Open Systems Interconnection (OSI) Protocol Stack

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Example: Postal System

- Hostel communication

Components:
- Hostel
- Students
- Letters
- Office Boy
- Postmen
- Vehicles/ Tracks/ Roads

Functionality:
- Generate letters
- Multiplex/de-multiplex letters
- End-to-end path determination
- Hop-to-hop transfer
- Physical transfer

Challenges

- Large Reach (international, national, villages)
- Need to be scalable (many users)
- Many user requirements (reliable, express, cheap)
- Heterogeneous Technology (airplanes, trucks, trains, bullock-carts)

Internet

- Computer communication

Components:

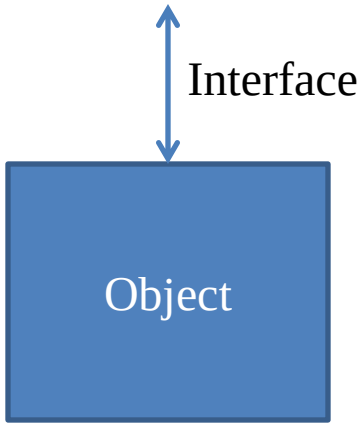
- Hostel → Computing Device
- Students → Application Processes
- Letters → Messages/Packets
- Office Boy → Transport Software
- Postmen → Routers/Switches
- Vehicles/ Tracks/ Roads → Hardware/Cables

Challenges

- Complex System
  - Many users (Billions)
  - World-wide reach
  - Many user requirements
    - reliable, express, cheap, interactive (real-time), multicast
  - Heterogeneous Technology
    - Ethernet, Wireless, Bluetooth, WiFi, Cellular

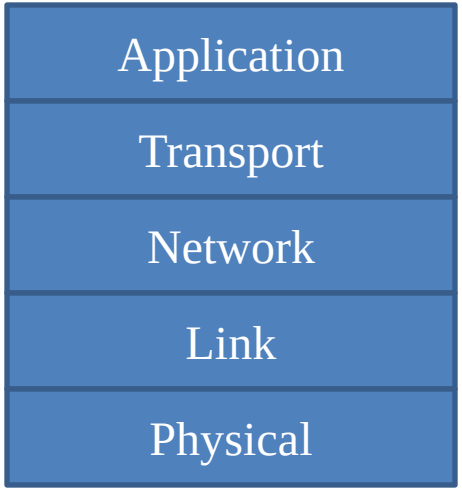
Solution:

- Object oriented approach
  - Segregate functionality → objects / layers
  - Hide details of how object implemented from users → define interface



Internet Protocol Stack

- Application
  - Supports application processes which generate messages
  - E.g. Email, Web, File-transfer
- Transport
  - Supervises process to process communication (multiplexing/demultiplexing messages, reliability)
  - E.g. TCP, UDP
- Network
  - Enables end-to-end routing of messages (from source to destination hosts)
  - E.g. IP
- Link
  - Enables hop-to-hop message transfer (between neighbors)
  - E.g. Ethernet, 802.11
- Physical
  - Enables bit transmissions on media (wire/air)
  - E.g. 10Base-T, OFDM

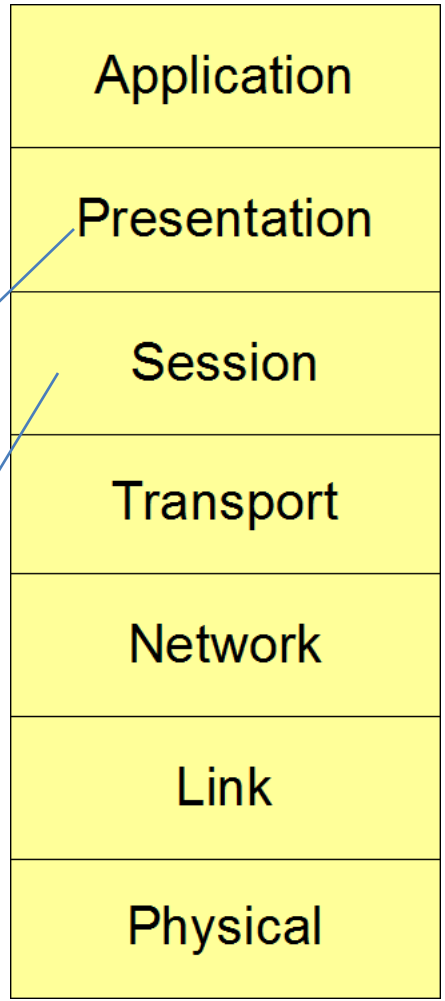


Advantages of Layering

- Modular design → less complex
  - Explicit structure allows identification, relationship of complex system's pieces
- Software reuse → upper layers can share lower layer functionality
  - E.g. Web, email both make use of TCP
- Abstraction of implementation
  - Allows extensibility, new technologies
    - Can change specific parts of implementation as long as interface kept same
    - E.g. Add new physical layer (technology) without having to change network or transport layer

OSI (Open Systems Interconnection) Stack

- Standard that specifies the functionality of the layers and the interface between them

