

Chapter 3: Transport Layer

our goals:

- ❖ understand principles behind transport layer services:
 - multiplexing, demultiplexing
 - reliable data transfer
 - flow control
 - congestion control
- ❖ learn about Internet transport layer protocols:
 - UDP: connectionless transport
 - TCP: connection-oriented reliable transport
 - TCP congestion control

Chapter 3 outline

3.1 transport-layer services

3.2 multiplexing and demultiplexing

3.3 connectionless transport: UDP

3.4 principles of reliable data transfer

3.5 connection-oriented transport: TCP

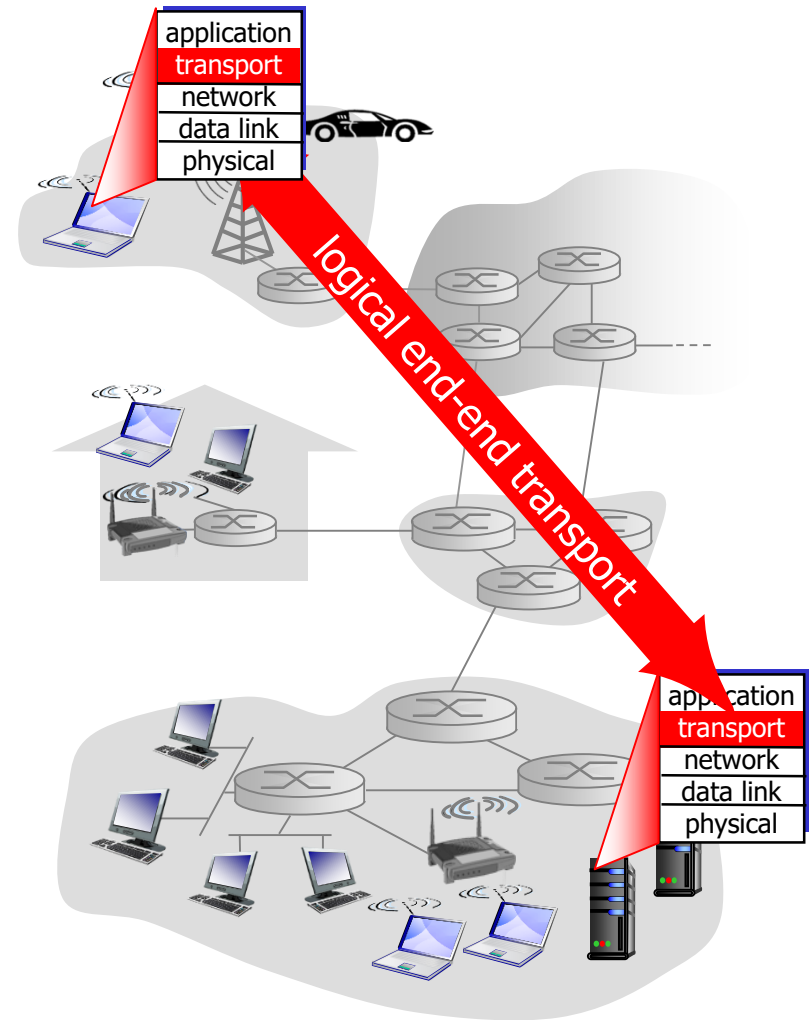
- segment structure
- reliable data transfer
- flow control
- connection management

