# Computer Networks

## User Datagram Protocol (UDP)

# Lecture Contents

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# References

- UDP is defined in RFC-768 ***User Datagram Protocol*** (3 pages)

  https://datatracker.ietf.org/doc/html/rfc768

- The UDP pseudo header for IPv6 is defined in RFC-2460, ***Internet Protocol, Version 6 (IPv6) Specification*** (39 pages)

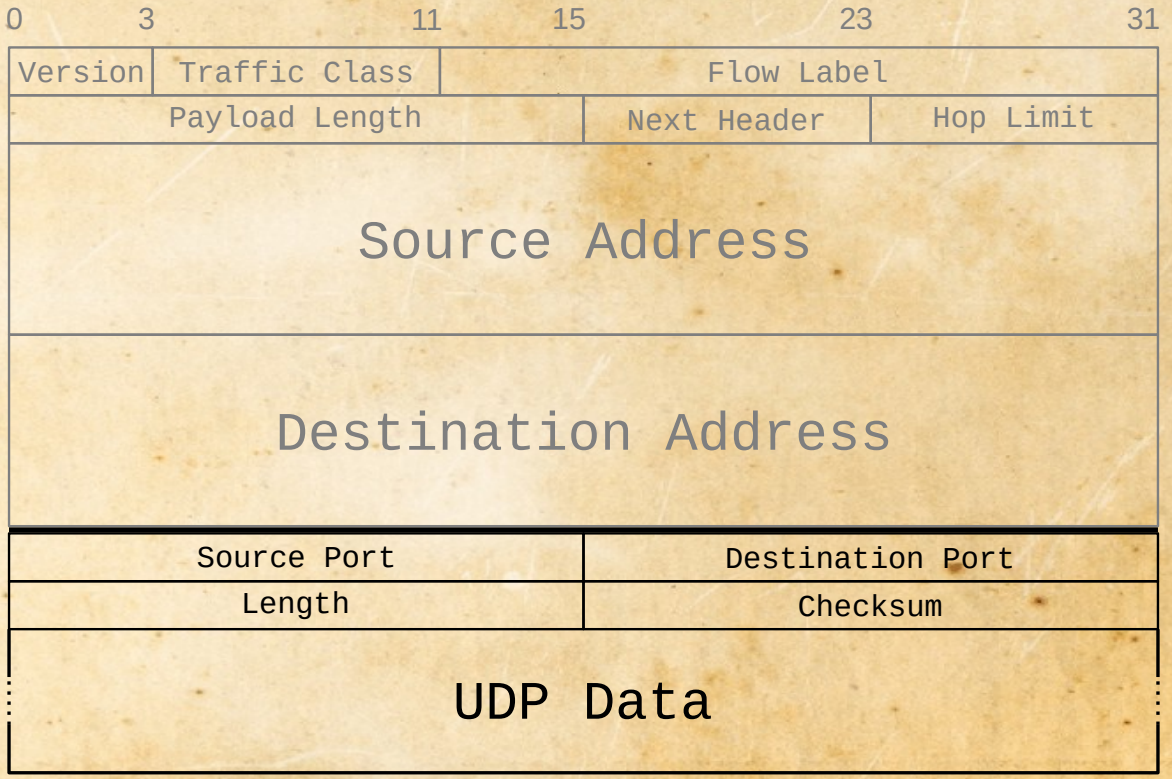
  https://datatracker.ietf.org/doc/html/rfc2460

# User Datagram Protocol – Basics

- Minimalistic
- Connectionless (TCP is connection-oriented)
- Assumes Internet Protocol (IP) is underlying protocol
- Delivery, duplication, ordering not guaranteed
  - Must be handled by upper layer (or use an alternative protocol, e.g.: TCP)