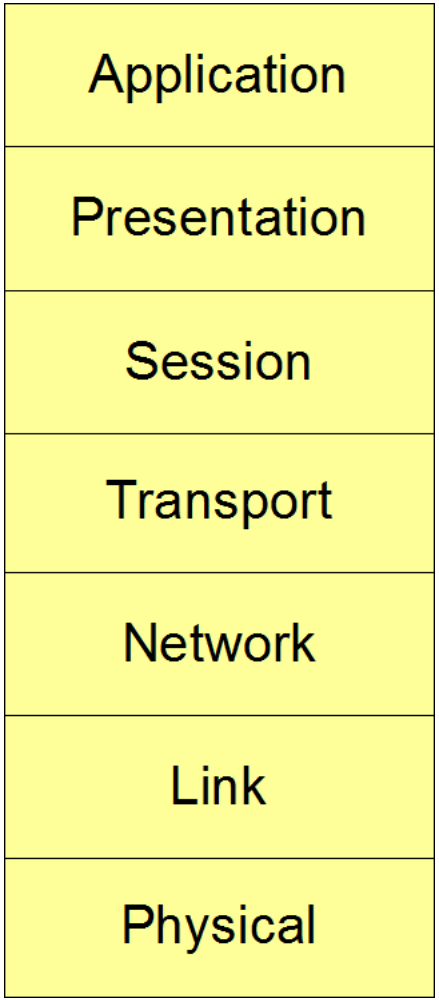


Presentation: Delivery and formatting of information
E.g. Convert rich text format (RTF) to Ascii

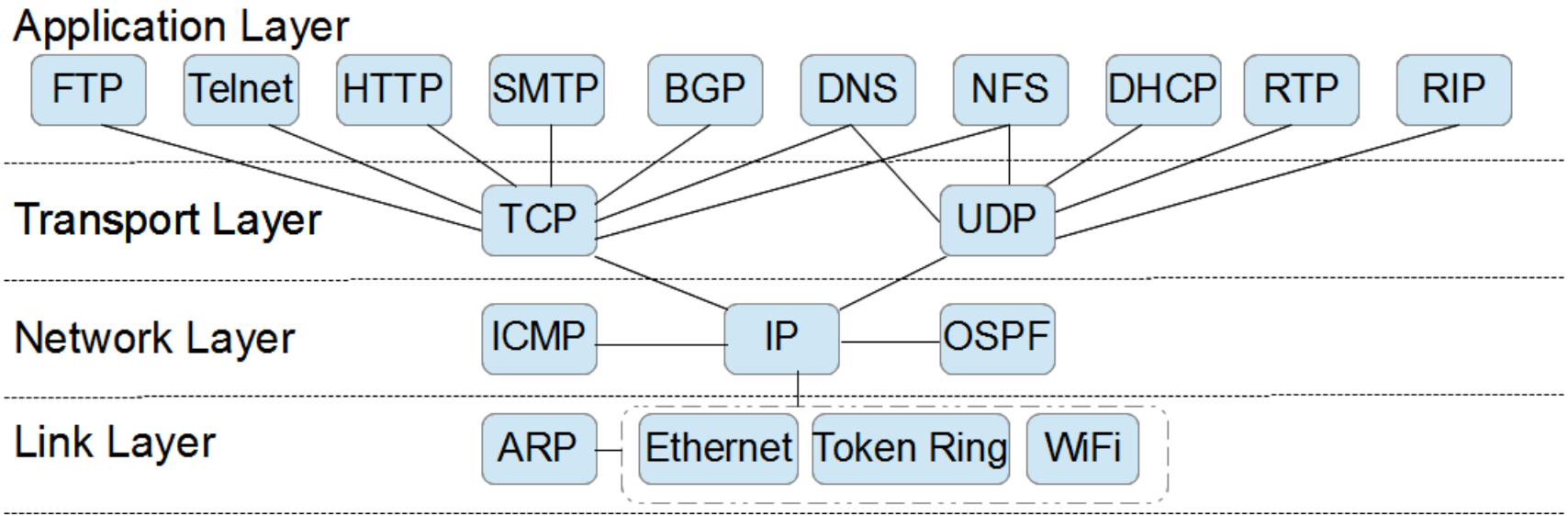
Session: Manages sessions between processes
E.g. combining audio, video streams; authentication

OSI Layering

- What is layering?
  - *"Structuring technique which permits the network... to be viewed as logically composed of a succession of layers, each wrapping the lower layers and isolating them from higher layers" [Zim80]*



Protocols


Application Layer
FTP
Telnet
HTTP
SMTP
BGP
DNS
NFS
DHCP
RTP
RIP
Transport Layer
TCP
UDP
Network Layer
ICMP
IP
OSPF
Link Layer
ARP
Ethernet
Token Ring
WiFi

Summary

- Internet service very similar to postal service
- Identified the many functionalities needed
  - Overall a very complex system
- Solution: Layering (Internet protocol stack)
  - Many advantages
- Provides a framework to learn the subject systematically (top-down or bottom-up)