Chal rahai hai).

- Lekin ek turm hoti hai burst error, toh yeh burst error kya hoti hai ?? Joh burst error means ek sequence of bits corrupt hue hai, usko hum kya kahate hai burst error.

- Kya single bit kabhi corrupt hoti hai, toh error aati hai due to noise, · Agar noise hai toh puri ek waveform distroy hoti hai, ek bit kabhi bhi ~~corred~~ nahi hoti hai, multiple bits corrupt hoti hai. corrupt

- Joh genrally it is burst error, toh burst error even length ki bhi hosakte hai odd length ki bhi hosakte hai.

- Joh hum kya kahaizey ki parity bit can detect single bit error but it cannot detect ~~all~~ burst error.

- Agar burst error k karan apke data ki first bit se 10th bit tak corrupt hogayi hai, likin iska yeh matlab nahi hai ki I se lekar 10 tak saari bits corrupt hue hai.

- Burst error k karan kuch bits corrupt hogi kuch nahi hogi.

- Agar ~~1~~ sec tak ki Burst error hai matlab ki 1 se 10 tak kuch bit corrupt hue hai aur kuch sahi hai. far 1 aur 10 corrupt hai.
  [L se 10]

- Burst error hai toh yeh jaruri nahi hai ki saari bits corrupt hue ho.

(*) Toh VRC can detect burst error if it is in odd length.

- Toh parity scheme itani useful nahi hai, because yeh saari burst error detect nahi karsakte hai.

- The technique is not foolproof against burst error that inverts more than one bit. If an even number of bits are inverted due to error then error is not detected.

2-D parity check :→

- Other name of this technique is Longitudinal parity check. (LRC)

- Parity bit mein hum for seven ek parity bit use karrahai hai;

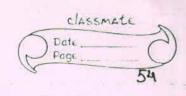- Performance can be improved by using 2-D parity check which organizes the block of bits in the form of table.

- Parity bit are calculated for each row which is equivalent to simple parity check

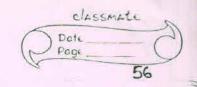- Parity check bit are also calculated for all columns.

- Both are send along with the data.

- At reciever end they are compared with parity bit.

Original Data :→

  1011011 : 1010101¢ : 0101101¢ : 1101010¢

P(even)

```
1 0 1 1 0 1 1     1
1 0 1 0 1 0 1     0      } → Row parity bit
0 1 0 1 1 0 1     0
1 1 0 1 0 1 0     0
_____       ___
1 0 0 1 0 0 1    (1)
```

column bit

Data to be Send :-

10110111 : 10101010 : 01011010 : 11010100 ;
                    10010011

Performance of 2D parity check :→

✓ ✗ LRC can (detect and correct) single bit error, Kaise.
For example agar

```
                    corrupt → 1 (even) → column corrupted
1 0 1 1 (0) 1 1      1  ───→ Row corrupted.
1 0 1 0 1 0 1        0
0 1 0 1 1 0 1        0
1 1 0 1 0 1 0        0
_____     __
1 0 0 1 0 0 1        1
```

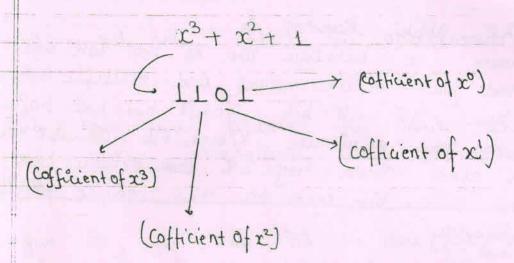- Joh Row corrupted hua hai aur joh column unki

Intersection min joh bit aarahai hai toh corrupt hue hai. Joh us bit ko invert kardo.

- VRC, not only detect but also correct single bit error.

- Jis row aur column ki parity sahi nahi aayi hai unka intersection wali bit corrupt hue hai.

- Agar do ya three bit or more bit corrupt hue hai to it can detect but cannot detect correct that error.

- Joh yeh technique burst error detect kar payegi ki nahi kar payegi -

→ Joh parity scheme hai apke technique min toh burst error detect karna muskil hai.

* Joh burst error detect karne ki guarant LRC provide nahi karta hai.

* Matlab it can detect many burst error but not all.

Example :-

```
          1  1
1 0 1 1 (0 0) 1 1   |(1)
1 0 1 0 (1 0) 1 1   |(1)
0 1 0 1 1 0 1 0     |(0)
1 1 0 1 0 1 0 1     |(1)
(1 0 0 1 0 1 1 1    |(1)
```

- Now is given polynomial ka binary represention kya hoga.

$$x^3 + x^2 + 1$$

$1 1 0 1$ → (cotficient of x^0)

(Cofficient of x^3)

(Cofficient of x^2)

(cofficient of x^1)

- Joh yeh kya hogaya given polynomial ka binary represention.

