Transport Layer and UDP

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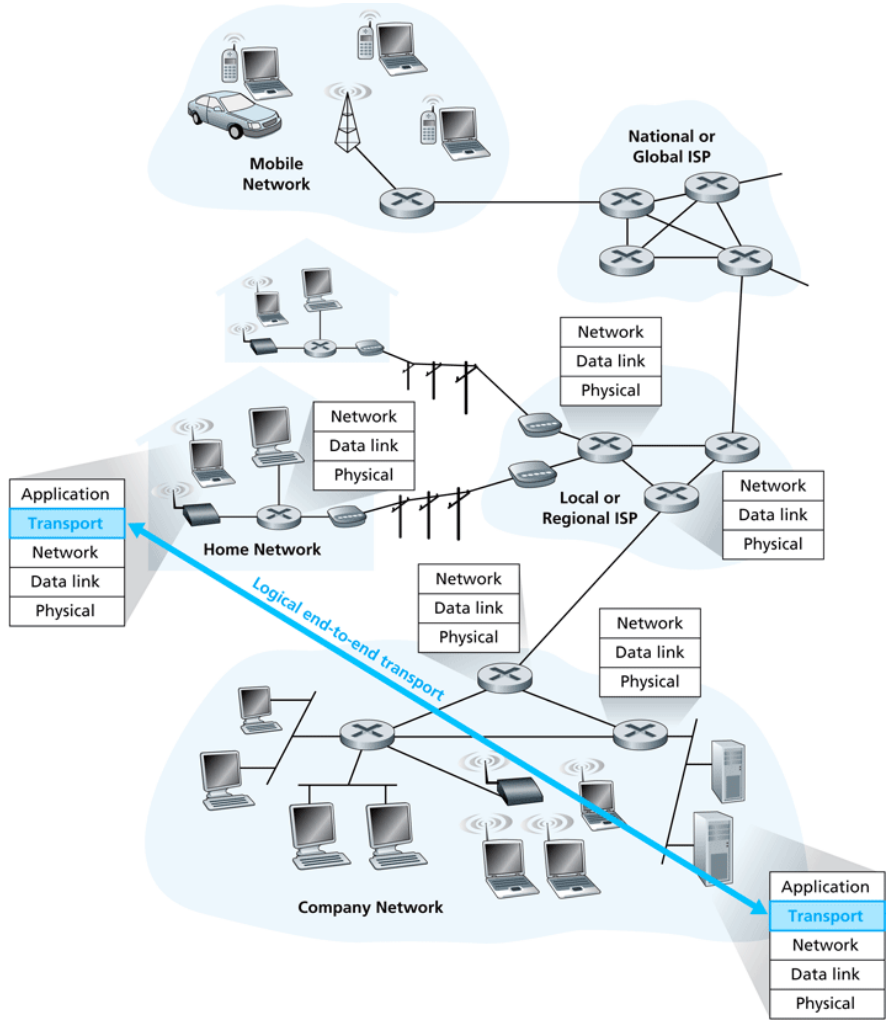
Transport Layer

Logical Communication and Message Segmentation

- logical communication between processes running on different hosts
  - network may lose, delay, duplicate, or re-order packets
  - provide an abstraction that two machines are directly connected
- message segmentation
  - sender divides messages into segments, passes them to network layer
  - receiver reassembles segments into a continuous byte stream



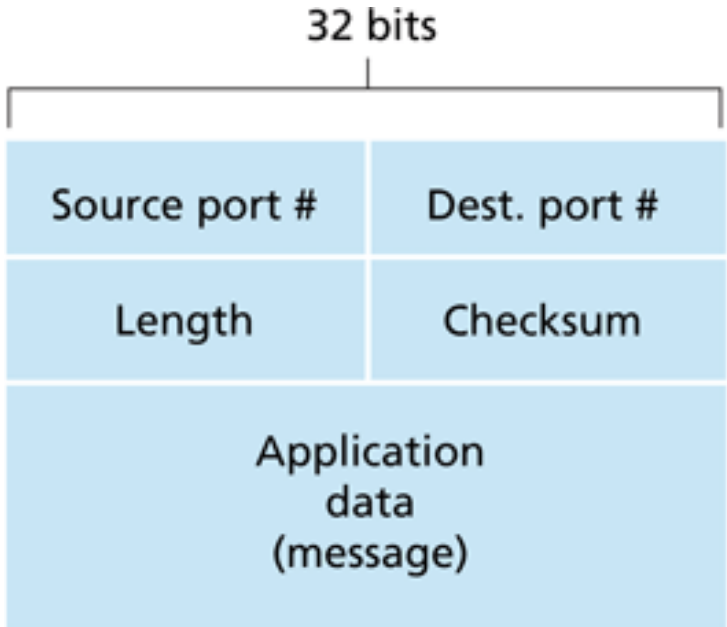
Transport Protocols

- TCP: reliable service
  - reliable, ordered byte-stream: cope with network events
  - flow control: avoid overwhelming receiver
  - congestion control: avoid overwhelming the network
- UDP: best-effort service
  - connectionless: no state setup
  - unreliable: lost packets are not re-sent
  - no flow control
  - no congestion control
- services not available
  - bandwidth guarantees
  - delay guarantees

UDP

UDP Header Format

- defined in RFC 768
- port numbers (16 bits each)
- length of UDP segment, including header (bytes)
- checksum
- application data (sometimes called ADU)



UDP Checksum

- goal: detect some bit errors in transmitted segment
- sender
  - treat segment (header and data) as a sequence of 16-bit integers
  - take the one's complement of the one's complement sum of the entire segment
  - put resulting value in UDP checksum field
  - ▸ RFC 768
- receiver
  - compute checksum of received segment
  - check if computed checksum = -0
    - yes – no error detected
    - no – a bit error occurred

1's Complement Addition

Binary	Decimal	Hex
0000 0000	0	00
0000 0001	1	01
0000 0010	2	02
0000 0011	3	03
...		
1111 1111	-0	FF
1111 1110	-1	FE
1111 1101	-2	FD
1111 1100	-3	FC

- add the carry to the least-significant bit
- -3 + 5 = 2
- 1111 1100 + 0000 0101 = (01) 0000 0001 = 0000 0010
- checksum for -3 + 5 + 0 = 1111 1101
- checksum for -3 + 5 + -2 = 1111 1111 = -0