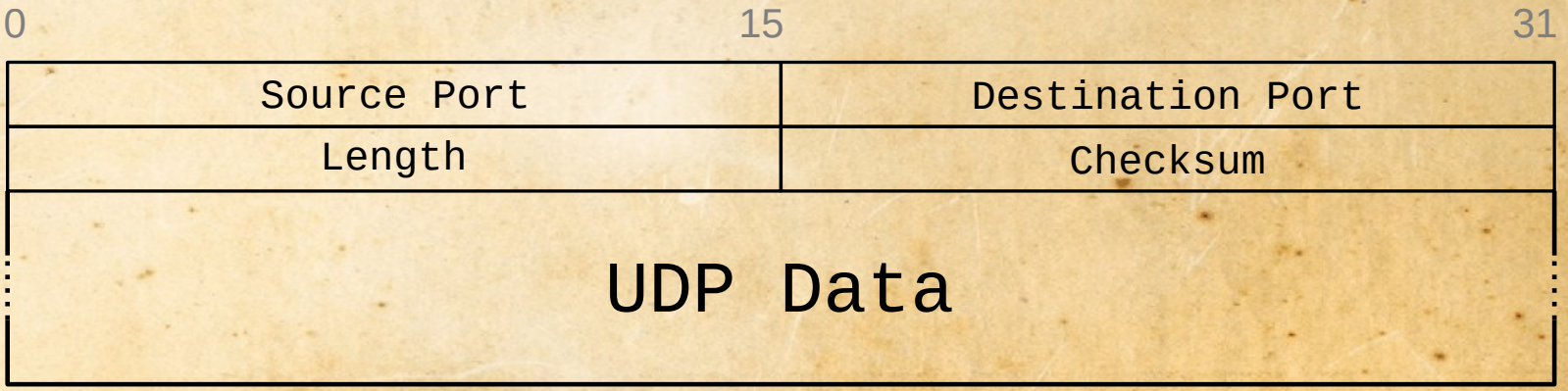
# UDP Header

- Immediately follows the IPv4 or IPv6 header



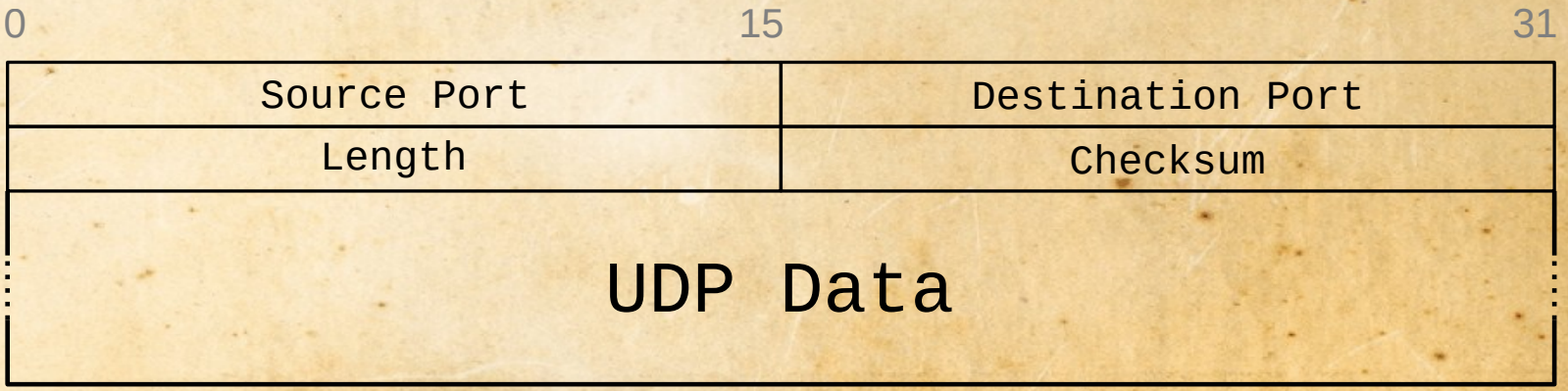
# UDP Header

- Source port
  - Optional (zero if unused)
  - Port of the sending process
  - Reply port, in the absence of other information



