Computer Network

DLL

Switching

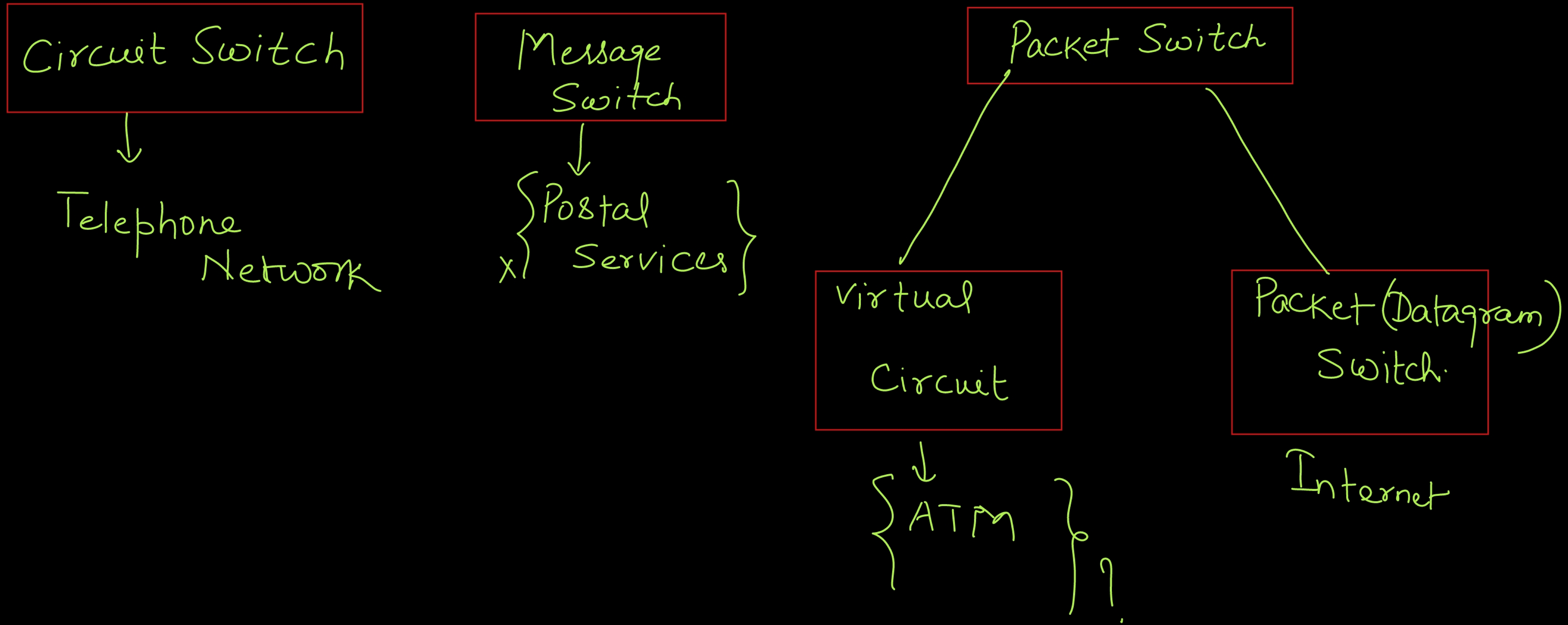
↓

Network layer

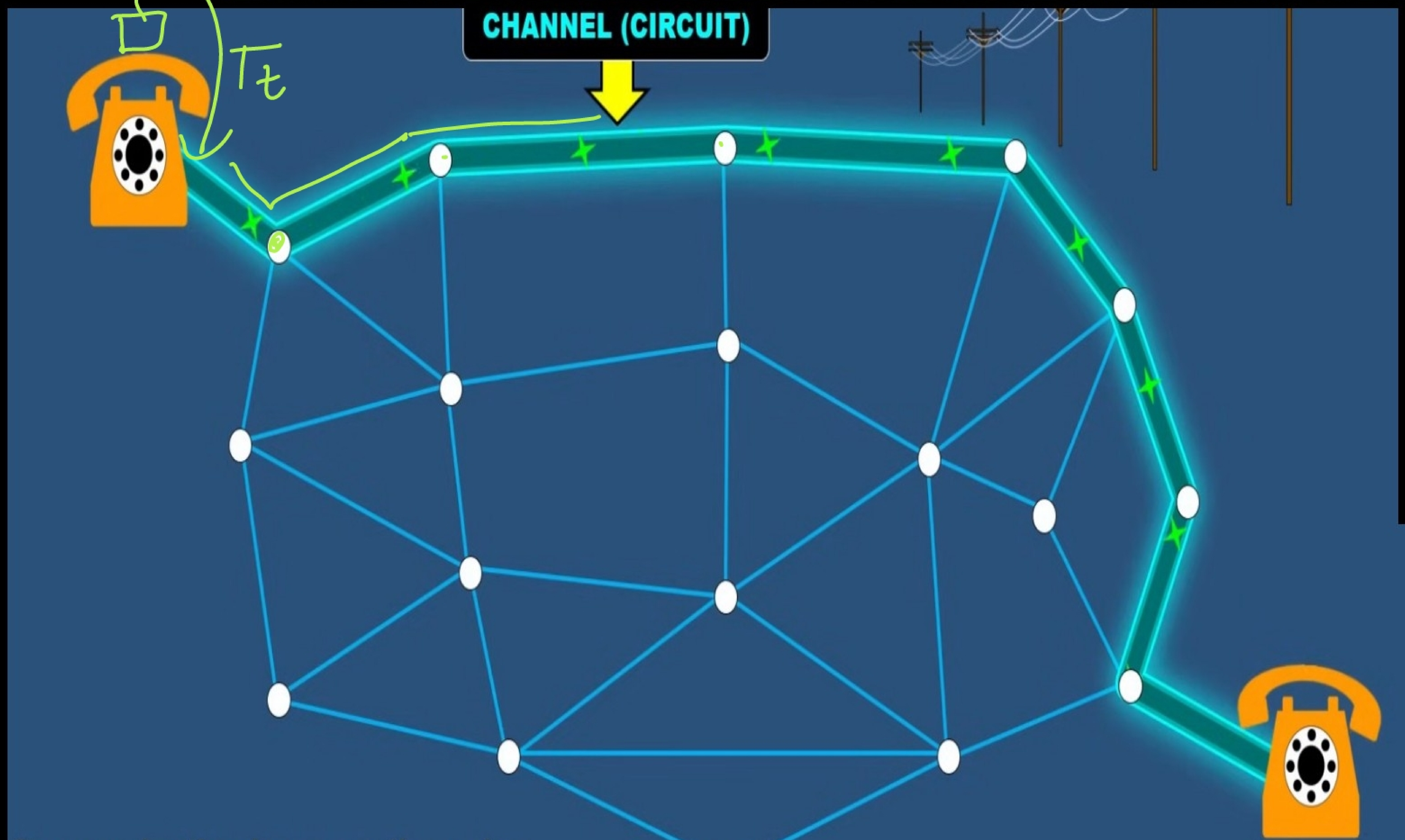
Lecture : 18

Gaurav Raj

Switching

