

National Institute of Technology Karnataka Surathkal

Department of Information Technology



IT 200 **Computer Communication and Networking**

Transport Layer

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NITK Surathkal

Syllabus

- **Evolution of Data Communication and Networks,**
- **Transmission Fundamentals: Signaling Schemes, Encoding and Modulation,**
- **Data Transmission over Networks – Switching Techniques, Layered Architecture of Computer Networks,**
- **OSI & TCP/IP Architectures and Layers with protocols,**
- **Data Link Control and Protocols, Error Detection and Correction,**
- **Internetworking & Routing,**
- **Transport Layer Protocols,**
- **Applications: E-Mail, HTTP, WWW, Multimedia;**
- **Implementation of Signaling and Modulation, Bit, Byte & Character Stuffing and Error Detection/Correction Coding Techniques, TCP/IP Level Programming, Routing Algorithms, Exercises comprising simulation of various protocols.**

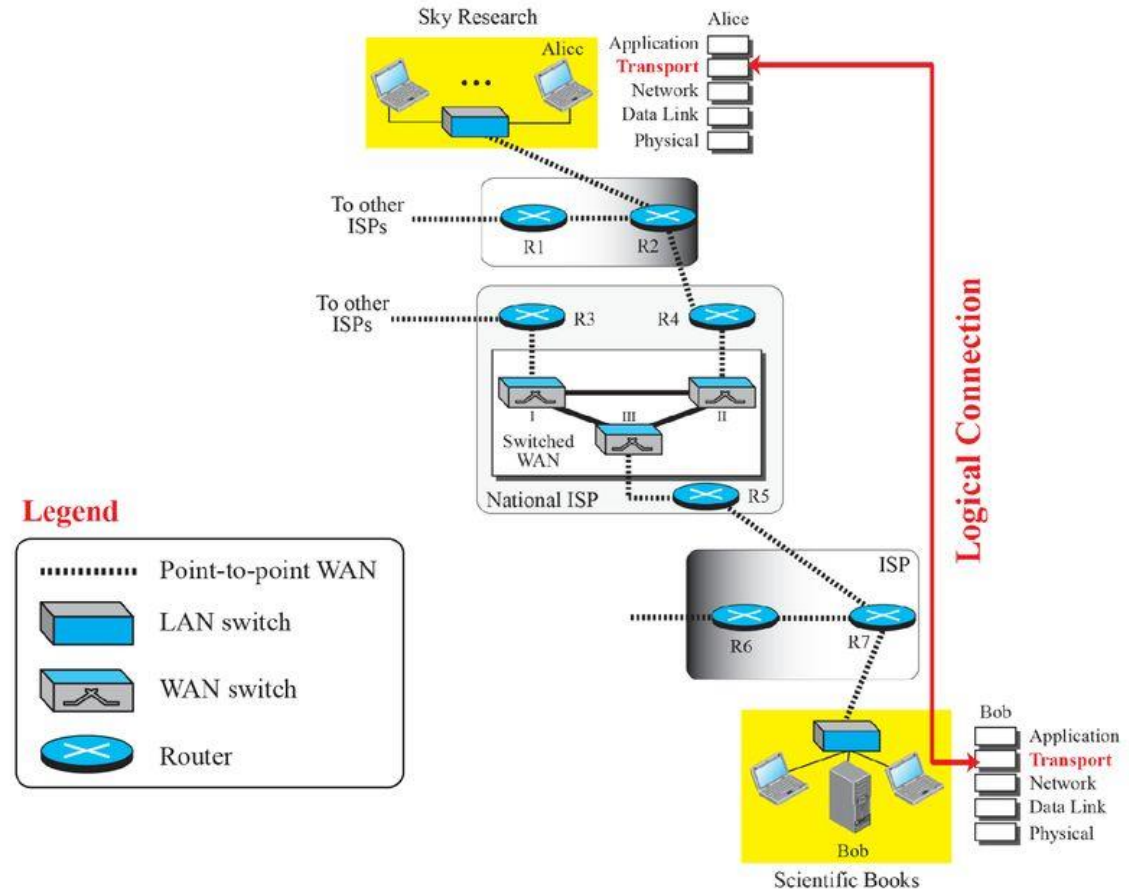
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- **Introduction**
- **UDP**
- **TCP**
- **Congestion Control**

1. Introduction

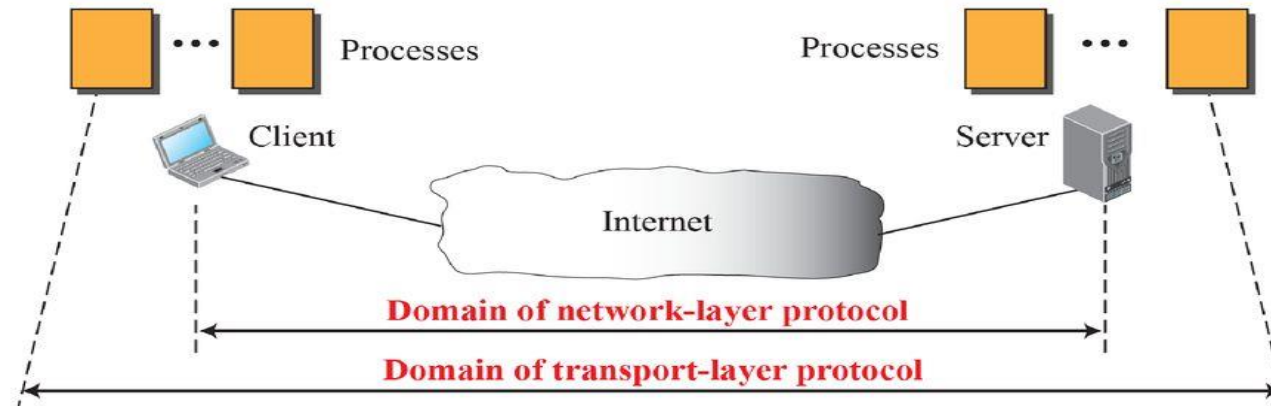
- Transport layer provides service to Application layer and Network layer
- It provides process to process communication
- Communication through logical connection (port number)