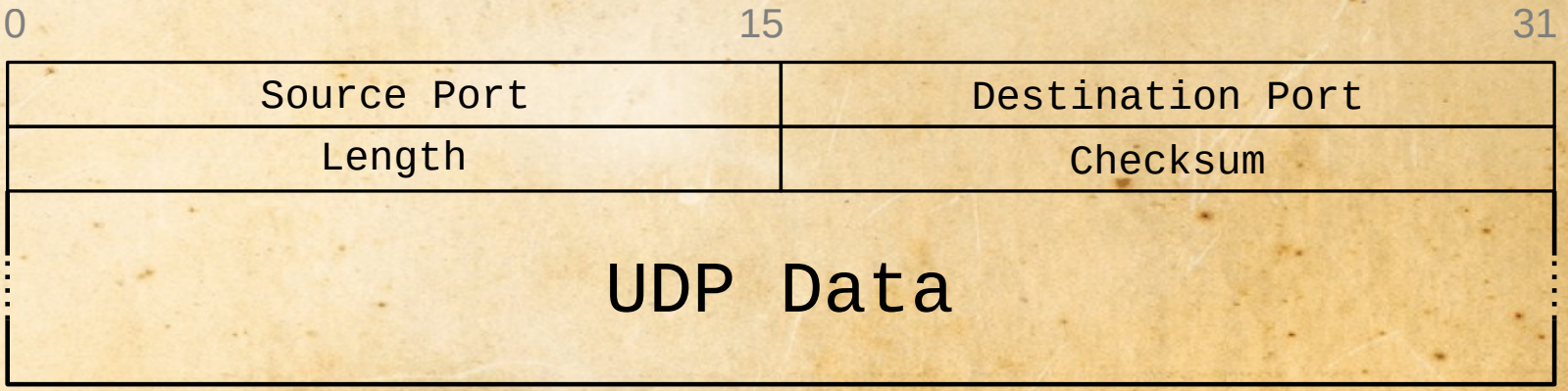
# UDP Header

- Destination port
  - Allows determination of which process should receive the data
  - UDP port numbers are independent of TCP port numbers



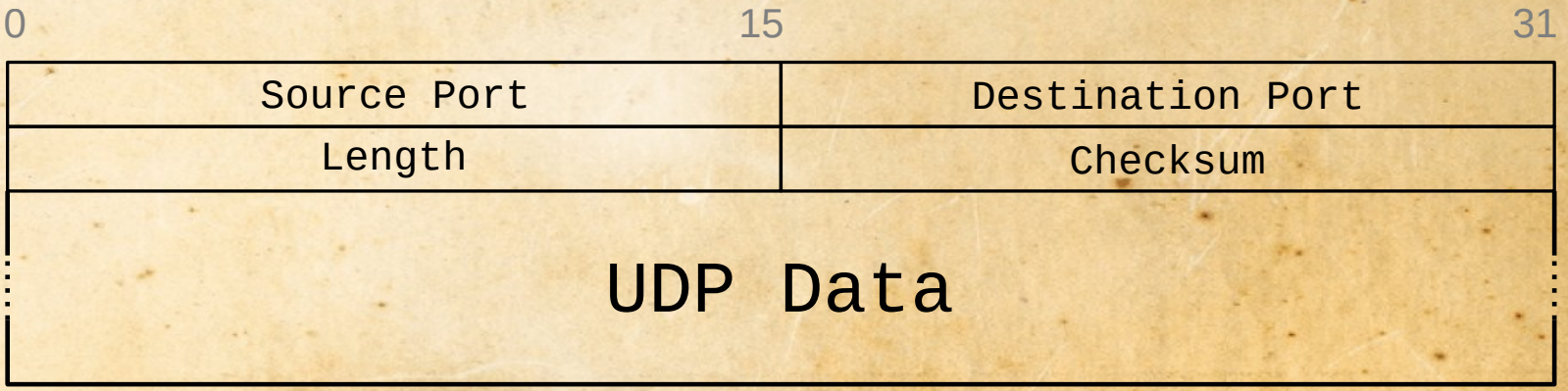
# UDP Header

- Destination port
  - Allows determination of which process should receive the data
  - UDP port numbers are independent of TCP port numbers
  - Port numbers are assigned by *Internet Assigned Numbers Authority* (IANA).



