Access Control - Part V

Complete Course on Computer Networks - Part II

TDM
CSMA/CD
polling
Token
1980's → 2hours
CG
J
Em
99%
1%
10G
M
$$$
Cost
1G

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Aloha-

There are two different versions of Aloha-

Versions of Aloha

- **Pure Aloha**
- **Slotted Aloha**

Why are we unhappy ;

Paradox of choice .

8th → 1 week .

AC
BC
MA

Hello

wireless

BN

5th

WL → MA → AC .

1. Pure Aloha-

N/O CS

CD A → ACK

wait

- It allows the stations to transmit data at any time whenever they want.
- After transmitting the data packet, station waits for some time.

Then, following 2 cases are possible-

Case-01:

- Transmitting station receives an acknowledgement from the receiving station.
- In this case, transmitting station assumes that the transmission is successful.

Case-02:

- Transmitting station does not receive any acknowledgement within specified time from the receiving station.
- In this case, transmitting station assumes that the transmission is unsuccessful.

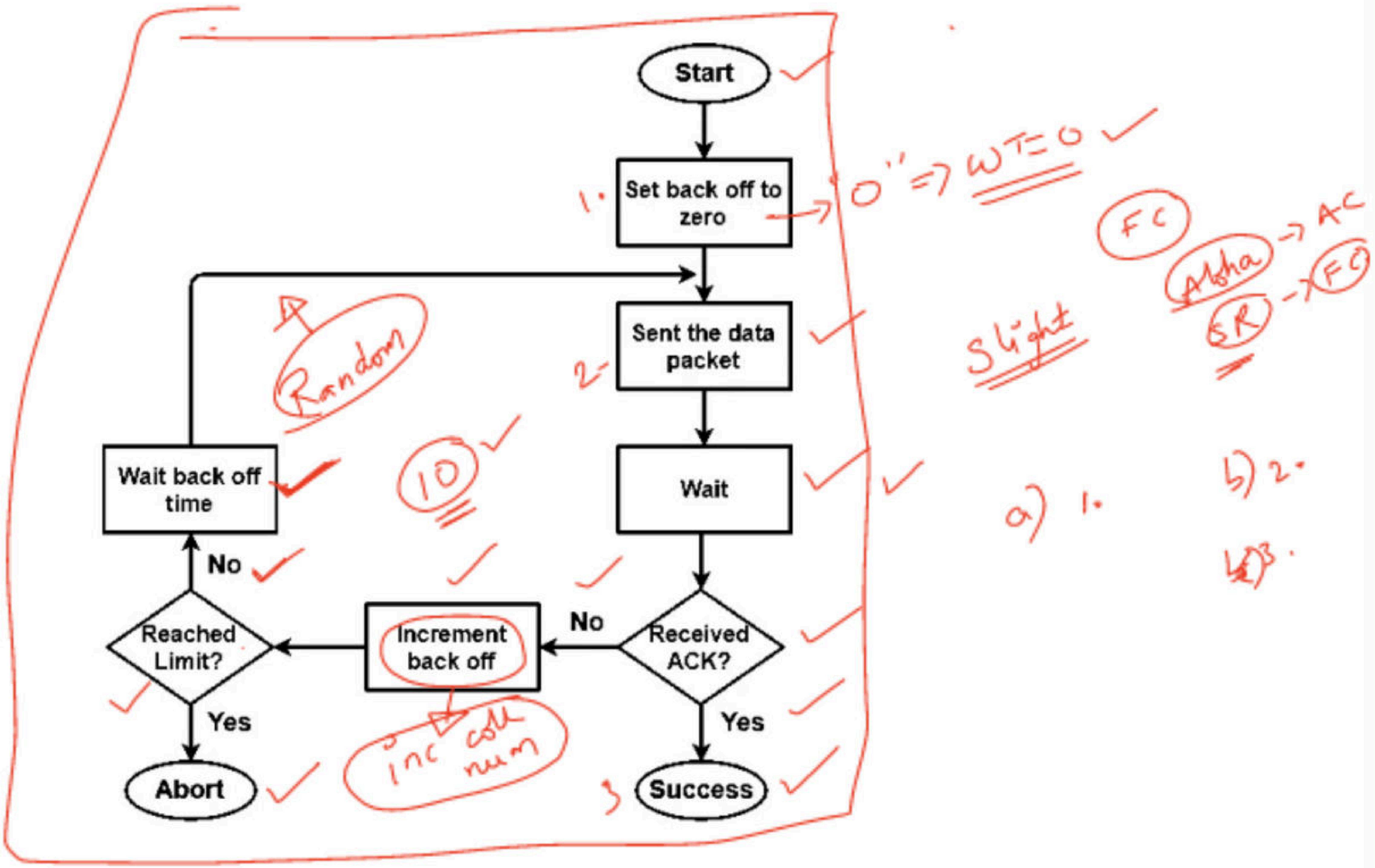
BO → ?

