DCC-22414

Unit III: Error Detection, Correction and Wireless Communication

(Weightage - 12 marks)

TRANJAL SAVE

3.1 Types of Error: Single Bit Error and Burst Error. Redundancy.

Error

A condition when the receiver's information does not match with sender information.

During transmission, digital signals suffer from noise that can introduce errors in binary bits travelling from sender to receiver.

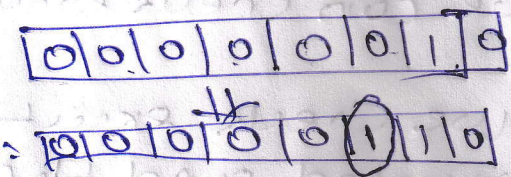
That means 0 bit may change to 1 or 1 will change to 0.

Types of error:

- Single-bit error
- Burst Error
- Multiple Bit error.

Single-Bit Error

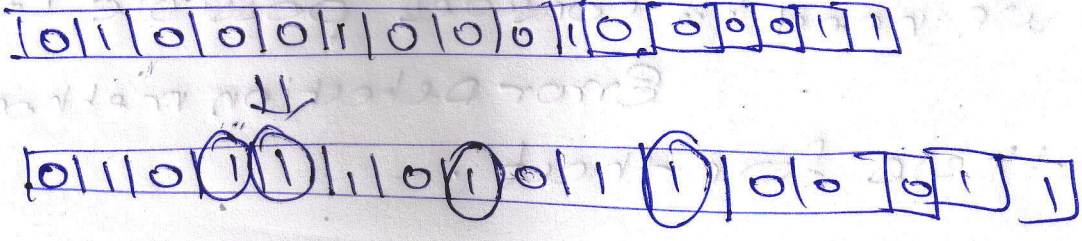
The term single-bit error means that only 1 bit of given data unit is changed from 1 to 0 or from 0 to 1.



0 change to 1.

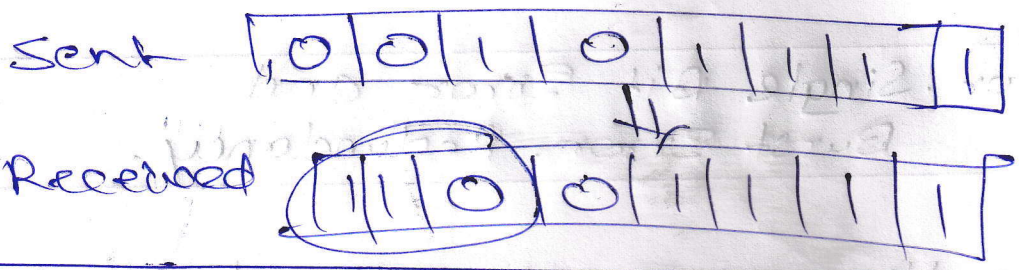
Burst Error

The term burst error means that 2 or more bits in data unit have changed from 1 to 0 or from 0 to 1.



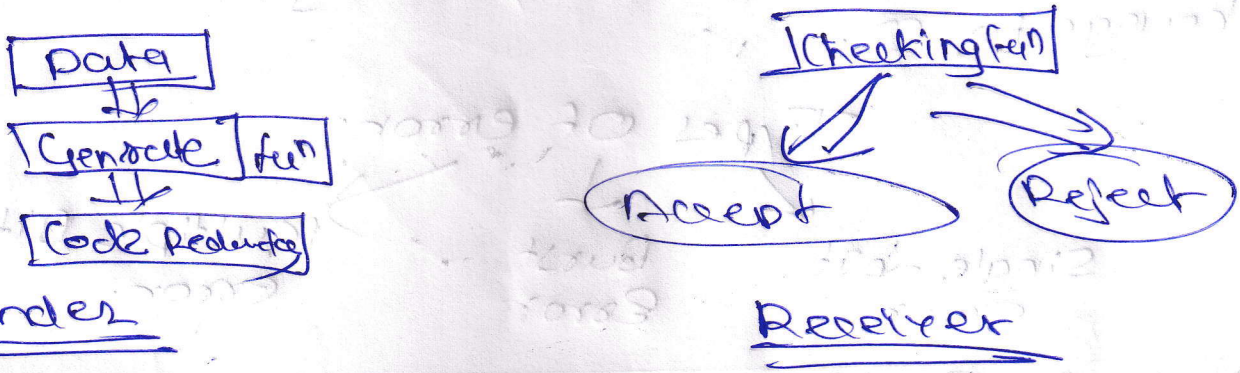
Multiple-Bit Error

A multiple bit error is an error type that arises when more than one bit data transmission is affect.



