Network Protocols

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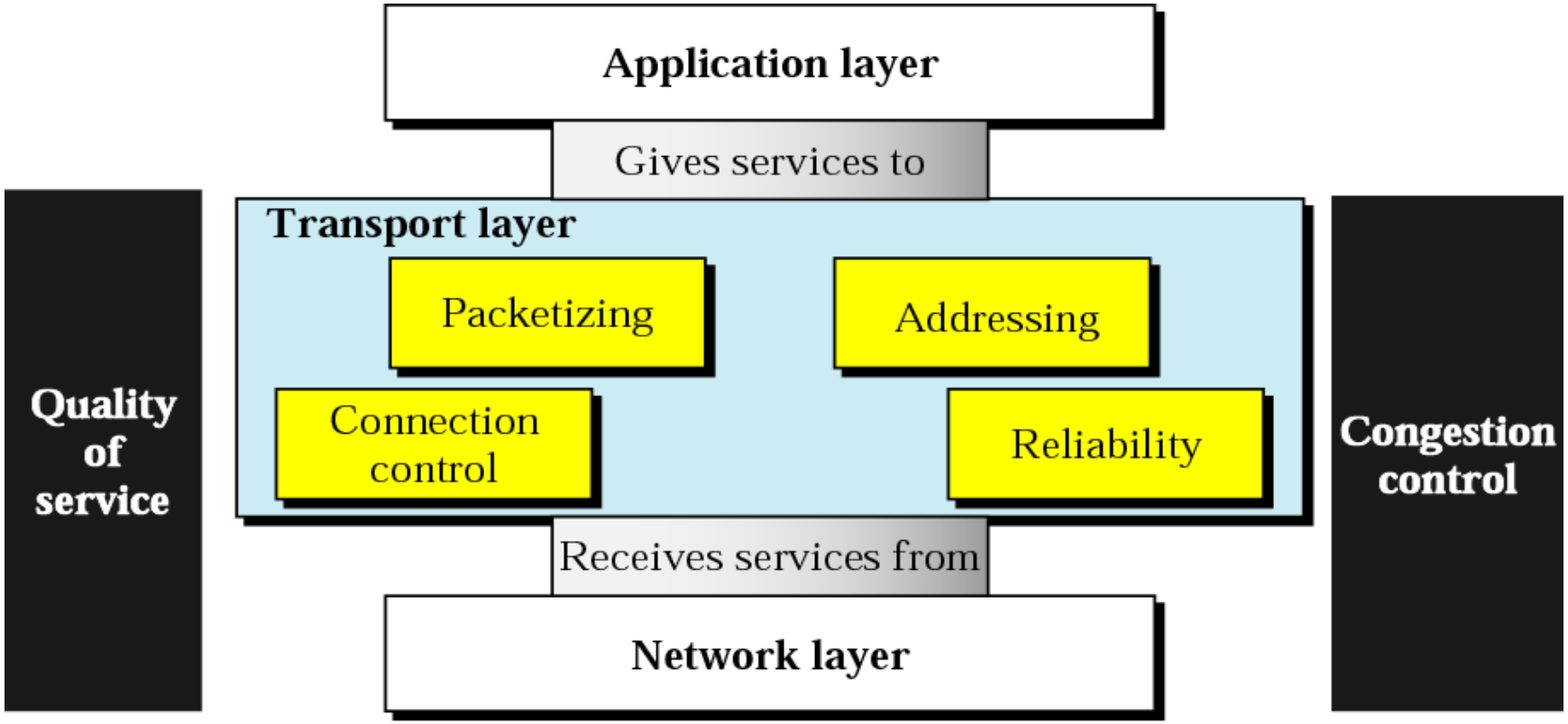
User Datagram Protocol (UDP)

