

CS & IT ENGINEERING



Computer Network

Transport Layer

Lecture No. - 01



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Recap of Previous Lecture



Topic

Routing Protocol

Topic

Traffic Shaping





Topics to be Covered



Topic

DHCP

Topic

Transport Layer

Topic

UDP

ABOUT ME



Hello, I'm **Abhishek**

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- M.Tech (CS) - IIT Kharagpur
- 12 years of GATE CS teaching experience

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Topic : Token Bucket Algorithm

→ Sometimes needed to speedup the output rate for a while

C = Capacity of token bucket (in bytes)

R = Token arrival rate (in bytes per sec)

M = Maximum output rate (in bytes per sec)

S = Duration for maximum output rate permissible (in sec)

$$[C + R * S] = M * S$$

$$S = \frac{C}{(M - R)}$$

#Q. A computer on a 10Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2Mbps. It is initially filled to capacity with 16Megabits. What is the maximum duration for which the computer can transmit at the full 10Mbps?

(A) 1.6 seconds

✓ (B) 2 seconds

(C) 5 seconds

(D) 8 seconds

$$M = 10 \text{ Mbps}$$

$$R = 2 \text{ Mbps}$$

$$C = 16 \text{ Mb (Full)}$$

$$S = ?$$

[GATE 2008]

$$\boxed{R \leftarrow M}$$

11 sec

Solution :-

$$\underline{C} = \underline{16 \text{ Mb (Megabits)}} \text{ (Full)}$$

$$\underline{M} = \underline{10 \text{ Mbps}}$$

$$\underline{R} = \underline{2 \text{ Mbps}}$$

$$\underline{S} = \left[\text{Maximum duration for which the computer can transmit at the full capacity} \right]$$

$$S = \frac{C}{(M - R)} = \frac{16 \text{ Mb}}{[10 \text{ Mbps} - 2 \text{ Mbps}]} = \frac{16 \text{ Mb}}{8 \text{ Mbps}} = 2 \text{ sec}$$

#Q. For a host machine that uses the token bucket algorithm for congestion control, the token bucket has a capacity of 1 megabyte and the maximum output rate is 20 megabytes per second. Tokens arrive at a rate to sustain output at a rate of 10 megabytes per second. The token bucket is currently full and the machine needs to send 12 megabytes of data. The minimum time required to transmit the data is _____ seconds.

[GATE 2016]

ISC

H.W.

Solution :-

Data Size = 12 MB

C = 1 MB (Megabytes)

M = 20 MBps

R = 10 MBps

S = Maximum duration for which
the computer can transmit at the full capacity

$$S = \frac{C}{(M - R)}$$

$$\text{Minimum time required to transmit the data} = S + \frac{(DataSize - M * S)}{R}$$



Topic : DHCP



- DHCP : Dynamic Host Configuration Protocol
- Dynamic assignment of IP address
[IP address assignment on demand]
- Avoid manual IP configuration
- Support mobility of laptops
- Earlier Protocols : RARP [Reverse ARP], BOOTP [Bootstrap Protocol]



Topic : DHCP



- Host dynamically obtains IP address from network server [DHCP server]
[when it join networks]
- Can renew its lease on address in use
- Client - Server Model



Topic : DHCP Client – Server Scenario

→ Typically DHCP server will be co-located in router
[serving all subnets to which routers is attached]

→ DHCP runs over UDP ✓
[Client uses port 68 and server uses port 67]

[DHCP → UDP → IP]

→ Sometimes a subnet may have multiple DHCP servers



Topic : DHCP Operation



→ DHCP protocol is four step process.

1. DHCP Server Discovery ✓

2. DHCP Server Offer(s) ✓

3. DHCP Request ✓

4. DHCP ACK ✓

ADORA



Topic : DHCP Server Discovery

- Newly arriving host (client) is to find DHCP server
- Client broadcast "DHCP discover" message

Source IP Address	: <u>0 . 0 . 0 . 0</u> : 68 ✓
Destinantion IP Address	: <u>255 . 255 . 255 . 255</u> : 67
yourIP	: 0 . 0 . 0 . 0
Type	: <u>DHCPDISCOVER</u>
transaction ID	: <u>752</u> ✓

0 . 0 . 0 . 0 : This Host

255 . 255 . 255 . 255 : Network / Sub-network Broadcast Address

(limited)



Topic : DHCP Server Offer

- When DHCP server receives "DHCP discover" message
- DHCP server responds by sending "DHCP offer" message