MAC

BO Time.

Then,

- Transmitting station uses a **Back Off Strategy** and waits for some random amount of time.
- After back off time, it transmits the data packet again.
- It keeps trying until the back off limit is reached after which it aborts the transmission.



Flowchart for Pure Aloha

Efficiency-

$$\text{Efficiency of Pure Aloha } (\eta) = G \times e^{-2G}$$

where G = Number of stations willing to transmit data

Maximum Efficiency-

For maximum efficiency,

- We put $d\eta / dG = 0$
- Maximum value of η occurs at $G = 1/2$
- Substituting $G = 1/2$ in the above expression, we get-

Maximum efficiency of Pure Aloha

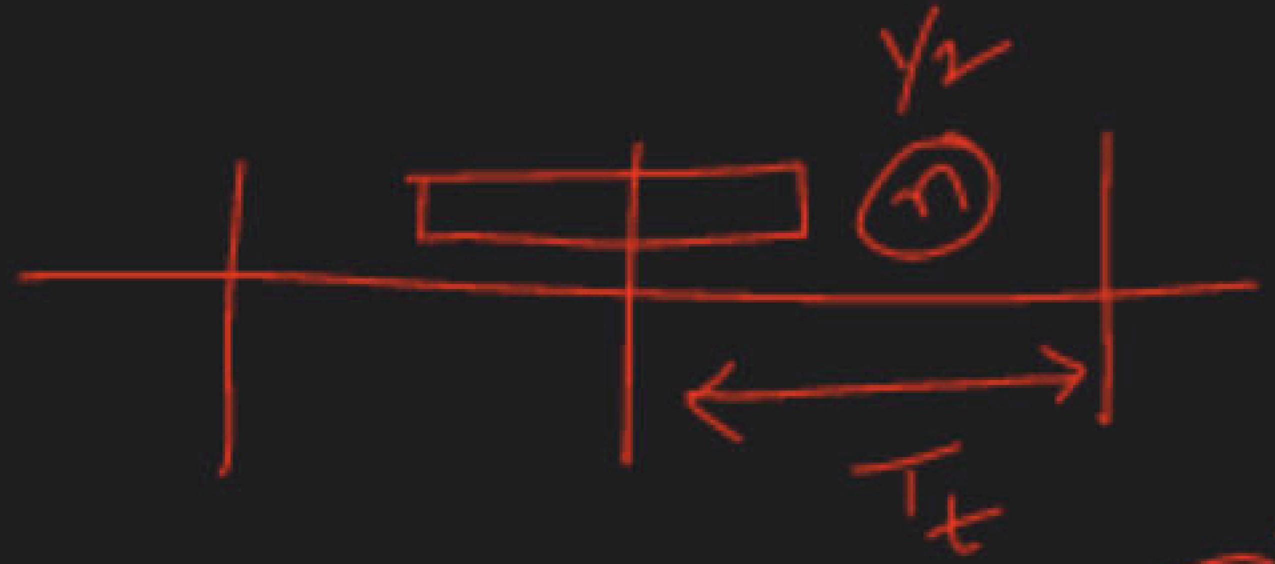
$= 1/2 \times e^{-2 \times 1/2}$

$= 1 / 2e$

$= 0.184$

$= 18.4\%$

Thus, Maximum Efficiency of Pure Aloha (η) = 18.4%



η ✓ max

$1/2 \rightarrow T_t$

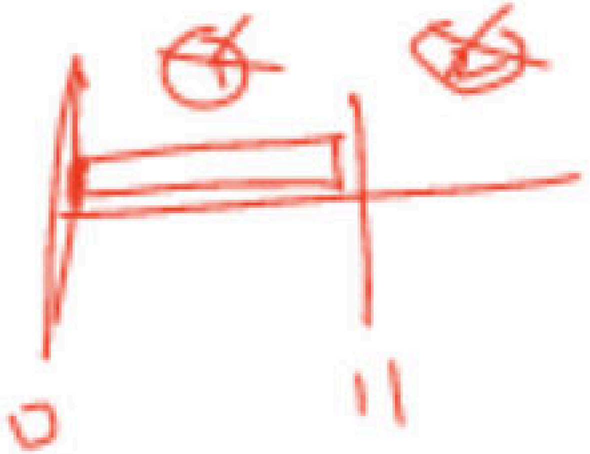
$2S$

$\eta\uparrow \cdot 1 \rightarrow 2 \times T_t$

2. Slotted Aloha-

- Slotted Aloha divides the time of shared channel into discrete intervals called as **time slots**.
- Any station can transmit its data in any time slot.
- The only condition is that station must start its transmission from the beginning of the time slot.
- If the beginning of the slot is missed, then station has to wait until the beginning of the next time slot.
- A collision may occur if two or more stations try to transmit data at the beginning of the same time slot.

