User Datagram Protocol (UDP)

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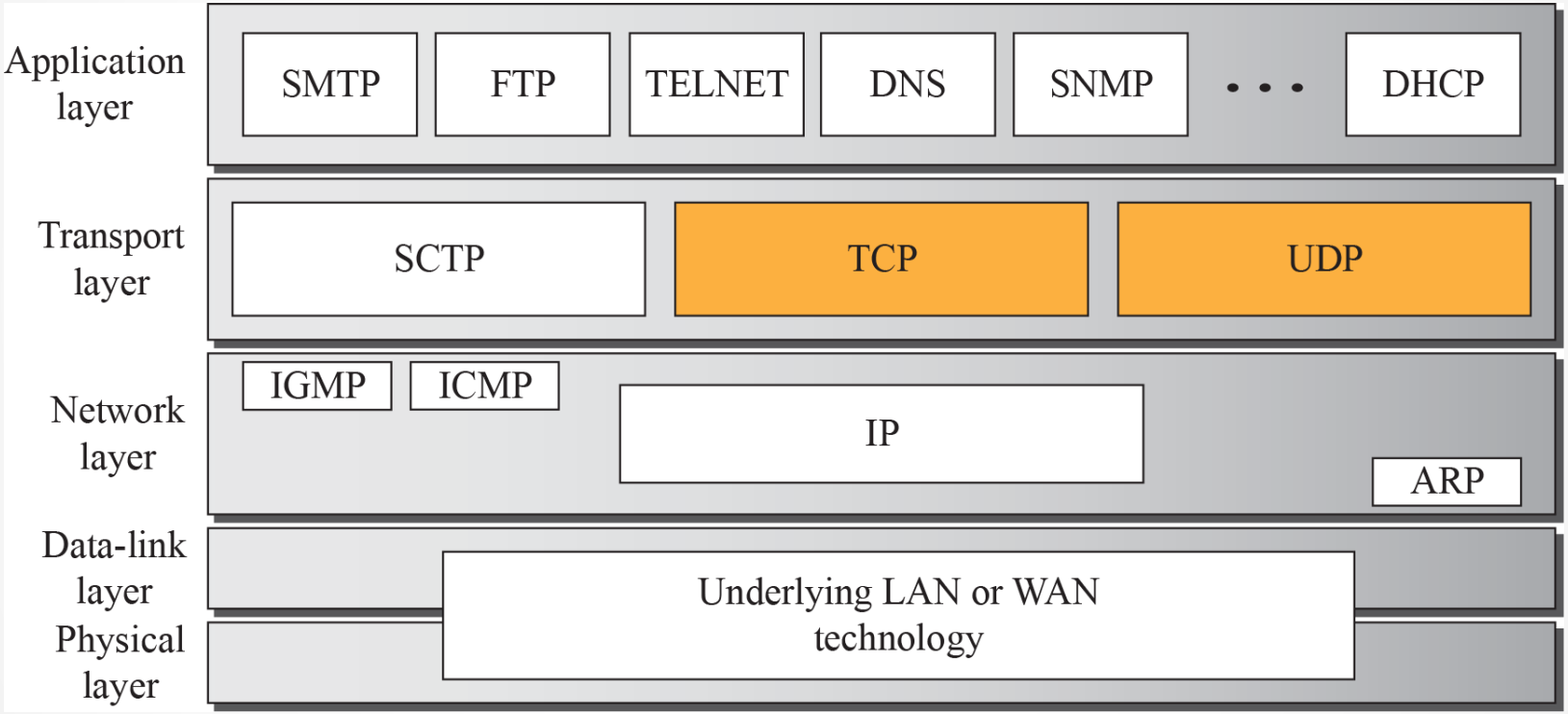
Internet Transport-Layer Protocols

- Transport layer provides logical communication between processes

- Internet supports a few transport layer protocols
  - UDP, TCP, SCTP

- UDP: ‘bare bones’ transport protocol

•Transport-layer protocols in the TCP/IP Stack



User Datagram Protocol

- Provides Mux/Demux capability over best-effort network layer service

- UDP segments can be lost, duplicated, delivered out of order to applications

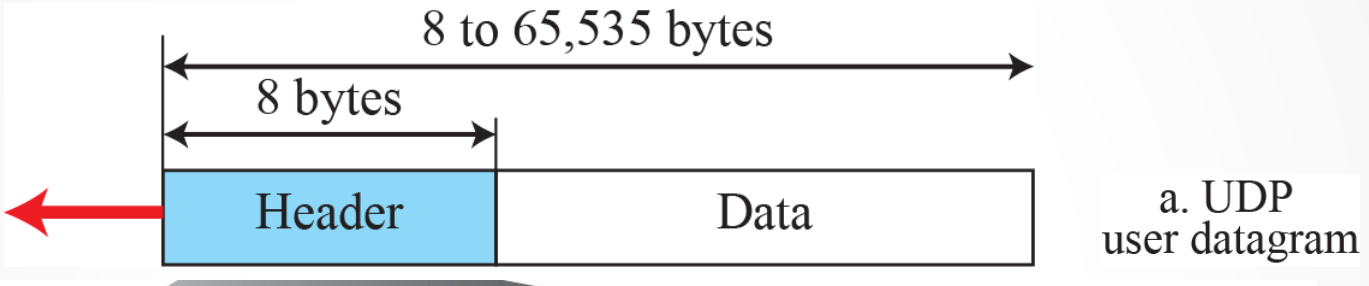
- Connectionless: no handshaking between UDP sender, receiver

