

Chapter 6

The Transport Layer

The Internet Transport Protocols: TCP

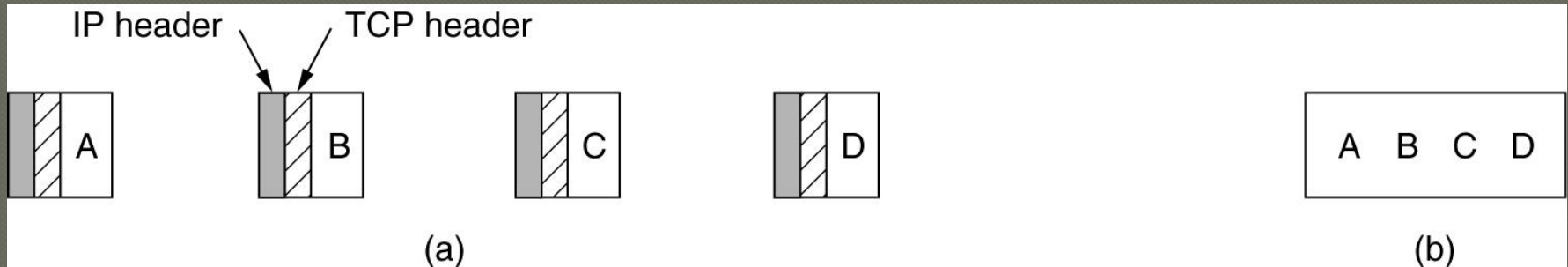
- Introduction to TCP
- The TCP Service Model
- The TCP Protocol
- The TCP Segment Header
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- TCP Connection Management Modeling
- TCP Transmission Policy
- TCP Congestion Control
- TCP Timer Management
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The TCP Service Model

Some assigned ports.

Port	Protocol	Use
21	FTP	File transfer
23	Telnet	Remote login
25	SMTP	E-mail
69	TFTP	Trivial File Transfer Protocol
79	Finger	Lookup info about a user
80	HTTP	World Wide Web
110	POP-3	Remote e-mail access
119	NNTP	USENET news

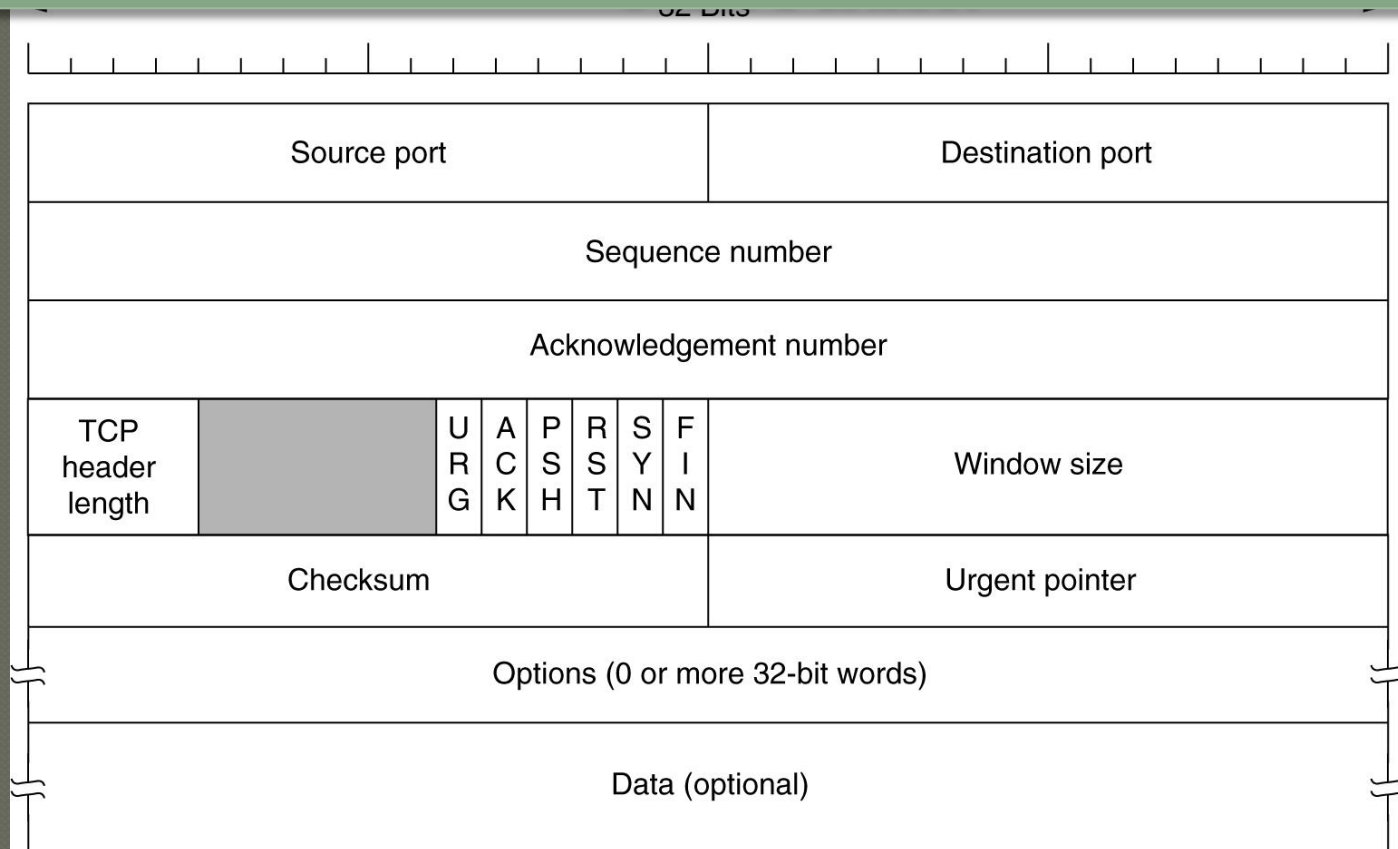
The TCP Service Model (2)



