CS 360

Lecture 3

Transport Layer

- Define how two processes communicate
  - on different hosts
  - IP Address
  - Port number
  - socket
  - **End to End**

What does the Network Layer provide?

- Not much

UDP vs TCP

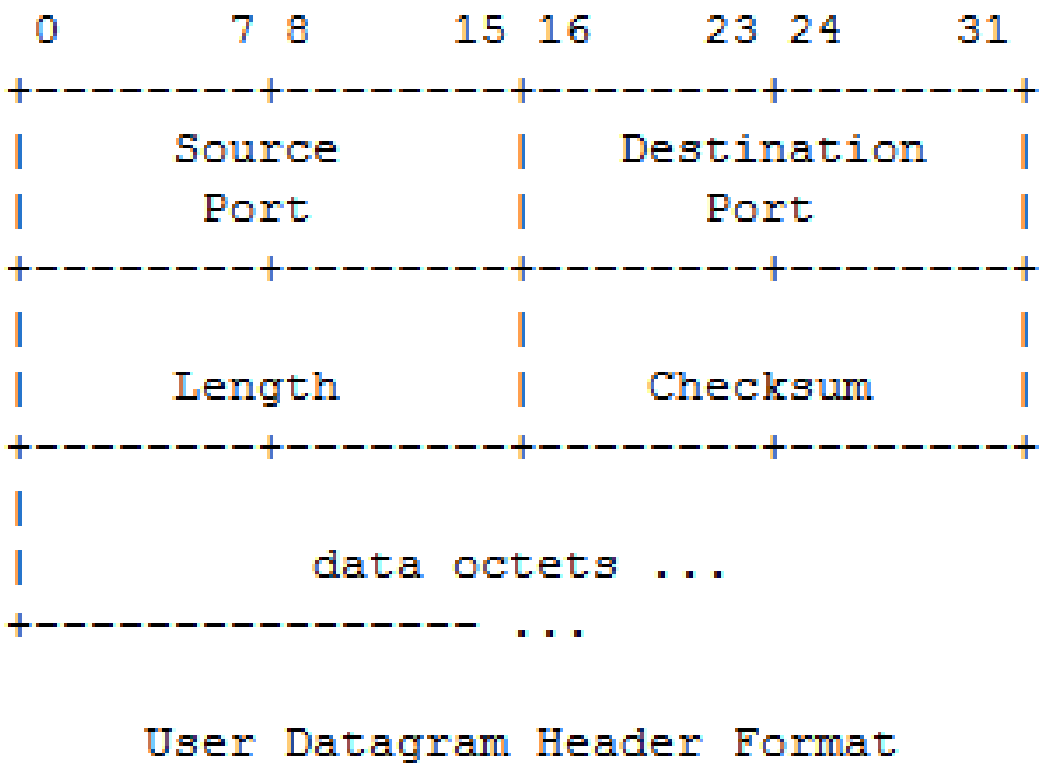
- Demultiplexing
- Connection vs connectionless
- Reliable vs unreliable
- Congestion control vs none