<u>Source IP Address</u>	: [210 . 210 . 210 . 2]: 67
<u>Destination IP Address</u>	: [255 . 255 . 255 . 255]: 68
<u>yourIP</u>	: [210 . 210 . 210 . 4]
<u>Type</u>	: <u>DHCPOFFER</u>
<u>transaction ID</u>	: 752 ✓
<u>DHCP Server IP</u>	: [210 . 210 . 210 . 2]
<u>Lifetime</u>	: 3600 sec



Topic : DHCP Request



- Newly arriving host (client) will choose from among one or more server offers
- DHCP Client responds to its selected offer with a "DHCP request" message

<u>Source IP Address</u>	: <u>[0 . 0 . 0 . 0]</u> : 68 ✓
<u>Destination IP Address</u>	: <u>[255 . 255 . 255 . 255]</u> : 67
<u>yourIP</u>	: <u>[210 . 210 . 210 . 4]</u>
<u>Type</u>	: <u>DHCPREQUEST</u>
<u>transaction ID</u>	: <u>753</u> ✓
<u>DHCP Server IP</u>	: <u>[210 . 210 . 210 . 2]</u>
<u>Lifetime</u>	: <u>3600</u> sec



Topic : DHCP Acknowledgment

→ DHCP server responds to DHCP client with a "DHCP ACK" message

<u>Source IP Address</u>	: [210 . 210 . 210 . 210] : 67
<u>Destination IP Address</u>	: [255 . 255 . 255 . 255] : 68
<u>yourIP</u>	: [210 . 210 . 210 . 4]
<u>Type</u>	: <u>DHCPACK</u>
<u>transaction ID</u>	: 753 ✓
<u>DHCP Server IP</u>	: [210 . 210 . 210 . 2]
<u>Lifetime</u>	: 3600 sec



Topic : DHCP Operation



- => DHCP server can return more than just allocated IP address on subnet
- Address of first hop router for client [Default Gateway]
 - Name and IP address of DNS server
 - Network Mask

=> DHCP server discovery and DHCP server offer(s) are optional steps ✓
[if a client remember and wishes to reuse previously allocated network address]



Topic : Loopback Address



→ Know as "localhost"

[127. Anything]

→ In IPv4 loopback address can be anyone from 127.0.0.0 to 127.255.255.255

→ In IPv6 loopback address is "::1" [00. . . . 001]

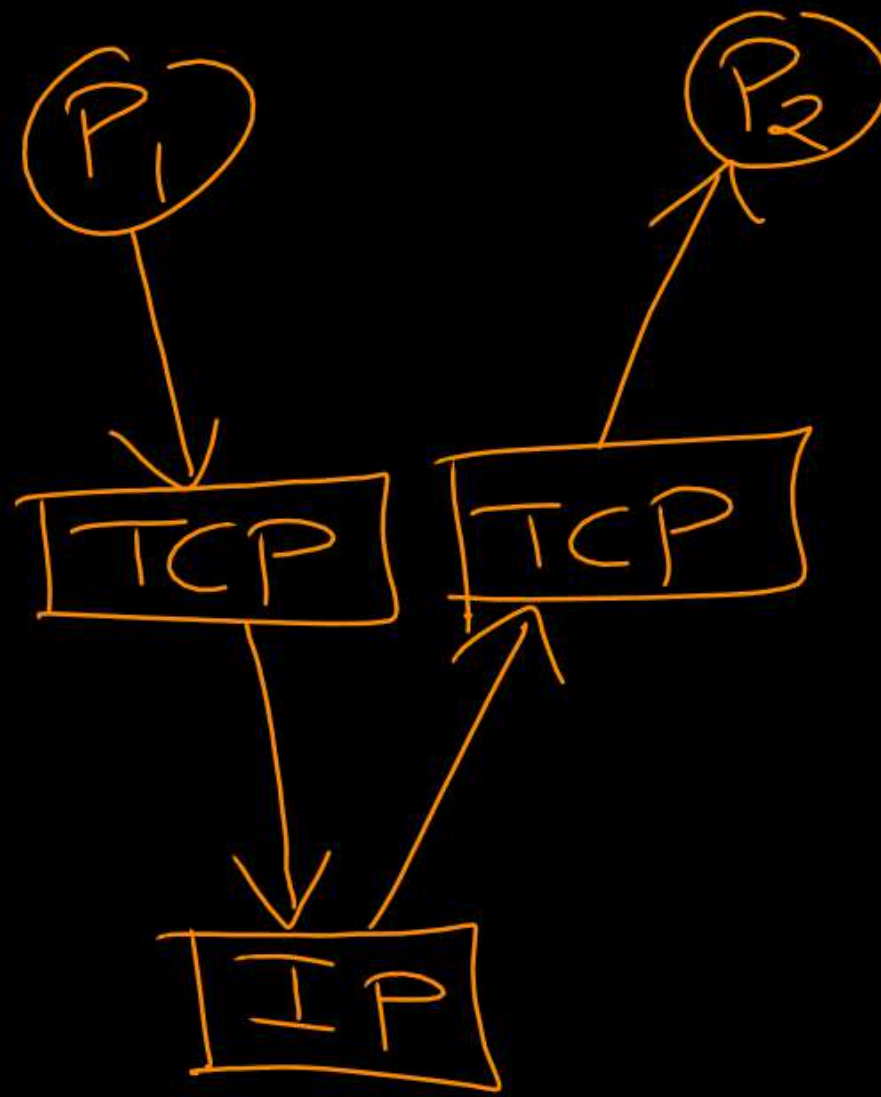
→ For diagnostic purpose to verify the internal connectivity