Figure 23.1: Logical connection at the transport layer



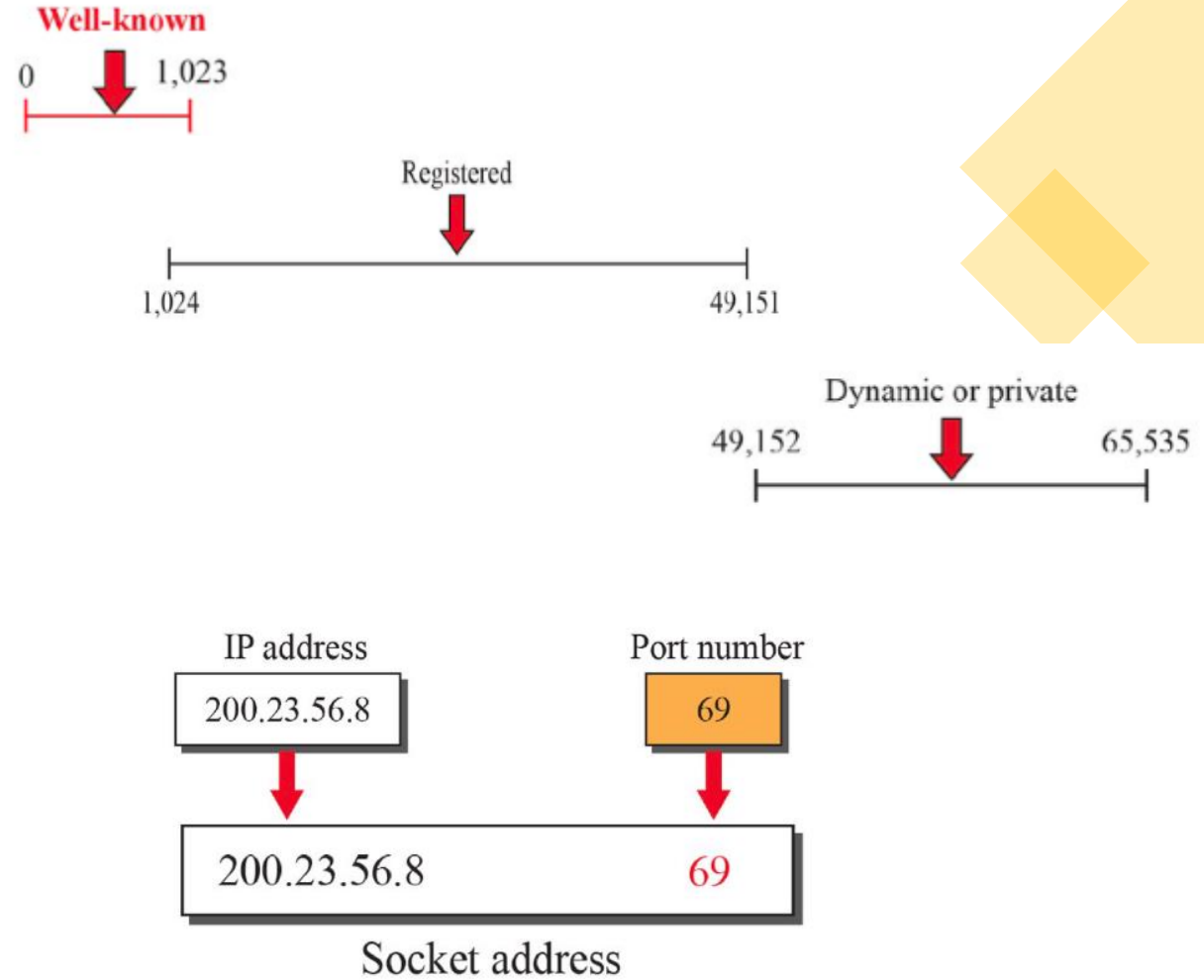
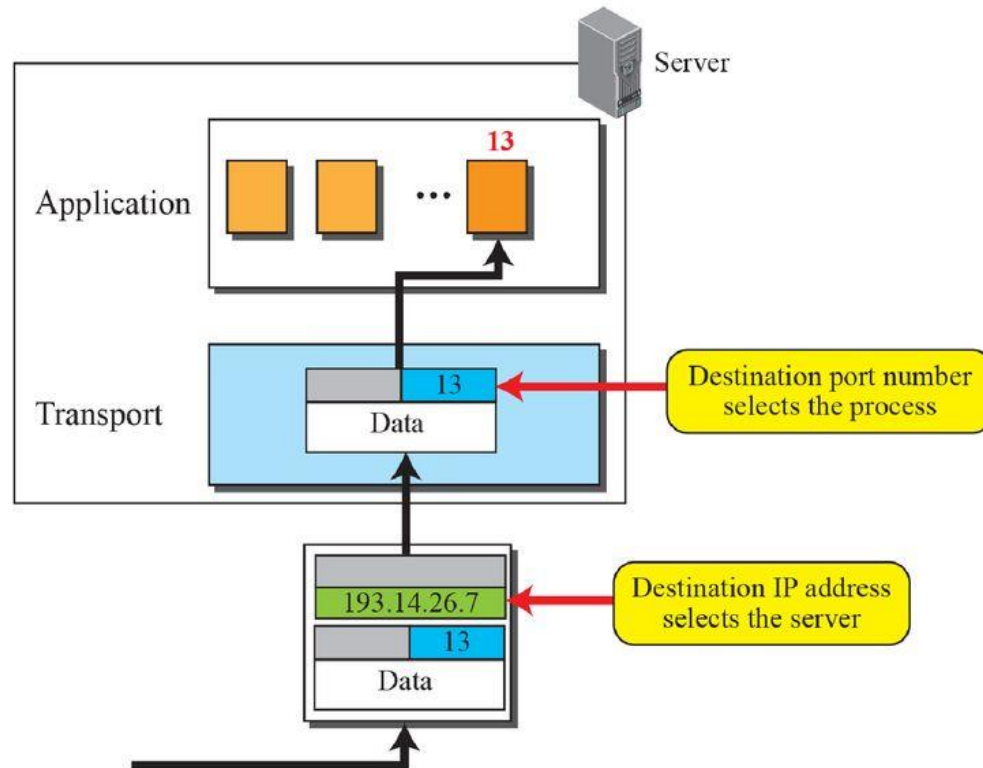
1. Introduction