UDP

- UDP Datagram
- Header
- Checksum

UDP Benefits

UDP Header

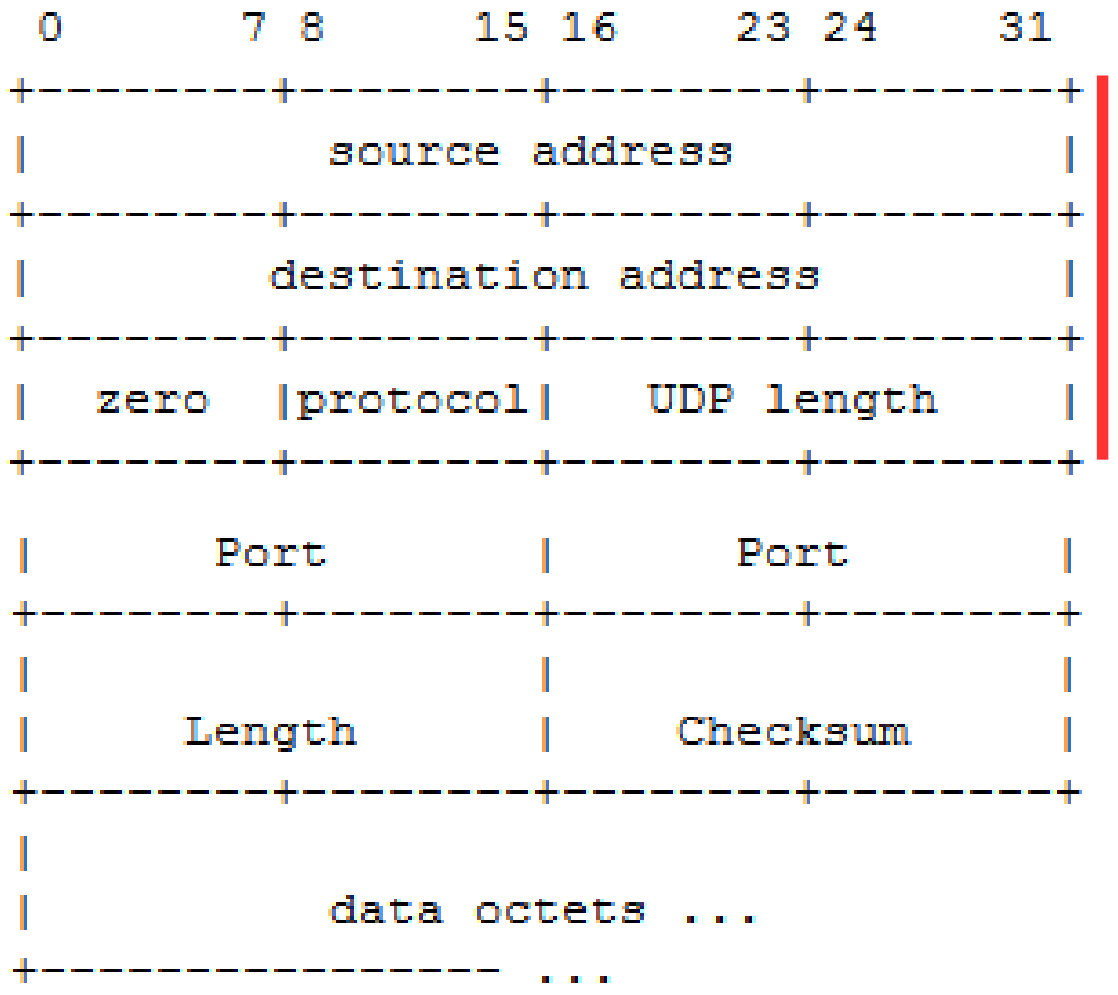


User Datagram Header Format

RFC 768

https://tools.ietf.org/html/rfc768

Pseudo Header for Checksum



Pseudo Header

Actual UDP Header

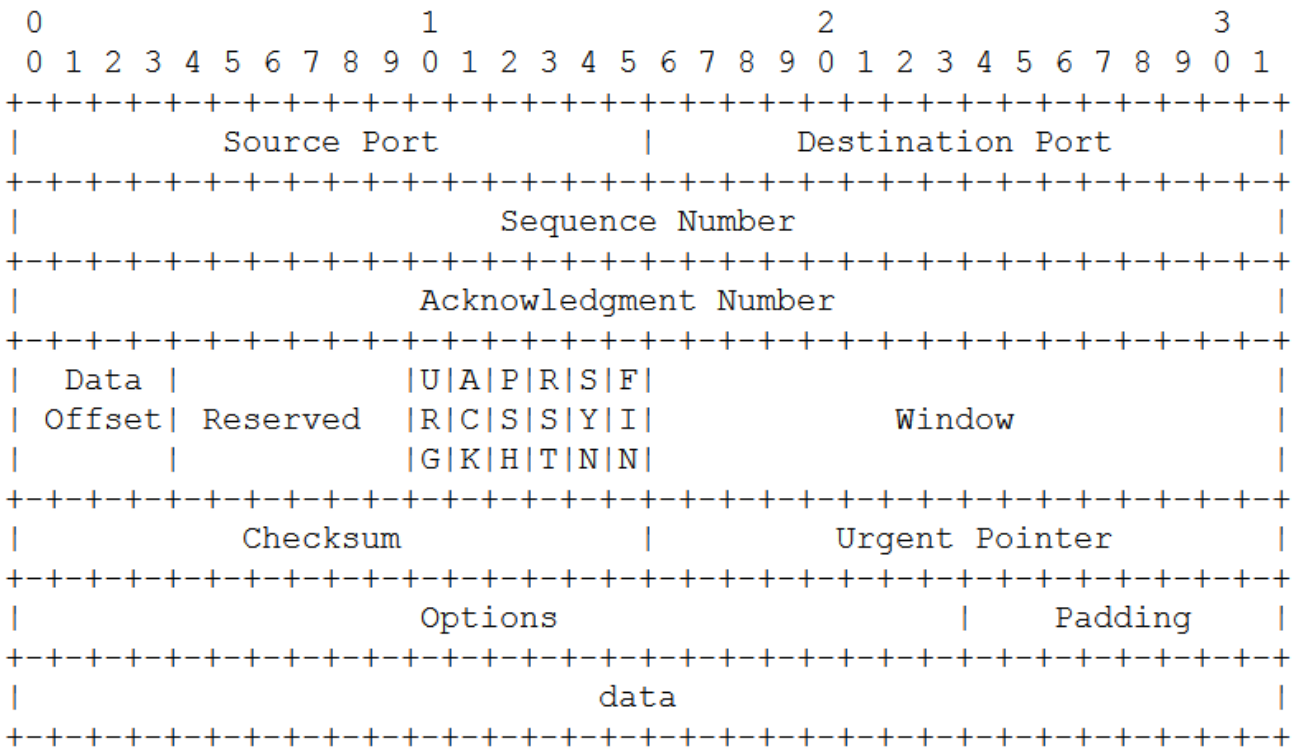
User Datagram Header Format

UDP

TCP

- Connection oriented
- Reliable
- Congestion/Flow control

TCP Header



TCP Header Format

https://tools.ietf.org/html/rfc793#section-3.1

Connection

- Resources allocated
- State maintained

Reliable

Recover from corruption

- Represent as state machine

Corrupt ACK/NACK

- We must expect any packet can be corrupted

Lost Packets

- How to detect a lost packet?

Pipelined Protocols

