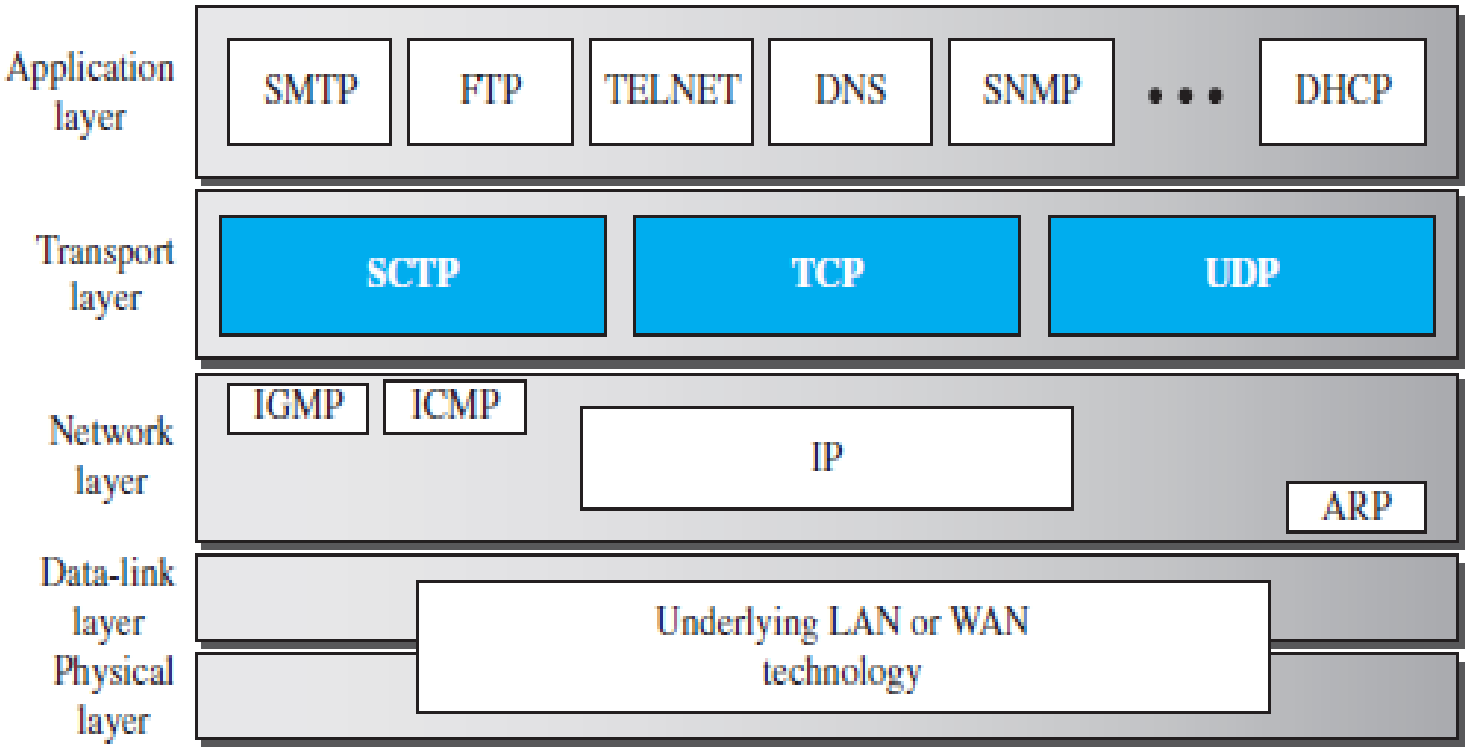
Transport Layer Protocols

INTRODUCTION

Figure 24.1 *Position of transport-layer protocols in the TCP/IP protocol suite*



Services

- UDP: UDP is an unreliable connectionless transport-layer protocol used for its simplicity and efficiency in applications where error control can be provided by the application-layer process.
- TCP: TCP is a reliable connection-oriented protocol that can be used in any application where reliability is important.
- SCTP: SCTP is a new transport-layer protocol that combines the features of UDP and TCP.

Port Numbers

Table 24.1 *Some well-known ports used with UDP and TCP*

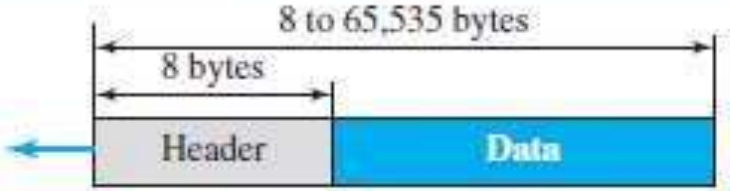
Port	*Protocol*	*UDP*	*TCP*	*SCTP*	*Description*
7	Echo	√	√	√	Echoes back a received datagram
9	Discard	√	√	√	Discards any datagram that is received
11	Users	√	√	√	Active users
13	Daytime	√	√	√	Returns the date and the time
17	Quote	√	√	√	Returns a quote of the day
19	Chargen	√	√	√	Returns a string of characters
20	FTP-data		√	√	File Transfer Protocol
21	FTP-21		√	√	File Transfer Protocol
23	TELNET		√	√	Terminal Network
25	SMTP		√	√	Simple Mail Transfer Protocol
53	DNS	√	√	√	Domain Name Service
67	DHCP	√	√	√	Dynamic Host Configuration Protocol
69	TFTP	√	√	√	Trivial File Transfer Protocol
80	HTTP		√	√	HyperText Transfer Protocol
111	RPC	√	√	√	Remote Procedure Call
123	NTP	√	√	√	Network Time Protocol
161	SNMP-server	√			Simple Network Management Protocol
162	SNMP-client	√			Simple Network Management Protocol