- (a) Four 512-byte segments sent as separate IP datagrams.
- (b) The 2048 bytes of data delivered to the application in a single READ CALL.

Basic Protocol: Sliding Window Protocol

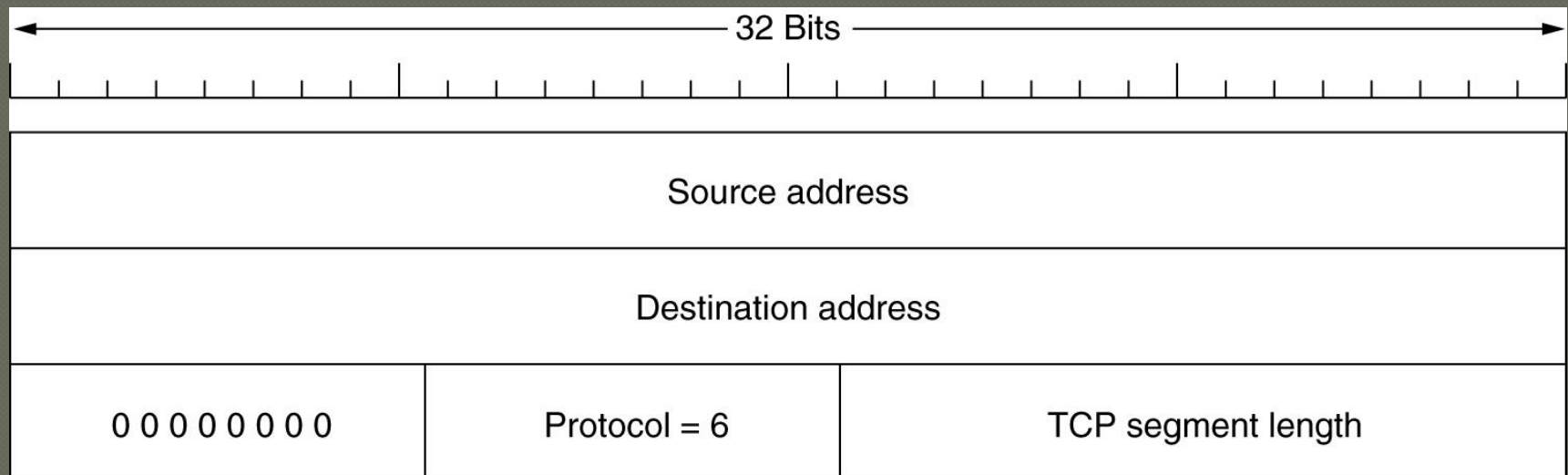
PSH: pushed data
 RST: reset data
 SYN: Synchronization
 FIN: Finish



