
Chapter 17

TCP: Transmission Control Protocol

Introduction

- ❑ The original specification for TCP is RFC 793, although some errors in that RFC are corrected in the Host Requirements RFC.

TCP Service

❑ TCP provides:

- ❖ Connection-oriented: establish a TCP connection with each other before they can exchange data.
- ❖ Reliability:
 - the application data is broken into what TCP considers the best sized chunks to send.
 - Acknowledge and retransmit: a timer for each TCP segment.
 - This acknowledgment is not sent immediately, but normally delayed a fraction of a second.
 - TCP maintains an end-to-end checksum on its header and data.
 - Re-sequencing: TCP segments can arrive out of order.
 - A receiver must discard duplicate data.
 - TCP also provides flow control.

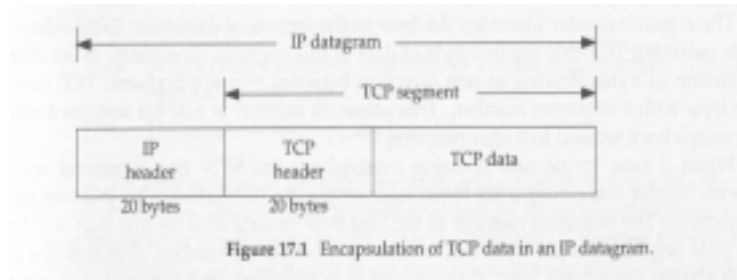
TCP Service (Cont.)

❑ Byte stream service

- ❖ A stream of 8-bit bytes is exchanged across the TCP connection between two applications.
- ❖ TCP did not automatically insert record markers.
- ❖ For example:
 - One end application writes 50 bytes, 20 bytes, and 10 bytes in three writes.
 - The other end application may read 20 bytes at a time in four reads.
- ❖ TCP does not interpret the contents of the bytes at all.
 - No idea about the data bytes being exchanged to be binary data, ASCII characters, or whatever.

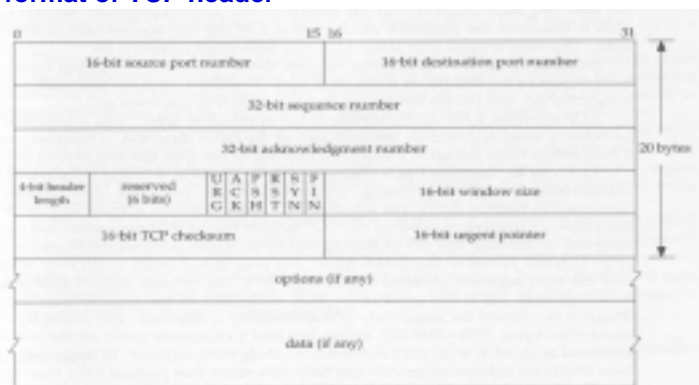
TCP Header

- ❑ TCP data is encapsulated in an IP datagram



TCP Header (Cont.)

- ❑ The format of TCP header



TCP Header (Cont.)

- ❑ **port number:** to identify the sending and receiving application.
- ❑ **Socket:** the combination of an IP address and a port number.
- ❑ **Socket pair:** the 4-tuple consisting of the client IP address, client port number, server IP address, and server port number.
- ❑ **sequence number:** identifies the byte in the stream of data from the sending TCP to the receiving TCP that the first byte of data in this segment represents.
 - ❖ TCP numbers each byte with a sequence number.
- ❑ **ISN:** initial sequence number (seq# of the 1st data byte = ISN+1)
- ❑ **acknowledgment number:** contains the next sequence number that the sender of the acknowledgment expects to receive.
- ❑ **header length:** this is required because the length of the option field is variable.

TCP Header (Cont.)

- ❑ **The six flag in the TCP header:**
 - ❖ **URG** The urgent pointer is valid.
 - ❖ **ACK** The acknowledgment number is valid.
 - ❖ **PSH** Passing this data to the application as soon as possible.
 - ❖ **RST** Reset the connection.
 - ❖ **SYN** Synchronize sequence numbers to initiate a connection.
 - ❖ **FIN** The sender is finished sending data.
- ❑ **window size:** TCP flow control (up to 65535 bytes)
- ❑ **checksum:** calculated and stored by the sender and then verified by the receiver
- ❑ **urgent pointer:** valid only if the URG flag is set. This pointer is a positive offset. TCP's urgent mode is a way for the sender to transmit emergency data to the other end.
- ❑ **option:** MSS (maximum segment size)

Summary

- ❑ TCP provides a reliable, connection-oriented, byte stream, full-duplex, transport layer service.
- ❑ TCP packetizes the user data into segments, sets a timeout any time it sends data, acknowledges data received by the other end, re-orders out-of-order data, discards duplicate data, provides end-to-end flow control, and calculates and verifies a mandatory end-to-end checksum.
- ❑ TCP is used by many of the popular applications, such as Telnet, Rlogin, FTP, and electronic mail (SMTP).