P → Anytime



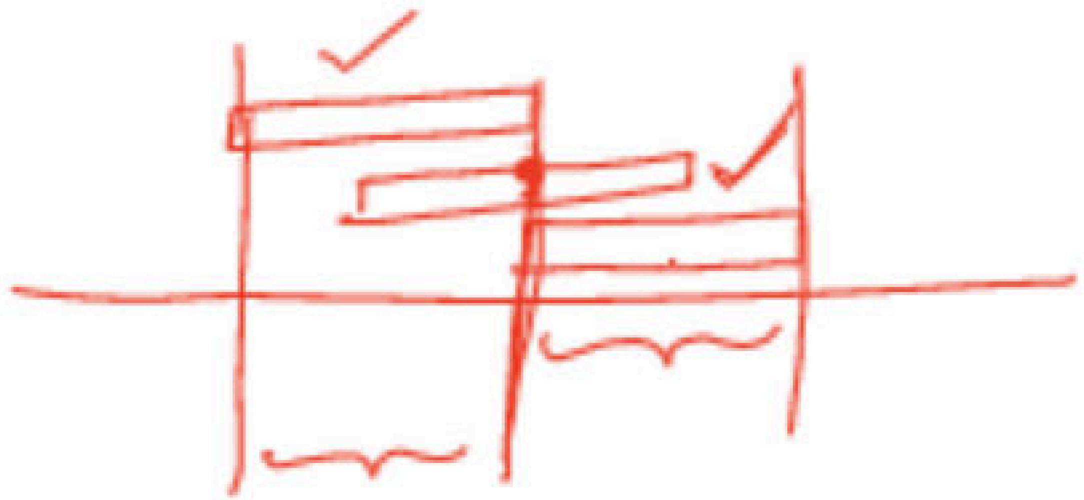
Efficiency-

Efficiency of Slotted Aloha (η) = G x e^{-G}

$G * e^{-1G}$

A → 10 ✗
11 ✓

where G = Number of stations willing to transmit data at the beginning of the same time slot



$VT = 1 * T_t$

Maximum Efficiency-

max. $\frac{d^2}{dx^2} < 0$

For maximum efficiency,
- We put $d\eta / dG = 0$
- Maximum value of η occurs at G = 1
- Substituting G = 1 in the above expression, we get-

Maximum efficiency of Slotted Aloha
= 1 x e^{-1}
= 1 / e
= 0.368
= 36.8%

36.8%

18.4%

36.8%

Thus,

Maximum Efficiency of Slotted Aloha (η) = 36.8%

Pure Aloha	Slotted Aloha
Any station can transmit the data at any time.	Any station can transmit the data at the beginning of any time slot.
The time is continuous and not globally synchronized.	The time is discrete and globally synchronized.
Vulnerable time in which collision may occur $= 2 \times T_t$	Vulnerable time in which collision may occur $= T_t$
Probability of successful transmission of data packet $= G \times e^{-2G}$	Probability of successful transmission of data packet $= G \times e^{-G}$
Maximum efficiency = 18.4% (Occurs at G = 1/2)	Maximum efficiency = 36.8% (Occurs at G = 1)
The main advantage of pure aloha is its simplicity in implementation.	The main advantage of slotted aloha is that it reduces the number of collisions to half and doubles the efficiency of pure aloha.

Computer Networks

Practice questions on Access Control Methods and GATE PYQ

Problem 1: GATE2015(CS)

Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits per second) over a 1 km (kilometer) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

(A) 8000

(B) 10000

(C) 16000

(D) 20000

Solution:

Data should be transmitted at the rate of 100 Mbps.

Transmission Time >= 2*Propagation Time
= $1250*8 / (100 * 10^6)$
= 2*length/signal speed
= signal speed = $(2 * 10^3 * 100 * 10^6) / (1250 * 8)$
= $2 * 10 * (10^3)$ km/sec = 20000

D is correct.

Problem 2: GATE2016(CS)

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 _________.

