Switching & Types - Part III and Doubt Clearing Session

Complete Course on Computer Networks - Part II

Ravindrababu Ravula • Lesson 8 • Feb 27, 2021

FRAMING

FIXED LENGTH

Here the size of the frame is fixed and so the frame length acts as delimiter of the frame. Consequently, it does not require additional boundary bits to identify the start and end of the frame.

VARIABLE LENGTH

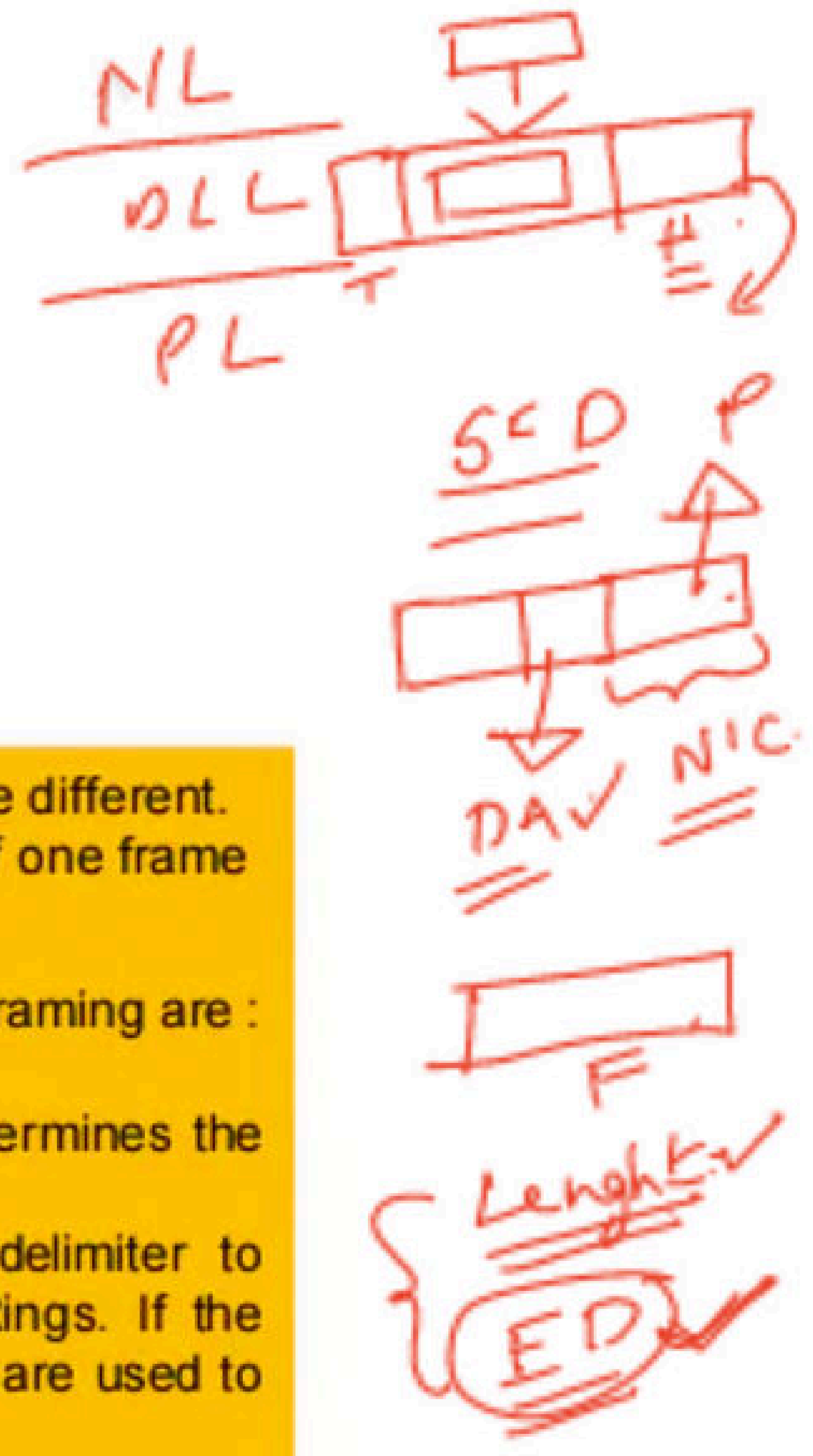
Here, the size of each frame to be transmitted may be different. So additional mechanisms are kept to mark the end of one frame and the beginning of the next frame.