Redundancy

Redundancy is one error detection mechanism that would adds extra bits for detecting errors at destination.



Detection Versus Correction

- The correction of errors is most difficult
- In error detection, we can check errors has occured or not.
- In error correction, we check exact number of bit that are corrupted and their location in the message.
- The number of errors and size of message are important factor. If we need to correct one single error in 8-bit data unit, we need to consider possible conditions.

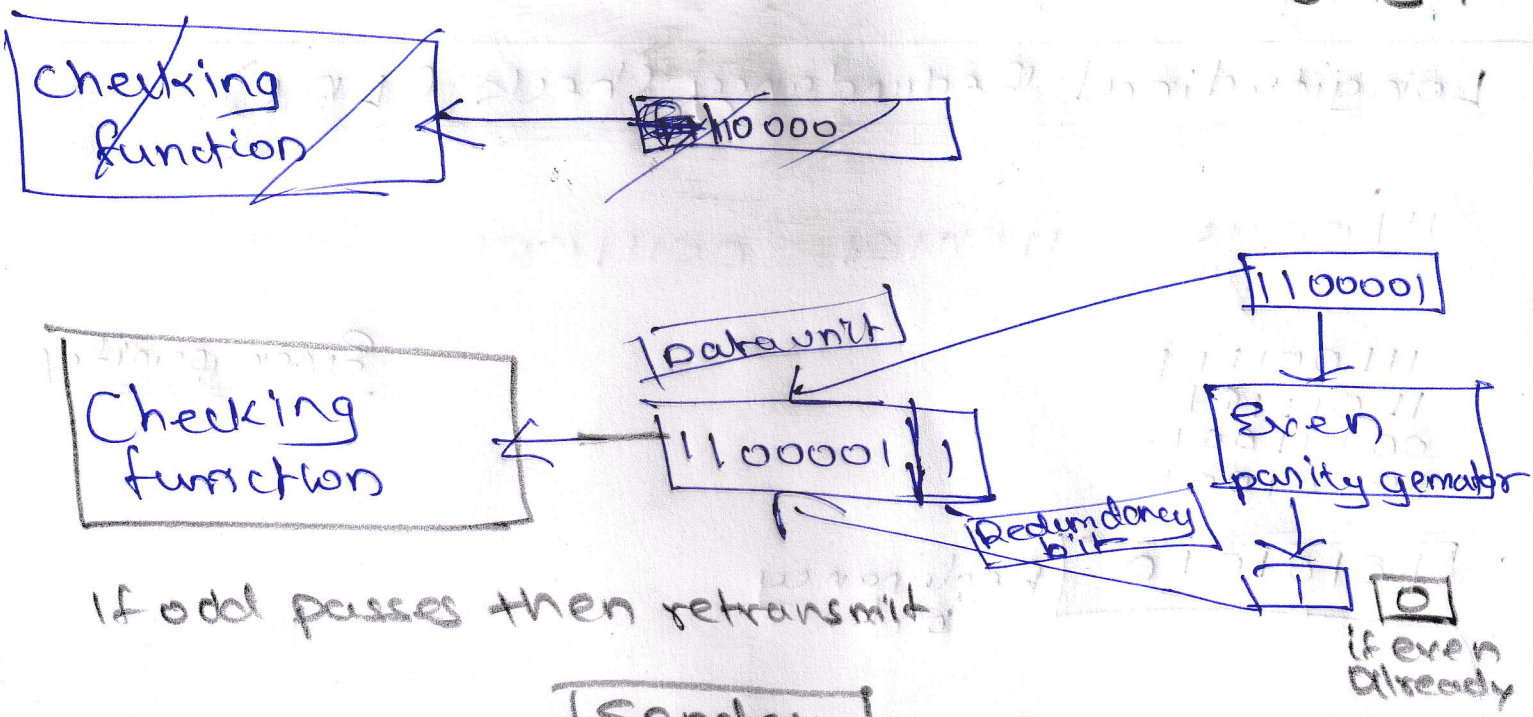
Error detection methods are there for that.