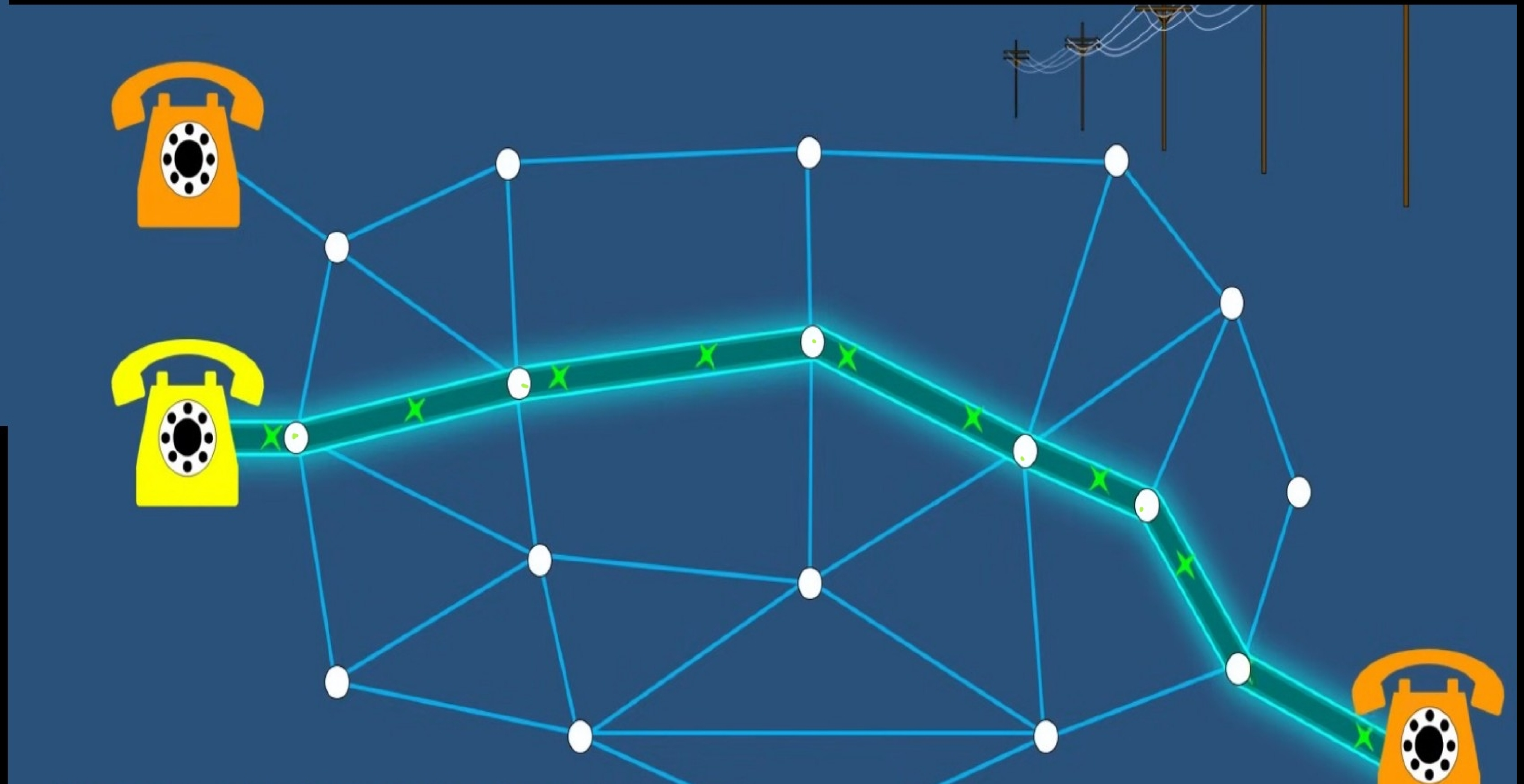

Circuit Switch
Telephone Network
Message Switch
Postal Services
x
Packet Switch
Virtual Circuit
ATM
?
Packet (Datagram) Switch
Internet