Figure 23.2: Network layer versus transport layer



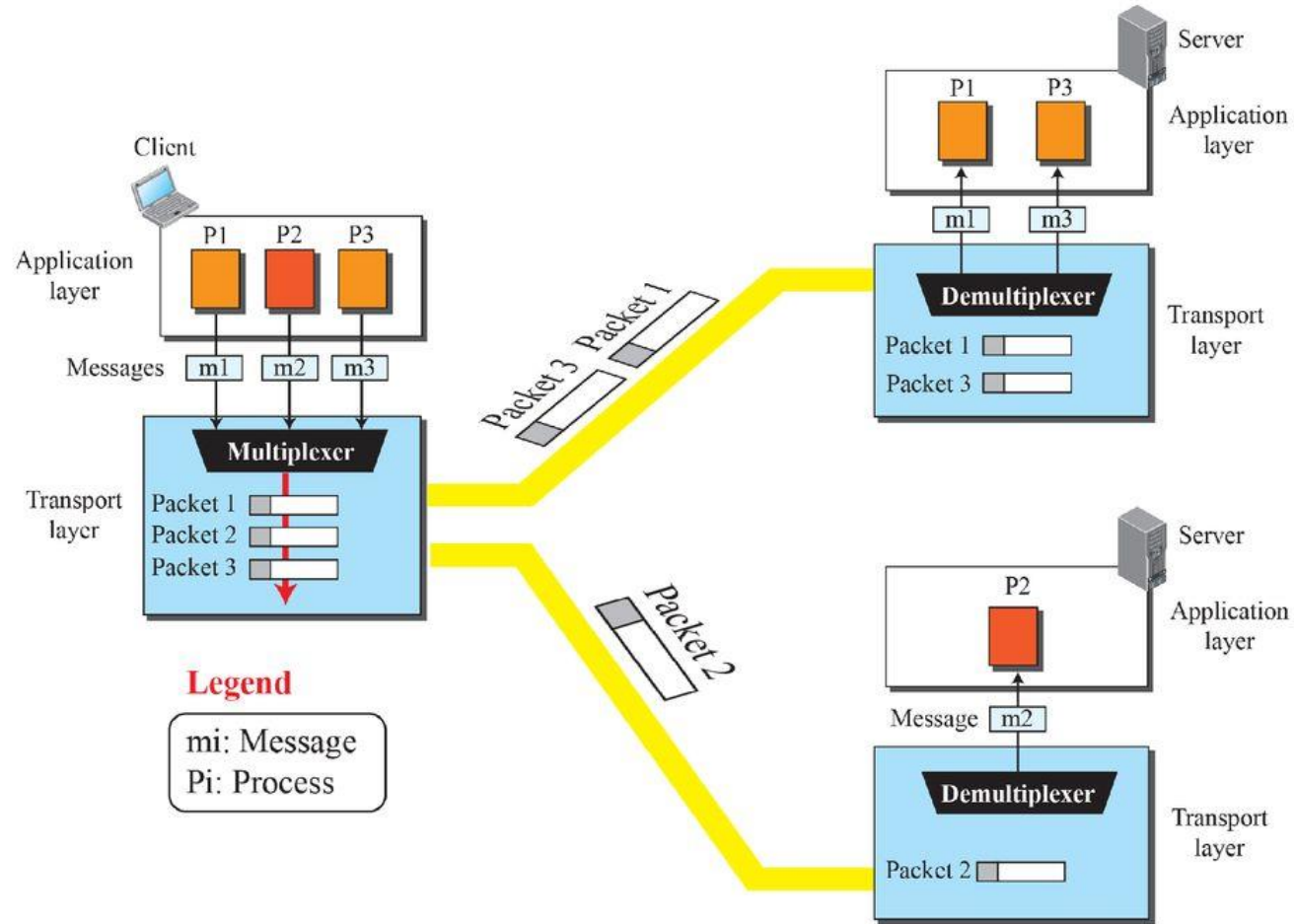
1. Introduction

Figure 23.4: IP addresses versus port numbers



1. Introduction

Figure 23.8: Multiplexing and demultiplexing



1. Introduction

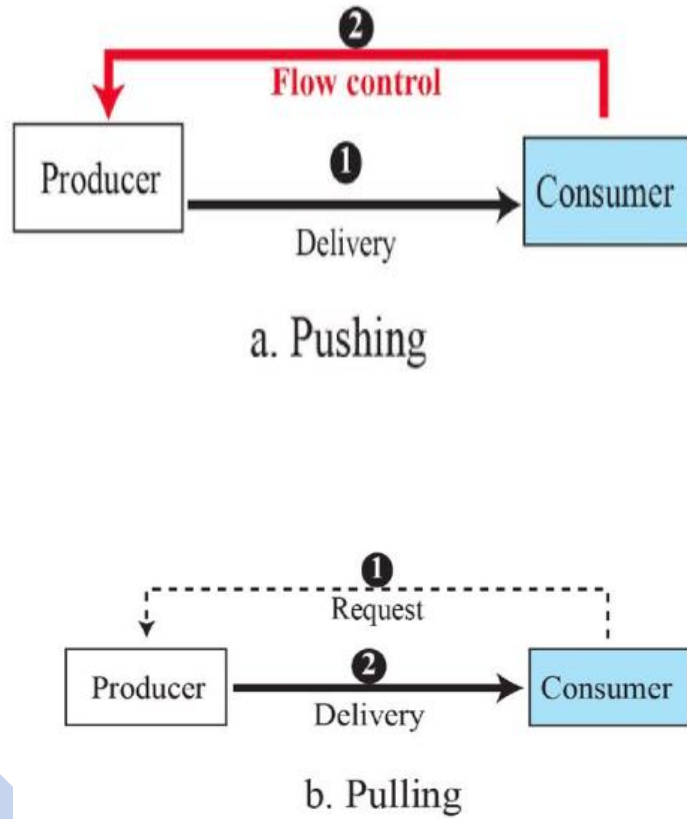
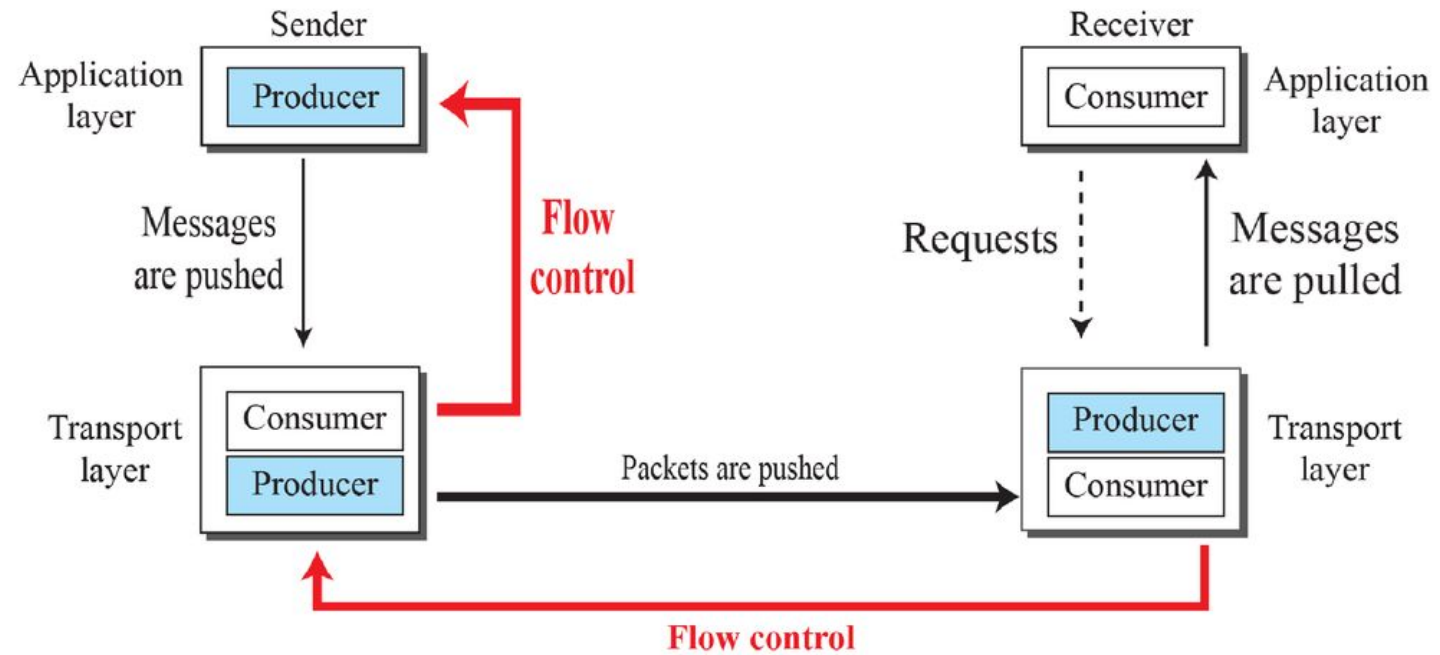


Figure 23.10: Flow control at the transport layer

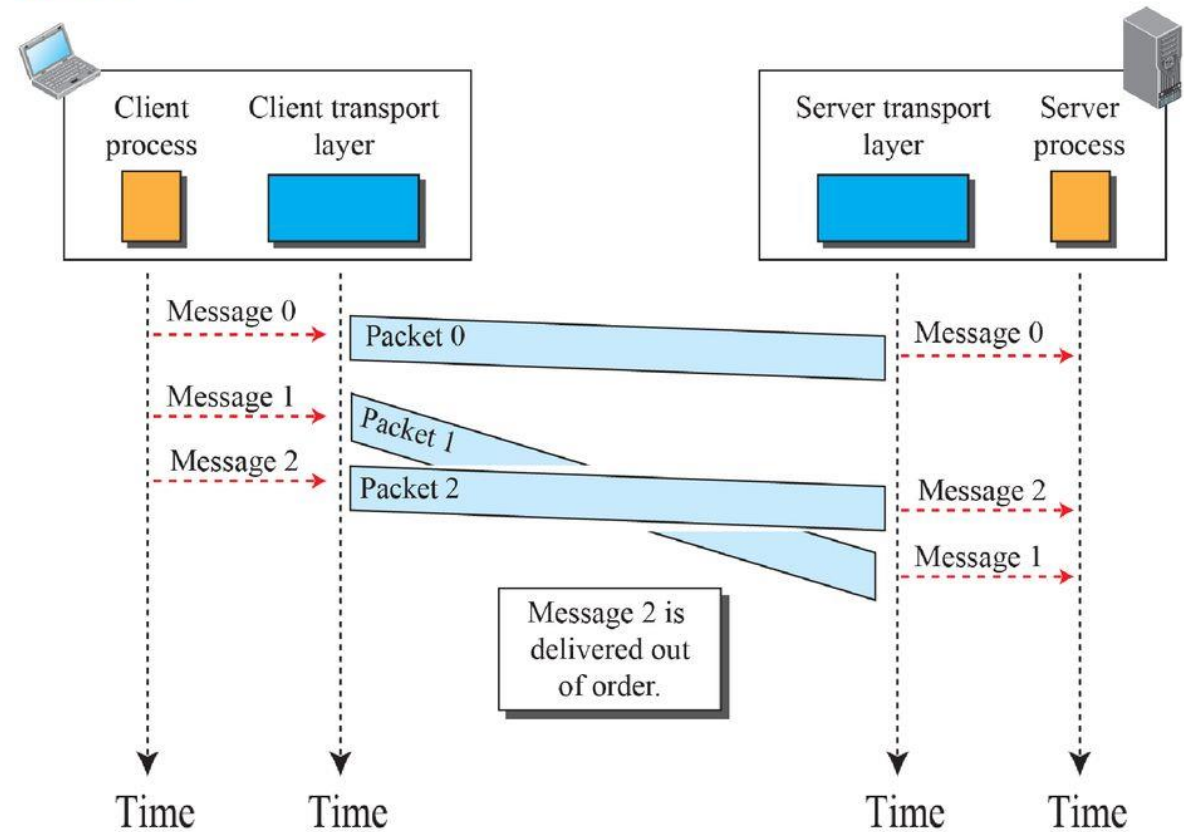


2. User Datagram Protocol (UDP)

UDP is connectionless,
Unreliable transport
protocol.