3.2 Error-Detection : Longitudinal Redundancy Check (LRC), Vertical Redundancy Check (VRC), Cyclic Redundancy check (CRC)

Vertical Redundancy Check

Redundancy → Extra bits

parity - counting of 1's.



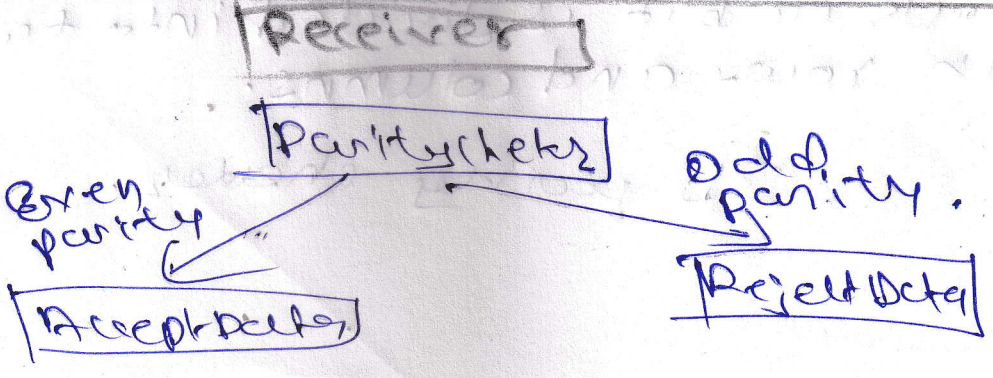
If odd passes then retransmit.

Vertical Redundancy check is also known as parity check.

VRC is an error detecting technique used to detect errors on an eight-bit ASCII characters.

In this method, a redundancy bit is added to each data unit.

This method includes even parity and odd parity.



Advantages :- VRC can detect all single bit error.
- It can also check burst error but only those cases where no. of bits changed is odd 1, 3, 5, 7.

Disadvantages : If there are even no of errors 2, 4, 6, 8 - - - .

Longitudinal Redundancy Check (LRC)

11100111 11011101 00111001 10101001

Even parity

11100111
11011101
00111001
10101001

10101010 Redundancy bit.

11100111 11011101 00111001 10101001
10101010

00000000 Even so accept else reject.

If final is 0000001 or someting so reject.

In this method, data which the user want to send is organized into tables of rows and columns.

A block of bit is divided into tables or matrix rows and columns.

2D parity checker.