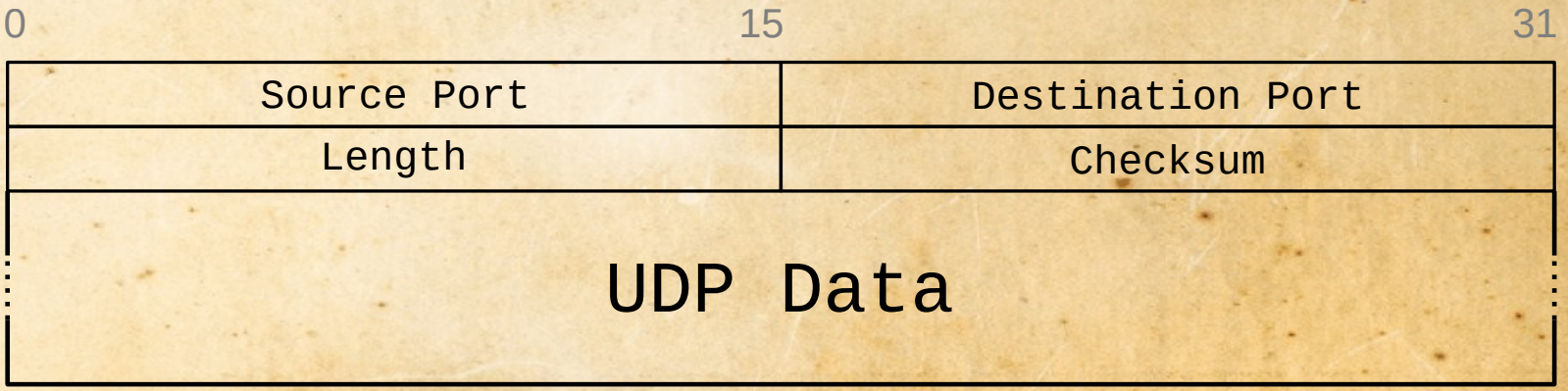
# UDP Header

- Length
  - Length in ***octets***
    - IP payload length also in octets
  - Including header, so minimum value is 8



# UDP Header

- Checksum
  - 16-bit one’s complement
  - Calculation includes part of IP header:
    - Source address, destination address, protocol, and UDP length
    - Next slides compare UDP with pseudo header to the IP headers



# UDP Header Checksum

- Checksum is calculated over an IP pseudo header, the UDP header, and the UDP Data.
  - `UDP length` is simply a copy of the UDP header `Length` field.

`UDP with IPv4 pseudo header`

| Source IP Address | | |
|---|---|---|
| Destination IP Address | | |
| 0x00 | Protocol | UDP Length |
| Source Port | | Destination Port |
| Length | | Checksum |
| UDP Data | | |