Circuit Switching

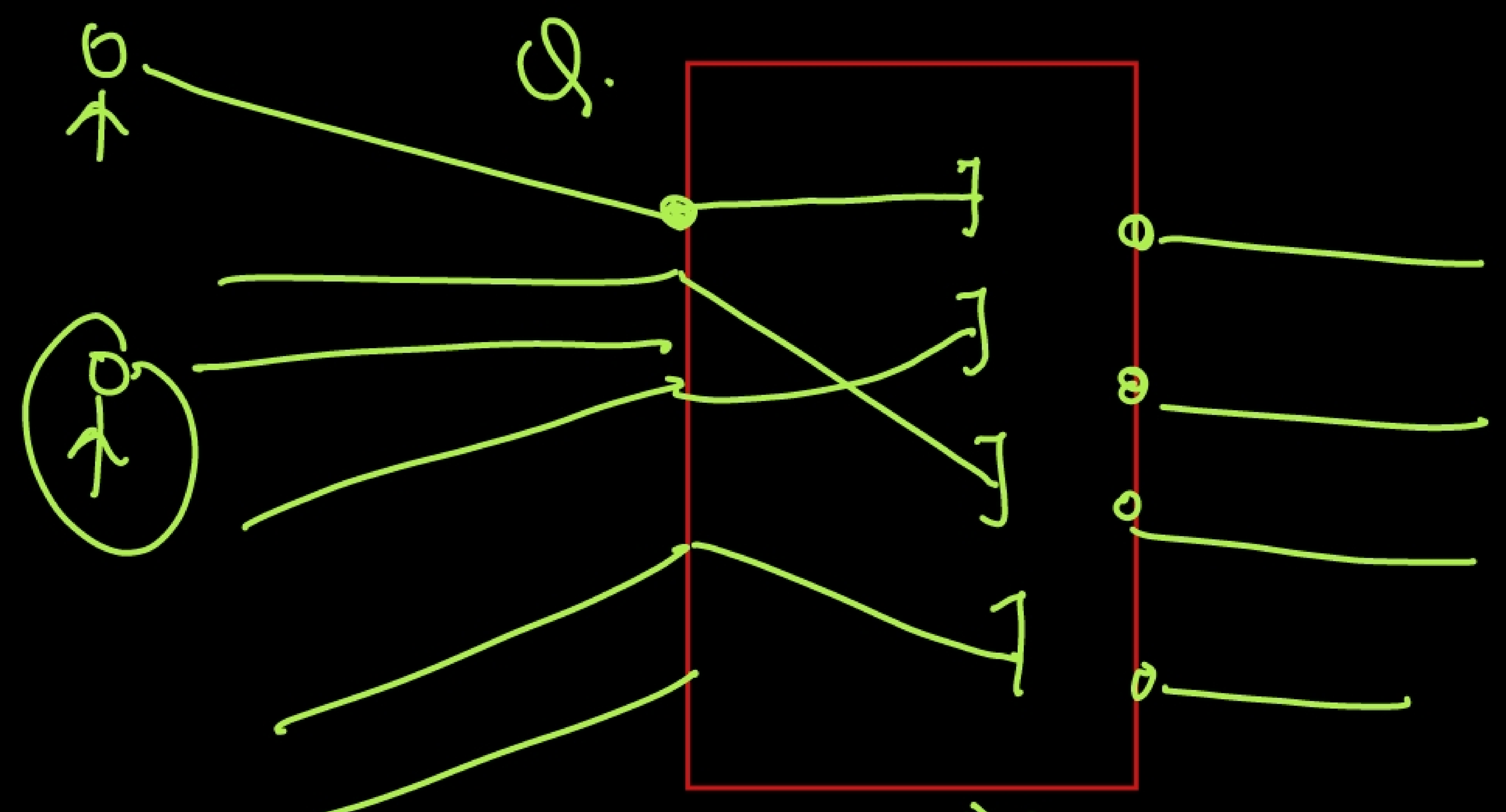


Communication happens through a **dedicated circuit** or **channel**.

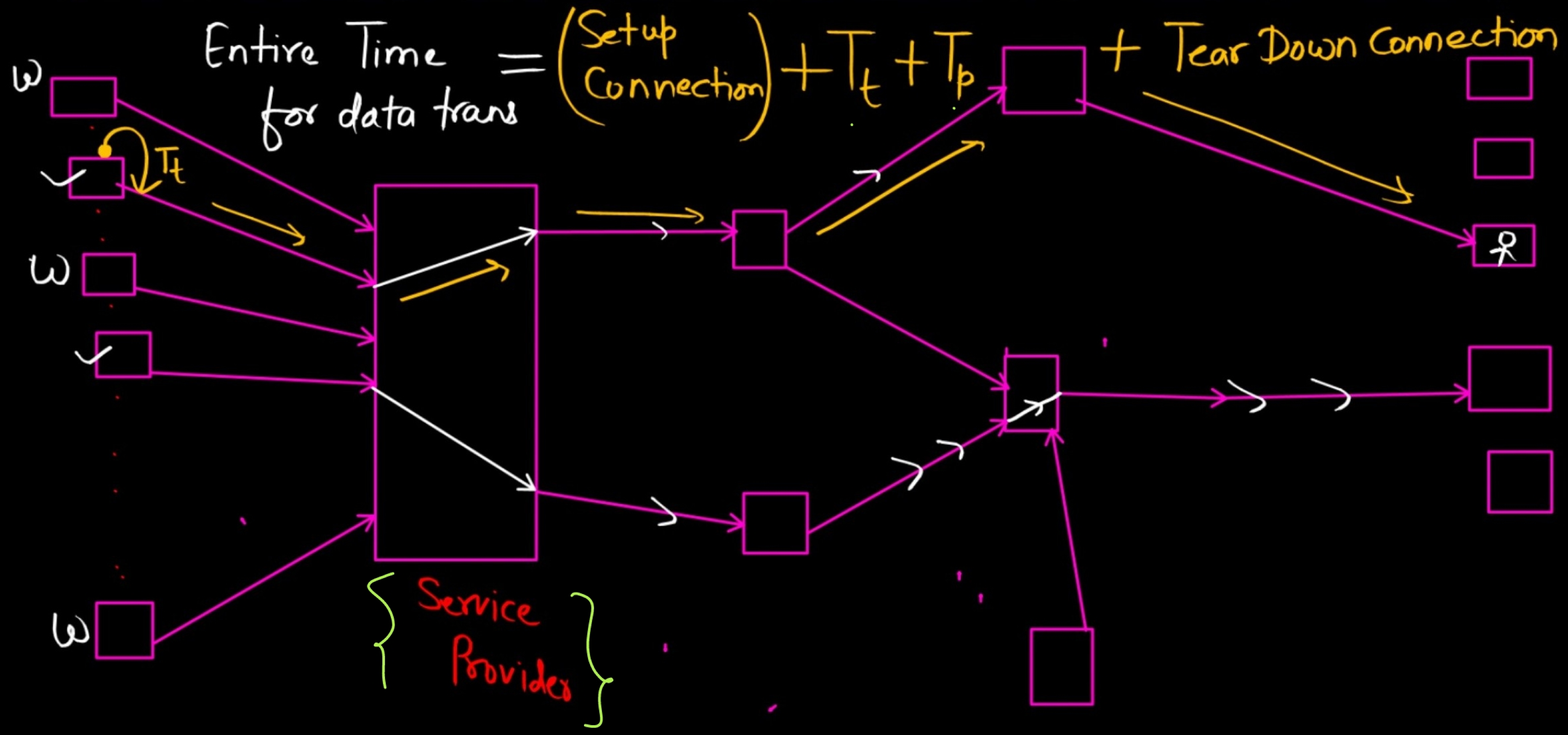
$$\text{Time (delay)} = \left\{ \begin{array}{c} \text{Set} \\ \text{up} \\ \text{Time} \end{array} \right\} + T_t + T_p + \left\{ \begin{array}{c} \text{Termi} \\ \text{nation} \end{array} \right\}$$