- Suppose $x^3 + x^2 + L$ is our polynomial, iska binary equivalent kitana hogaya, $1 1 0 1$.

- Now aab data mein kitane reducdant bit add ki jati hai,

- Joh data mim number of reducdant bits is equal to highest power of the polynomal.

- Yaha par polynomial ki highest power kitane hai three (3), toh kitani redandant bit add karne hai three.

- Aur agar apka polynomial four bit long hai, toh how many redandant bits, three.

- Then if your polynomial is n bit long, then

number of redandant bits will be n-1 bits.

- Yaha hamare polynomial ki degree three hai, toh isliye hamare number of redandant bit kitane hogi three.

- Toh yeh Redandant bit kaha add karoogey, toh Redandant bit kaha add karne hai apko data k end par.

- Suppose hamara data hai :→

$$1\ 0\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 0$$

data k end mein aapko kya add karna hai reducdant bit, reducdant bit kitani add karna hai, jitani ki polynomial ki highest power hai.

- Polynomial ki highest power kitani hai three, toh kitani reducdant bit add karogey three.
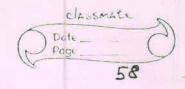
- Initially un reducdant bit ki value zero hogi.

$$1\ 0\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 0\quad 0\ 0\ 0$$

→ Reducdant bit

→ data bits.

- Now aab kya karna hai, toh aab hum is data ko, divide karna by its polynomial.

Polynomial: $x^3 + x^2 + 1$ = 1101.

$$
\begin{array}{r}
1111111 \\
1101\ \overline{)\ 10110011000000} \\
\end{array}
$$

(+) 1101 ⟵ XOR

```
        1111111
1101 ) 10110011000000
   (+) 1101
       ─────
        01100
        1101
        ────
        0001011
           1101
           ────
           01100
           1101
           ────
           1101
           ────
           0001000
              1101
              ────
              01010
              1101
              ────
              1101
              ────
              01110
              1101
              ────
              0(0111)
```

Remainder :→ 011

• Joh us data mein yeh remainder add karo jisme hamane yeh ~~remainder~~ reducdaint bits add kari the-

→

```
1011 0011 000 000
+          011
────────────────
1011 0011 000 011
```

• Now aab hum is data ko send karege, sender is data ko send karega.

- Now aab reciever k pass data aa gaya, now aab reciever ko kaise pata chalega ki there is some error

- Joh reciever k pass joh aaya data woh us data ko polynomial se divide karega.

- If ~~remainder~~ Agar reciever ko divide karne k baad remainder 0 milta hai, it means there is no error.

- And if remainder is non-zero it means there exist some error in our recieved data.

* yeh technique surf error ko detect karsakte hai but correct nahi karsakte.

* CRC (can) detect the burst error of the length = highest power of the polynomial.

- Agar polynomial ki highest power three hai, toh yeh three length ki burst error ko detect karsakte hai.

- Agar polynomial ki highest power 16 hai toh yeh 16 bit ki length ki burst error ko detect karsakte hai.

* CRC (can) detect all odd-length error if polynomial is divisible of $x+1$.

- Odd-length error matlab highest & degree of polyno.
  ...°1 s knn° boundaries nahi hai. ~~usssssssss~~

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- Kya $x^3 + x^2 + 1$ yeh $(x+1)$ ka divisible hai.

- Now question yeh hai ki yeh kaise pata karegey ki hamara polynomial $x+1$ ka divisible hai ki nahi.

- Agar $x+1$ ka kohi divisible hai toh $x = -1$ kya hoga iska factor.

* Agar x ko -1 rakha toh polynomial zero aana chahiye.

- Joh kya yaha polynomial min $x = -1$ rakhne min zero aaraha hai kya.

$$f(-1) = (-1)^3 + (-1)^2 + 1$$
$$= -1 + 1 + 1 \neq 0$$

- Nahi aaraha hai. toh given polynomial $(x+1)$ ka divisible nahi hai.

- Abhi tak hamne jitane bhi polynomial dekhe hai unme x^0 ka coffiient one hai. Kyo aaisa kyo??

- Agar x^0 wali term 0 rak de, CRC aapke error detect karne mein capable nahi hoga.

- Matlab aapka polynomial agar x k divisible ho-gaya toh CRC aapke error detect nahi kar payegi.

* CRC-16 $(x^{16} + x^{15} + x^2 + 1)$ used in ATM.