Transmission Control Protocol (TCP) – Overview

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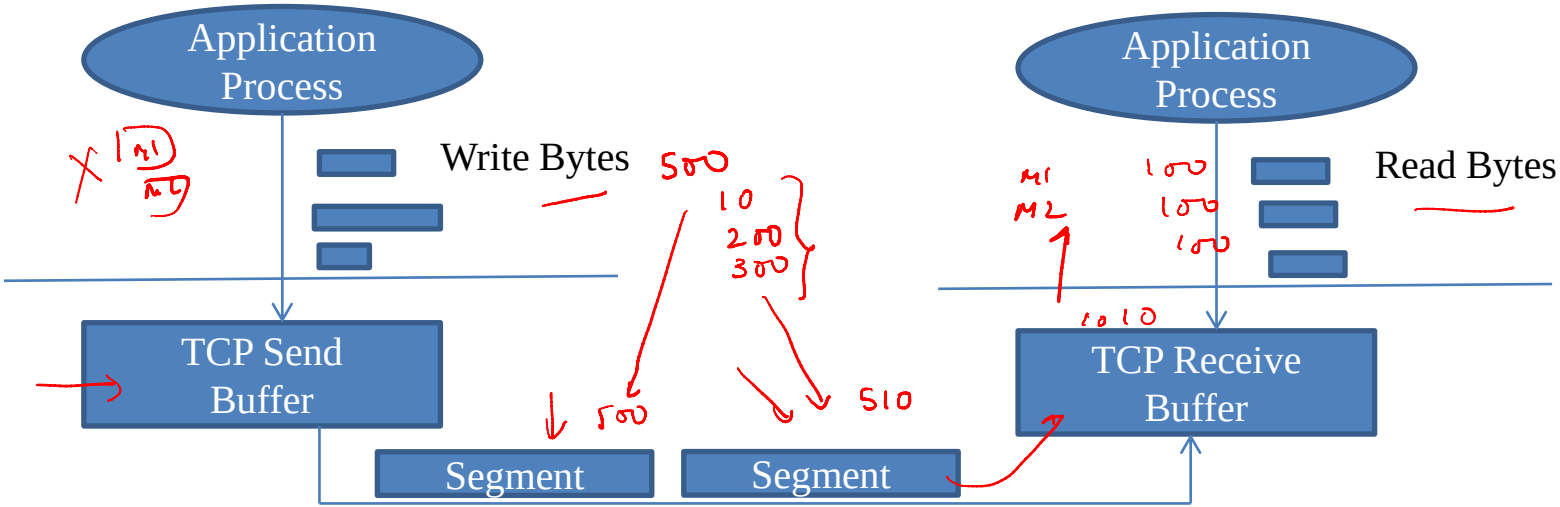
Background

- TCP most widely used transport layer protocol
- Entire Internet Protocol suite is often called TCP/IP suite
- Most carefully tuned protocol
  - Many Request For Comment (RFC): 675, 793, 1122, 1323, 2018, 2581, 5681 etc