(A) 0.462

(B) 0.711

(C) 0.5

(D) 0.652

Solution:

The probability of sending a frame in the first slot
without any collision by any of these four stations is sum of following 4 probabilities
Probability that S1 sends a frame and no one else does
+ Probability thatS2 sends a frame and no one else does
+ Probability thatS3 sends a frame and no one else does
+ Probability thatS4 sends a frame and no one else does
= 0.1 * (1 - 0.2) * (1 - 0.3) *(1 - 0.4)
+ (1 -0.1) * 0.2 * (1 - 0.3) *(1 - 0.4)
+ (1 -0.1) * (1 - 0.2) * 0.3 *(1 - 0.4)
+ (1 -0.1) * (1 - 0.2) * (1 - 0.3) * 0.4
= 0.4404

Problem-3:

In a CSMA / CD network running at 1 Gbps over 1 km cable with no repeaters, the signal speed in the cable is 200000 km/sec. What is minimum frame size?

Solution-

Given-

- Bandwidth = 1 Gbps
- Distance = 1 km
- Speed = 200000 km/sec

Calculating Propagation Delay-

Propagation delay (T_p)

= Distance / Propagation speed

= 1 km / (200000 km/sec)

= 0.5×10^{-5} sec

= 5×10^{-6} sec

Calculating Minimum Frame Size-

Minimum frame size

= 2 x Propagation delay x Bandwidth

= $2 \times 5 \times 10^{-6}$ sec x 10^{9} bits per sec

= 10000 bits

Computer Networks

Error Control Methods PART 1

CRC ->

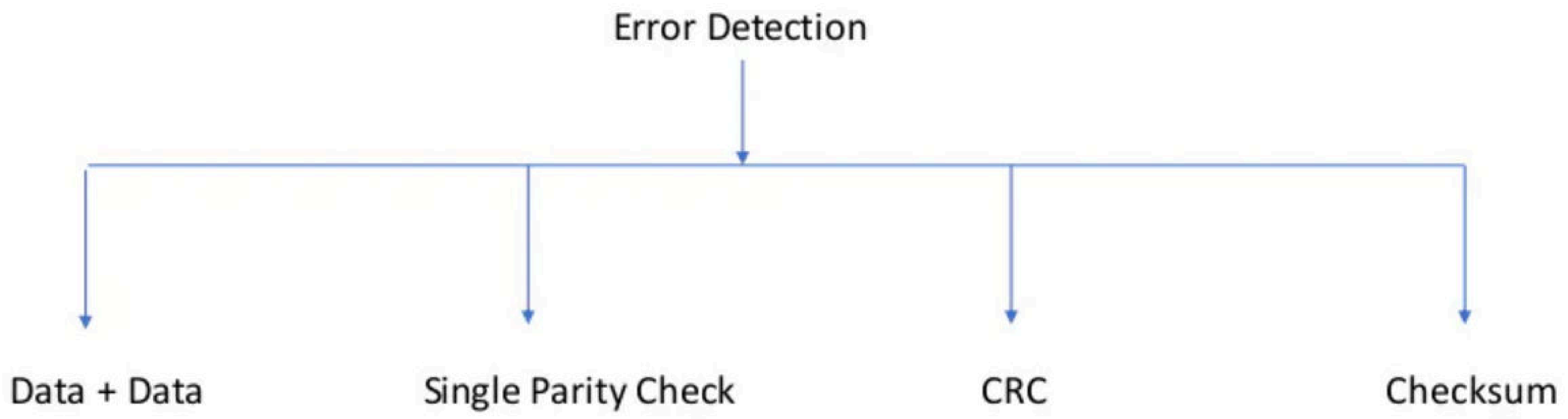
Error Handling Methods

Error Detection

Error detection is a technique that is used to check if any error occurred in the data during the transmission.