Host A

P_1
port = x

P_2
port = y

SIP = 127....
DIP = 127....
Sport = x
Dport = y

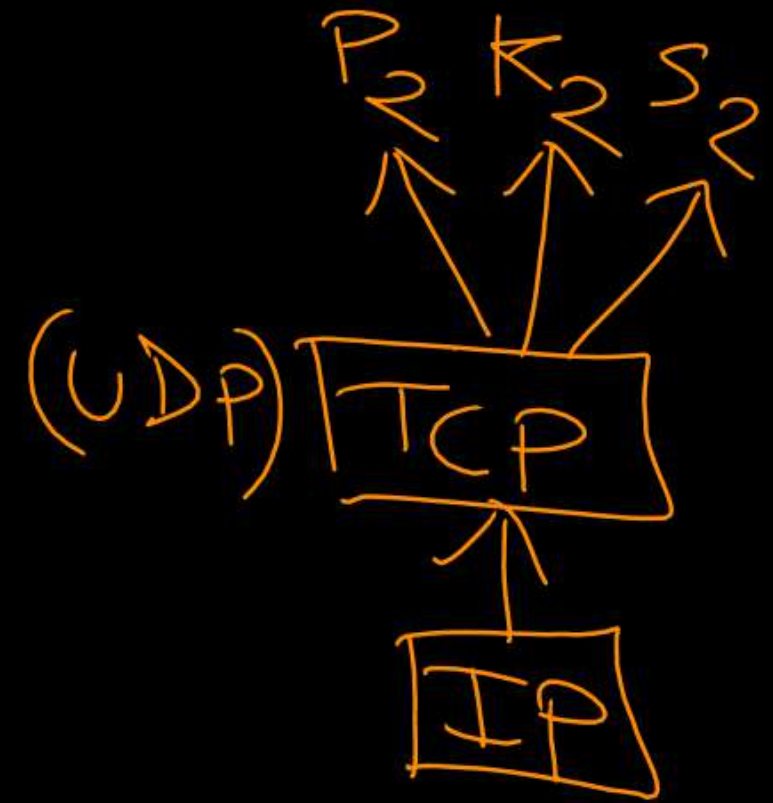
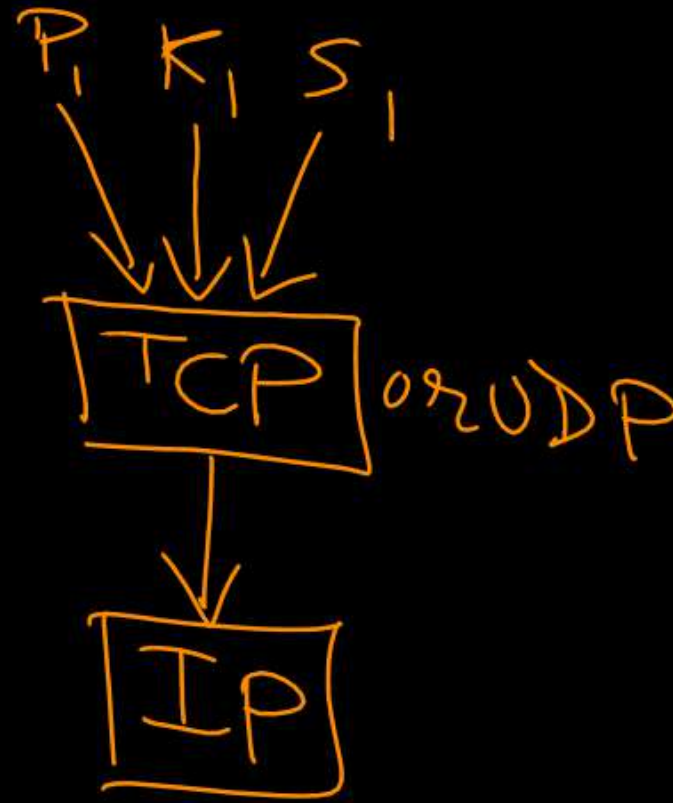