It provides process to
process
communication.

Figure 3.14: Connectionless service



2. User Datagram Protocol (UDP)

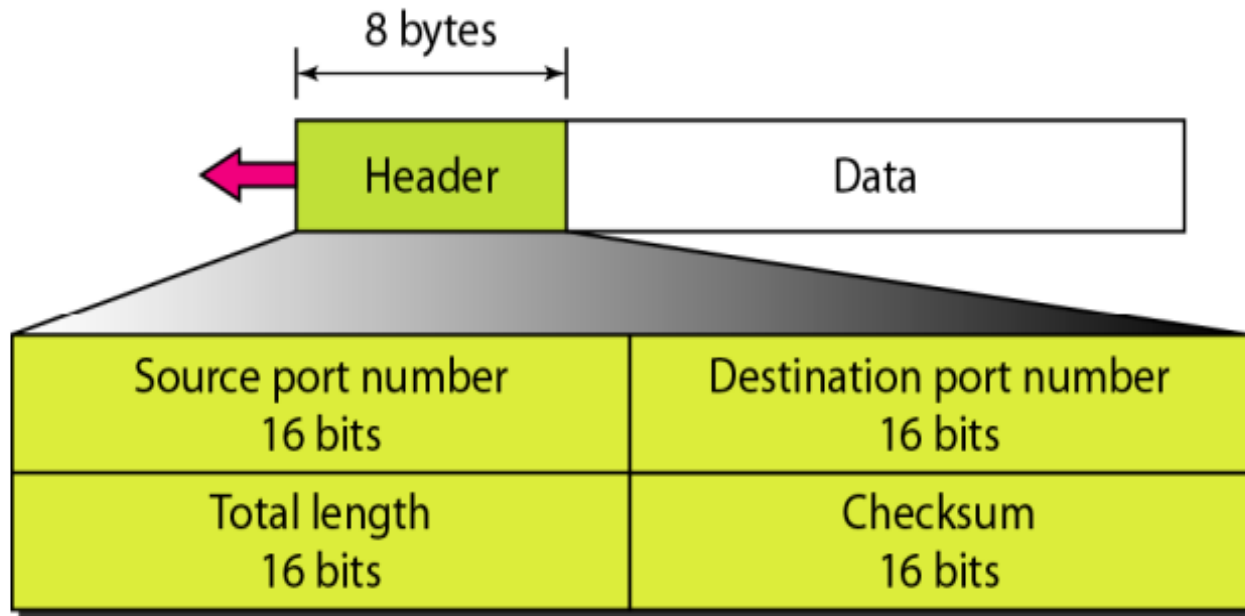
FTP can be used both with TCP and UDP (port 21)

SNMP uses port 161(TCP/UDP) and 162 (UDP)

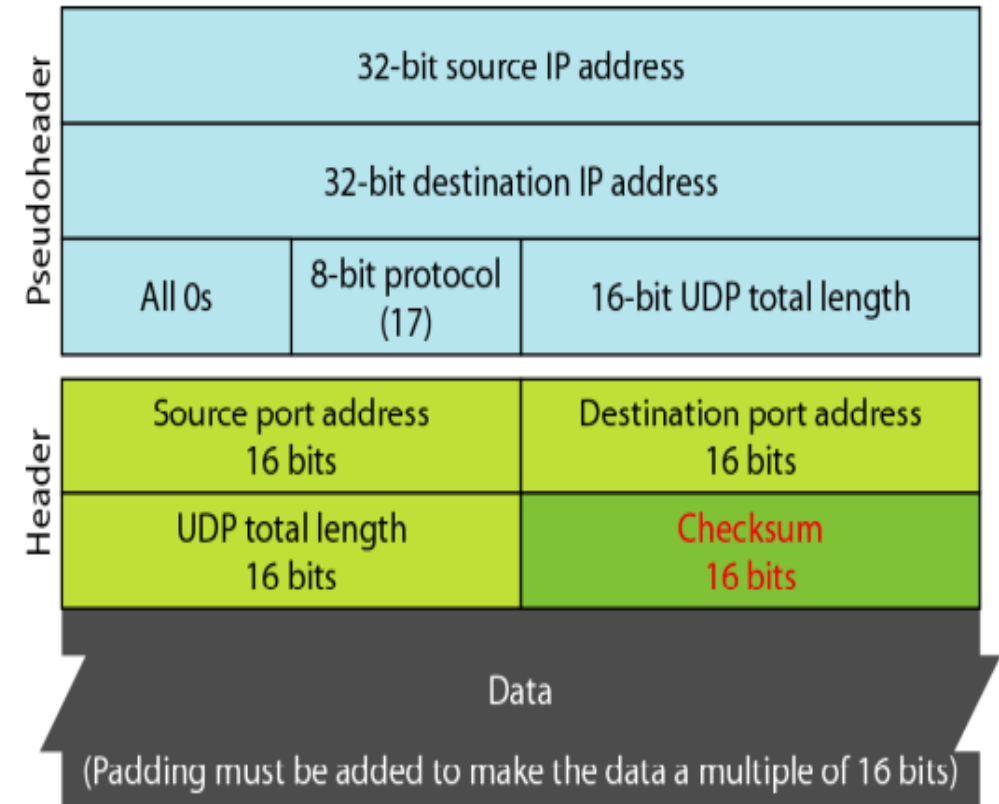
Table 23.1 *Well-known ports used with UDP*

<i>Port</i>	<i>Protocol</i>	<i>Description</i>
7	Echo	Echoes a received datagram back to the sender
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
53	Nameserver	Domain Name Service
67	BOOTPs	Server port to download bootstrap information
68	BOOTPc	Client port to download bootstrap information
69	TFTP	Trivial File Transfer Protocol
111	RPC	Remote Procedure Call
123	NTP	Network Time Protocol
161	SNMP	Simple Network Management Protocol
162	SNMP	Simple Network Management Protocol (trap)

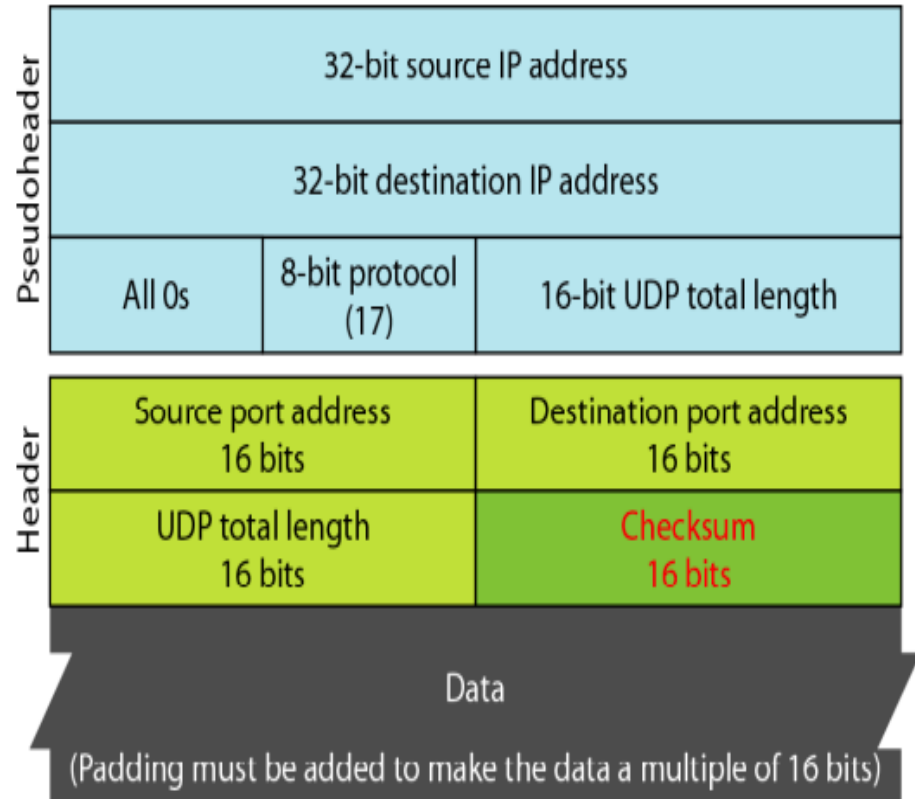
2. User Datagram Protocol (UDP)