- Each UDP segment handled independently of others

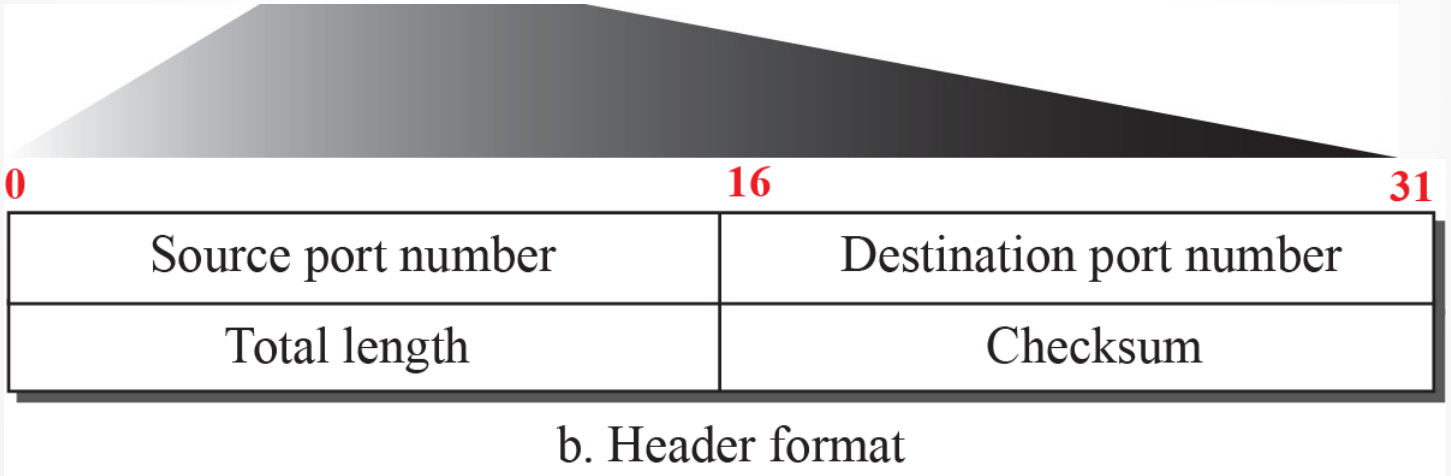
Why to use?

- No connection establishment (which can add delay)
  - DNS uses UDP
- Simple: no connection state at sender, receiver
  - A server can support more clients
- Small segment header: Less overhead per packet
- No congestion control: UDP can blast away as fast as desired
- No retransmission delays: Useful for real-time applications like VoIP, online games
- Want additional features? Applications have to implement them themselves