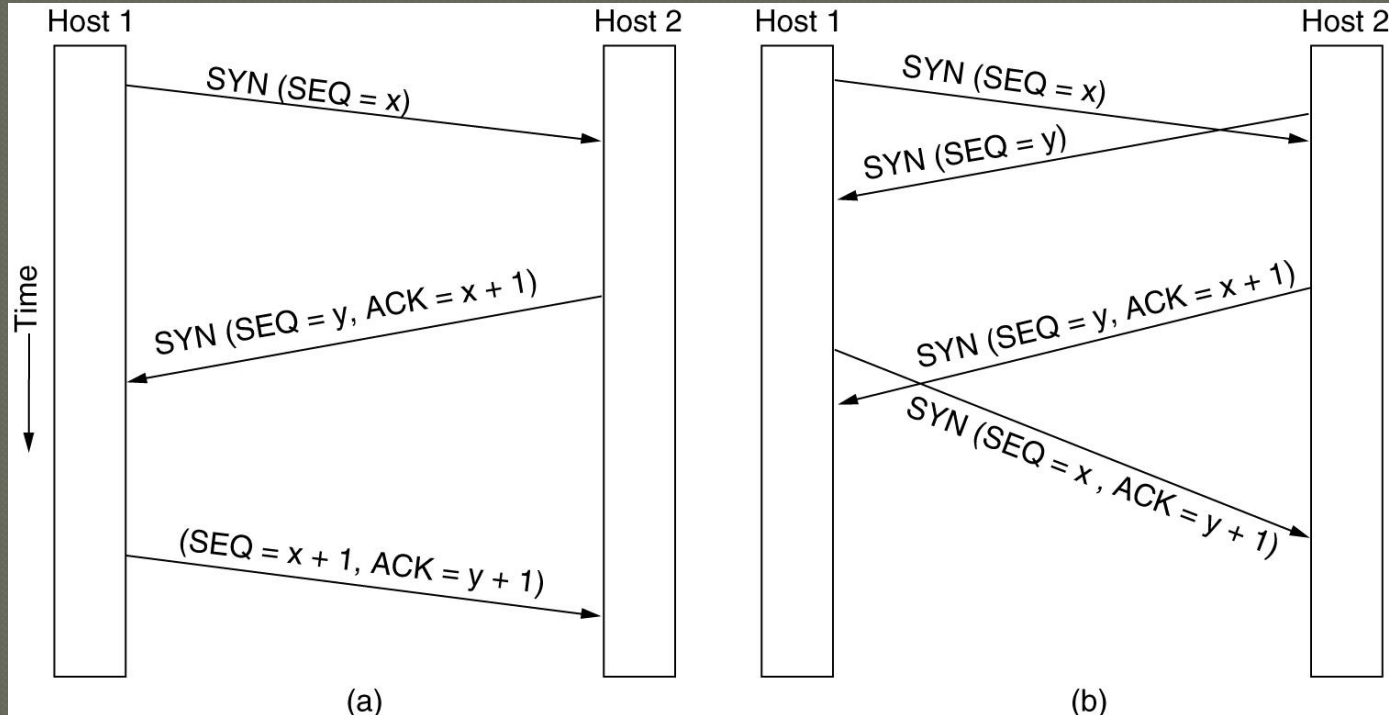
TCP Header.

The TCP Segment Header (2)

The pseudoheader included in the TCP checksum.



TCP Connection Establishment



- (a) TCP connection establishment in the normal case.
- (b) Call collision.