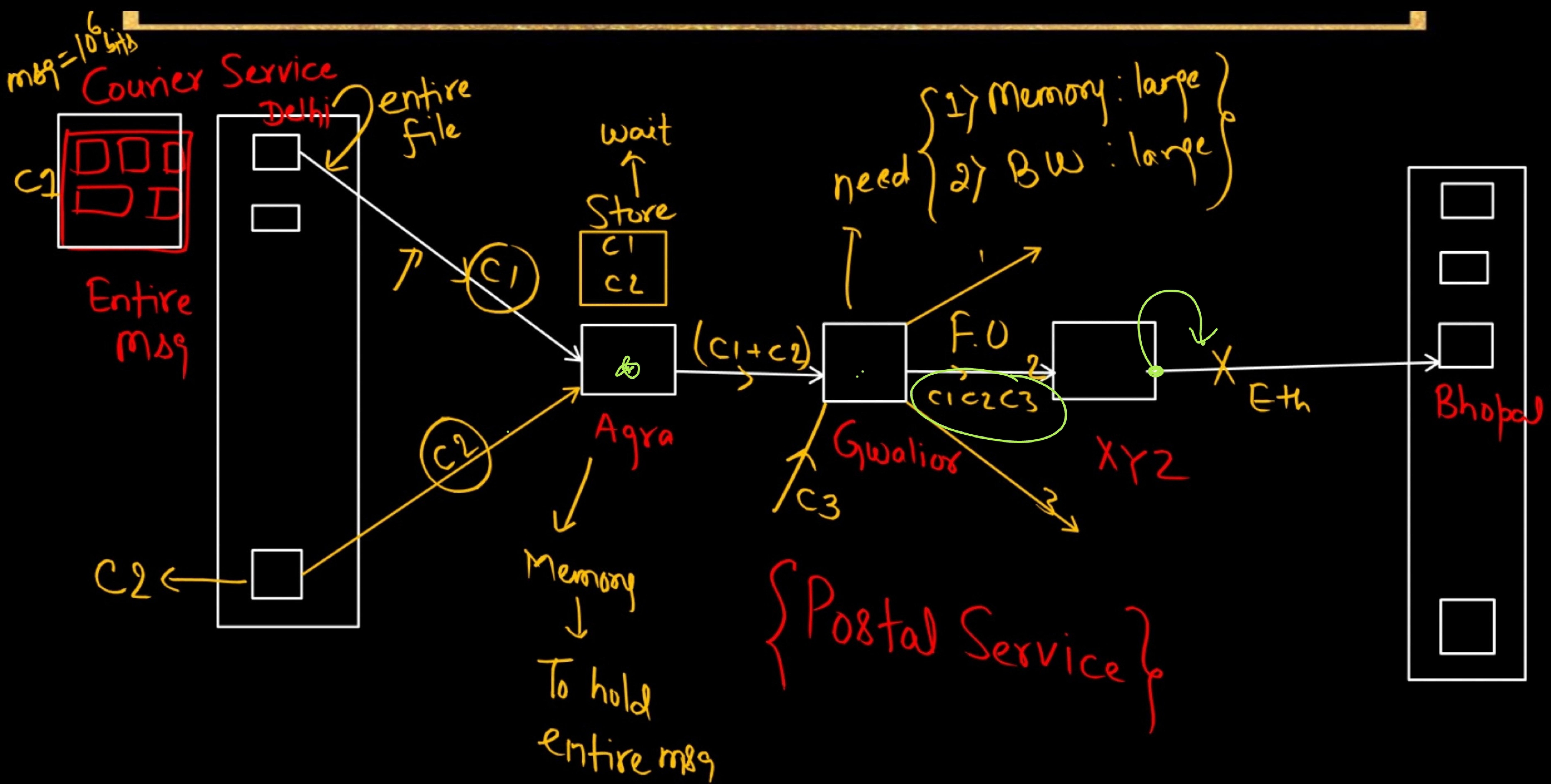
Once a session is over, the channel is terminated and made available to other devices to use.