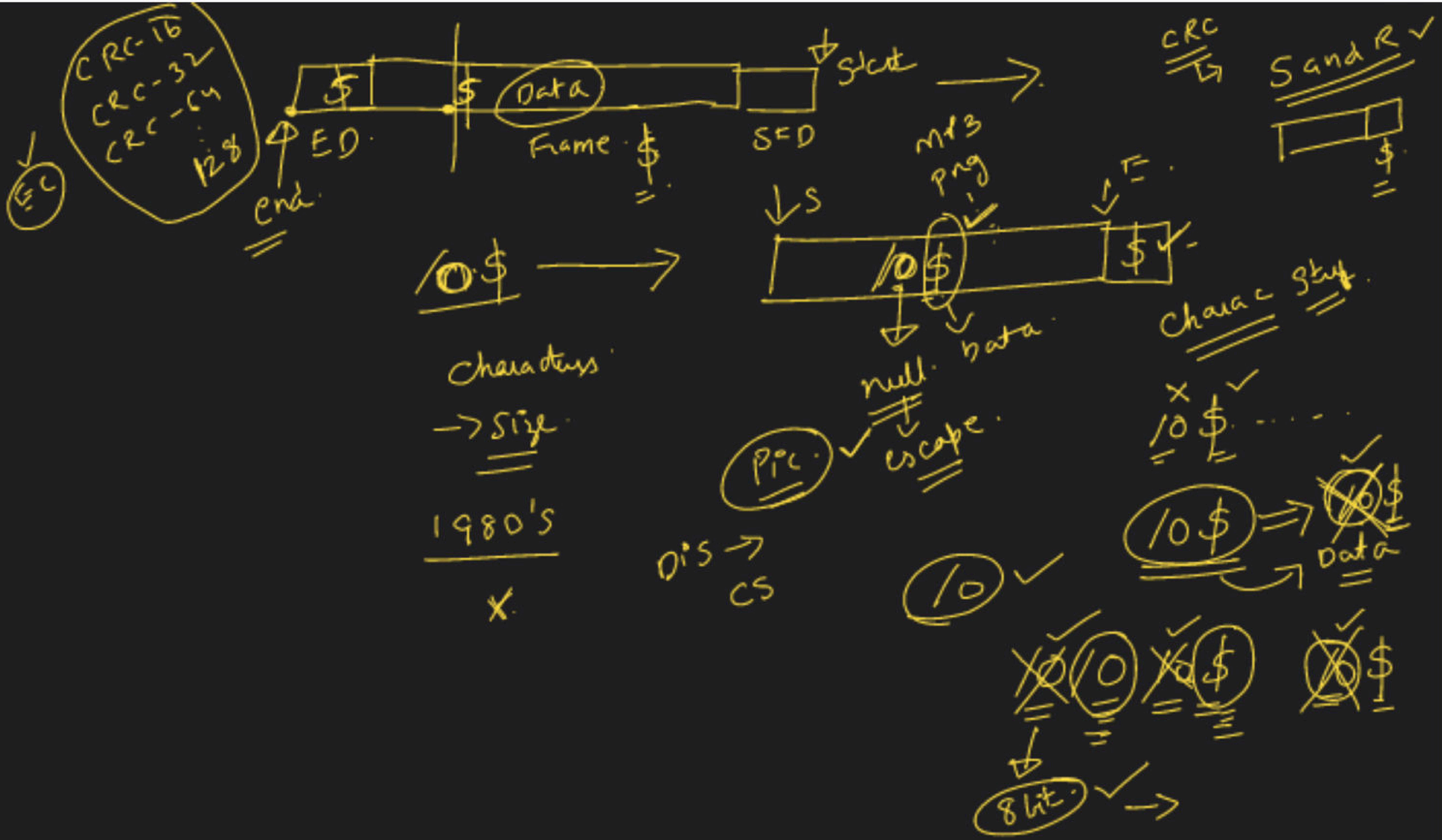
Two ways to define frame delimiters in variable sized framing are :

•**Length Field** – Here, a length field is used that determines the size of the frame. It is used in Ethernet (IEEE 802.3).

•**End Delimiter** – Here, a pattern is used as a delimiter to determine the size of frame. It is used in Token Rings. If the pattern occurs in the message, then two approaches are used to avoid the situation –

- **Character-Stuffing** – A byte is stuffed in the message to differentiate from the delimiter. This is also called character-oriented framing.
- **Bit – Stuffing** – A pattern of bits of arbitrary length is stuffed in the message to differentiate from the delimiter. This is also called bit – oriented framing.





CRC-16
CRC-32
CRC-64
128
EC
$
$ Data
ED
end
Frame
$
SFD
Start
CRC
S and R
$
mp3
png
S
E
/0$
/0 $
$
null
escape
Data
Charac stuy
Characters
→ Size
1980's
X
Pic
DIS → CS
X
/0$
/0$
/0$
Data
/0
/0$
8 bit

SFD 01111		01111

start

stop

end

01111 → pattern → end of the packet

pattern ↓ Binary pattern

End

Sol: Break the pattern.

01011 1 × ✓ I

01'011 × ✓ II

0111'01 × ✓ III ✓

→ ? ✓

000

0 1 1 1 1 → Broken.

Sender

01111

0111[0]1

add

Rec:

01111[0].

Remove.

01111 $\xrightarrow[\text{stuff}]{\text{Bit}}$ 0111[0]1 $\xrightarrow{\text{Sent}}$ 0111[0]1

01110 1 $\xrightarrow{\text{Send}}$ 0111[0]1 → Remove.