Topic : Transport Layer



- Provide logical communication between application processes (Processes running on different hosts)
- Responsible for process-to-process (end-to-end) communication ✓
- Multiplexing & Demultiplexing ✓





Topic : Transport Layer



→ Transport Layer PDU : "Segment"

→ Sender : Divide application messages into segments, *[segmentation]*
Segments passes to network layer

→ Receiver : Resembles segments into messages,
Messages passes to application layer



Topic : Transport Layer



Two Transport Layer Protocols :

1. UDP : User Datagram Protocol ✓
2. TCP : Transmission Control Protocol ✓

UDP : Basic Protocol

i) End-to-End Connectivity
[MUX & DEMUX]

TCP =
UDP + Extra
Services



Topic : UDP



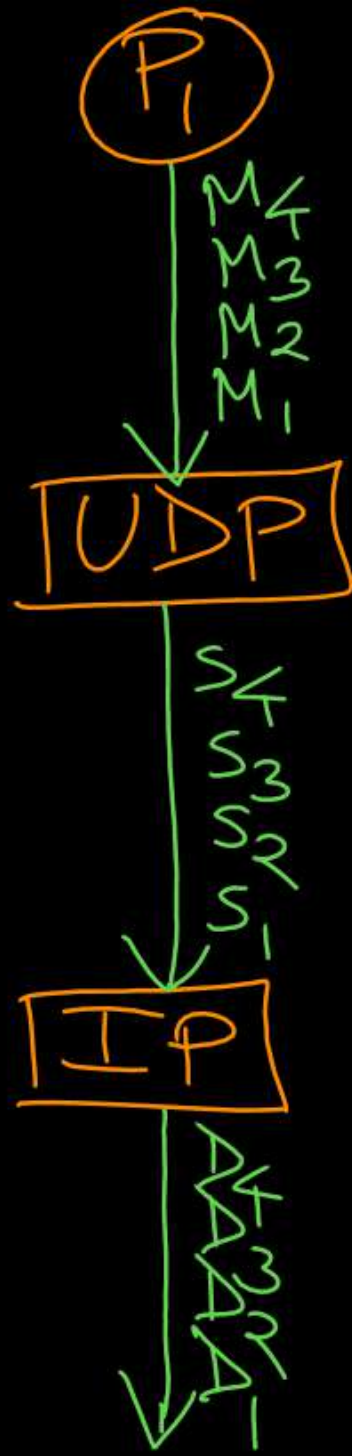
→ UDP : User Datagram Protocol

→ Provide 'Connection-less' and 'Unreliable' services
[Unordered delivery of messages, messages may be lost]