UDP length
= IP length – IP header's length



2. User Datagram Protocol (UDP)



153.18.8.105			
171.2.14.10			
All 0s	17	15	
1087		13	
15		All 0s	
T	E	S	T
I	N	G	All 0s

10011001 00010010 → 153.18
 00001000 01101001 → 8.105
 10101011 00000010 → 171.2
 00001110 00001010 → 14.10
 00000000 00010001 → 0 and 17
 00000000 00001111 → 15
 00000100 00111111 → 1087
 00000000 00001101 → 13
 00000000 00001111 → 15
 00000000 00000000 → 0 (checksum)
 01010100 01000101 → T and E
 01010011 01010100 → S and T
 01001001 01001110 → I and N
 01000111 00000000 → G and 0 (padding)

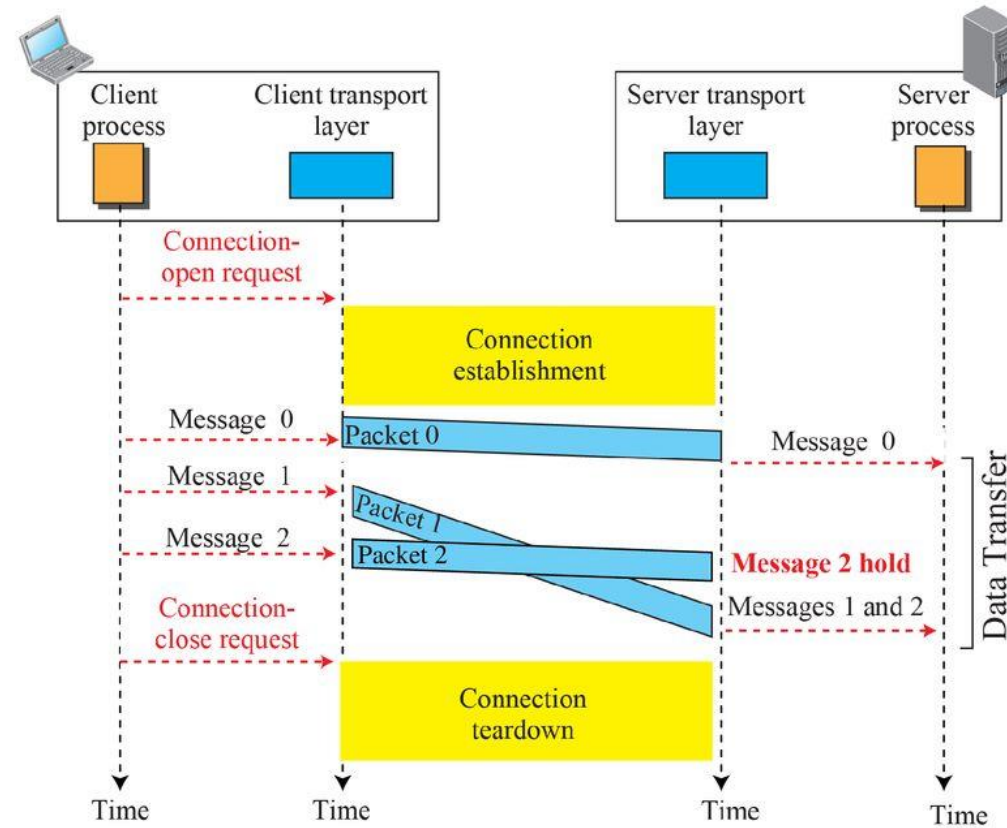
10010110 11101011 → Sum
 01101001 00010100 → Checksum

3. Transmission Control Protocol (TCP)

TCP is connection oriented reliable transport protocol.

It provides process to process communication.

Figure 23.15: Connection-oriented service



3. Transmission Control Protocol (TCP)

TCP is connection oriented reliable transport protocol.

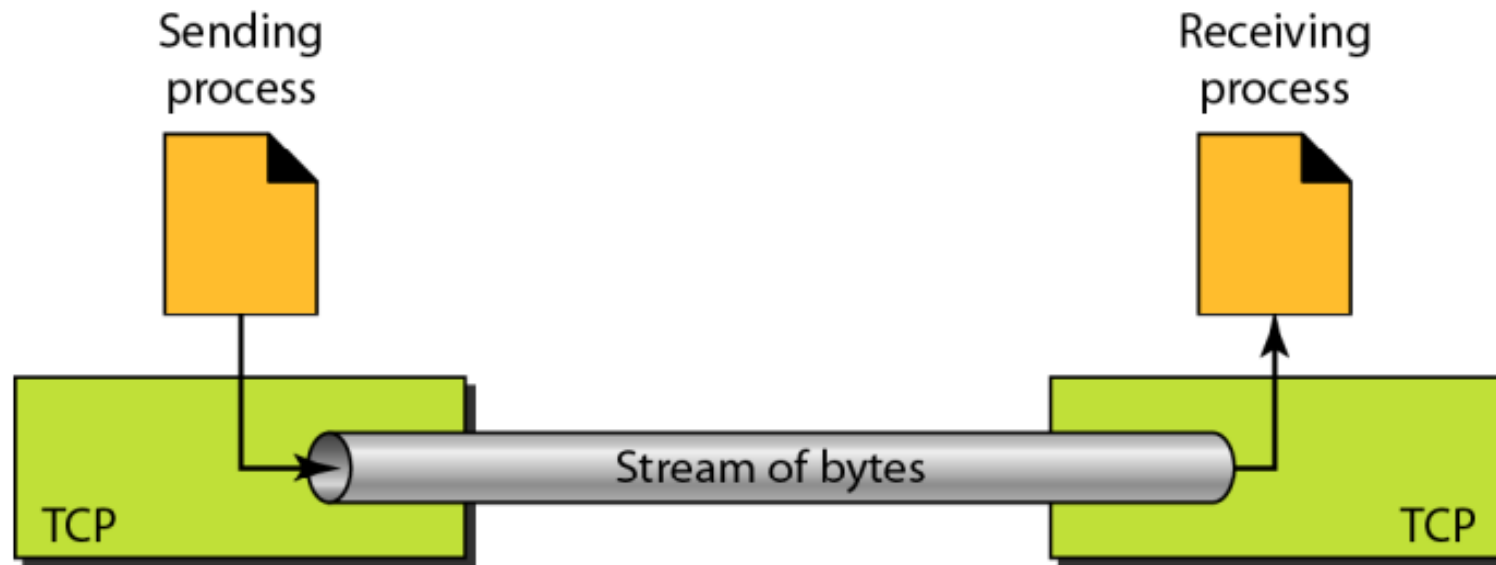
It provides process to process communication.