- More than one unacknowledged packet in flight
- More difficult to deal with corruption, loss, and delay

Go Back N

- sliding window

Selective Repeat

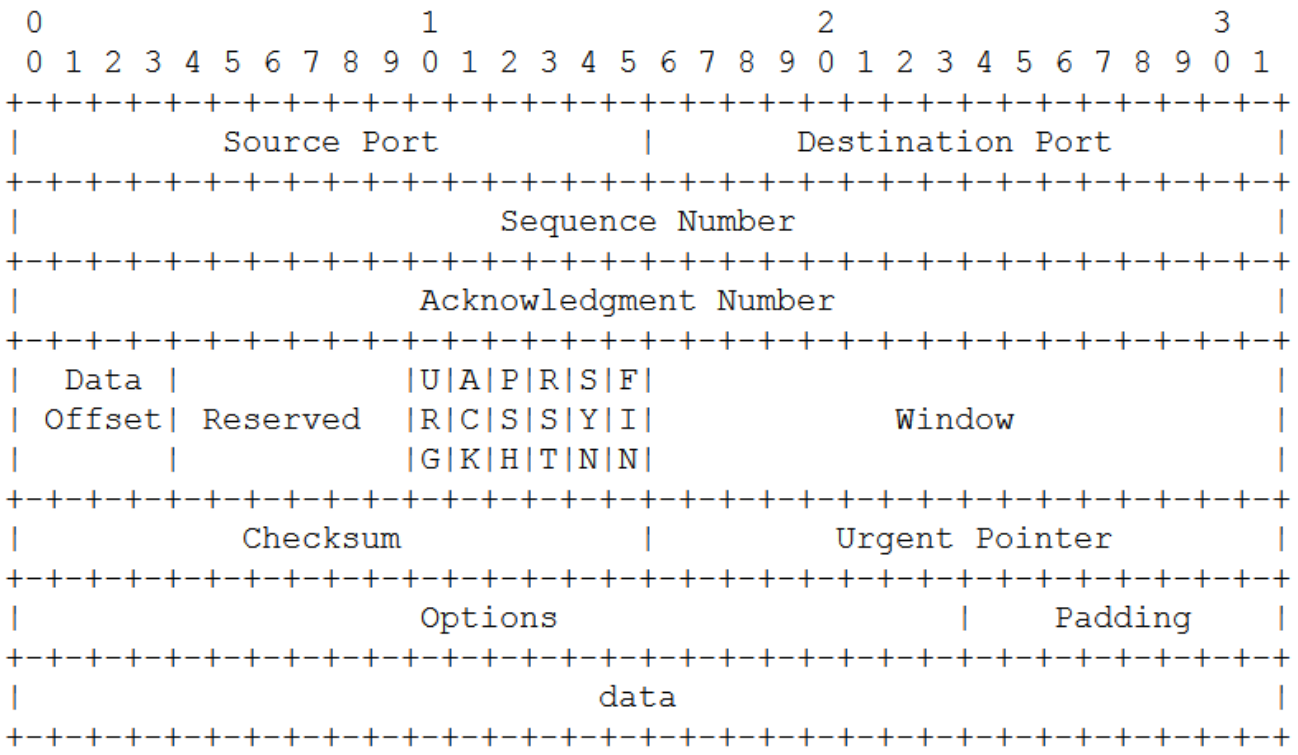
Pieces

- Checksum
- Timer
- Sequence Number
- Acknowledgment
- Negative Acknowledgment
- Window/pipeline

TCP

- Three way handshake
  - shutdown
- Send buffer
- Maximum Segment Size
- Maximum Transmission Unit
- TCP segment

TCP Header



TCP Header Format

https://tools.ietf.org/html/rfc793#section-3.1

Sequence and Ack numbers

Round Trip Time Estimation

- Estimate

- Timeout

Reliable Transfer

- Timeouts

- Duplicate ACKs
  - fast retransmit

Retransmit

Flow Control

- Receive window

- Congestion Control

Congestion Control