Error Correction

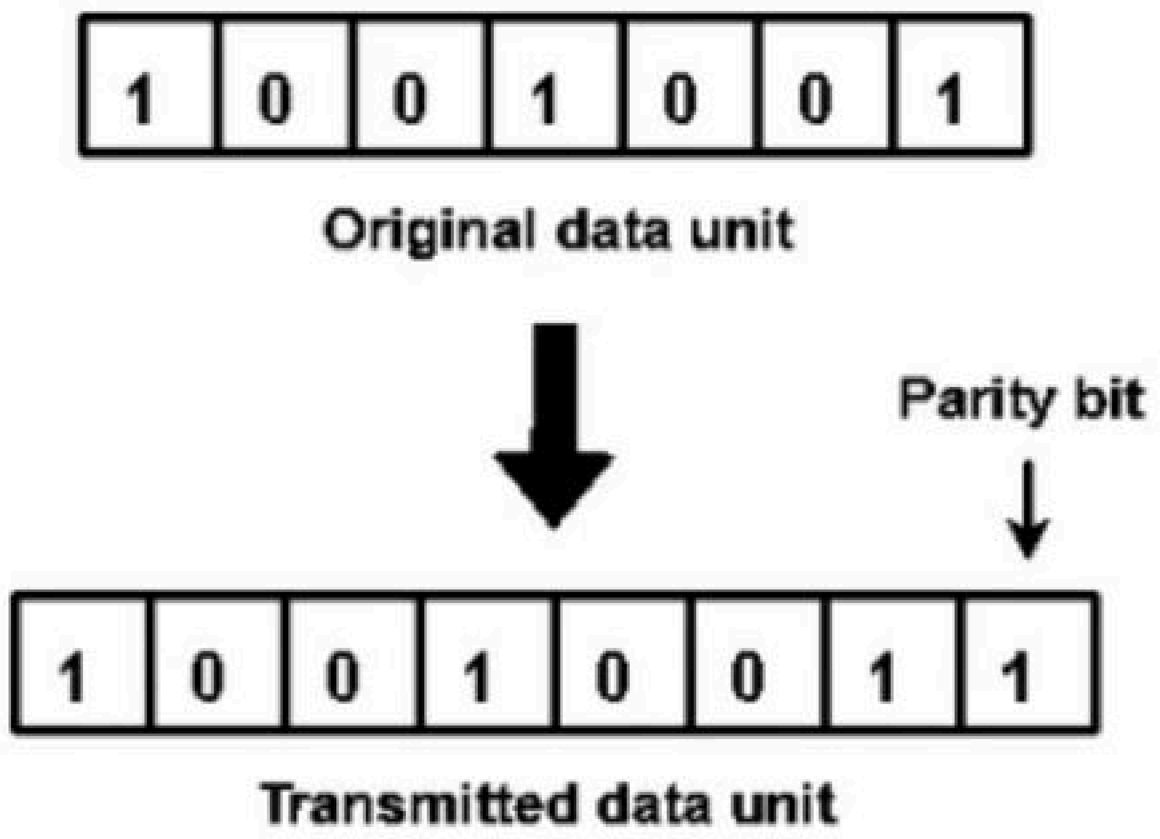
Error Correction is a technique that is used to correct error occurred in the data by its own during the transmission.


Error Detection
Data + Data
Single Parity Check
CRC
Checksum

Single Parity Check-

In this technique,

- One extra bit called as **parity bit** is sent along with the original data bits.
- Parity bit helps to check if any error occurred in the data during the transmission.



Limitation-

- This technique can not detect an even number of bit errors (two, four, six and so on).
- If even number of bits flip during transmission, then receiver can not catch the error.

Cyclic Redundancy Check-

- Cyclic Redundancy Check (CRC) is an error detection method.
- It is based on binary division.

Cyclic Generator-

Data to be sent : 1 0 1 1 0 1 1
CRC generator: 1 1 0 1

CRC generator is 4 bits
There for sender appends 3 bits of 0's to the data

Note: if CRCG= n bits then bits to be appended in data is (n-1) 0's

SENDER'S SIDE

Appended 0's

```
1101 | 1 0 1 1 0 1 1 0 0 0
       1 1 0 1
       -------------------
       0 1 1 0 0 1 1 0 0 0
```

Go on applying XOR

Appended 0's

```
1101 ) 1 0 1 1 0 1 1 0 0 0
       1 1 0 1
       ---------------------
       0 1 1 0 0 1 1 0 0 0
         1 1 0 1
       ---------------------
         0 0 0 1 1 1 0 0 0
```

Go on applying XOR

```
                          Appended 0's
1101 ) 1011011 000

       1101
       ----------
       0110011000
         1101
       ----------
         000111000
               1101
       ----------
          000001100
```

Go on applying XOR

Appended 0's

```
1 1 0 1 | 1 0 1 1 0 1 1 0 0 0
          1 1 0 1
          -------------------
          0 1 1 0 0 1 1 0 0 0
            1 1 0 1
          -------------------
            0 0 0 1 1 1 0 0 0
                  1 1 0 1
          -------------------
             0 0 0 0 0 1 1 0 0
                       1 1 0 1
          -------------------
             0 0 0 0 0 0 0 0 1
```

Go on applying XOR

CRC

DATA SENT : 1 0 1 1 0 1 1 0 0 1

RECEIVER'S SIDE

```
1101 | 1011011001
       1101
       ----------
       0110011001
        1101
       ----------
        000111001
           1101
       ----------
         000001101
              1101
       ----------
         000000000
```

Go on applying XOR

CRC IS 0, DATA RECEIVED IS RIGHT!