Circuit Switching

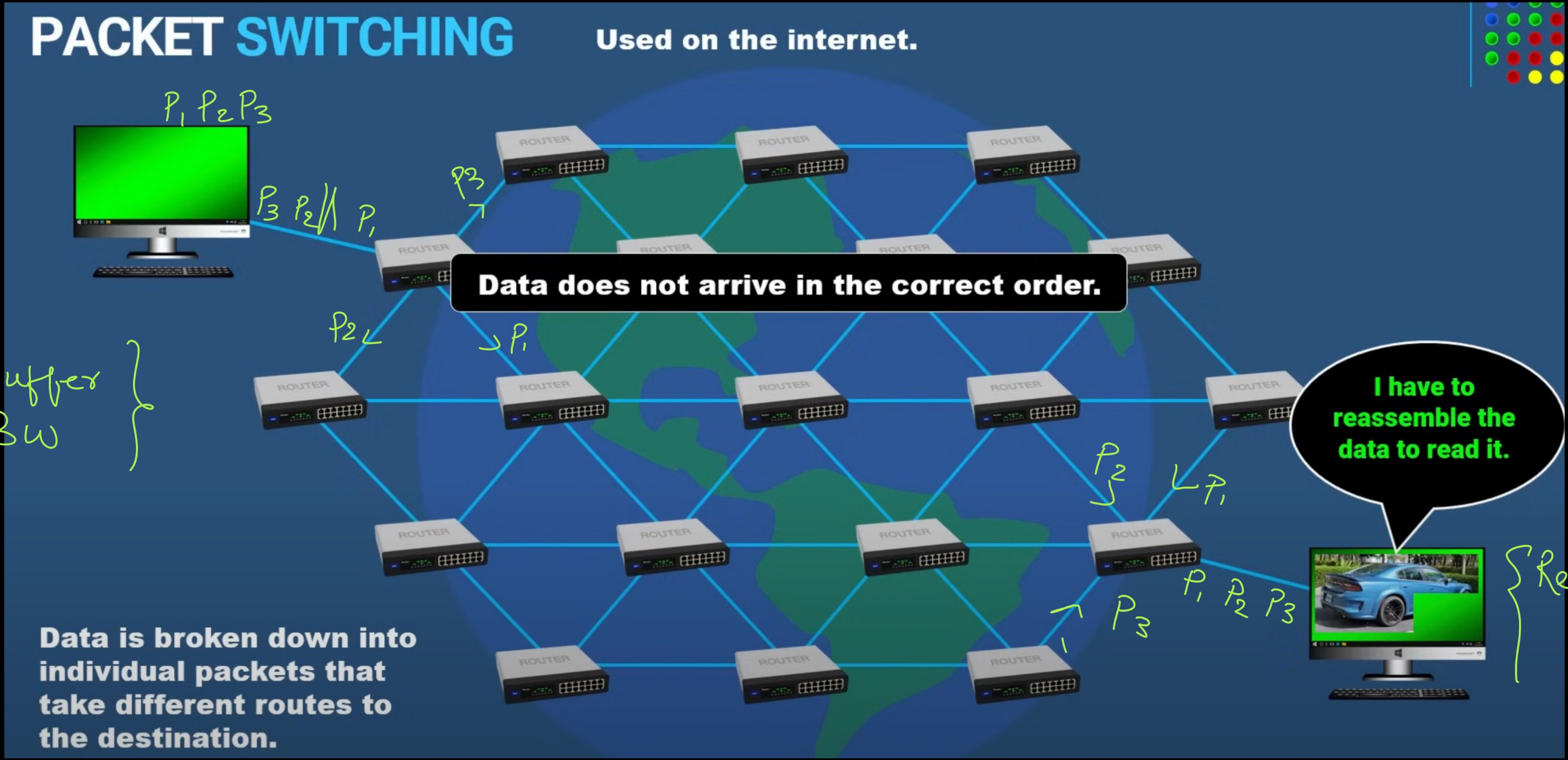


Message Switching



Packet Switching

N/w layer



R_i { Buffer
BW }

{ Reassembly }

Packet Switching: Datagram

Internet } → Datagram

MTU 1500