IETF
Internet society

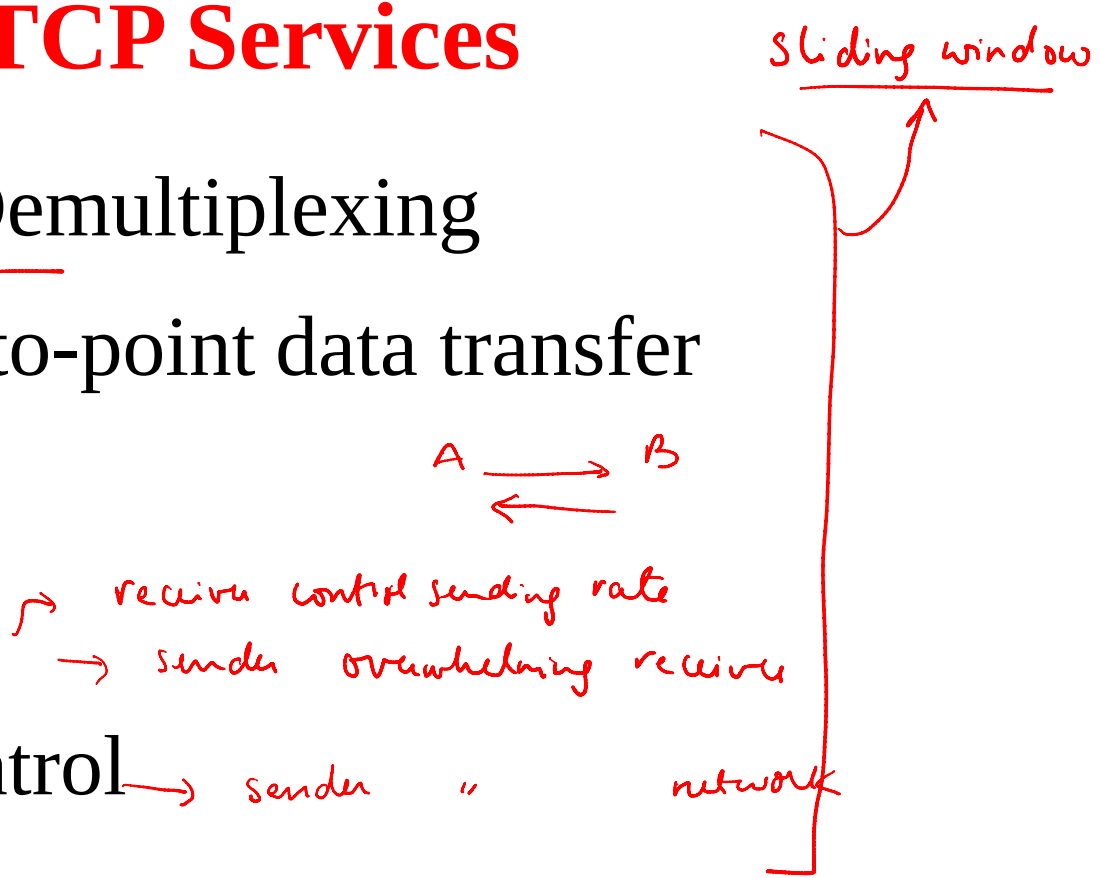
TCP Model

- Connection oriented byte-stream protocol

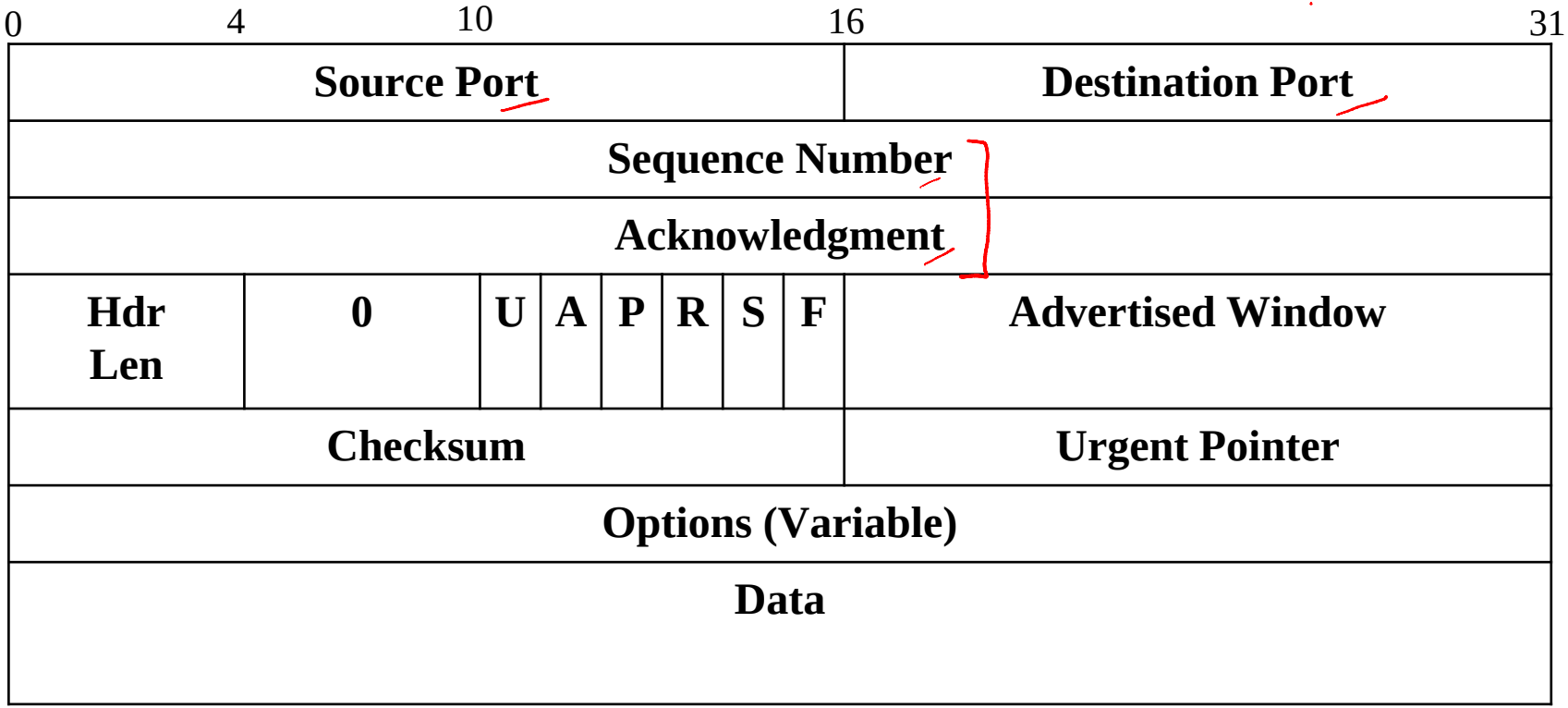


TCP Services

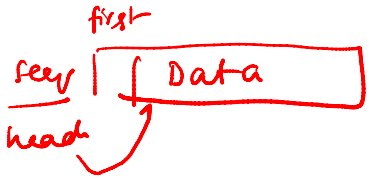
- Multiplexing/Demultiplexing
- Reliable point-to-point data transfer
- Full-duplex
- Flow control
- Congestion control



