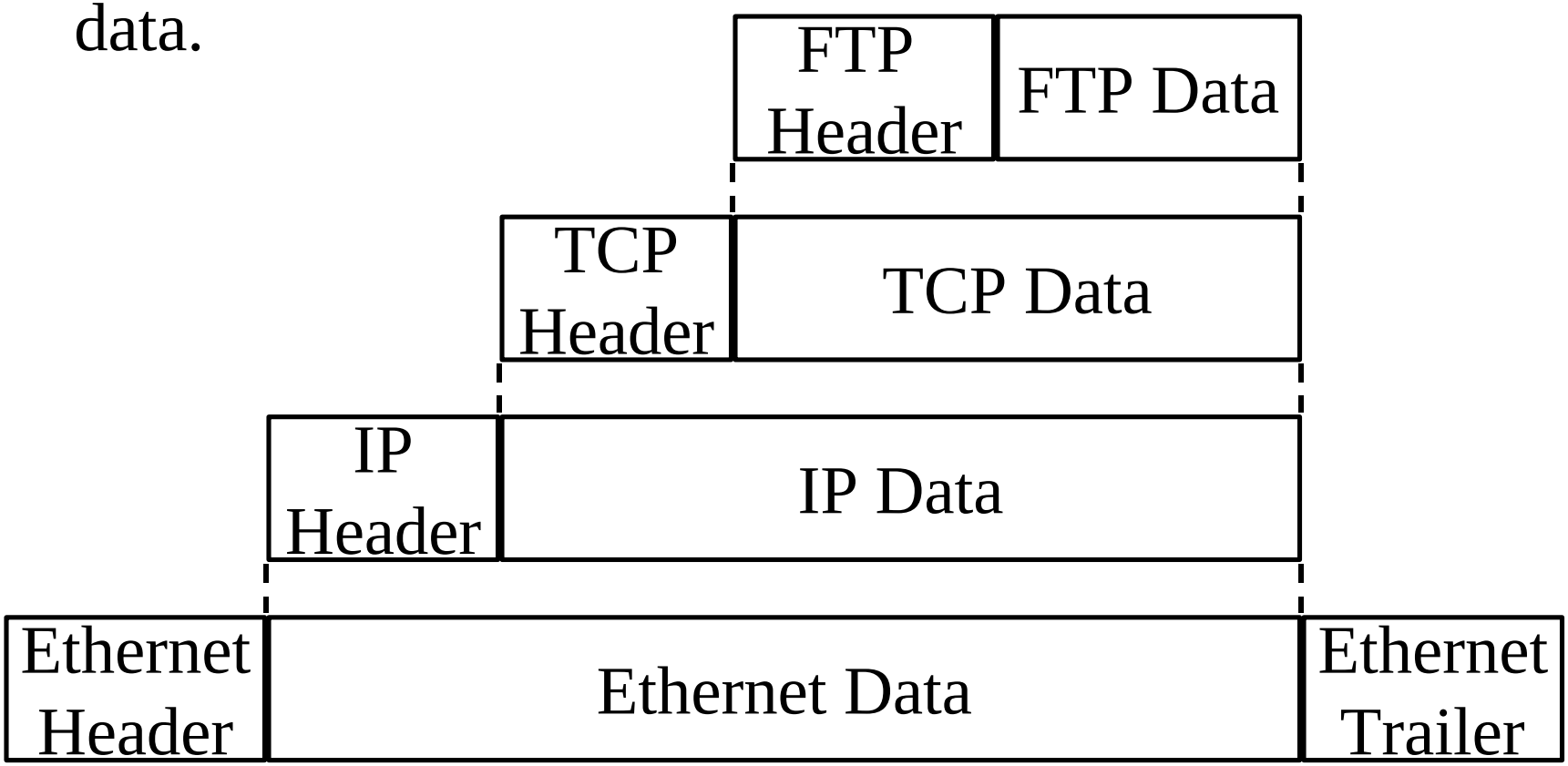


OSI vs TCP Reference Models

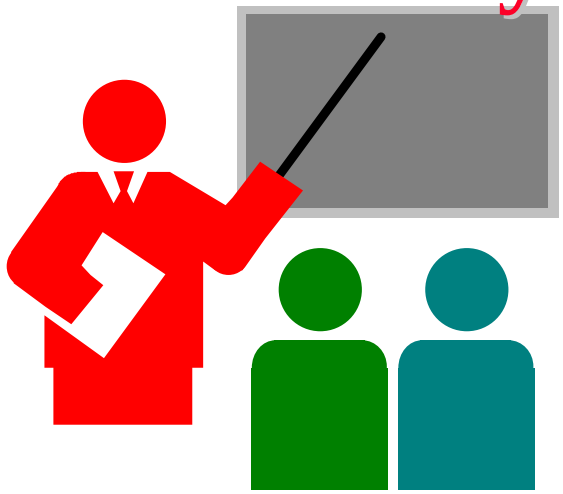
- OSI introduced concept of services, interface, protocols. These were force-fitted to TCP later
  ⇒ It is not easy to replace protocols in TCP.
- In OSI, reference model was done before protocols.
  In TCP, protocols were done before the model
- OSI: Standardize first, build later
  TCP: Build first, standardize later
- OSI took too long to standardize. TCP/IP was already in wide use by the time.
- OSI become too complex.
- TCP/IP is not general. Ad hoc.

Layered Packet Format

- Nth layer control info is passed as N-1th layer data.



Summary



- Communication, Networks, and Distributed systems
- ISO/OSI's 7-layer reference model
- TCP/IP has a 4-layer model
- PDU, SAP, Request, Indication

Reading Assignment

- Read Sections 1.4, 1.5, Appendix 1A, 1B, Sections 2.2, and 2.3 of Stallings 6th Edition
  - 1.4 Protocols and Protocol Architecture
  - 1.5 Standards
  - Appendix 1A: Standards organizations
  - Appendix 1B: Internet Resources
  - 2.2 OSI
  - 2.3 TCP/IP

Homework

- Visit www.ietf.org and find the titles of RFC1 and RFC137
- Check newsgroup comp.protocols.tcp-ip and list any one of the current issues being discussed there
- Submit answers to Problems 2.4 and 2.7 of Stallings 6th Edition
  - Problem 2.4: Communications between France and China
  - Problem 2.7: Segmentation and Blocking