

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 |

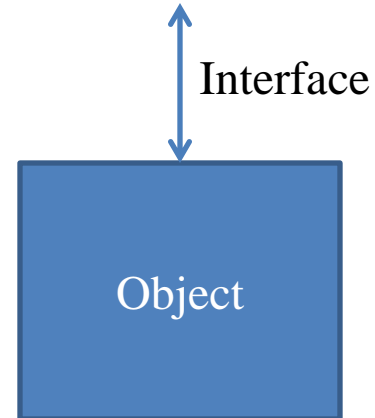


Challenges

- 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

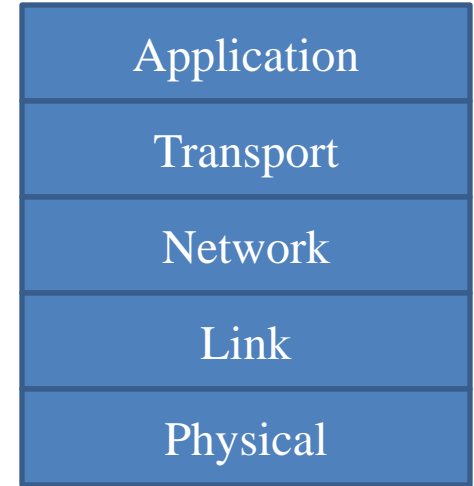
Solution:

- 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

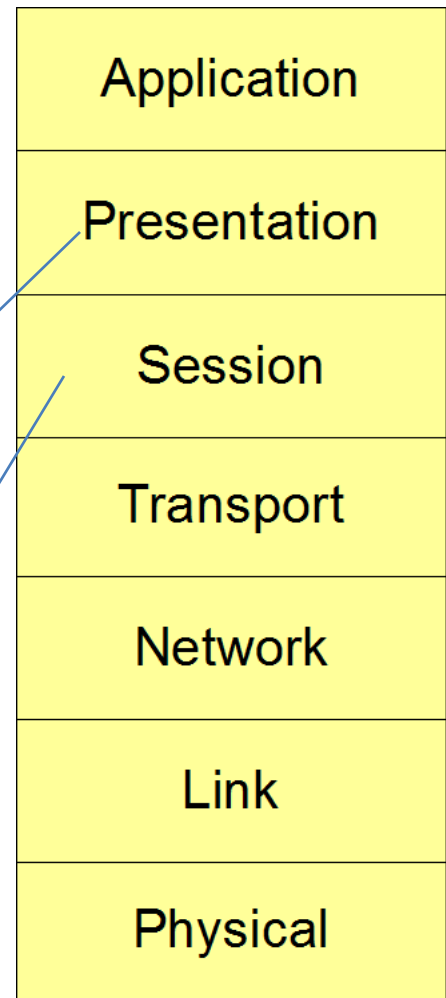
- **Modular design** → less complex
 - Explicit structure allows identification, relationship of complex system's pieces
- **Software reuse** → upper layers can share lower layer functionality
 - E.g. Web, email both make use of TCP
- **Abstraction of implementation**
 - Allows extensibility, new technologies
 - 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



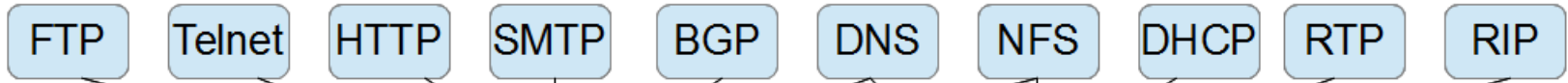
OSI Layering

- 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



Transport Layer



Network Layer



Link Layer



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)