TCP Header Format

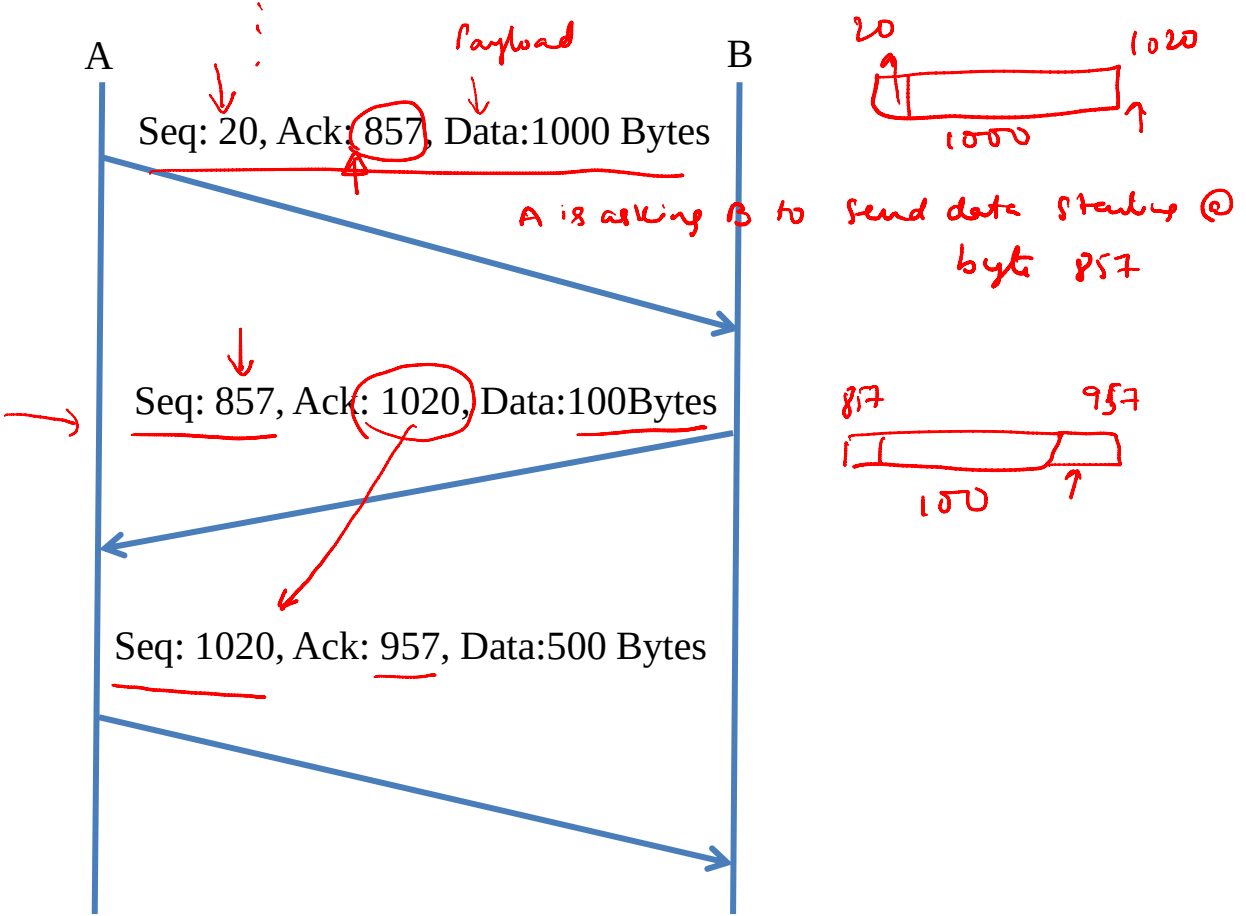


Sequence Number and Acknowledgment

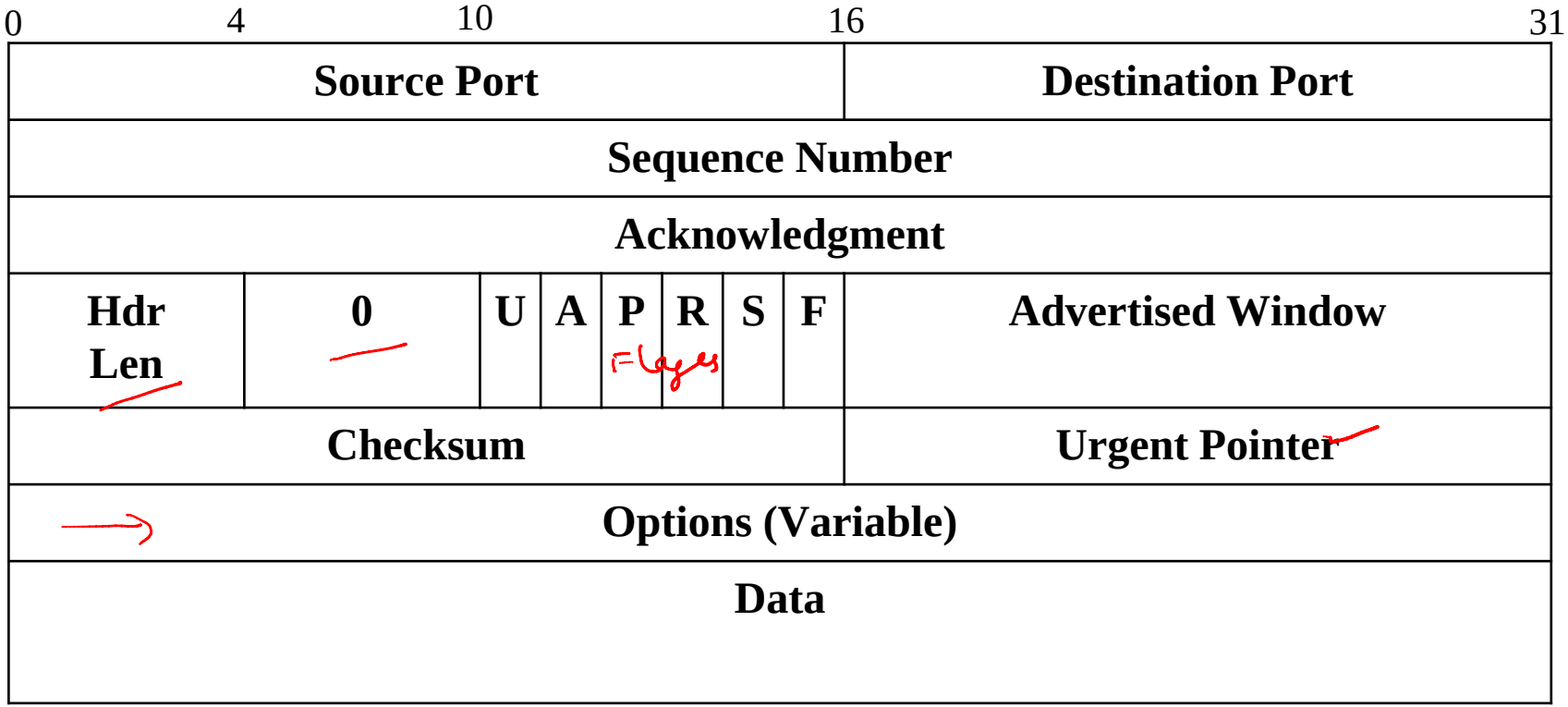


- Each byte has a sequence number
- Sequence number field contains the sequence number of the first byte in the segment
- Acknowledgment field carry information about flow in the other direction
  - Carries sequence number of next byte a host is expecting
  - Unless specified, ack is cummulative

Example


A
B
Payload
Seq: 20, Ack: 857, Data:1000 Bytes
A is asking B to send data starting @ byte 857
Seq: 857, Ack: 1020, Data:100Bytes
Seq: 1020, Ack: 957, Data:500 Bytes
Seq ?
Ack ?
20
1020
1000
857
957
100