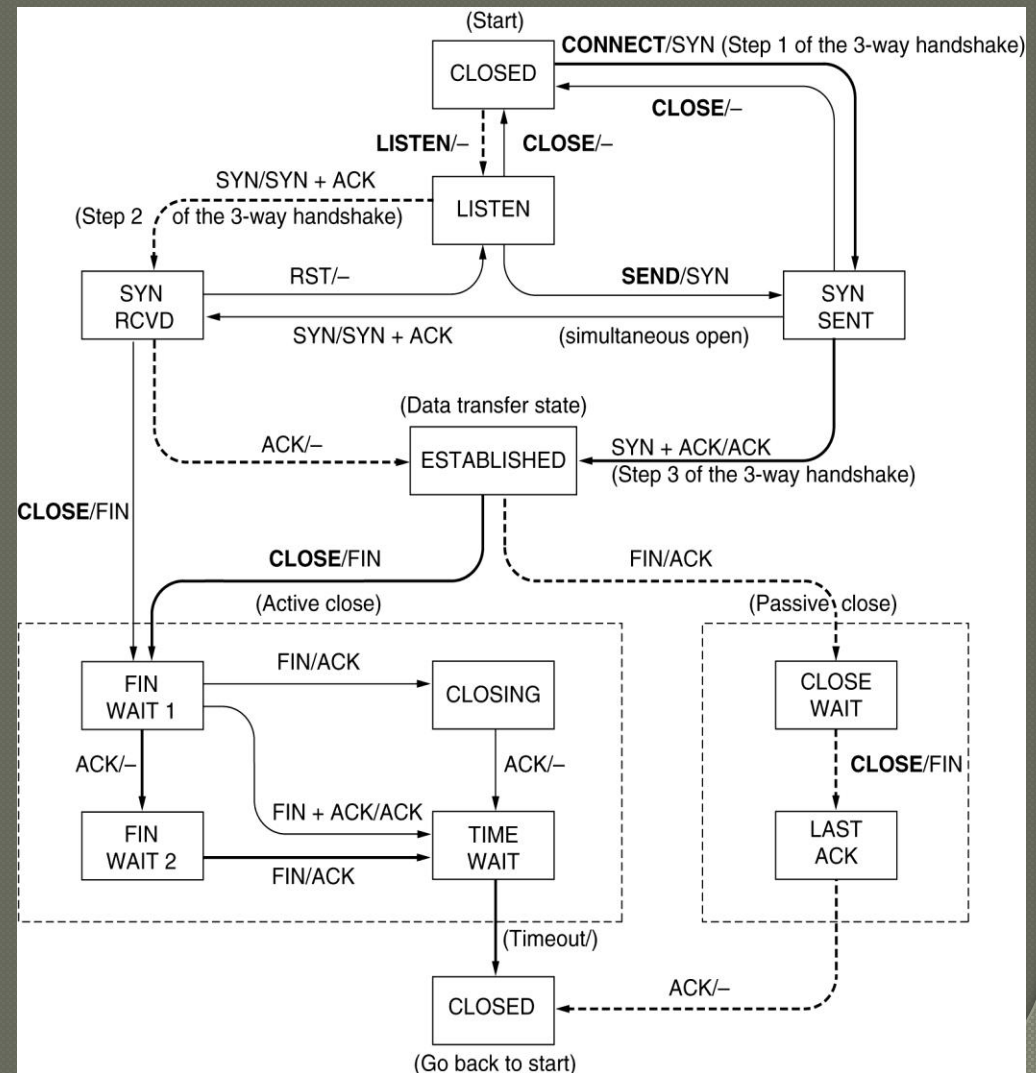
TCP Connection Management Modeling

The states used in the TCP connection management finite state machine.

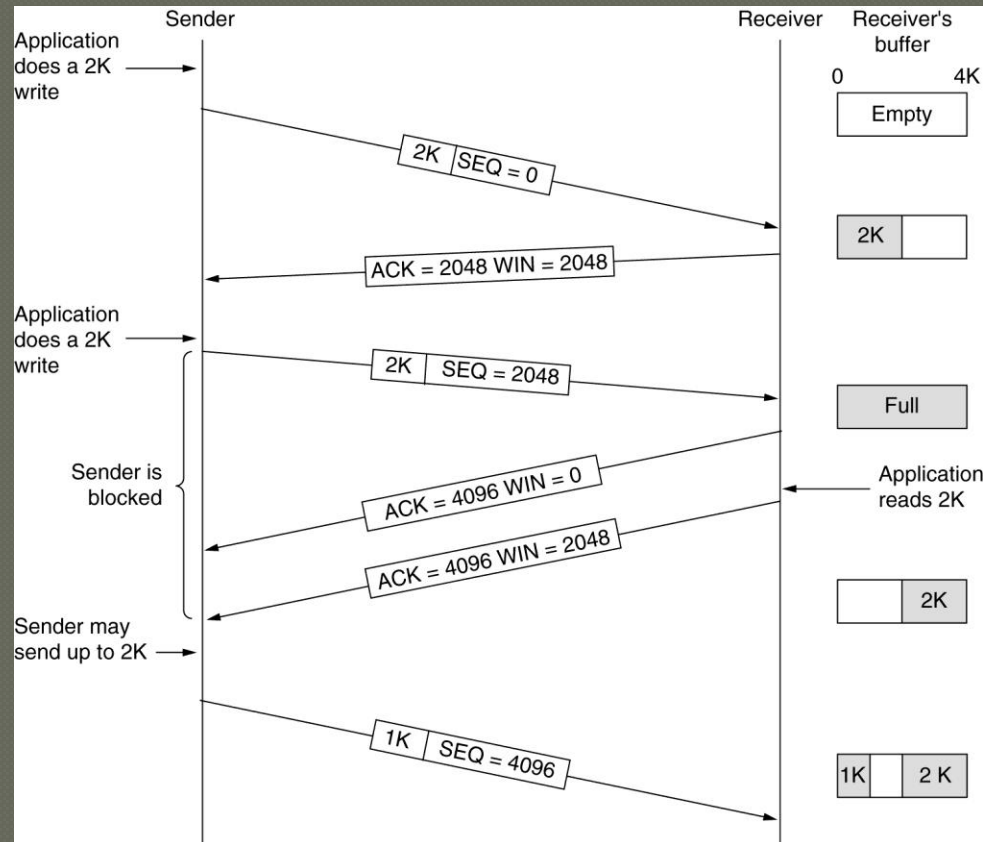
State	Description
CLOSED	No connection is active or pending
LISTEN	The server is waiting for an incoming call
SYN RCVD	A connection request has arrived; wait for ACK
SYN SENT	The application has started to open a connection
ESTABLISHED	The normal data transfer state
FIN WAIT 1	The application has said it is finished
FIN WAIT 2	The other side has agreed to release
TIMED WAIT	Wait for all packets to die off
CLOSING	Both sides have tried to close simultaneously
CLOSE WAIT	The other side has initiated a release
LAST ACK	Wait for all packets to die off