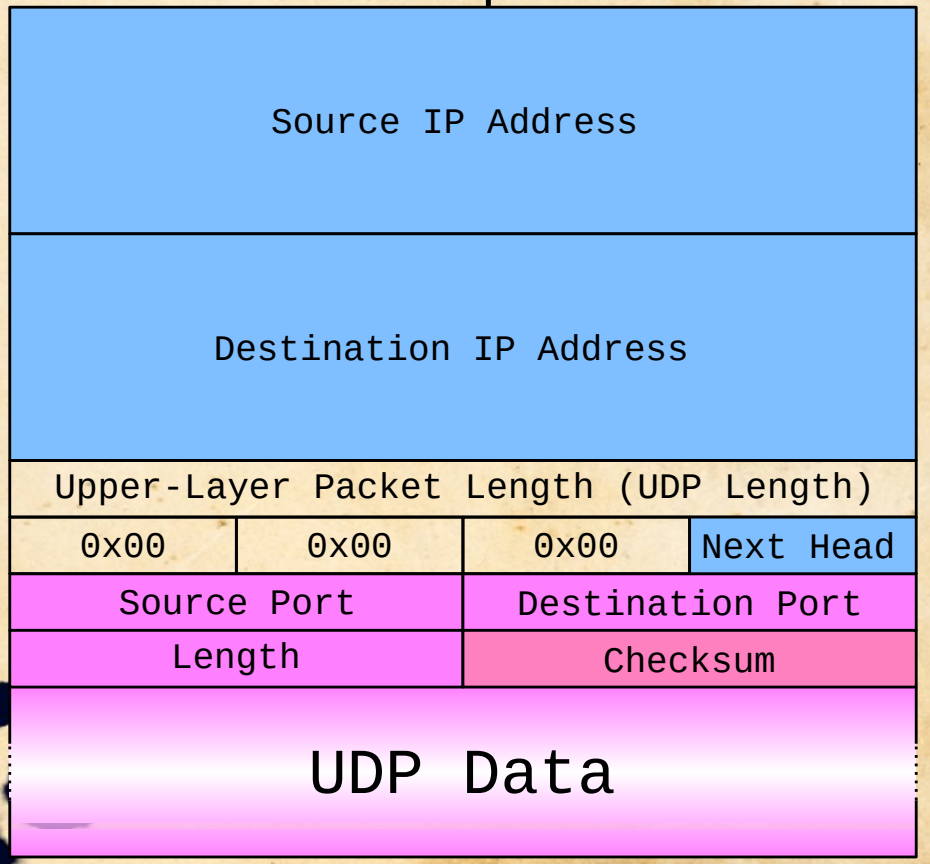
`IPv4 header`

| Ver | IHL | ToS | Total Length |
|---|---|---|---|
| Identification | | Flg | Fragment Offset |
| TTL | Protocol | | Header Checksum |
| Source IP Address | | | |
| Destination IP Address | | | |

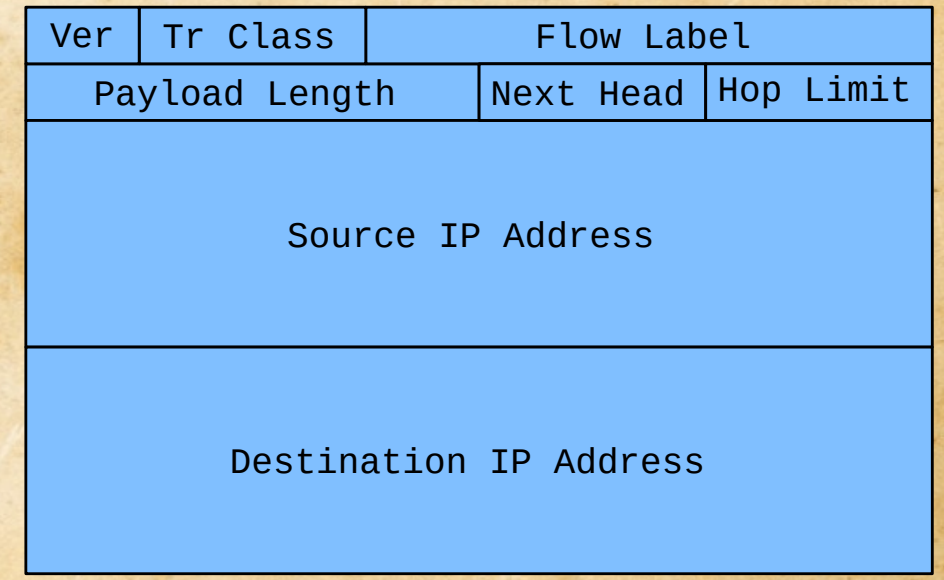
  - Note that the pseudo header is not actually transmitted !

# UDP Header Checksum (IPv6)

UDP with IPv6 pseudo header




IPv6 header




- Recall: "`Next Header`" is the equivalent to the "`Protocol`" field of IPv4

# UDP and the OSI Model

- UDP corresponds to the OSI Model layer 4: Transport Layer
- Notice that the calculation of the checksum containing lower-layer information tightly couples the UDP protocol to IP.
  - Changes in the IP protocol require changes in the UDP protocol

# UDP Characteristics

- Connectionless
  - No setup handshaking
  - No acknowledgement
- No flow-control
- Unreliable
  - Actually not really; this means there is no checking for lost packets and no request for re-transmission
- Fast
  - Again, not really; we just get the packets immediately, no waiting for re-transmission or out-of-order packets, and no initial setup handshaking

# UDP Use Cases

- Real-time data
  - Gaming
  - Voice / Video (real-time, not streaming)
- Low-level uses:
  - Dynamic Host Configuration Protocol (**DHCP**)
  - Domain Name System (**DNS**)
  - Network Time Protocol (**NTP**)
  - Routing Information Protocol (**RIP**)
  - Simple Network Management Protocol (**SNMP**)
  - Bootstrap Protocol (**BOOTP**) – used to boot over a network

# UDP Use Cases

- Port numbers for commonly-used UDP applications

| | |
|---|---|
| 67 / 68 | DHCP Server / Client |
| 546 / 547 | DHCPv6 Server / Client |
| 53 | DNS |
| 123 | NTP |
| 161-162 | SNMP |
| 520 | RIP |

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