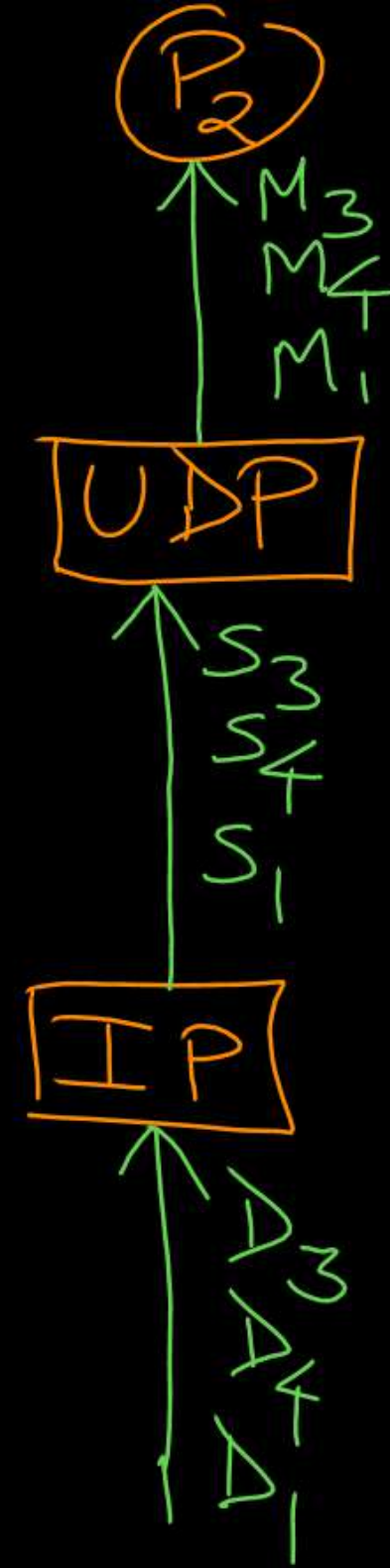
→ Prefer for shorter communication [like query and response]

→ UDP as transport protocol used by :
DNS, SNMP, HTTP/3, RIP and Real Time Multimedia [Streaming Multimedia]

→ UDP provide fast communication over TCP



IP: Connection
less
and
Unreliable





Topic : TCP



→ TCP : Transmission Control Protocol

→ Provide 'Connection-oriented' and 'Reliable' services

[In-order delivery of messages] [*No any message lost*]