Table 23.2 *Well-known ports used by TCP*

<i>Port</i>	<i>Protocol</i>	<i>Description</i>
7	Echo	Echoes a received datagram back to the sender
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 (data connection)
21	FTP, Control	File Transfer Protocol (control connection)
23	TELNET	Terminal Network
25	SMTP	Simple Mail Transfer Protocol
53	DNS	Domain Name Server
67	BOOTP	Bootstrap Protocol
79	Finger	Finger
80	HTTP	Hypertext Transfer Protocol
111	RPC	Remote Procedure Call

3. Transmission Control Protocol (TCP)

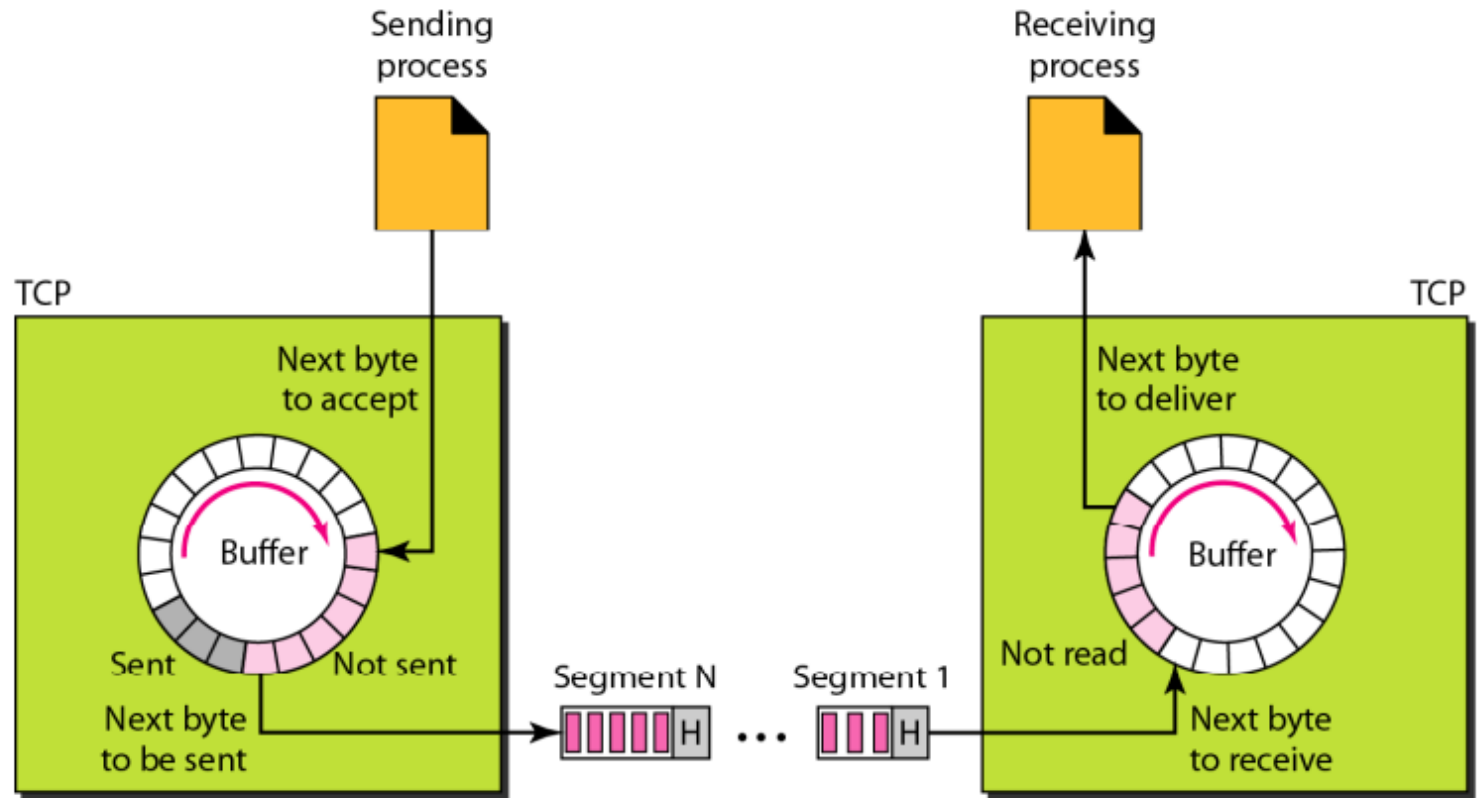
Stream Delivery



3. Transmission Control Protocol (TCP)

Sending and receiving buffers for end to end flow control.

The bytes of data being transferred in each connection are numbered by TCP. The numbering starts with a randomly generated number.



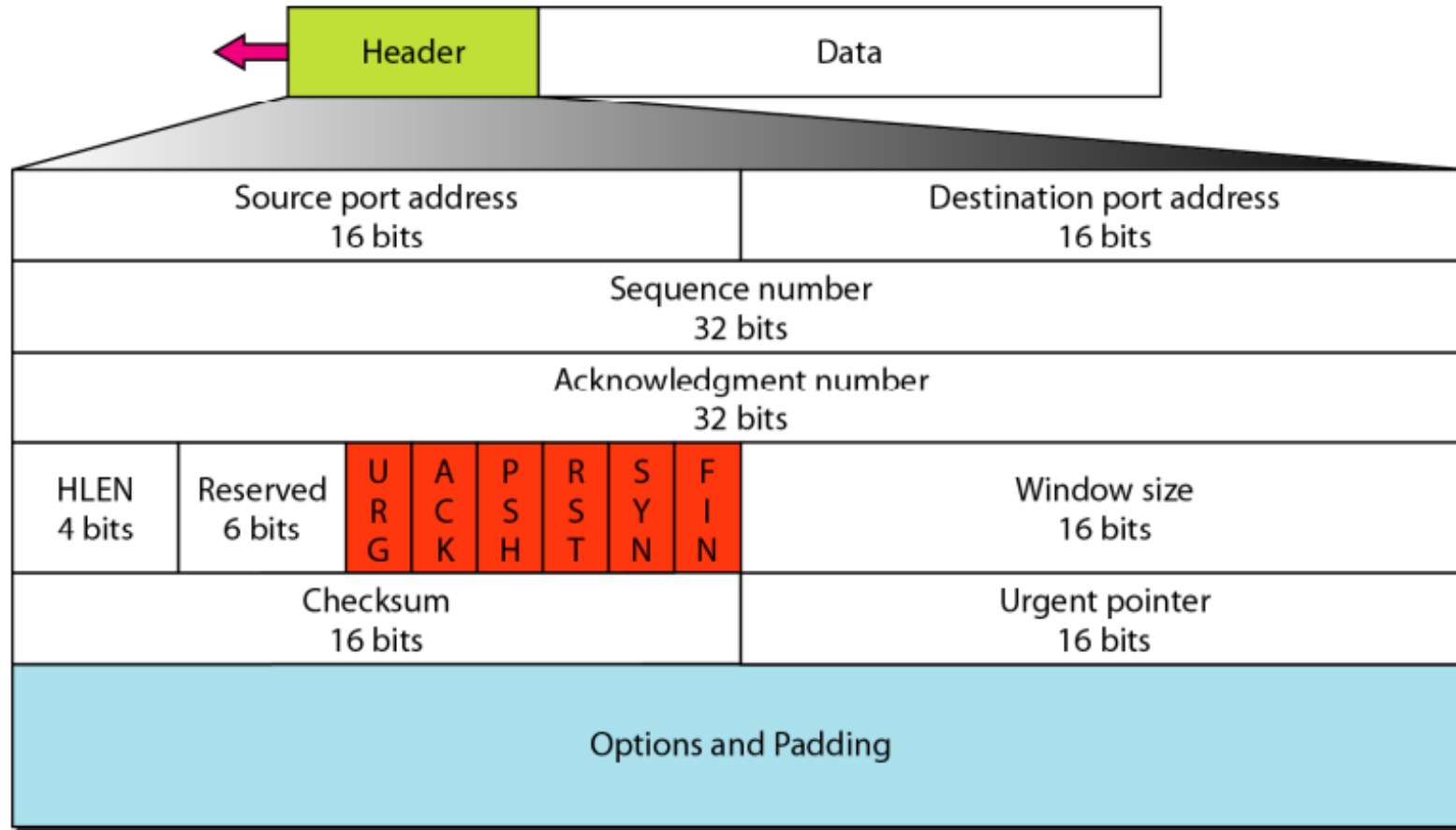
3. Transmission Control Protocol (TCP)

Sending and receiving buffers for end to end flow control.

The bytes of data being transferred in each connection are numbered by TCP. The numbering starts with a randomly generated number.