TCP Header Format



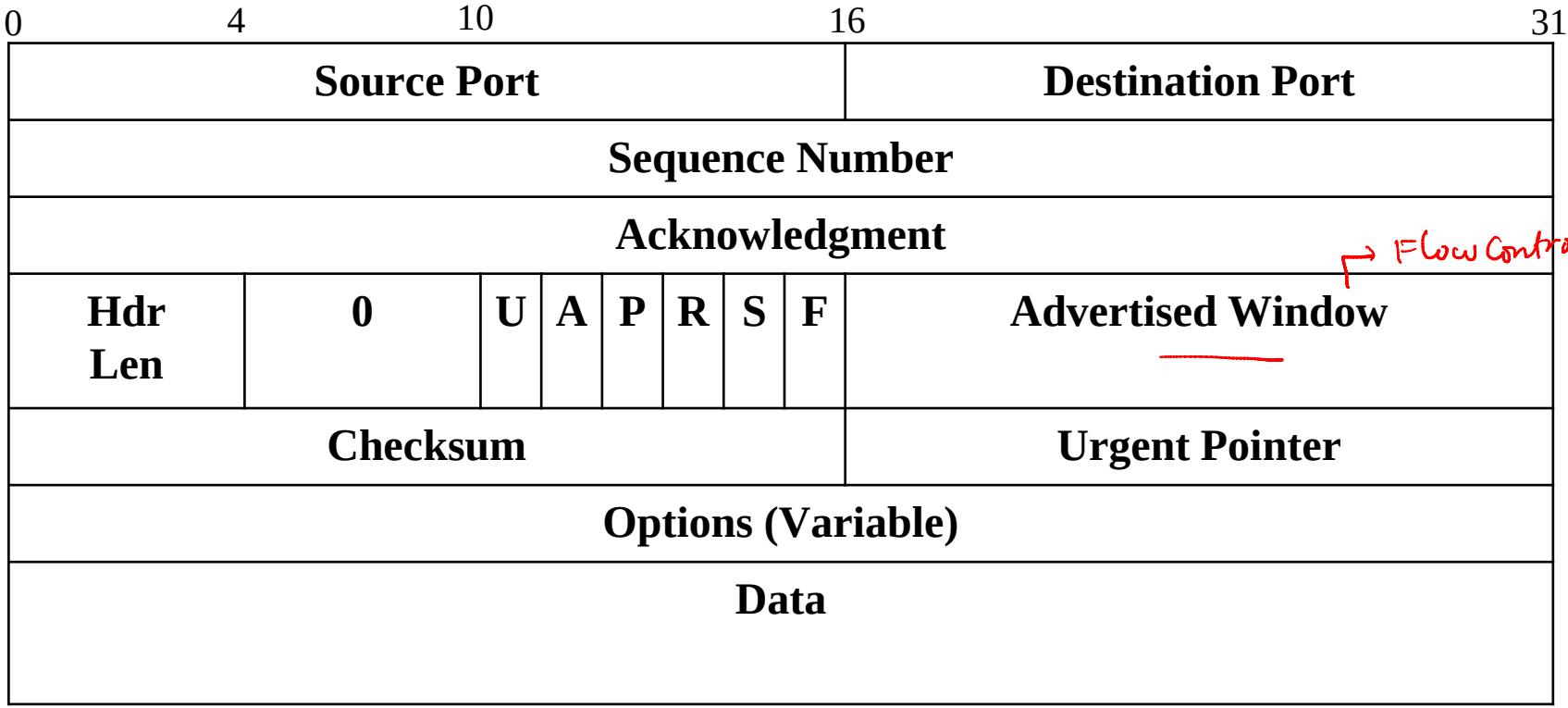
Flags

- UAPRSF
- U: Urgent flag indicates segment contains urgent data (not used)
  - UrgentPointer (bytes) indicates where in the segment non-urgent data begins
- A: Ack bit is set if the acknowledgment field is valid

Flags

- UAPRSF
- P: Push flag indicates receiver should pass data to higher layers immediately (not used)
- R: Reset, used to abort connection
- S/F: Syn and Fin flags are used during connection establishment and termination

TCP Header Format



Checksum

- Similar to UDP
- Compulsory in IPv4 and IPv6
- Calculated over TCP header, data and pseudoheader
  - Pseudoheader: source, destination, protocol of IP header and TCP segment total length (calculated)

Options

- Can negotiate maximum segment size
- Can perform window scaling
- Permits use of selective-acks
  - Both to indicate the device supports selective acknowledgments and carry the actual ack information
- Permits use of alternate checksum

min(,)

Adv. wind 16

$> 2^{16}$ bytes

$\rightarrow 3$ X window size

Summary

- TCP: a very popular, finely tuned protocol
- Provides quite a few features at the transport layer
- Heart of TCP is the sliding window protocol
- Examined TCP header
- Ahead: TCP connection management