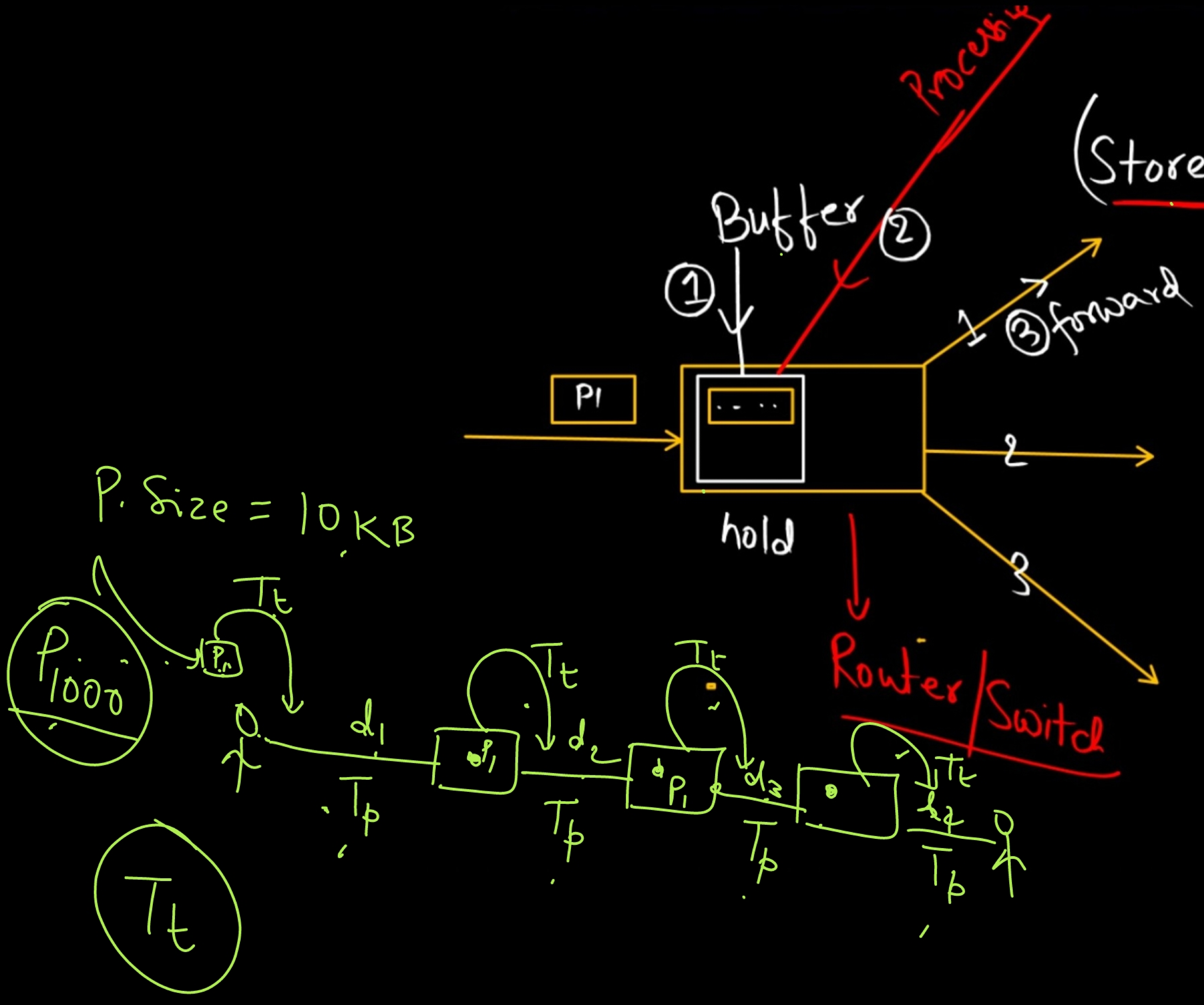
may be ordered

& may not be

T. Delay (1) $\{T_t + T_p\}$

$T.D(4)_K = \{(K-1)T_t + T_t + T_p\}$

Packet Switching: Datagram

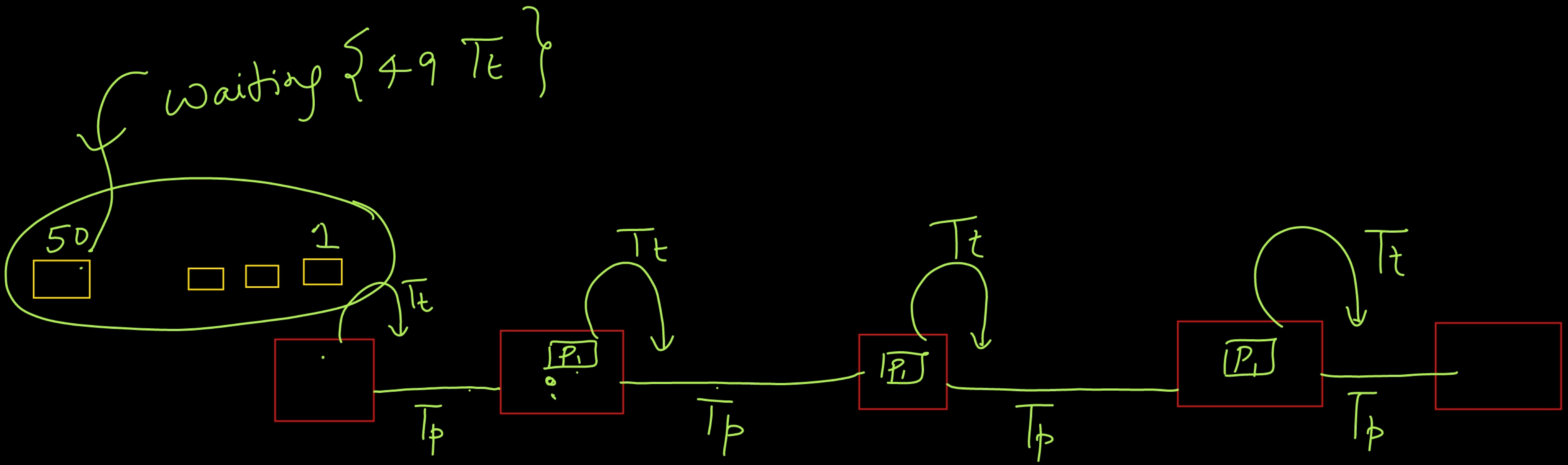


(Store n forward)