0111[0] ✓

Remove

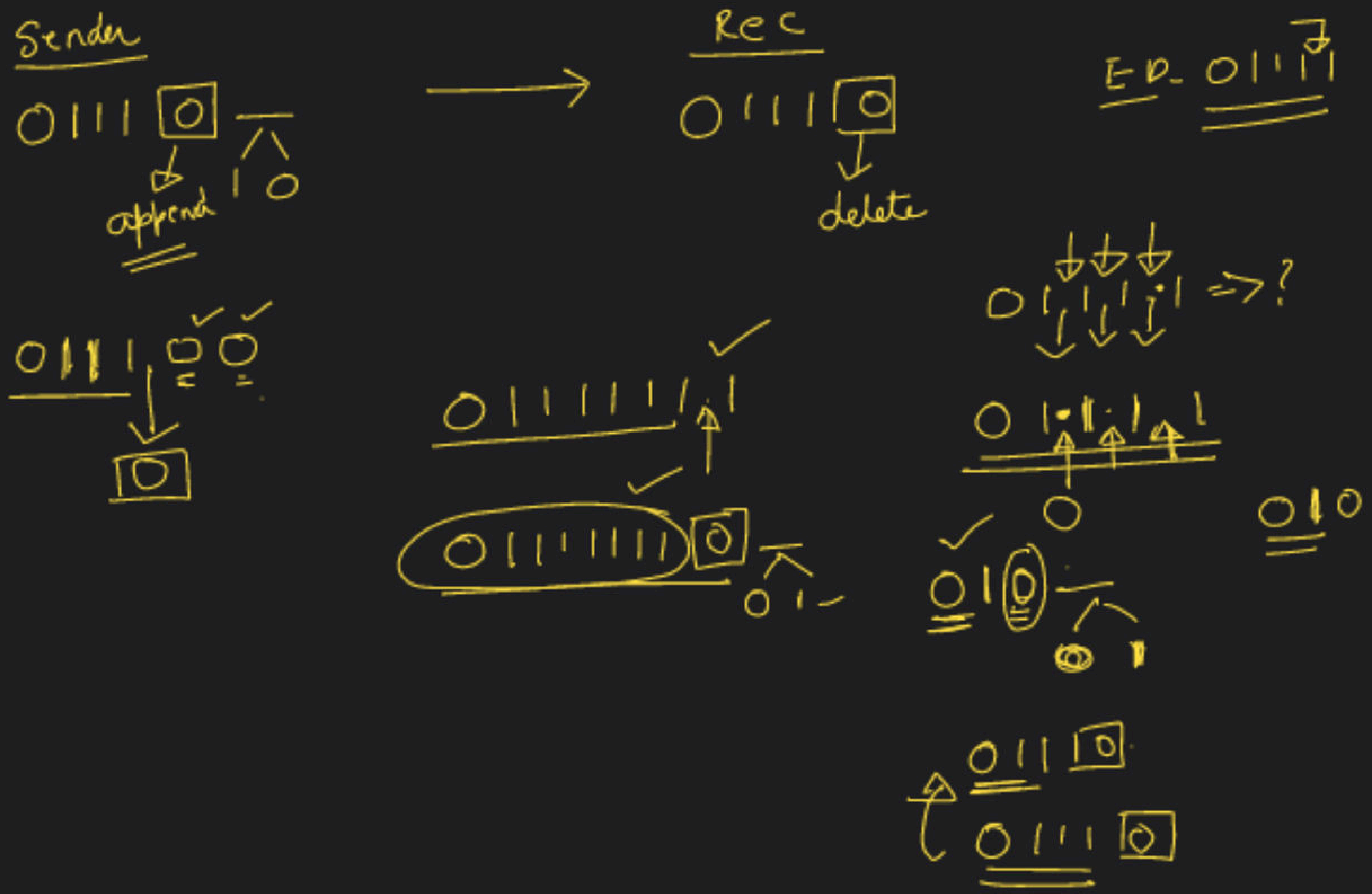
01110 0

01111 ✓

0 ✓

0111 1 0 ✓

0



Sender
Rec
ED- 01111
0111 0
append
delete

GATE 2004 IT

In a data link protocol, the frame delimiter flag is given by 0111. Assuming that bit stuffing is employed, the transmitter sends the data sequence 01110110 as