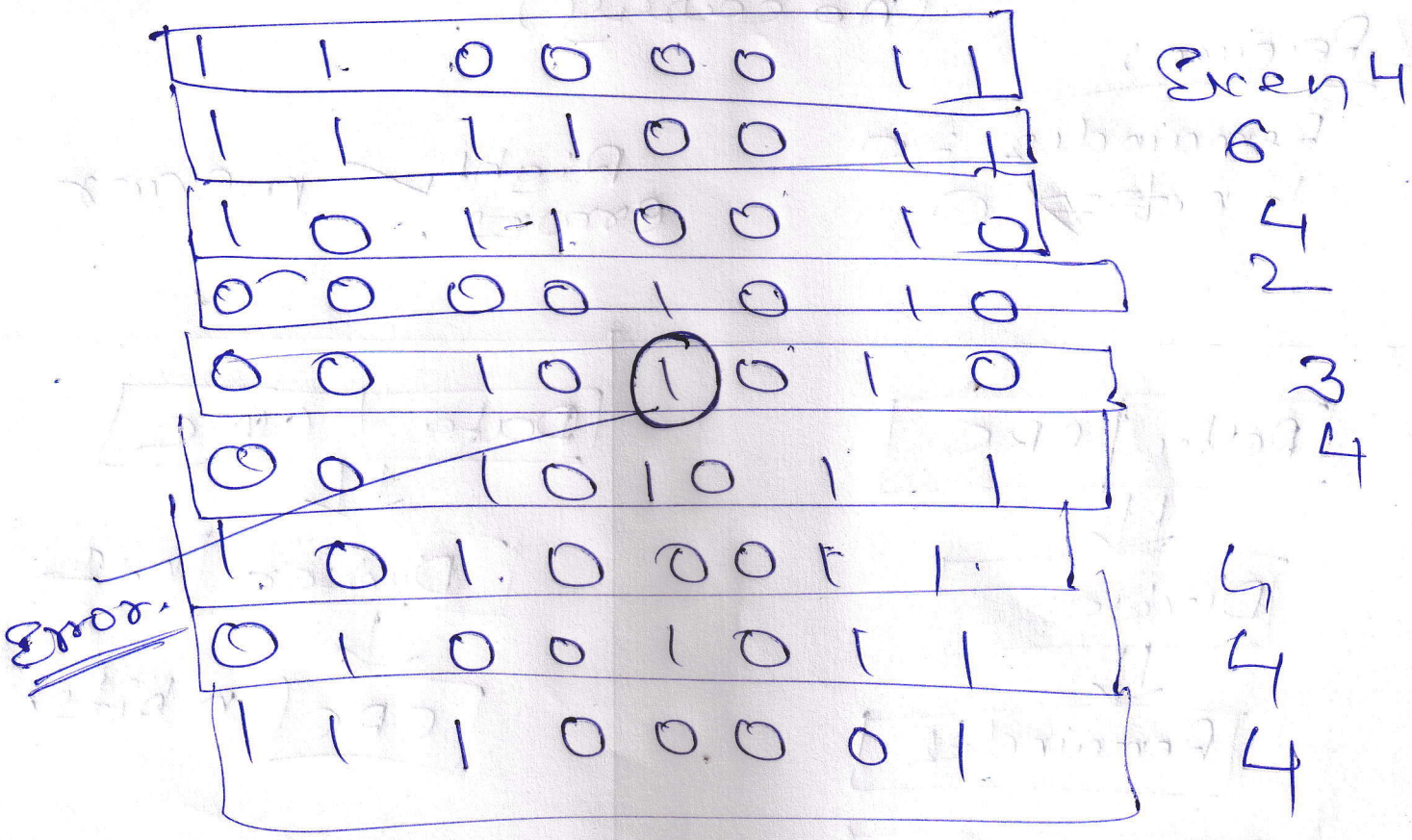
Question

The following bit stream is encoded with VRC, LRC and even parity. Locate and correct the error if it is present. (4m)

11 0000 11
10 1100 10
00 1010 10
10 1000 11
111 0000 1

1111 00 11
0000 1010
0010 1011
0100 1011

Soln



5 × 5 error detected.

row column

CRC ~~for~~ Cyclic Redundancy check

- It is the method of Error detection
- CRC uses Generator Polynomial
- K bits are calculated.

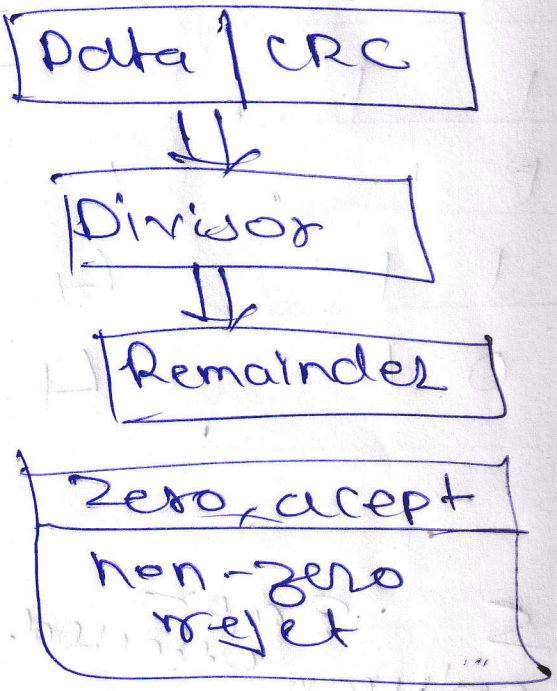
Sender bits.

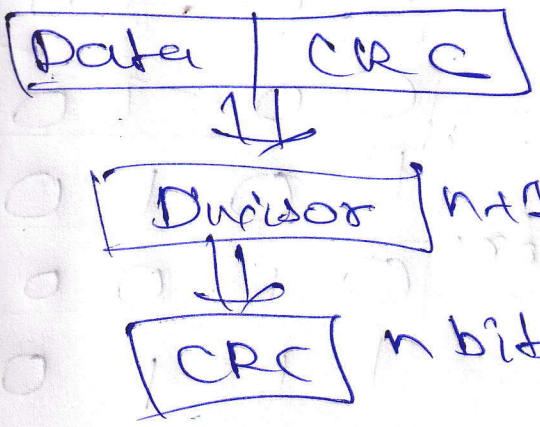
- Add (K-1) bits to end of data.
- Use mod-2 binary division to divide binary data by key & store remainder & divisor.
- Append the remainder to end of data to form encoded data & send the same (no carry).