UDP Segment Format



a. UDP user datagram



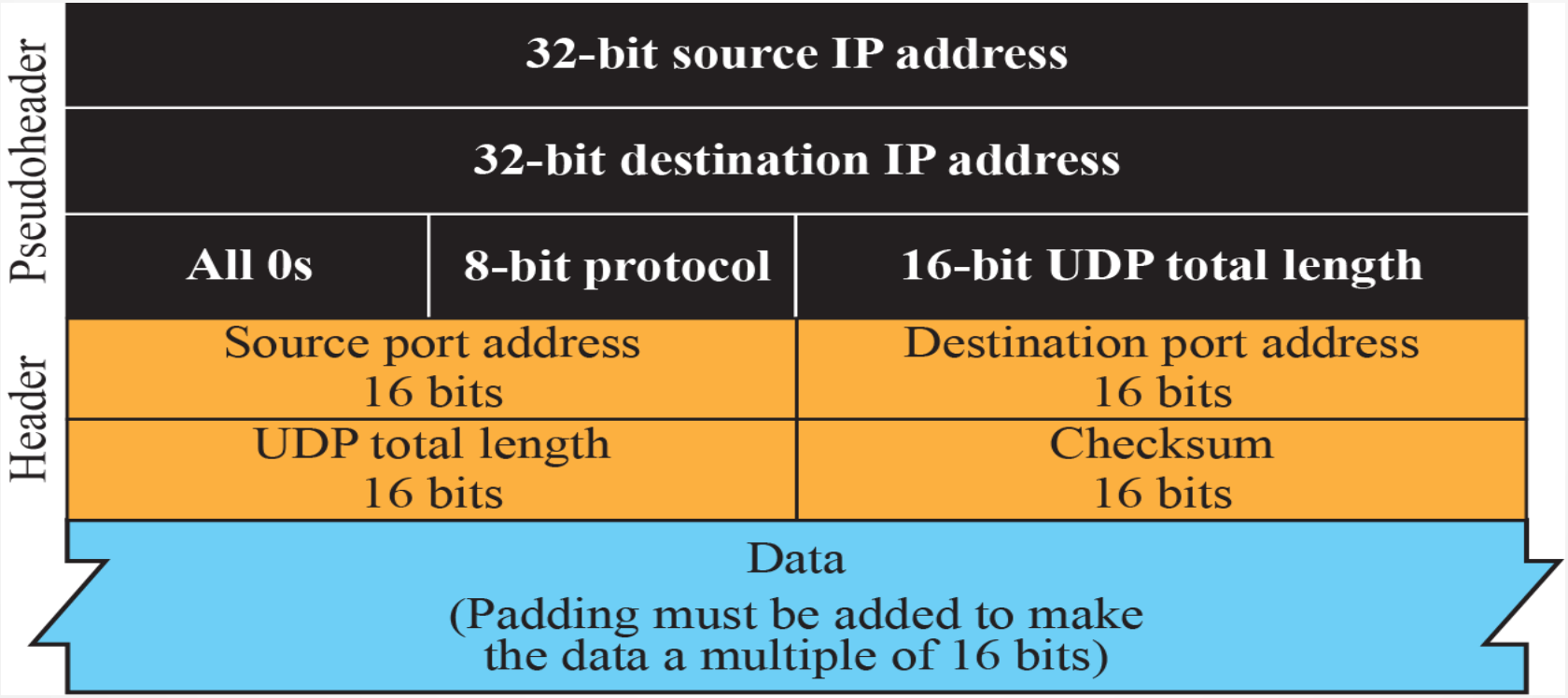
b. Header format

UDP Segment Format

- Source/Destination Port: Identifies sending/receiving process
  - Client: Ephemeral port; Server: Well-known port
- Length: Specifies the total length of the segment in bytes
- Checksum : Ensures correctness of message
  - Optional in IPv4, Compulsory in IPv6
  - Calculated over UDP header, body and pseudoheader

Pseudoheader for checksum calculation

– The purpose of using a pseudo-header is to verify that the UDP datagram has reached its correct destination.
– Pseudoheader: three fields from IP (protocol number, source IP, destination IP) and UDP length field
– Pseudoheader included to help verify if packet is indeed delivered to the right host



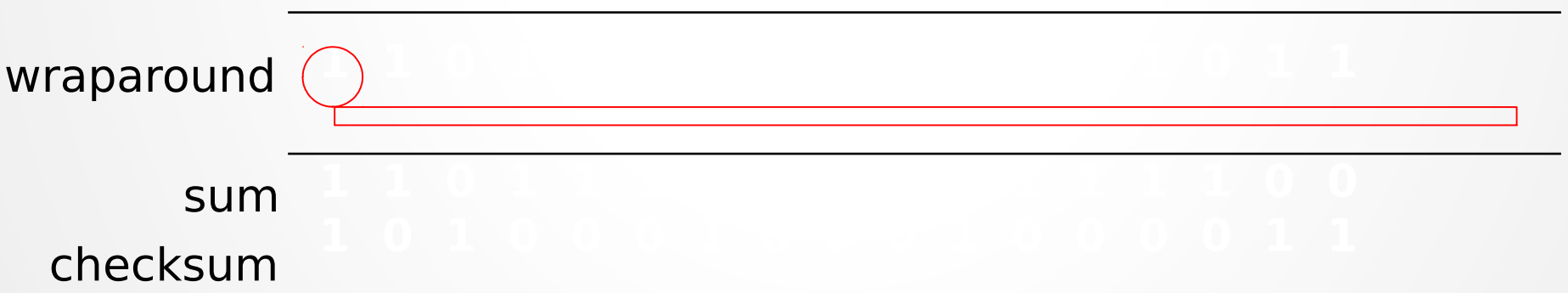
checksum computation

- All 16-bit words are summed using one's complement arithmetic .
- Add the 16-bit values up. Each time a carry-out (17th bit) is produced, swing that bit around and add it back into the least significant bit.
- The sum is then one's complemented to yield the value of the UDP checksum field.
- If the checksum calculation results in the value zero (all 16 bits 0) it should be sent as the one's complement (all 1s).

Note: The Checksum field is itself part of the TCP header and thus one of the fields over which the checksum is calculated, creating a “chicken and egg” situation of sorts. This field is assumed to be all zeroes during calculation of the checksum.

Internet Checksum Example

- Note: when adding numbers, a carryout from the most significant bit needs to be added to the result
- Example: add two 16-bit integers



Why UDP checksum as underlying Link-layer provides error checking?

- There is no guarantee that all the links between source and destination provide error checking.

- Even if segments are correctly transferred across a link, it's possible that bit errors could be introduced when a segment is stored in a router's memory.