$$999 . t_t + \{4T_t + 4T_p\}$$

: One Node behavior

{ 4 links : BW
$T_p = 1$
link speed }

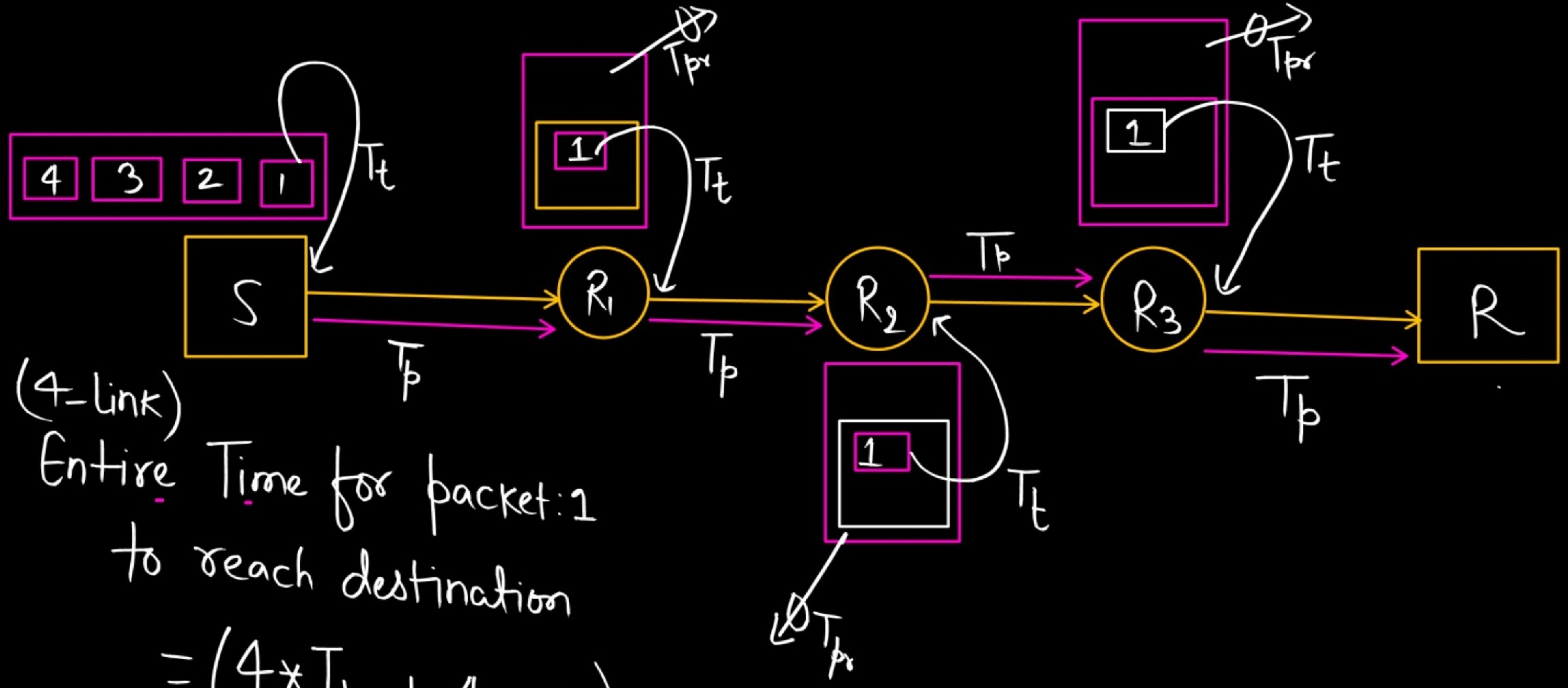


$$T.D(P_1) = \{4(T_t + T_p)\}$$

$$T.D(P_{50}) = \{\text{Waiting Time}\} + \{4(T_t + T_p)\}$$

$$= \{\underline{49\, T_t} + 4(T_t + T_p)\}$$

Packet Switching :Pipelining

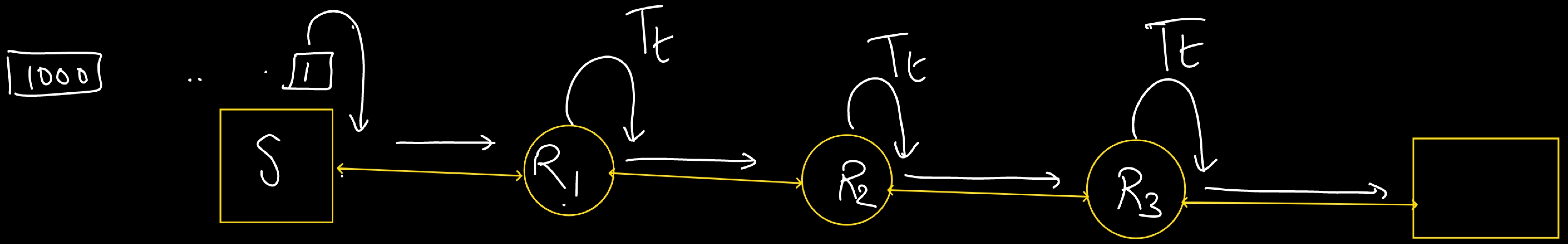


(4-Link)

Entire Time for packet: 1
to reach destination

$$= (4 * T_t + 4 * T_p)$$

Given file is split into **1000 packets**, each of size 1000 bytes. It is sent through **3 routers** (i.e., 4 links total), with each link having a bandwidth of **1 Mbps** and a propagation delay of **10 ms**.
Calculate **total time** to deliver all packets using **store-and-forward packet switching with pipelining**.