Outline

- User Datagram Protocol

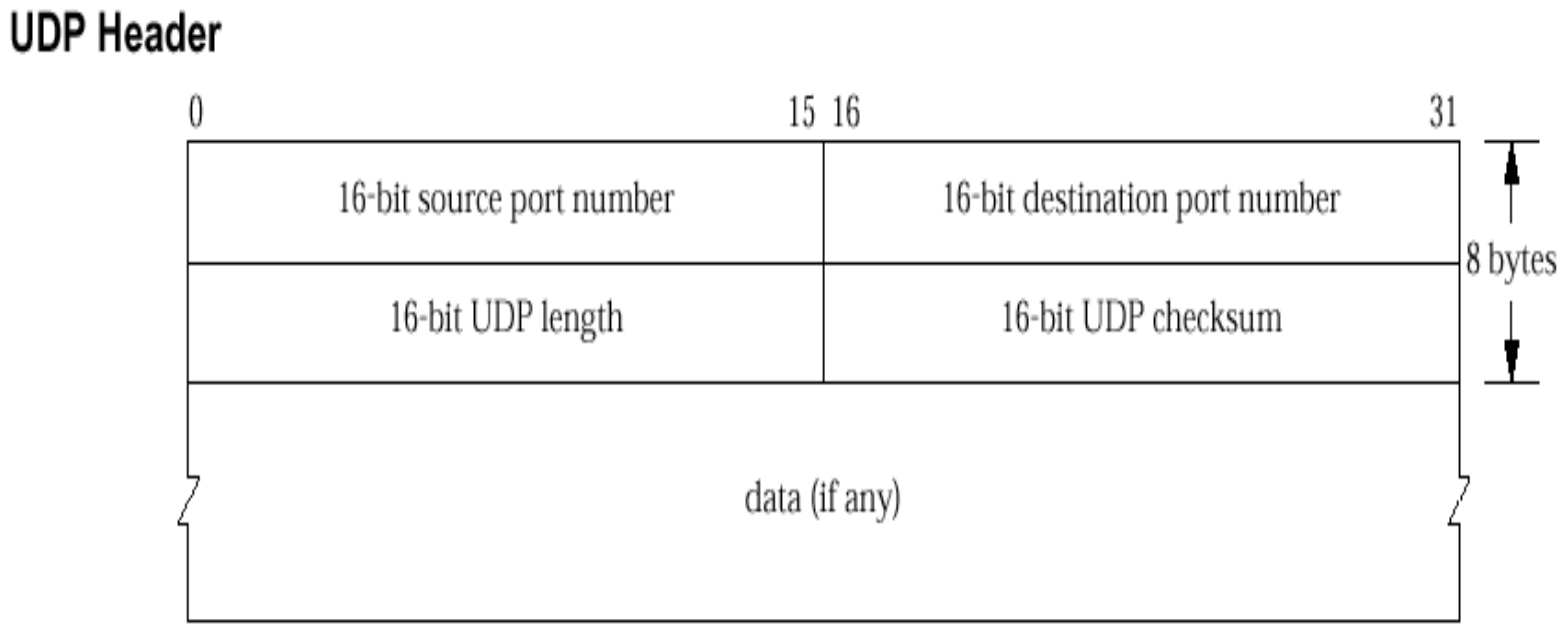
Transport Layer



User Datagram protocol (UDP) 1/2

- Described in [RFC 768, 1980]
- *Simple*
- *Connectionless* (no long term relationship between UDP client and server)
  - Create a socket → send a datagram to a server, then immediately send another datagram on the same socket to a different server
- *Unreliable* (no guarantees, no order, and can deliver duplicates)
- Each UDP datagram has a length (limited to IP MTU)
- *Full duplex* -- concurrent transfers can take place in both directions

User Datagram protocol (UDP) 2/2



UDP Length: length of datagram in bytes, including header and data, max is 65,535 bytes

Checksum: optional -- 16-bit checksum over header and data, or zero

UDP output

•Send buffer size: upper limit on maximum-sized UDP datagram to be written to socket