Receiver

Remainder = 0 → Right ✓ no error

If not ≠ 0 → errors.





Question: Calculate for CRC for frame 11010101 and generator Polynomial x^4+x+1 and write transmitted frame.

Solution

Frame for transmission : 11010101

Generator Polynomial = x^4+x+1.

x^4+x+1

$1x^4+0x^3+0x^2+0x+1$.

K = 10011

K-1 = 5-1 = 4

Add 4 zeros to frame

11010101 0000

K ÷ frame

11000011 — Transmitted value

```
10011 ) 11010101 0000
        10011
        -----
         10011
         10011
         -----
         00000
         00000
         -----
          00001
          00000
          -----
           00011
           00000
           -----
            00110
            00000
            -----
             01100
             00000
             -----
              11000
              10011
              -----
              10110
```

```
10110
10011
-----
00101
```

LRC VS VRC

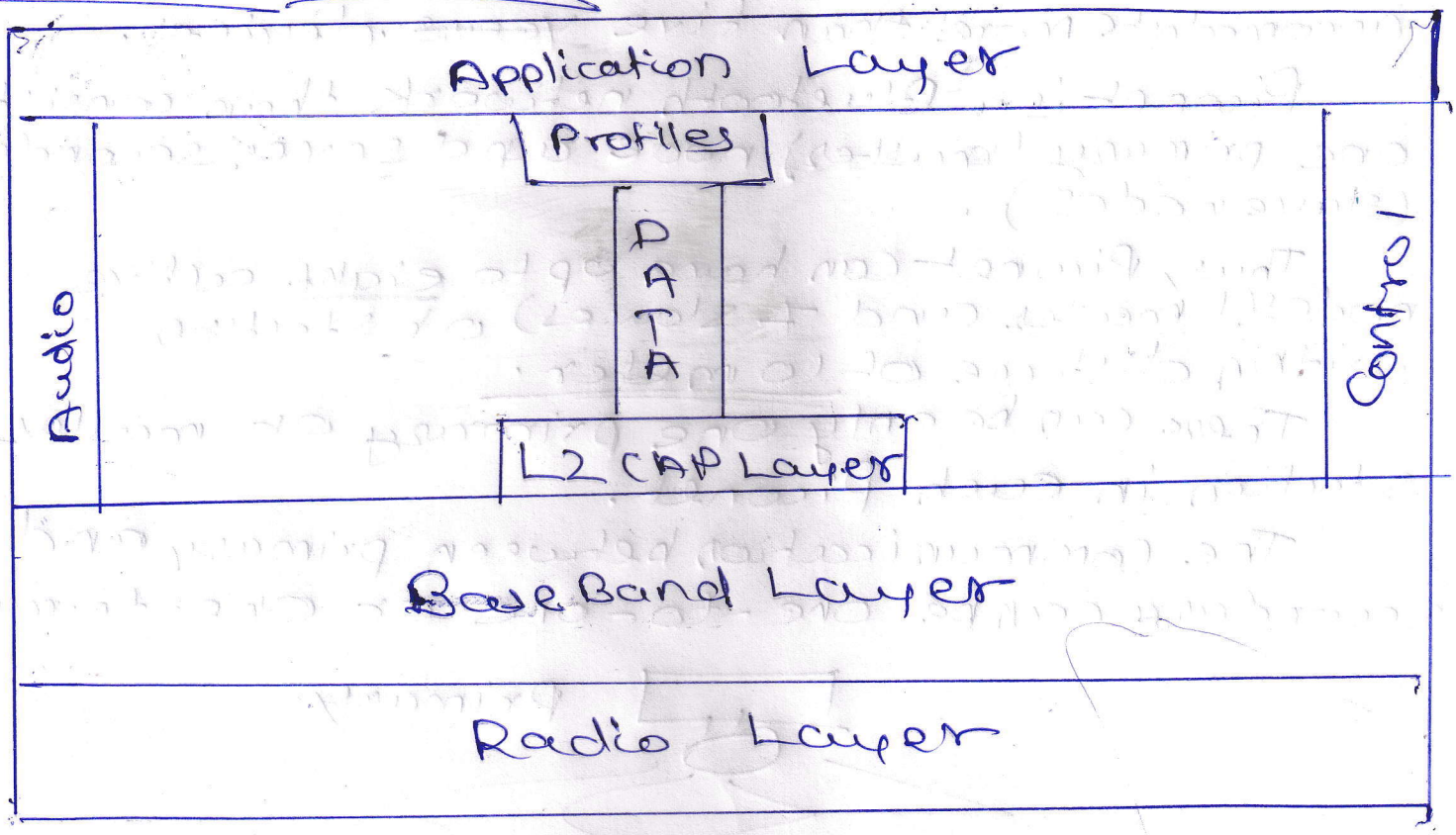
VRC	LRC
It stands for Vertical Redundancy Check	It stands for Longitudinal Redundancy Check.
Also known as parity Checker	Also known as 2-D parity checker.
VRC detects single-bit error.	~~VRC~~ LRC detects burst errors.
not applicable for errors are even.	~~not~~ applicable for error when even
example [10101010] 10101010 Even parity	example 10100 1 10101 1 10101 1 101000 1