$T.D(1) = 4(T_t + T_p)$

$T_p = 10\text{ ms}$

$T.D(1000) = \omega.T. + T.D(1)$

$= \boxed{999(T_t) + 4(T_t + T_p)}$

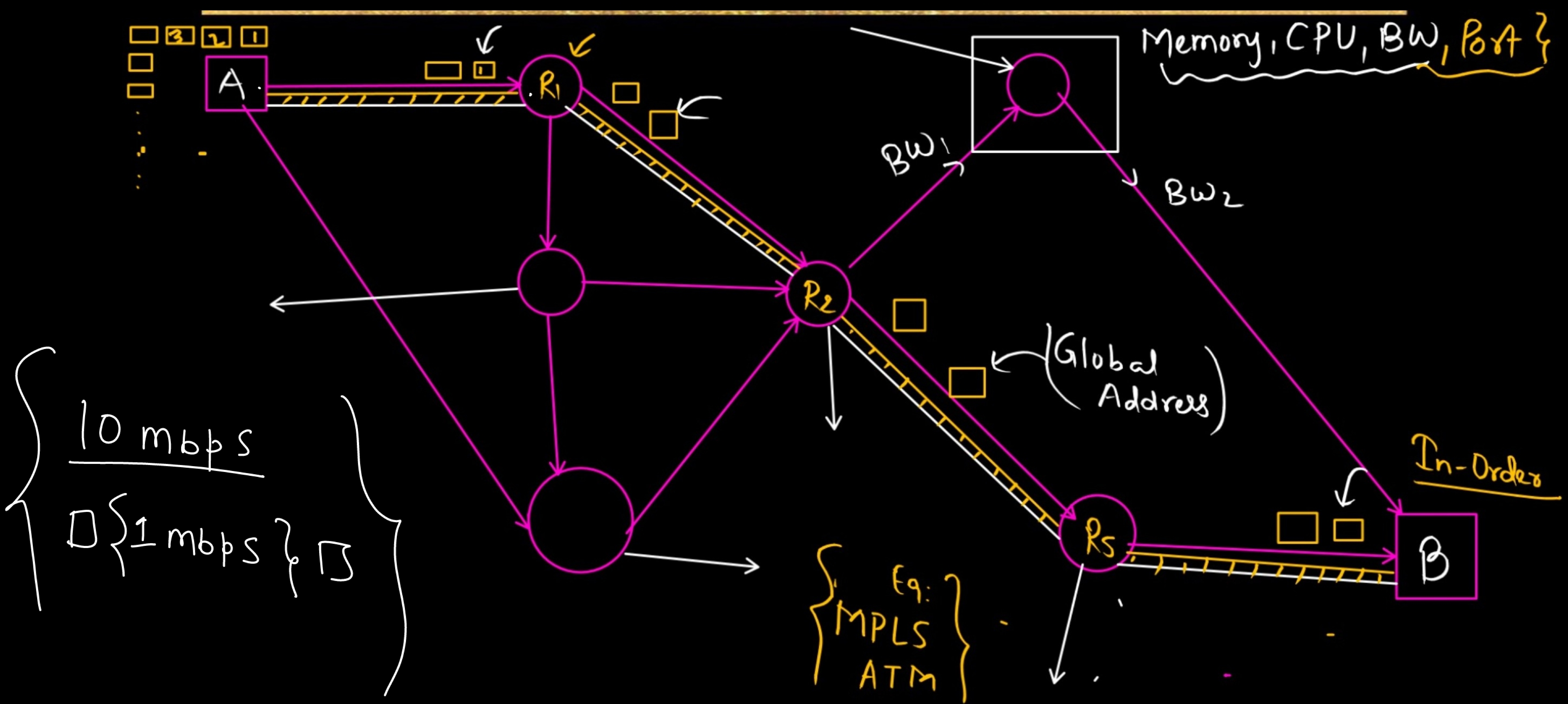
$= 8064\text{ ms}$

$T_t = \frac{1000 \times 8\ b}{10^6\ b} \times s$

$= 0.008\text{ sec}$

$= 8\text{ ms}$

Virtual Circuit Switching



Virtual Circuit Switching

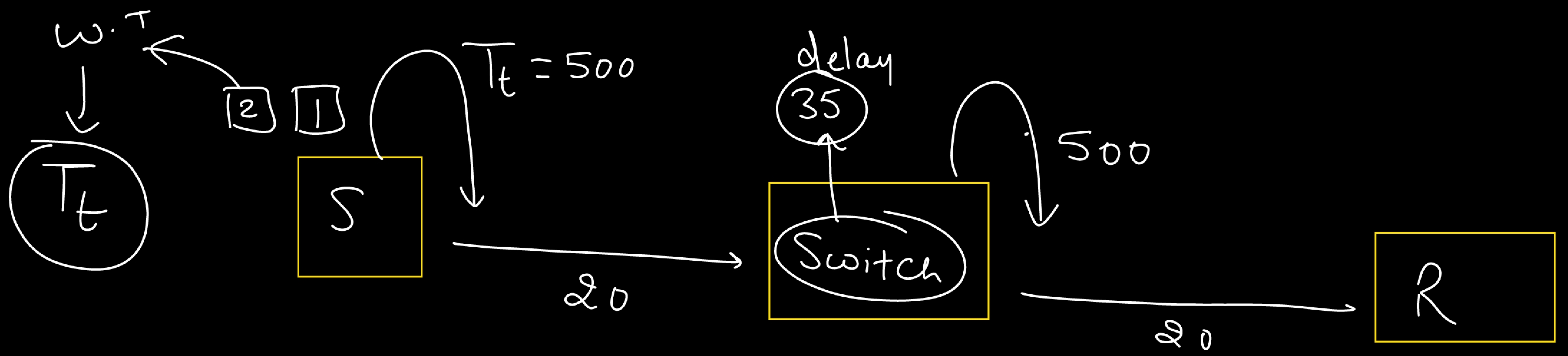
Router	In Port	In VCI	Out Port	Out VCI
R1	1	17	3	45
R2	3	45	2	22
R3	2	22	1	99

Switching

Feature / Type	Circuit Switching	Packet Switching (Datagram)	Packet Switching (Virtual Circuit)	Message Switching
Path Establishment	Required (Dedicated path setup before data)	No (Each packet takes independent route)	Required (Path established before sending data)	No path setup required
Resource Reservation	Yes (Fixed bandwidth, reserved end-to-end)	No	Yes (during VC setup)	No
Connection Type	Connection-oriented	Connectionless	Connection-oriented	Connectionless
Data Transmission Unit	Continuous stream or fixed-size data	Small packets (independent)	Small packets (same route)	Entire message sent at once
Switching Type	Physical circuit	Store-and-forward	Store-and-forward	Store-and-forward
Transmission Delay	Low (once circuit is established)	High (due to routing per packet)	Moderate (routing only once at setup)	High (entire message is stored at each node)
Setup Time	High (initial setup needed)	Zero	Moderate (initial VC setup)	Zero
Reliability	High (guaranteed path)	Lower (packets may be lost/reordered)	Moderate to High (path established)	High (entire message either goes or fails)
Congestion Control	Difficult (fixed resources)	Easier (can drop packets or reroute)	Easier (based on VC management)	Easier (entire message buffering possible)
Example	Traditional Telephone Networks	Internet (UDP/IP)	ATM, MPLS, X.25	Telegraphy, old email systems
Addressing	Once (during setup)	Per packet	Once (during VC setup)	Once (per message)
Use in Modern Internet	Rare	Widely used	Limited but still relevant in MPLS,ATM etc.	Rare

Two hosts are connected via a packet switch with 10^7 bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in microseconds is______________.

GATE 2015



$$T.D(1) = 500 + 20 + 35 + 500 + 20$$

$$T.D(2) = \underline{W.T} + \dots = 1575$$

Consider a LAN with four nodes S1, S2 , S3 and S4. Time is divided into fixed-size slots, and a node can begin its transmission only at the beginning of a slot. A collision is said to have occurred if more than one node transmit in the same slot. The probabilities of generation of a frame in a time slot by S1, S2, S3 and S4 are 0.1, 0.2, 0.3 and 0.4, respectively. The probability of sending a frame in the first slot without any collision by any of these four stations is ______________.

GATE 2015

Consider the store and forward packet switched network given below. Assume that the bandwidth of each link is 10^6 bytes / sec. A user on host A sends a file of size 10^3 bytes to host B through routers R1 and R2 in three different ways. In the first case a single packet containing the complete file is transmitted from A to B. In the second case, the file is split into 10 equal parts, and these packets are transmitted from A to B. In the third case, the file is split into 20 equal parts and these packets are sent from A to B. Each packet contains 100 bytes of header information along with the user data. Consider only transmission time and ignore processing, queuing and propagation delays. Also assume that there are no errors during transmission. Let T1, T2 and T3 be the times taken to transmit the file in the first, second and third case respectively. Which one of the following is CORRECT?

GATE 2014

A. $T1<T2<T3$

B. $T1>T2>T3$

C. $T2=T3, T3<T1$

D. $T1=T3, T3>T2$

Consider a source computer (S) transmitting a file of size 10^6 bits to a destination computer (D) over a network of two routers (R1 and R2) and three links (L1, L2, and L3). L1 connects S to R1; L2 connects R1 to R2; and L3 connects R2 to D. Let each link be of length 100 km. Assume signals travel over each link at a speed of 10^8 meters per second. Assume that the link bandwidth on each link is 1Mbps. Let the file be broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D?

GATE 2012

Consider a token ring network with a length of 2km having 10 stations including a monitoring station. The propagation speed of the signal is $2x10^8$ m/s and the token transmission time is ignored. If each station is allowed to hold the token for 2 μsec, the minimum time for which the monitoring station should wait (in μsec) before assuming that the token is lost is _______.

GATE 2014

Thank You