A. 01101011

B. 011010110

C. 011101100

D. 0110101100

0111

$0110\boxed{0}$

ED: 1,0's

N/W: → special encoding

Rule

10000 →

$1000\boxed{1}$

CS ✗

BS ✓

DL: 01 ------

10 ------

ED ✓

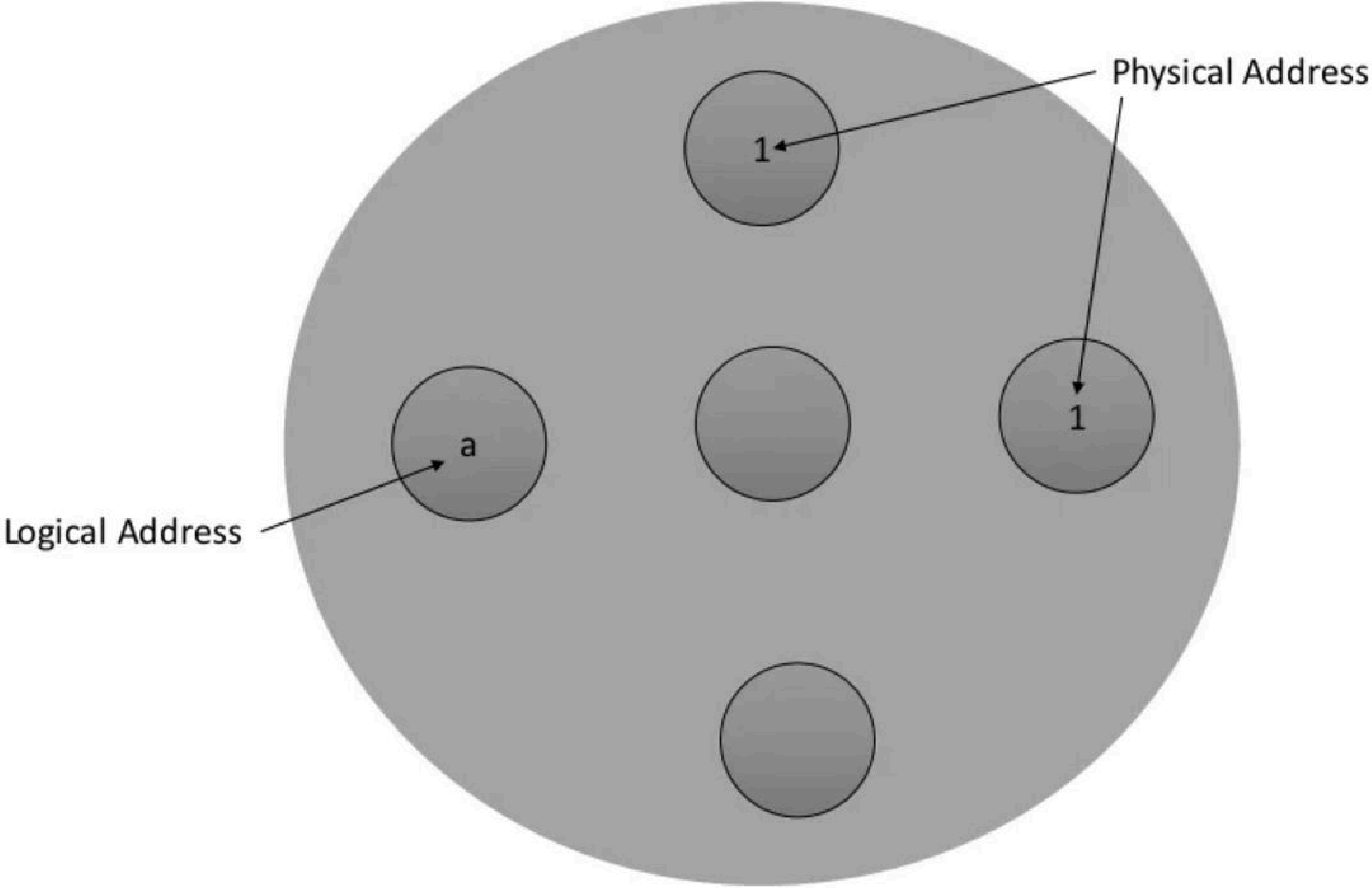
data → bit stuff

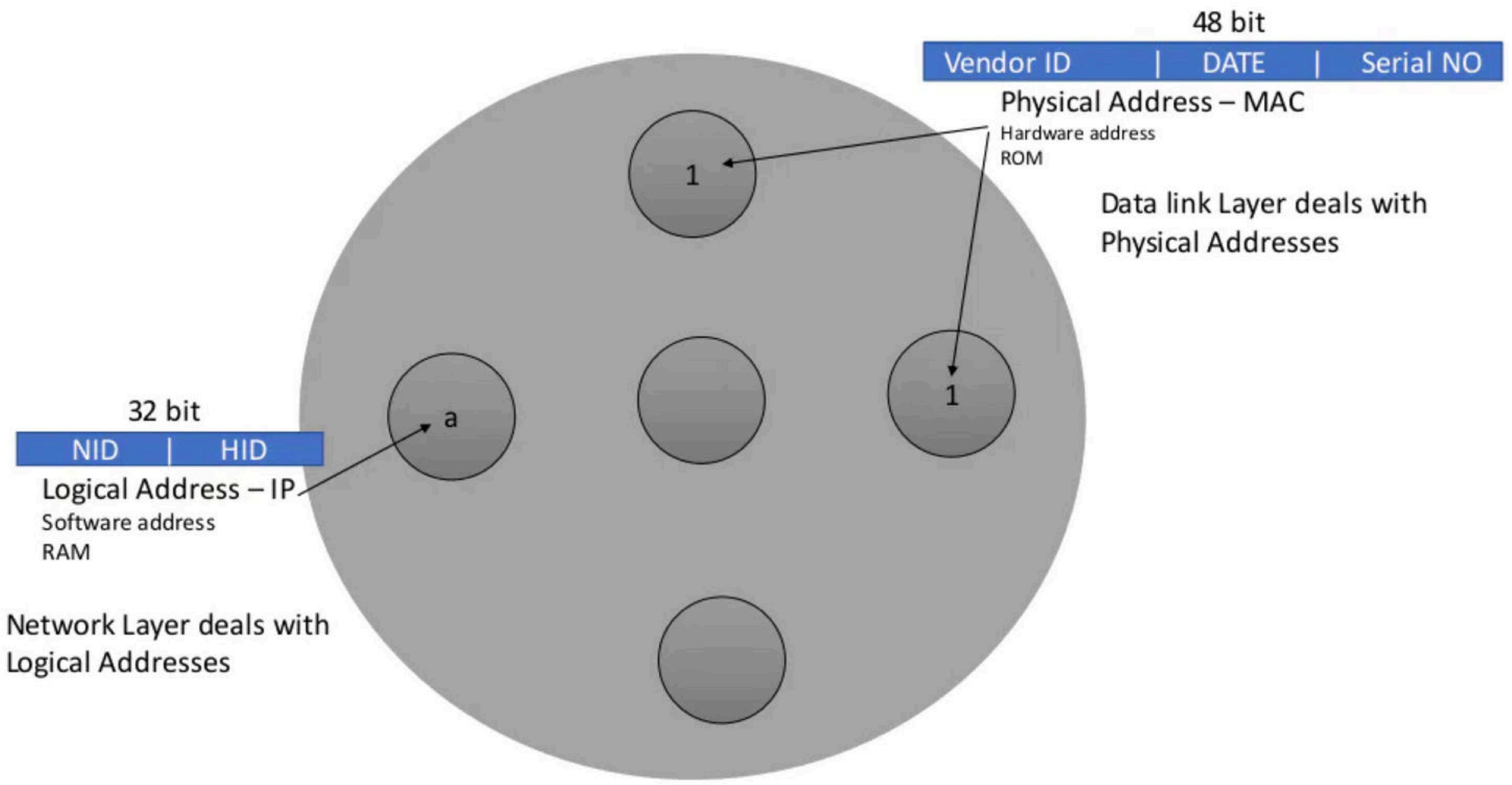
In the data link layer, bits stuffing is employed then bit stuffing is done using the flag delimiter. If there is a flag of n bits then we will compare the data sequence with the flag and for every n-1 bits matched found, a bit 0 is stuffed in the data sequence.
Thus using the above logic,
Delimiter flag: 0111
Data sequence: 01110110
So, for a flag of 4 bits we will compare data sequence with a pattern of 3 bits, i.e., 011.
0 1 1 0 1 0 1 1 0 0
In the above pattern the underlined bits are found matched. Hence, 0 in italics is stuffed. Thus resulting in the data sequence as 0110101100