TCP Connection Management Modeling (2)

TCP connection management finite state machine. The heavy solid line is the normal path for a client. The heavy dashed line is the normal path for a server. The light lines are unusual events. Each transition is labeled by the event causing it and the action resulting from it, separated by a slash.



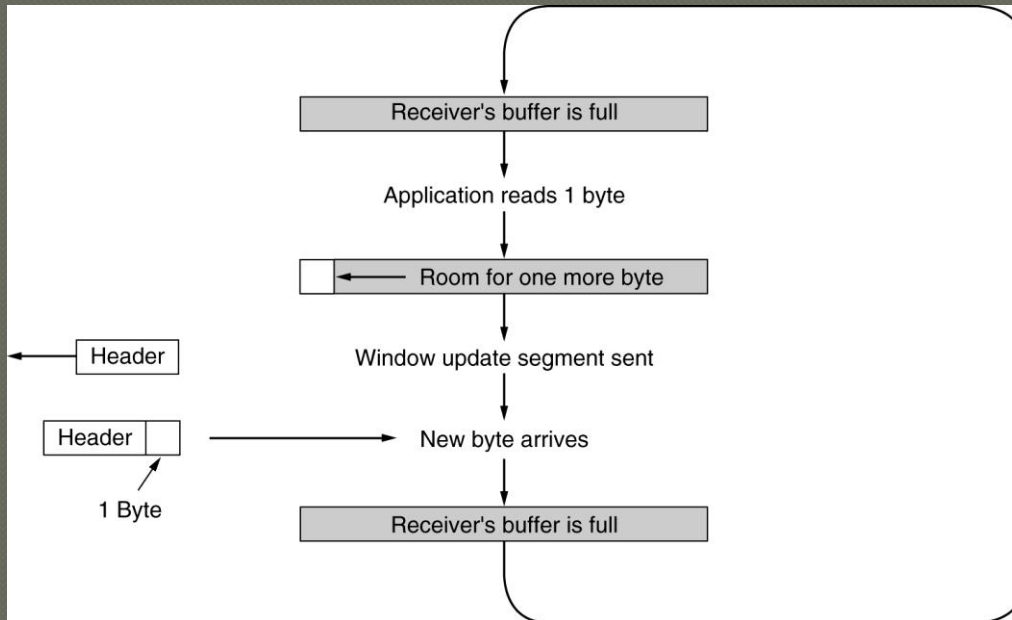
TCP Transmission Policy



Window management in TCP.

What is the next reply from the receiver?

TCP Transmission Policy (2)