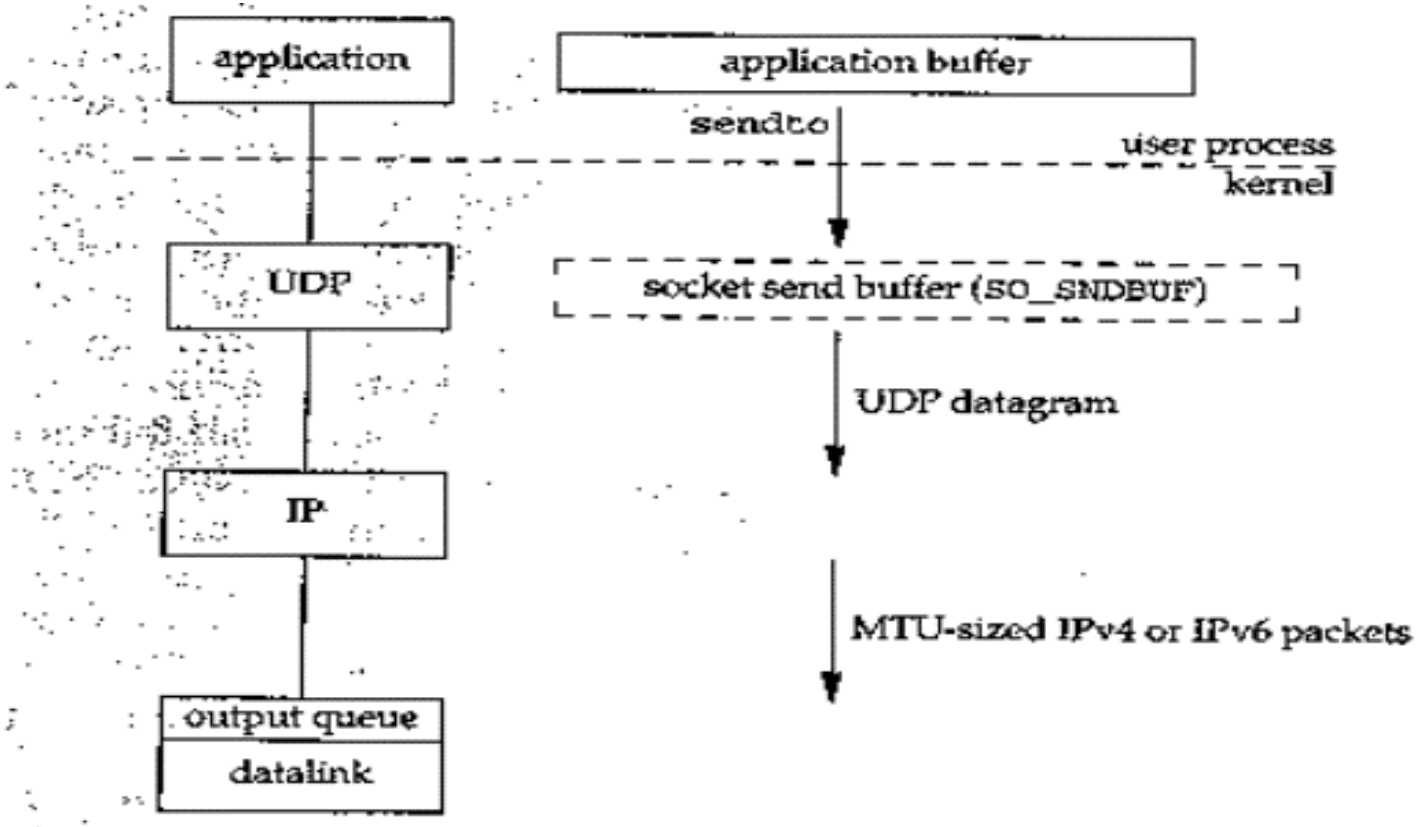


Figure 2.12 Steps and buffers involved when application writes to a UDP socket.

Why is there a UDP?

- no connection establishment (which can add delay)
- simple: no connection state at sender, receiver
- small segment header
- no congestion control: UDP can blast away as fast as desired
- often used for streaming multimedia apps
  - loss tolerant
  - rate sensitive
- other UDP uses → DNS and SNMP
- Suitable for multicasting
- reliable transfer over UDP: add reliability at application layer
  - application-specific error recovery!

UDP versus TCP 1/4

- *Choice of UDP versus TCP is based on*
  - Functionality
  - Performance
- *Performance*
  - TCP's window-based flow control scheme leads to bursty bulk transfers (not rate based)
  - TCP's "slow start" algorithm can reduce throughput
  - TCP has extra overhead per segment
  - UDP can send small, inefficient datagrams

UDP versus TCP 2/4

- *Reliability*
  - TCP provides reliable, in-order transfers
  - UDP provides unreliable service – application must accept or deal with
    - ✓ Packet loss due to overflows and errors
    - ✓ Out-of-order datagrams
- *Multicast and broadcast*
  - Supported only by UDP
  - TCP's error control scheme does not lend itself to reliable multicast

UDP versus TCP 3/4

- *Application complexity*
  - *Application-level framing* (ALF) can be difficult using TCP because of the *Nagle* algorithm [RFC 896, 1984]
    - ✓ALF implies that data should be organized in units that make the most sense for the application
    - ✓What makes sense for a video application or an audio application ?
  - *Nagle* algorithm controls when TCP segments are sent to use IP datagrams efficiently
  - But, data may be received and read by applications in different units than how it was sent

UDP versus TCP 4/4

- *Nagle Algorithm*
  - Tinygrams (small datagrams) can cause congestion in WANs
    - "Small" means less than the segment size
    - ✓Think what is the datagram size for 1 byte of data?
  - A TCP connection can have only one outstanding small segment that has not yet been acknowledged
  - No additional small segments can be sent until the acknowledgment is received.
  - small amounts of data are collected by TCP and sent in a single segment when the acknowledgment arrives