USER DATAGRAM PROTOCOL

The User Datagram Protocol (UDP) is a connectionless, unreliable transport protocol. It does not add anything to the services of IP except for providing process-to-process communication instead of host-to-host communication.

User Datagram

Figure 24.2 *User datagram packet format*



a. UDP user datagram

b. Header format

Example 24.1

The following is the content of a UDP header in hexadecimal format.

CB84000D001C001C

a) What is the source port number?
b) What is the destination port number?
c) What is the total length of the user datagram?
d) What is the length of the data?
e) Is the packet directed from a client to a server or vice versa?
f) What is the client process?

Continue…

a) The source port number is $(CB84)_{16}$, i.e. the source port number is 52100.
b) The destination port number is $(000D)_{16}$, which i.e destination port number is 13.
c) The $(001C)_{16}$ define the length of the whole UDP packet as 28 bytes.
d) The length of the data is 28 – 8 = 20 bytes.
e) Since the destination port number is 13 (well-known port), the packet is from the client to the server.
f) The client process is the Daytime. (see table)

UDP Services

- Process-to-Process Communication
- Connectionless Services
- Flow Control
- Error Control
- Checksum: UDP checksum calculation includes three sections: a pseudoheader, the UDP header, and the data coming from the application layer.
- Congestion Control
- Encapsulation and Decapsulation
- Queuing
- Multiplexing and Demultiplexing

UDP Applications

- Suitable for a process that requires simple request-response communication with little concern for flow and error control. E.g. FTP
- UDP is suitable for a process with internal flow- and error-control mechanisms. E.g. TFTP
- UDP is a suitable transport protocol for multicasting.
- UDP is used for management processes such as SNMP
- UDP is used for some route updating protocols such as Routing Information Protocol (RIP)
- UDP is normally used for interactive real-time applications

UDP Features

- Connectionless Service
- Lack of Error Control
- Lack of Congestion Control

TRANSMISSION CONTROL PROTOCOL

Transmission Control Protocol (TCP) is a connection-oriented, reliable protocol. TCP explicitly defines connection establishment, data transfer, and connection teardown phases to provide a connection-oriented service.

TCP Services

- Process-to-Process Communication
- Stream Delivery Service

Figure 24.5 *Sending and receiving buffers*

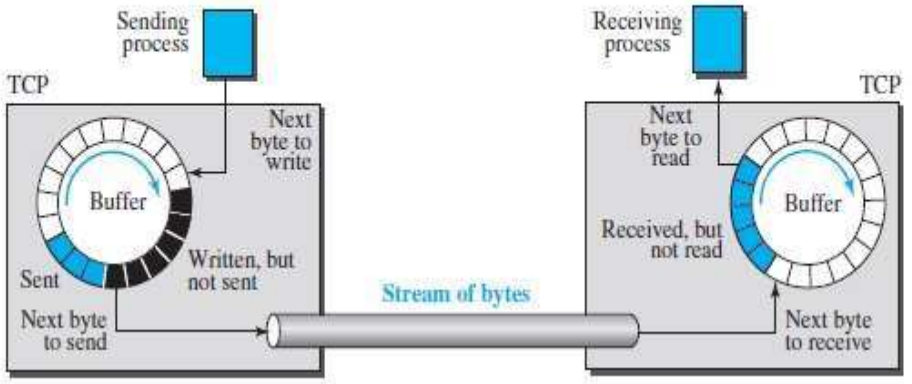
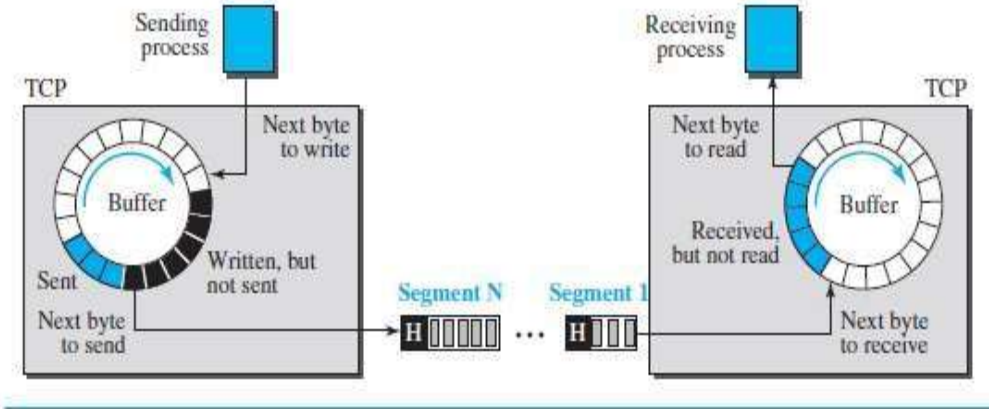