Segment 1	➡	Sequence Number: 10,001 (range: 10,001 to 11,000)
Segment 2	➡	Sequence Number: 11,001 (range: 11,001 to 12,000)
Segment 3	➡	Sequence Number: 12,001 (range: 12,001 to 13,000)
Segment 4	➡	Sequence Number: 13,001 (range: 13,001 to 14,000)
Segment 5	➡	Sequence Number: 14,001 (range: 14,001 to 15,000)

3. Transmission Control Protocol (TCP)



URG: Urgent pointer is valid
ACK: Acknowledgment is valid
PSH: Request for push

RST: Reset the connection
SYN: Synchronize sequence numbers
FIN: Terminate the connection

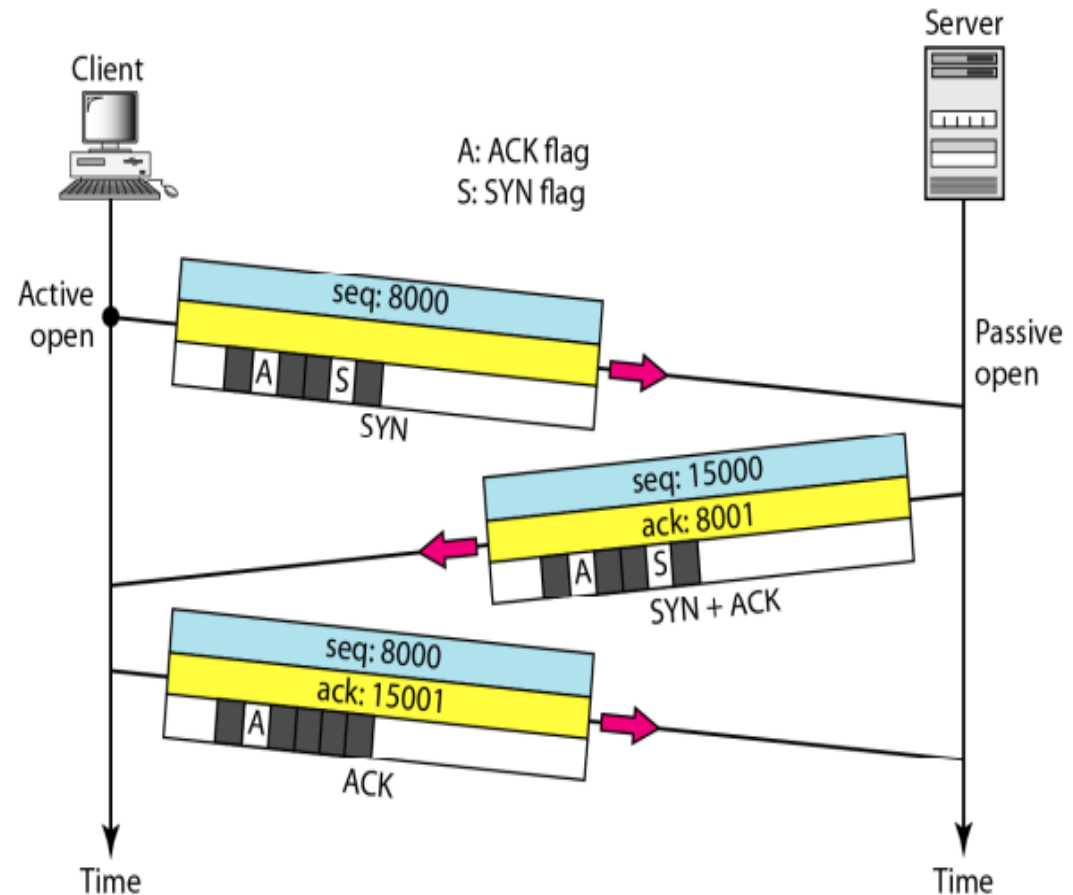
3. Transmission Control Protocol (TCP)

A SYN segment cannot carry data, but it can consume one sequence number.

A SYN+ACK segment cannot carry data, but it can consume one sequence number.

AN ACK segment, if carrying no data consumes no sequence number.