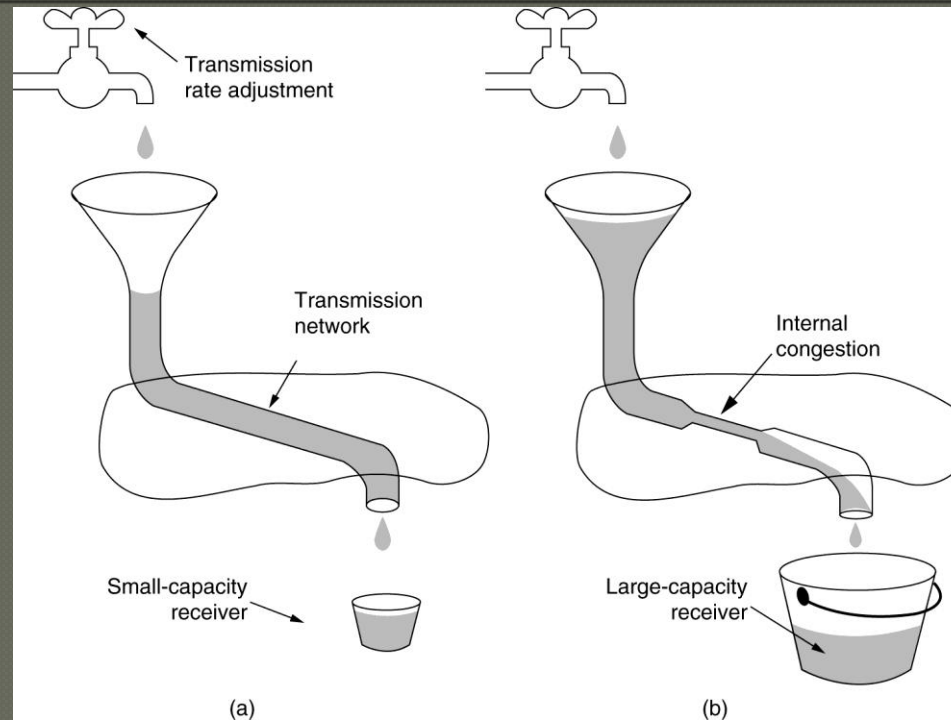


Nagle's alg: when data come in 1 byte at a time just send the first byte and buffer all the rest until the outstanding byte is ack

Clark's alg:
The receiver is forced to wait until it has a decent amount of space and advertise that instead

Silly window syndrome.

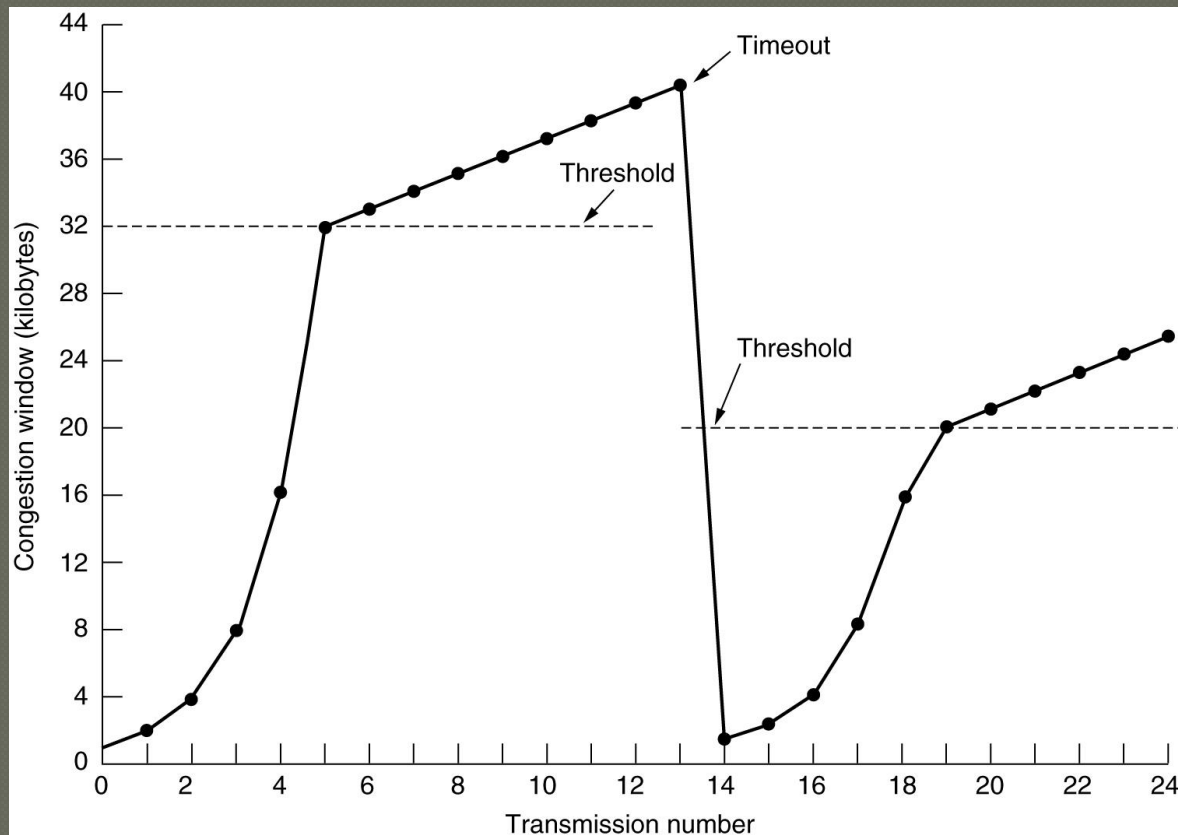
TCP Congestion Control



(a) A fast network feeding a low capacity receiver.