Figure 24.6 *TCP segments*



Continue…

- Full-Duplex Communication
- Multiplexing and Demultiplexing
- Connection-Oriented Service
- Reliable Service

TCP Features

Numbering System: There are two fields in segment, called the sequence number and the acknowledgment number. These two fields refer to a byte number and not a segment number.

Byte Number: The bytes of data being transferred in each connection are numbered by TCP. For example, if the number happens to be 1057 and the total data to be sent is 6000 bytes, the bytes are numbered from 1057 to 7056.

Continue…

Sequence Number: After the bytes have been numbered, TCP assigns a sequence number to each segment that is being sent.

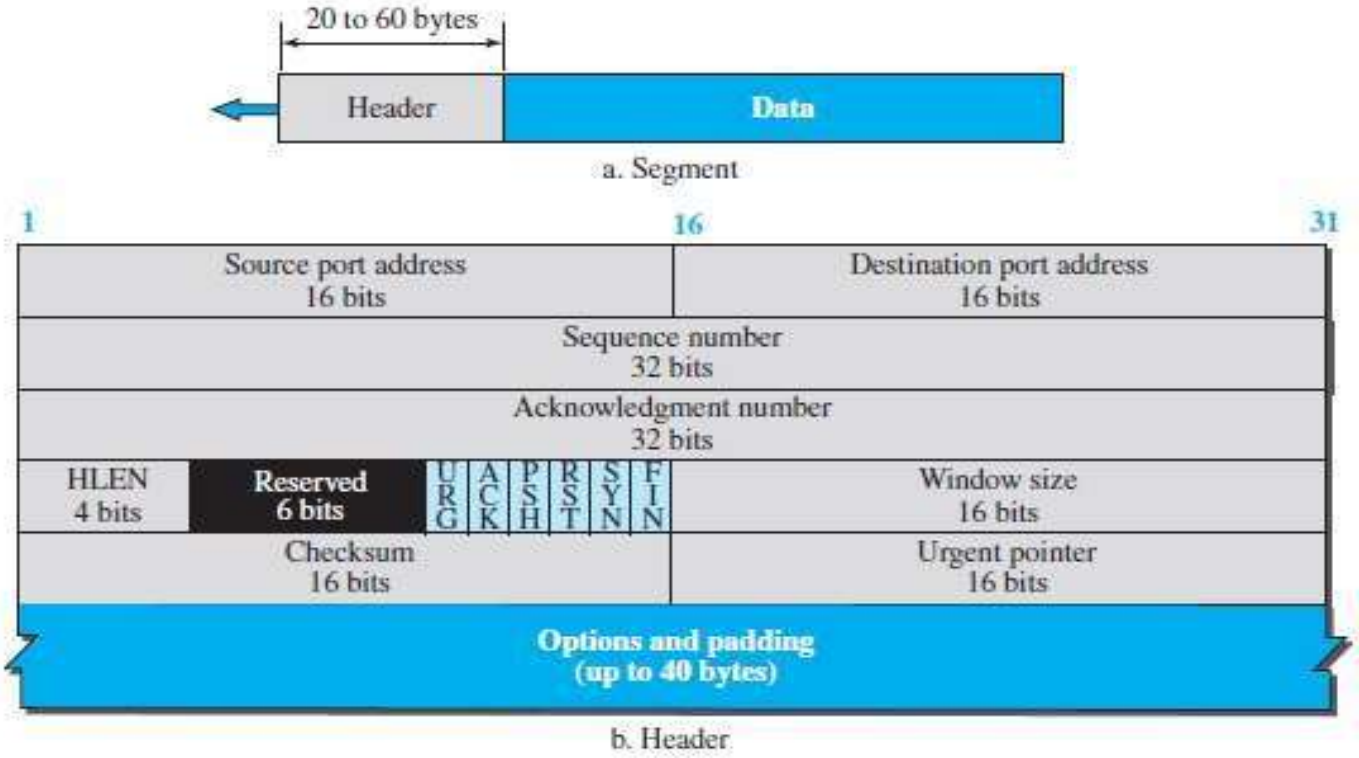
1. The sequence number of the first segment is the ISN (initial sequence number), which is a random number.
2. The sequence number of any other segment is the sequence number of the previous segment plus the number of bytes (real or imaginary) carried by the previous segment.

Continue…

Acknowledgment Number: the acknowledgment number defines the number of the next byte that the party expects to receive. E.g. if a party uses 5643 as an acknowledgment number, it has received all bytes from the beginning up to 5642.

Segment

Figure 24.7 *TCP segment format*



References

- Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, TMH, 2013.