

ISO/OSI Architecture (cont'd)

invite your friend for dinner via postal mail

1. Truck physically travels from one city to next
2. Place mail on trucks
3. Based itineraries for delivery trucks
4. Post office picks up mail from mailboxes
5. put in envelope & drop in mailbox
6. write letter
7. decide on specifics (time, date, ...)

app-specific
interface
network-dependent

sender
receiver @ destination

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ISO/OSI Architecture (cont'd)

- The ISO/OSI model consists of seven layers:
 - Layers 5-7 are **application-oriented**
 - Layers 1-3 are **network-dependent**
 - Layer 4 provides the interface between 5-7 and 1-3

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The OSI Reference Model

Layer

| Layer | Protocol | Name of unit exchanged |
|-------|-----------------------|------------------------|
| 7 | Application protocol | Application |
| 6 | Presentation protocol | PPDU |
| 5 | Session protocol | SPDU |
| 4 | Transport protocol | TPDU |
| 3 | Network protocol | Packet |
| 2 | Data link protocol | Frame |
| 1 | Physical layer | Bit |

Handwritten notes:

- user interface
- code conversion, encryption, compression
- Synchronise data exchange
- MUX, fragmentation, error control, flow control
- addressing & routing
- Link level error & flow control
- encoding bits over signals
- 3.5 internetwork sublayer
- 1.5 MAC sublayer
- checkpoints

- A **protocol** defines message types and associated actions
- MAC sublayer to handle multi-access (shared) links
- Internetwork sublayer to connect networks

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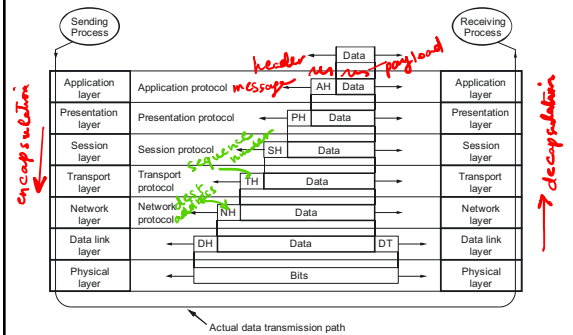
ISO/OSI Architecture (cont'd)

- Seven layers with following typical functions:
 - m **application**: user interface
 - m **presentation**: code conversion, encryption, compression
 - m **session**: organizes and synchronizes the data exchange
 - m **transport**: multiplexing/demultiplexing, fragmentation/reassembly, end-to-end flow control, congestion control and error control
 - m **network**: addressing and routing
 - m **data link**: link-level flow and error control
 - m **physical**: physical and electrical interfaces (normally 100% hardware)

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How is the OSI Model used?



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Service Offered by a Layer

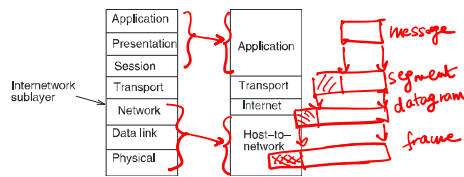
- Connection-oriented:
 - m Before data exchange takes place, a logical (virtual) connection has to be first established
 - m Usually reliable; delivery is in-order, error- and loss-free, no duplication
- Connection-less: data is sent directly in a best-effort way; data can arrive out-of-order, be lost, corrupted, duplicated

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TCP/IP (Internet) Architecture

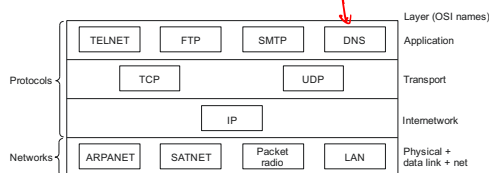
- An industry / de facto standard
- Four layers (application, transport, internet, network interface)
- Data units: messages, segments, datagrams, frames
- Many intranets also use TCP/IP



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Initial Protocols & Networks in the TCP/IP model



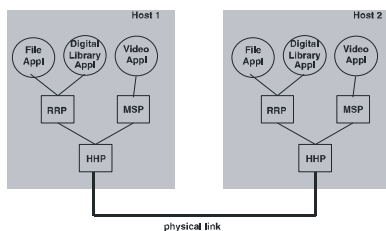
- TCP (Transmission Control Protocol):
m offers **connection-oriented reliable** service
- UDP (User Datagram Protocol):
m offers **connection-less unreliable** service

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Protocol Graph

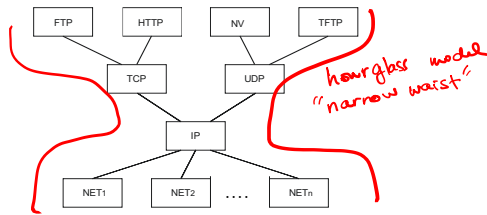
- collection of protocols and their dependencies
- most peer-to-peer communication is indirect
- peer-to-peer is direct only at hardware level



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Protocol Graph for the Internet



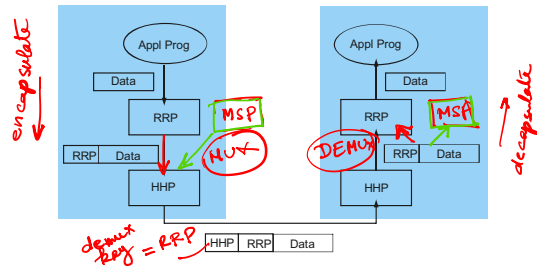
- IP provides a connection-less “best-effort” *datagram state-less* service

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Protocol Stack

- Multiplexing and Demultiplexing (demux key)
- Encapsulation (header/body) and Decapsulation



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We will cover ...

- In a top-down Internet-centric fashion ...
- Applications
 - Socket programming
- Transport Services
 - Error, flow and congestion control
- Internetworking
 - Addressing and Routing
 - Scalability/heterogeneity
- LANs, point-to-point links
 - Access control, data communication
- Wireless (WiFi LAN), mobility
- As time permits: wide-area wireless, real-time, management, operational security, *see CS 558 in spring*

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