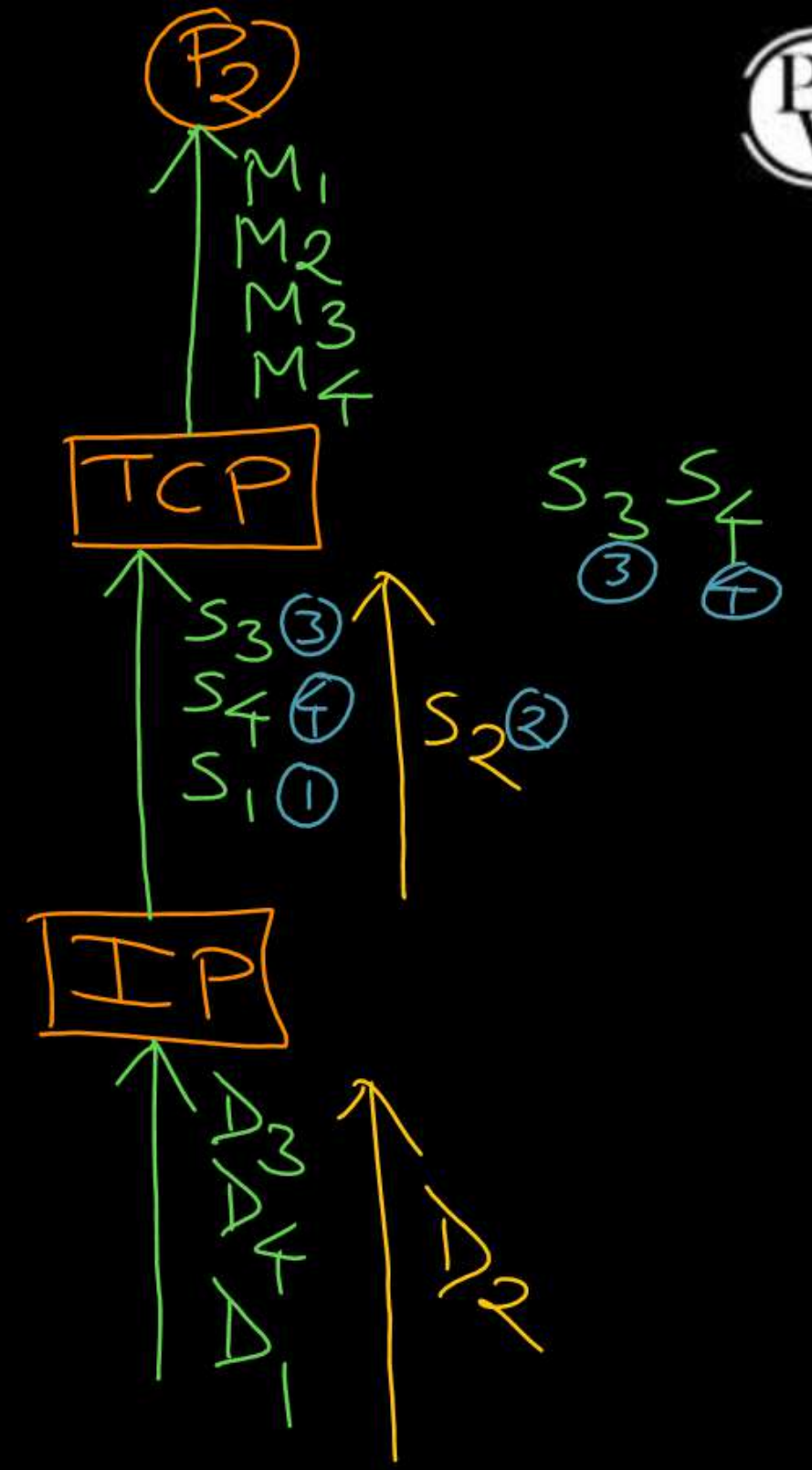
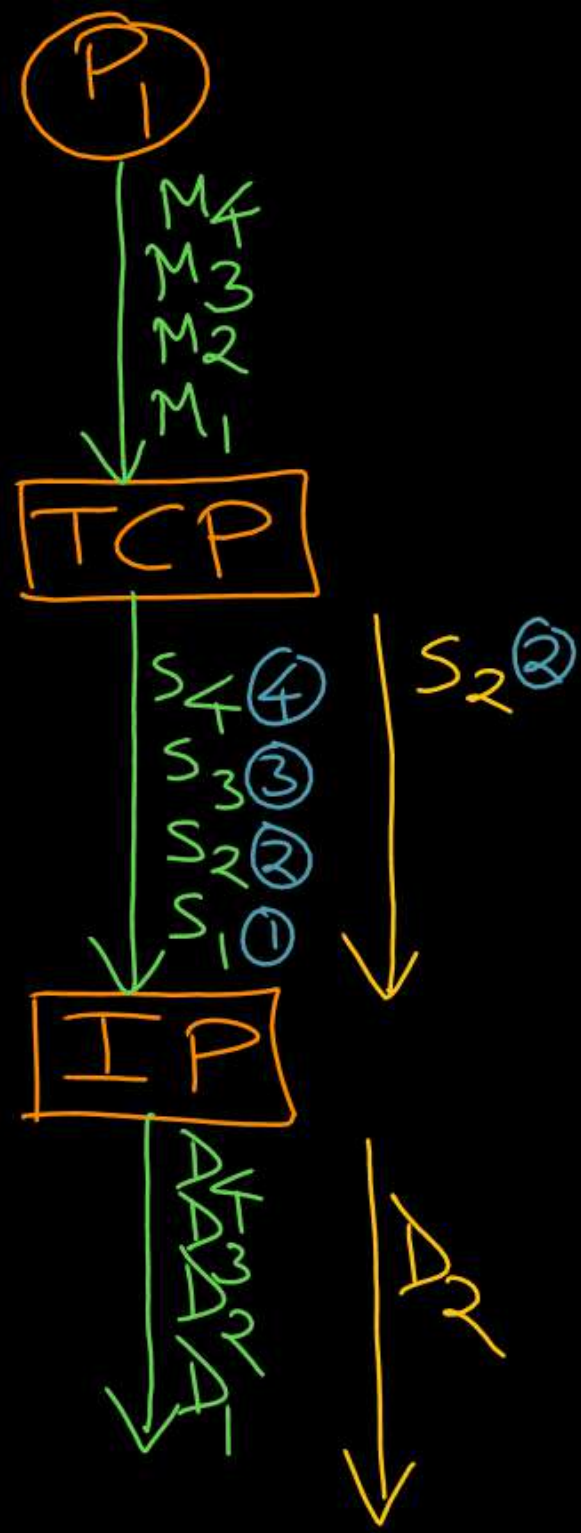
→ Provide Flow, Error and Congestion Control ✓

→ Prefer for long communication

i) Establish connection ✓

ii) Comm.

iii) Release the conn. ✓





Topic : Transport Layer



Application Layer Protocol	Transport Layer Protocol
DNS	→ UDP (Default) → TCP (Conditional)
HTTP/1 HTTP/2	→ TCP
HTTP/3	→ UDP
FTP	→ TCP
SMTP	→ TCP



2 mins Summary



Topic

DHCP ✓

Topic

Transport Layer

Topic

~~XXXXXXXXXX~~



THANK - YOU