Figure 23.18 *Connection establishment using three-way handshaking*

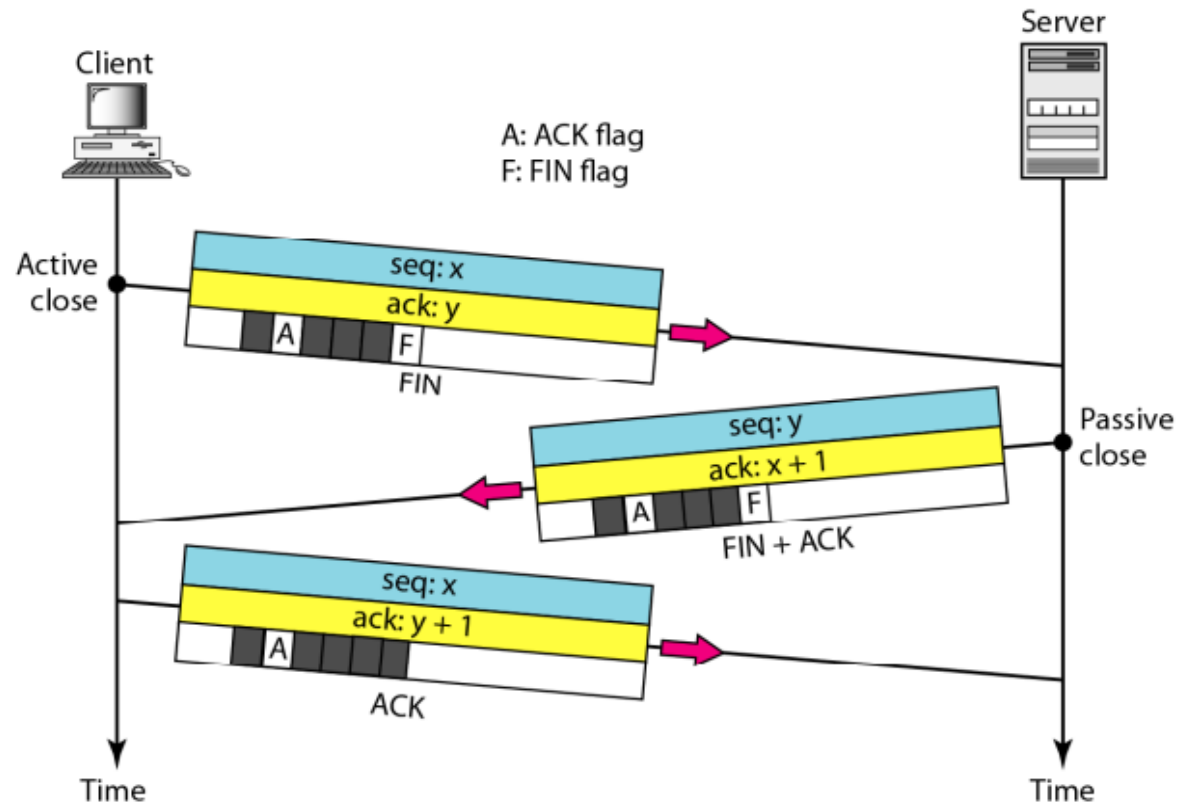


3. Transmission Control Protocol (TCP)

A FIN segment consumes one sequence number if it does not carry data.,

A FIN+ACK segment consumes one sequence number if it does not carry data.,

Figure 23.20 *Connection termination using three-way handshaking*

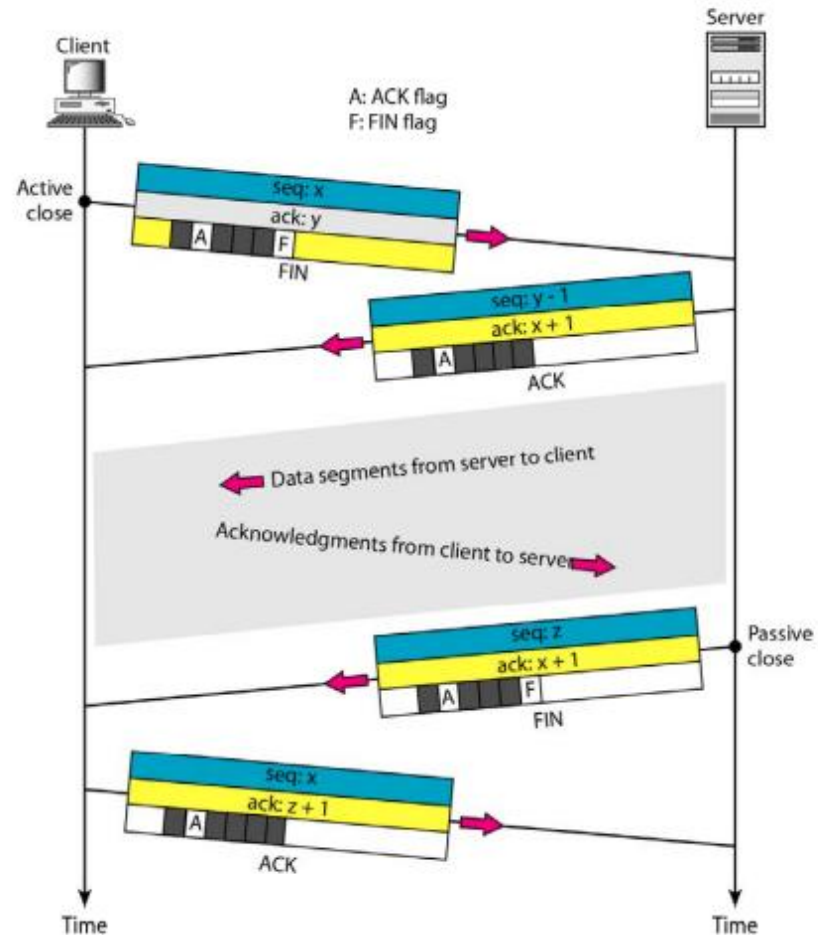


3. Transmission Control Protocol (TCP)

A FIN segment consumes one sequence number if it does not carry data.,

A FIN+ACK segment consumes one sequence number if it does not carry data.,

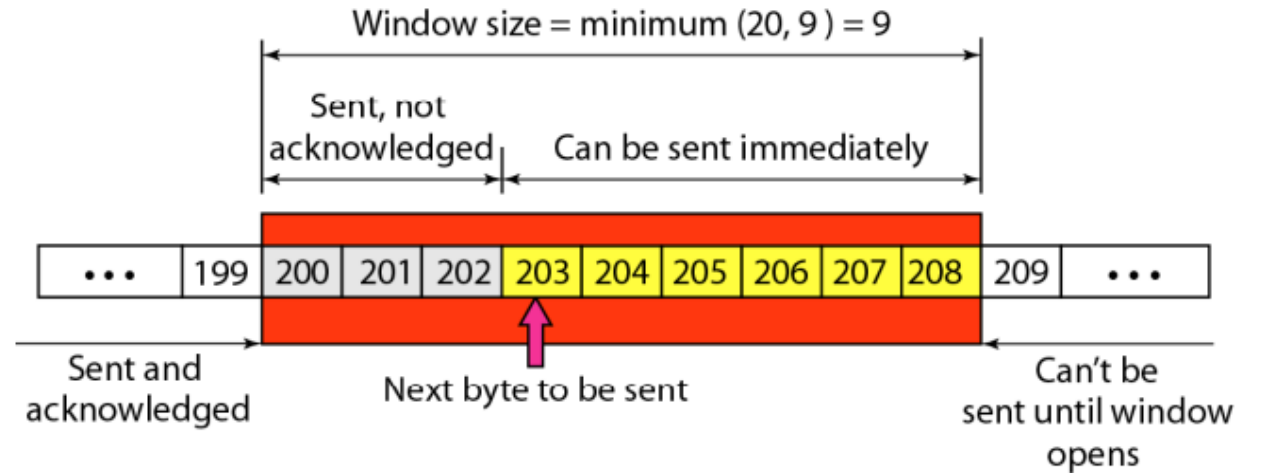
Figure 23.21 *Half-close*



3. Transmission Control Protocol (TCP)

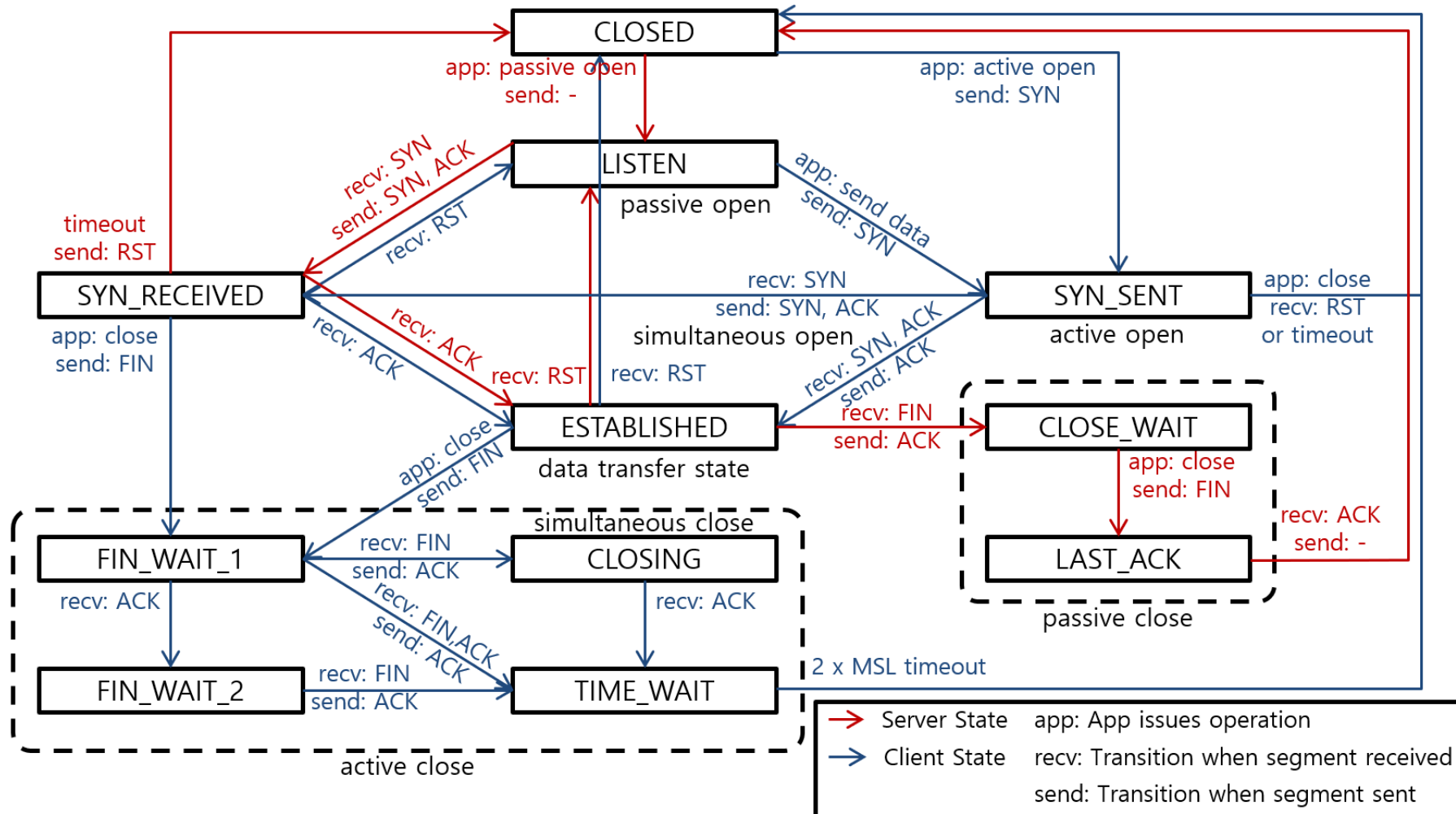
Sliding window for flow control

In modern implementations, a retransmission occurs if the retransmission timer expires or three duplicate ACK segments have arrived.



3. Transmission Control Protocol (TCP)

TCP Connection State Diagram



Reference

- “Data Communications and Networking”, Behrouz A. Forouzan, 5th Edition, McGraw Hill, 2017.

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Next Topic

Congestion Control