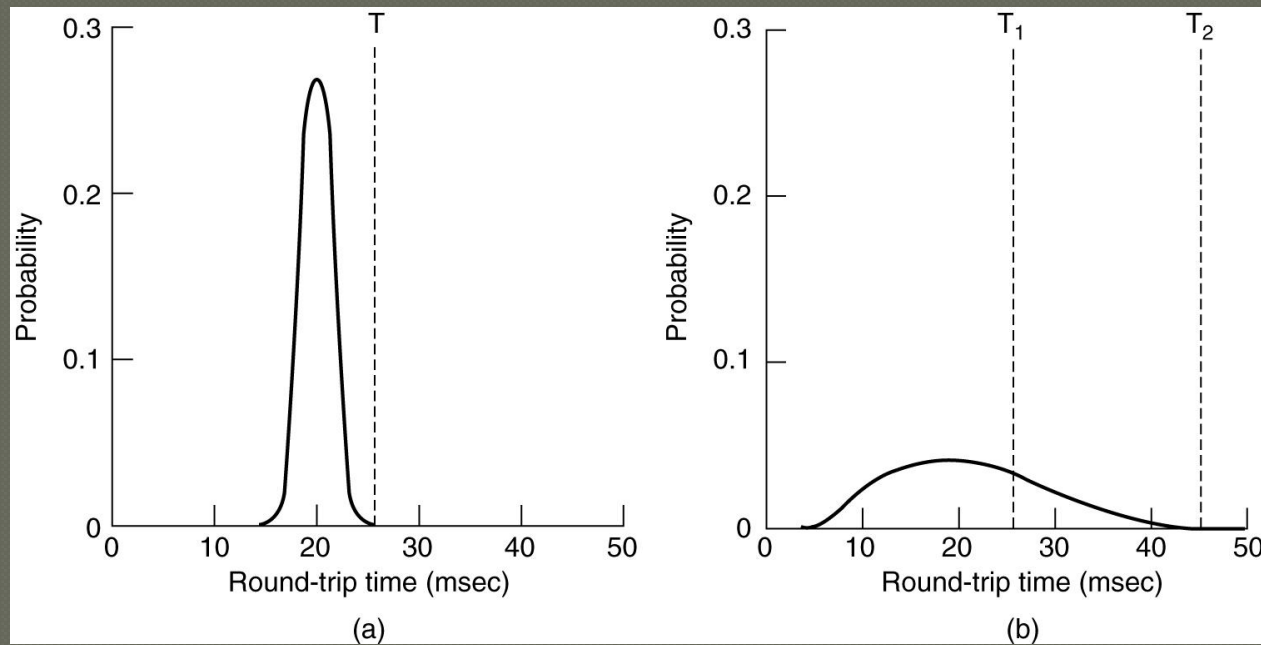
(b) A slow network feeding a high-capacity receiver.

TCP Congestion Control (2)



An example of the Internet congestion algorithm.