3.6 principles of congestion control

3.7 TCP congestion control

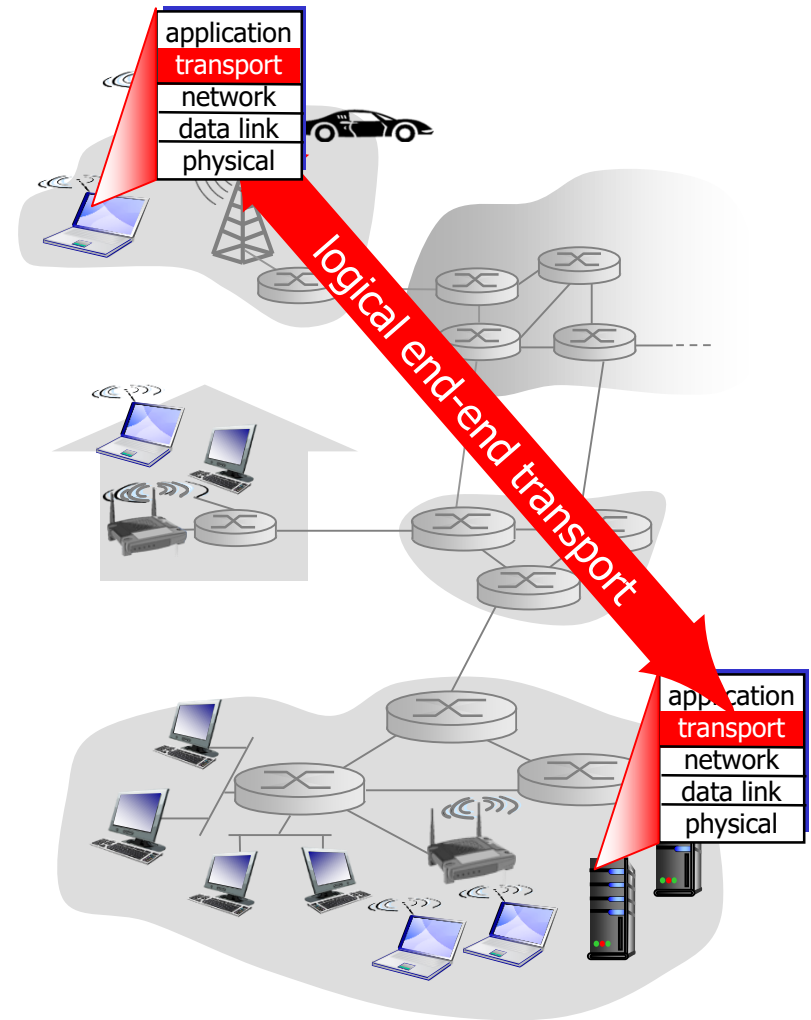
Transport services and protocols

- ❖ provide *logical communication* between app processes running on different hosts
- ❖ transport protocols run in end systems
 - send side: breaks app messages into *segments*, passes to network layer
 - rcv side: reassembles segments into messages, passes to app layer
- ❖ more than one transport protocol available to apps
 - Internet: TCP and UDP



Transport vs. network layer

- ❖ *network layer*: logical communication between hosts
- ❖ *transport layer*: logical communication between processes
 - relies on, enhances, network layer services
 - key fact: each layer knows how to access and communicate with the layers above and below it!



Transport vs. network layer

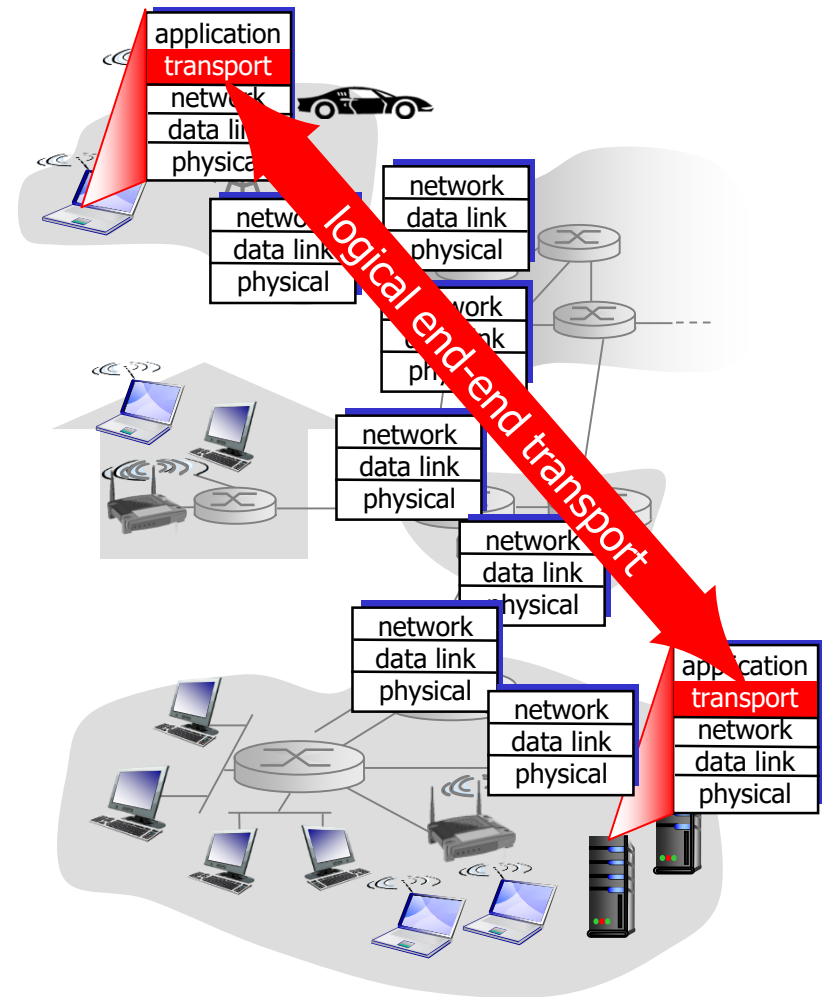
household analogy:

12 kids in Ann's house sending letters to 12 kids in Bill's house:

- ❖ hosts = houses
- ❖ processes = kids
- ❖ app messages = letters in envelopes
- ❖ transport protocol = Ann and Bill who demux to in-house siblings
- ❖ network-layer protocol = postal service

Internet transport-layer protocols

- ❖ reliable, in-order delivery (TCP)
 - congestion control
 - flow control
 - connection setup
- ❖ unreliable, unordered delivery: UDP
 - no-frills extension of “best-effort” IP
- ❖ services not available:
 - delay guarantees
 - bandwidth guarantees



Chapter 3 outline

3.1 transport-layer services

3.2 multiplexing and demultiplexing

3.3 connectionless transport: UDP

3.4 principles of reliable data transfer

3.5 connection-oriented transport: TCP

- segment structure
- reliable data transfer
- flow control
- connection management

3.6 principles of congestion control

3.7 TCP congestion control