Computer Networks

Data Link Layer

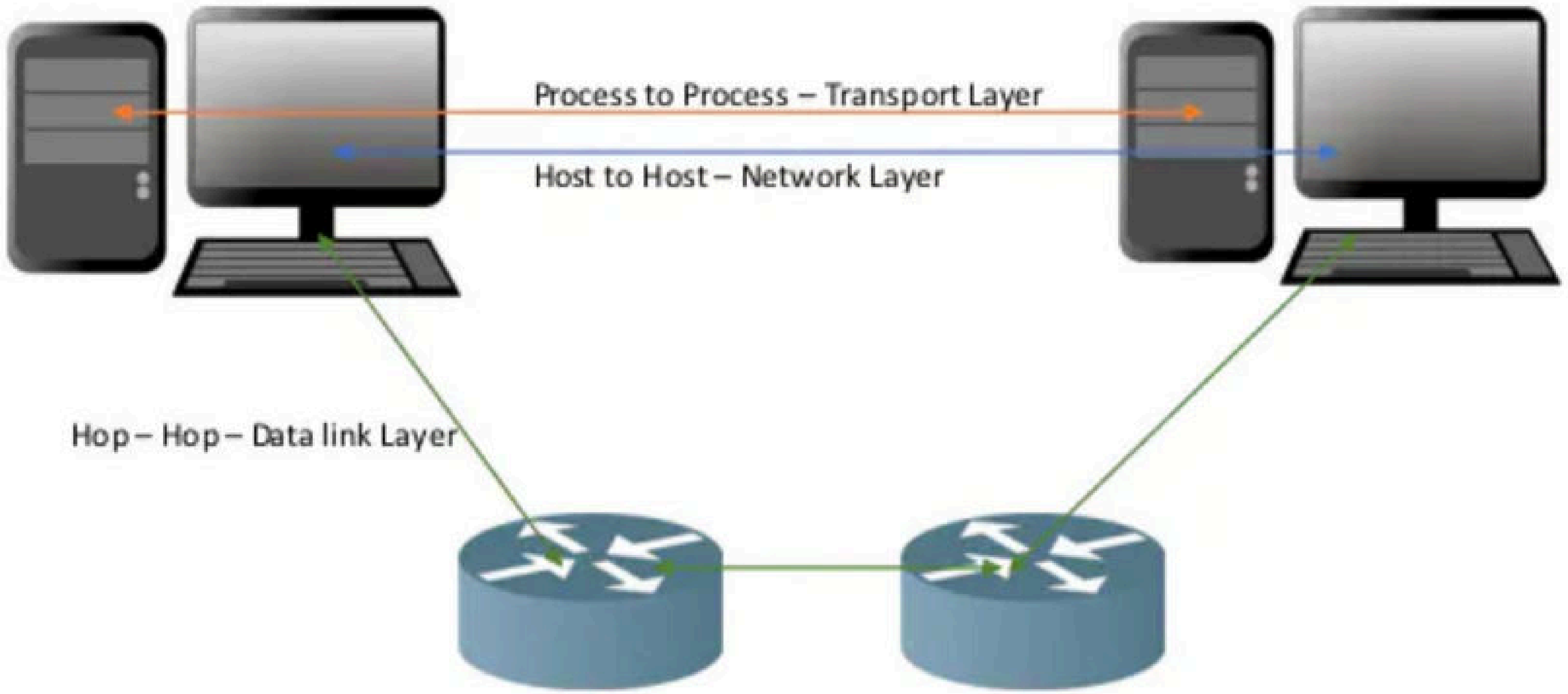
Understanding Addresses




48 bit
Vendor ID | DATE | Serial NO
Physical Address – MAC
Hardware address
ROM
Data link Layer deals with Physical Addresses
1
1
a
32 bit
NID | HID
Logical Address – IP
Software address
RAM
Network Layer deals with Logical Addresses

Computer Network

Network Layer


Process to Process – Transport Layer
Host to Host – Network Layer
Hop – Hop – Data link Layer

Functions of Network Layer

- Host to Host Connectivity
- Logical Addressing
- Switching
- Routing

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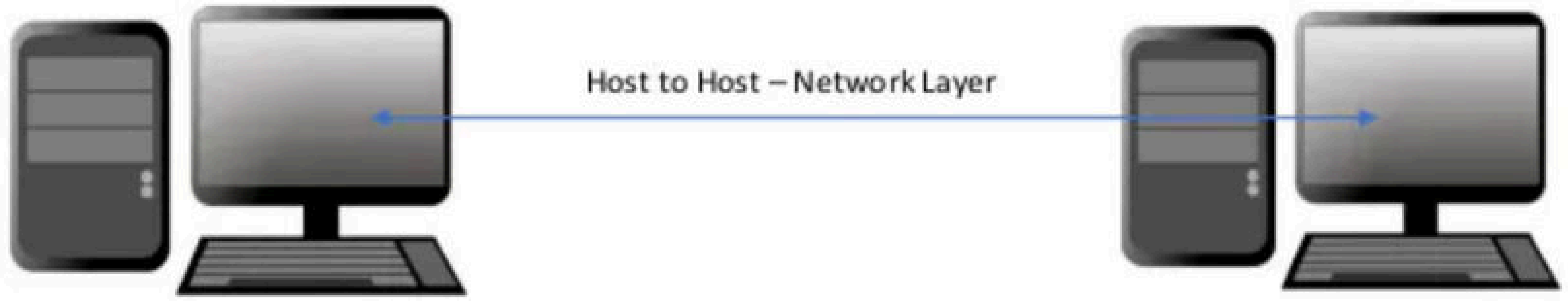