TCP Timer Management

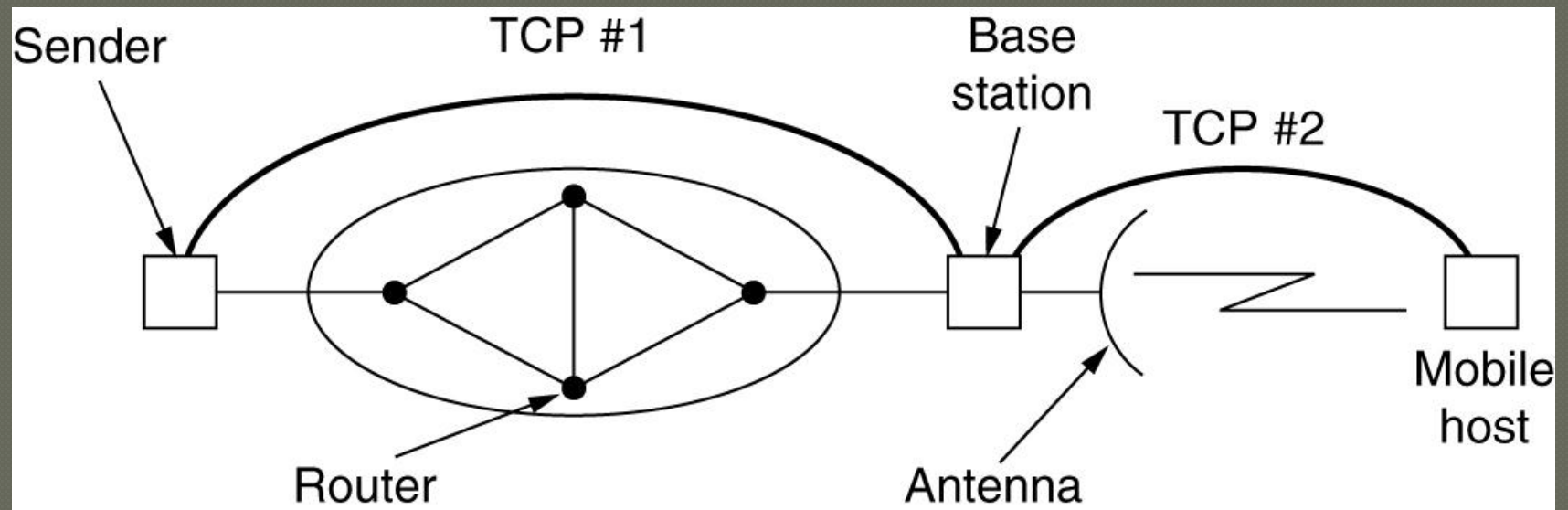


(a) Probability density of ACK arrival times in the data link layer.

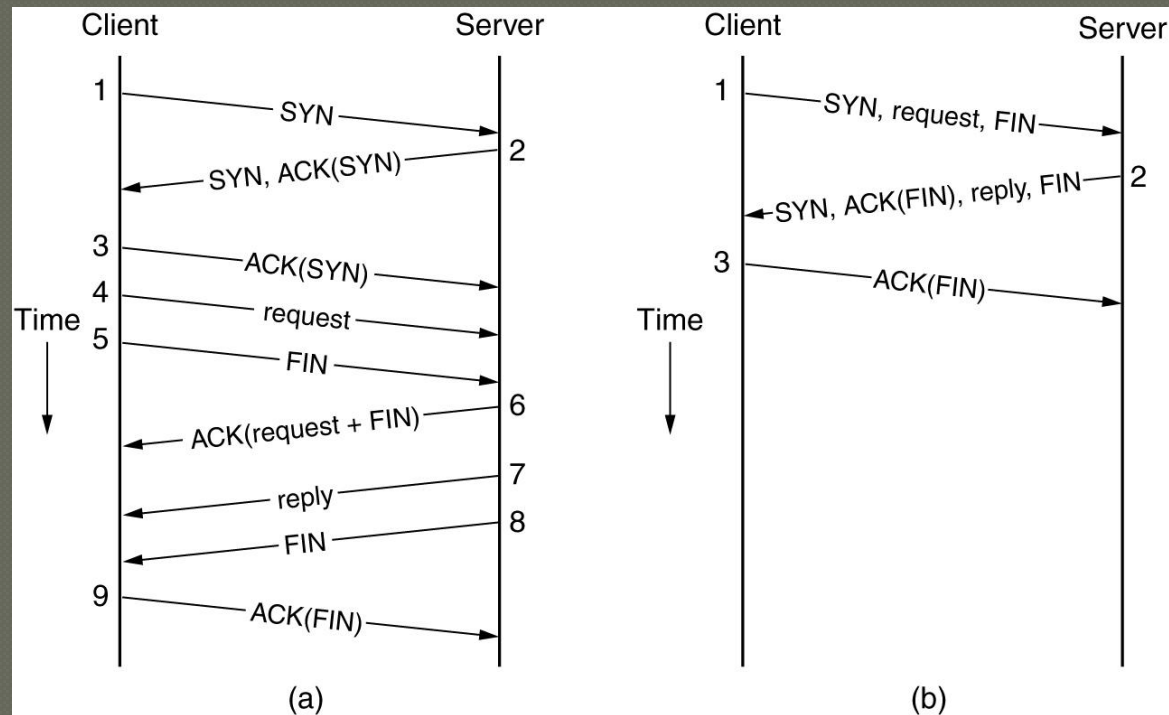
(b) Probability density of ACK arrival times for TCP.

Wireless TCP and UDP

Splitting a TCP connection into two connections.



Transitional TCP



- (a) RPC using normal TPC.
- (b) RPC using T/TCP.