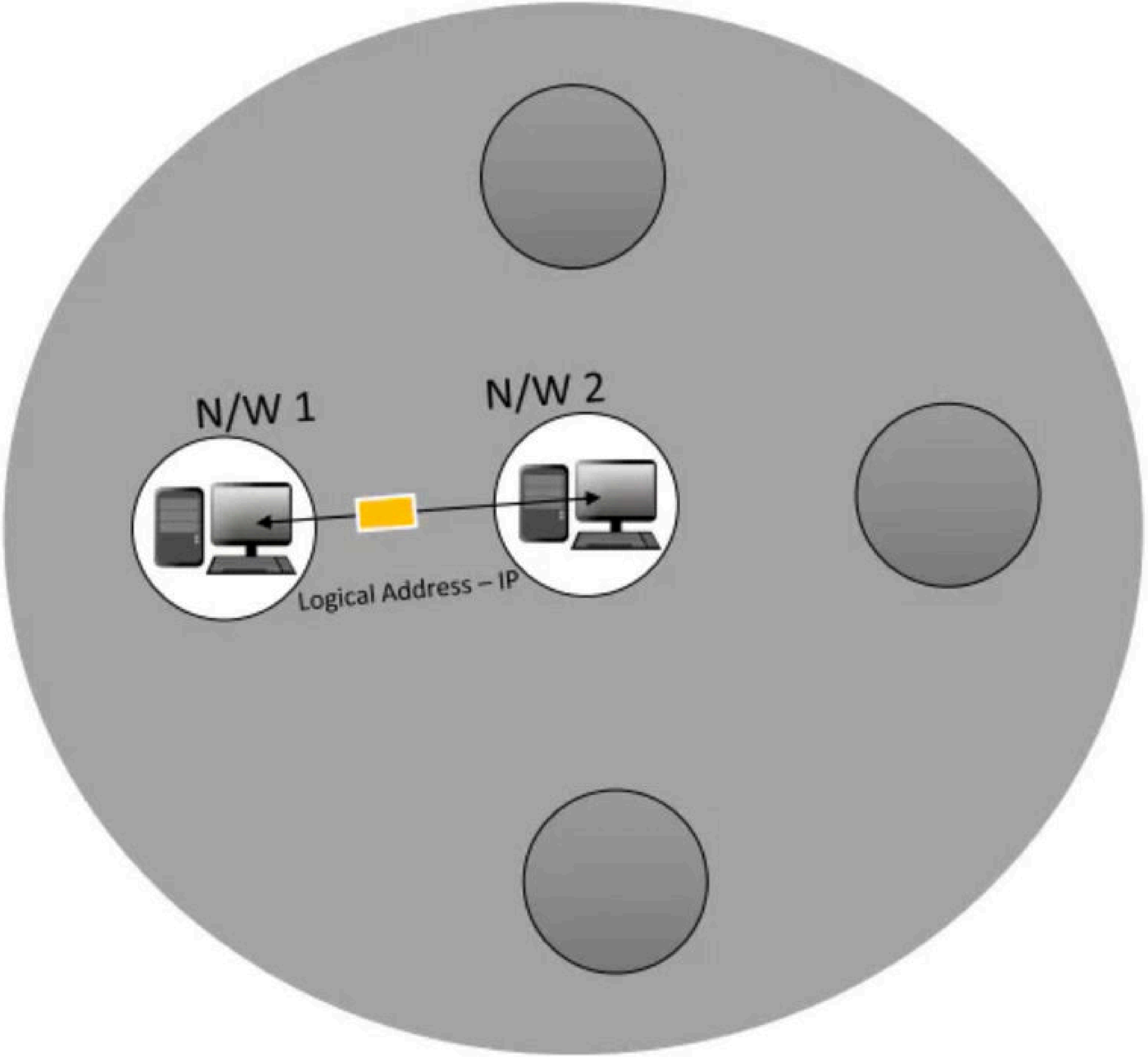
Functions of Network Layer

Host to Host Connectivity

Logical Addressing

Switching

Routing



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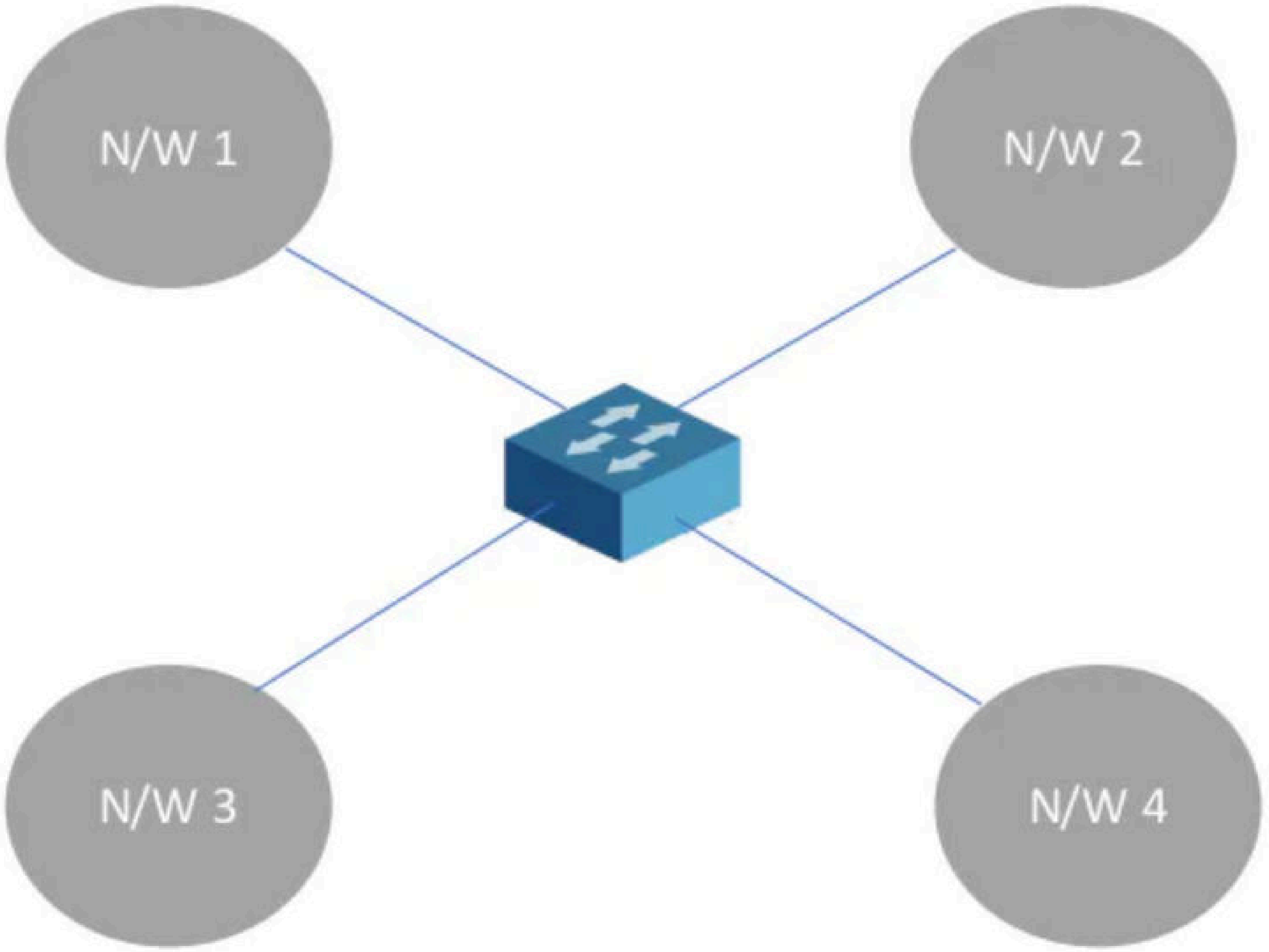

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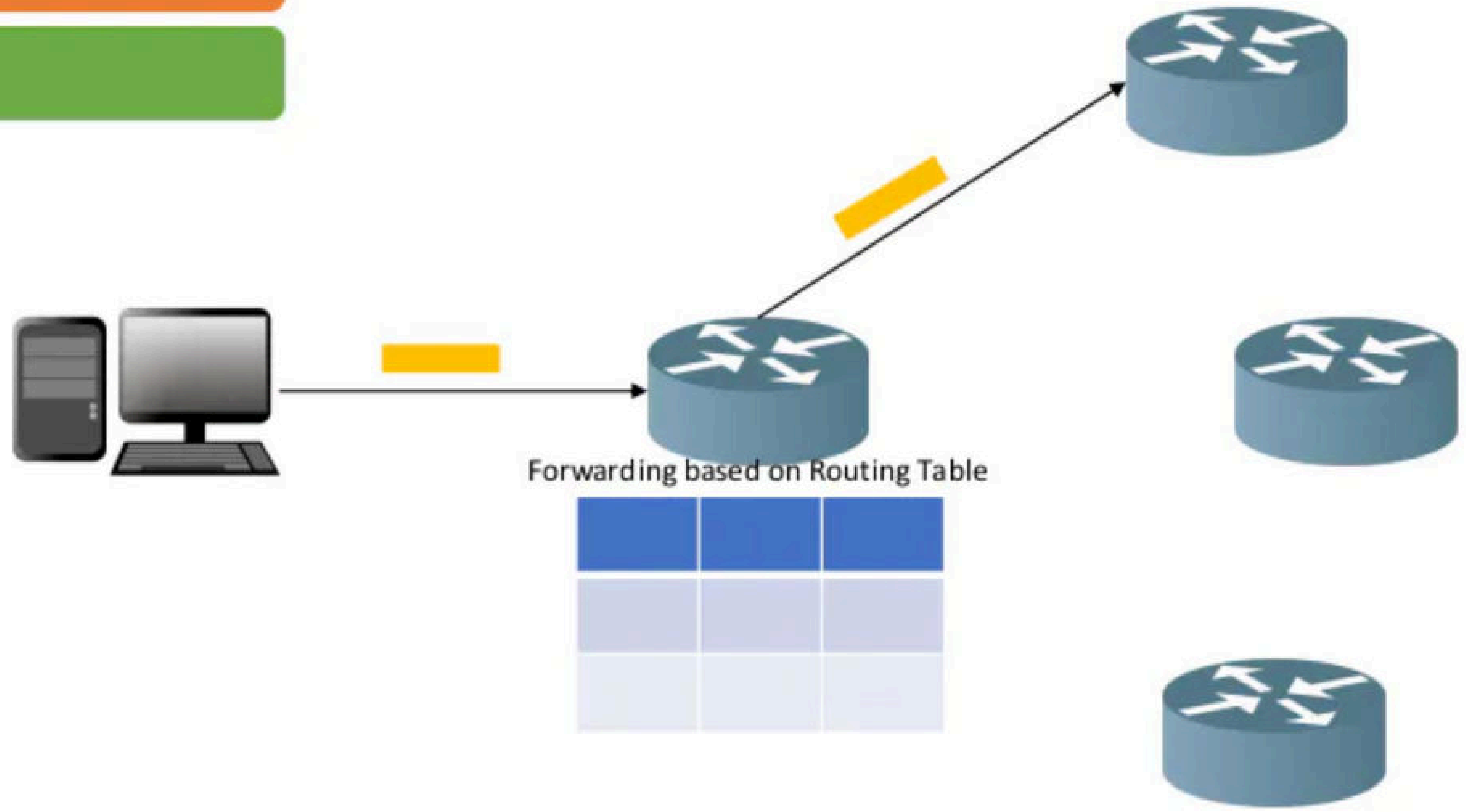

Computer Networks

GATE QUESTIONS

1.) An organization requires a range of IP addresses to assign one to each of its 1500 computers. The organization has approached an Internet Service Provider (ISP) for this task. The ISP uses CIDR and serves the requests from the available IP address space 202.61.0.0/17. The ISP wants to assign an address space to the organization which will minimize the number of routing entries in the ISP's router using route aggregation. Which of the following address spaces are potential candidates from which the ISP can allot any one to the organization? [GATE 2020]

I. 202.61.84.0/21

II. 202.61.104.0/21

III. 202.61.64.0/21

IV. 202.61.144.0/21

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I. 202.61.84.0/21
II. 202.61.104.0/21
III. 202.61.64.0/21
IV. 202.61.144.0/21

Solution: Option C

Given CIDR IP is 202.61.0.0/17 and for HID 32 - 17 = 15 bits can be used.
And to Assign an IP address for 1500 computer, we require 11 bit from HID part.
So NID + SID = 17 + 4 = 21 bits and HID = 11 bits
NID HID
202.61.0 0000 000.00000000
So, from the given option, possible IP Address is
I. 84 - >0 1010 100 (Because in HID bit 1 is not possible)
II. 104 ->0 1101 000
III. 64 -> 0 1000 000
IV. 144->1 0010 000 (Because in NID bit 1 is not possible)

2.) A computer network uses polynomials over GF(2) for error checking with 8 bits as information bits and uses x3 + x + 1 as the generator polynomial to generate the check bits. In this network, the message 01011011 is transmitted as [GATE 2017]

A	01011011010
B	01011011011
C	01011011101
D	01011011100

Solution:

Given CRC generator polynomial = x3+x+1

= 1·x3+0·x2+1·x1+1·x0

=1011

Message =01011011

```
1011 | 01011011000 | 01000011
     ⊕ 0000
       01011
        1011
        00000
         0000
         00001
          0000
          00011
           0000
           00110
            0000
            01100
             1011
             01110
              1011
              0[101]  CRC
```

So, the message 01011011 is transmitted as $\boxed{0101\ 1011\ 101}$

3.)The value of parameters for the Stop-and-Wait ARQ protocol are as given below:

Bit rate of the transmission channel = 1 Mbps.
Propagation delay from sender to receiver = 0.75 ms.
Time to process a frame = 0.25 ms.
Number of bytes in the information frame = 1980.
Number of bytes in the acknowledge frame = 20.
Number of overhead bytes in the information frame = 20.

Assume that there are no transmission errors. Then, the transmission efficiency (expressed in percentage) of the Stop-and-Wait ARQ protocol for the above parameters is _________ (correct to 2 decimal places). [GATE 2017]

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Solution:
Given Data:
B = 1Mbps, L = 1980Bytes, Overhead = 20Bytes
TProc = 0.25ms, LAck = 20Bytes
Tp=0.75ms
Total Data size(L) = (L + overhead) = 1980+20 = 2000Bytes
Efficiency of Stop & Wait ARQ?
Tt = L/B = 2000Bytes/1Mbps = (2000×8bits)/(106 b/s) = 16msec
TAck = LAck/B = (20×8bits)/(106 bits/sec) = 0.16msec
∴ In Stop and Wait ARQ, efficiency
η = Tt/(Tt+TAck+2Tp+TProc) = 16ms/(16+0.16+2×0.75+0.25ms)
= 16ms/17.91ms = 0.8933 ≈ $\boxed{89.33\%}$

4.)A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames. Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps (1Kbps = 1000 bits/second). Size of an acknowledgement is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds.

Assuming no frame is lost, the sender throughput is _________ bytes/second. [GATE 2016]

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Assuming no frame is lost, the sender throughput is _________ bytes/second. [GATE 2016]

Solution:
Given,
Frame size (L) =1000 bytes
Sender side bandwidth (BS) = 80 kbps = 10 * 103 bytes/sec
Acknowledgement size (LA) =100 bytes
Receiver side bandwidth (BR) = 8 kbps = 1 * 103 bytes/sec
Propagation delay (Tp) =100 ms
By formula:
Transmission delay (Tt) = L/BS = 1000 bytes / 10 * 103 bytes/sec = 100 ms
Acknowledge delay (Tack) = LA / BR = 100 bytes / 1 * 103 bytes/sec = 100 ms
Total cycle time = Tt + 2 * Tp + Tack = 100 ms + 2 * 100 ms + 100 ms = 400 ms
Efficiency (η) = Tt / Total cycle time = 100 ms / 400 ms = 1 / 4 = 0.25
Throughput = Efficiency (η) * Bandwidth (BS) = 0.25 * 10 *103 bytes/s = 2500 bytes/second

5.) A network has a data transmission bandwidth of 20×106 bits per second. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 40 microseconds. The minimum size of a frame in the network is _________ bytes. [GATE 2016]

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Solution:

For frame size to be minimum, its transmission time should be equal to twice of one way propagation delay. i.e, Tt = 2 × TP

Given,

Bandwidth (B) = 20 × 106 bps

TP = 40 μs ⇒ 40 × 10- 6 sec

Suppose minimum frame size is L.

Tt = 2 × TP ⇒ L / B = 2 × TP

⇒ L = 2 × TP × B = 2 × 40 × 10-6 × 20 × 106 = 1600 bits ⇒ 200 bytes

Therefore, L = 200 bytes

6.) Consider a 128 × 103 bits/ second satellite communication link with one way propagation delay of 150 milliseconds. Selective retransmission (repeat) protocol is used on this link to send data with a frame size of 1 kilobyte. Neglect the transmission time of acknowledgement. The minimum number of bits required for the sequence number field to achieve 100% utilization is __________ [GATE 2016]

6.) Consider a 128×103 bits/ second satellite communication link with one way propagation delay of 150 milliseconds. Selective retransmission (repeat) protocol is used on this link to send data with a frame size of 1 kilobyte. Neglect the transmission time of acknowledgement. The minimum number of bits required for the sequence number field to achieve 100% utilization is __________ [GATE 2016]

Solution:

To achieve 100% efficiency, the number of frames that we should send $N = 1 + 2 * a$

$a = Tp / Tt$ where Tp is propagation delay, and Tt is transmission delay.

Given, $B = 128$ kbps, $Tp = 150$ msec,

$L = 1$ KB $= 1 * 8 * 210$ bits

$Tt = L / B \Rightarrow 1 * 8 * 210$ bits / $128 * 103$ bps $\Rightarrow 0.064$ sec = 64 msec

So, $a = 150$ msec / 64 msec = 2.343

Efficiency (η) = 100 % $\Rightarrow 1 = N/ 1 + 2 * a$

So, $N = 1 + 2 * a \Rightarrow 1 + 2 * 2.343 = 5.686$

No. of sequence numbers requires in SR is $2*N = 2 * 5.686 = 11.375$

Minimum No. of bits required in the sequence number = [log2 (11.375)] = 4