LRC	CRC
Longitudinal Redundancy Check	Cyclic Redundancy check
Parity based	polynomial based
Historically used in older system	used in morden system
LRC of n bit can easily detect	CRC is more powerful.
Less effective	mor effective
typically used for error correction	not typically used for error correction
Simple to implenet	Itender to implement
Burst error.	VRC & LRC in detecting errors.

3.5 : Bluetooth Architecture: Piconet / Scatternet.

V.Imp

Architecture of Bluetooth:



Bluetooth is used for short-range wireless voice and data communication.

It is a Wireless Personal Area Network (WPAN) technology and is used for data communication over smaller network (distances.

Bluetooth simply follows the principle of transmitting and receiving data using Radio waves.

It can paired with other network device which also has Bluetooth but it should be within the estimated communication range to connect.

~~When two~~

Bluetooth Architecture defines two types of Network

- Piconet
- Scatternet.

Piconet

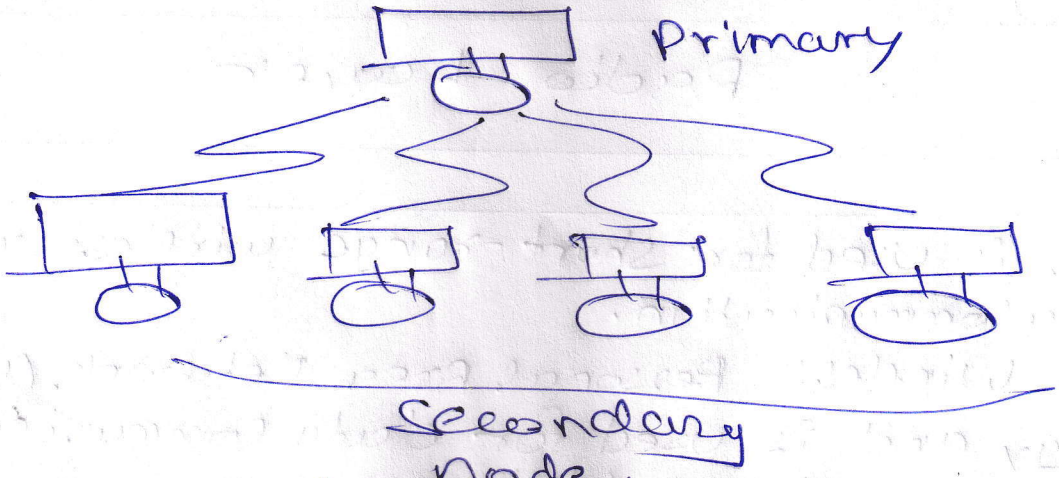
When two device start to share data, they form a network called piconet which can further accomodate more than five ~~users~~ devices.

Piconet is a Bluetooth network than consist one primary (master) node and seven secondary (slave nodes).

Thus, Piconet can have upto eight active nodes (1 master and 7 slaves) or station within distance of 10 meter.

There can be only one primary or master station in each Piconet.

The communication between primary and secondary can be one-to-one or one-to-many.

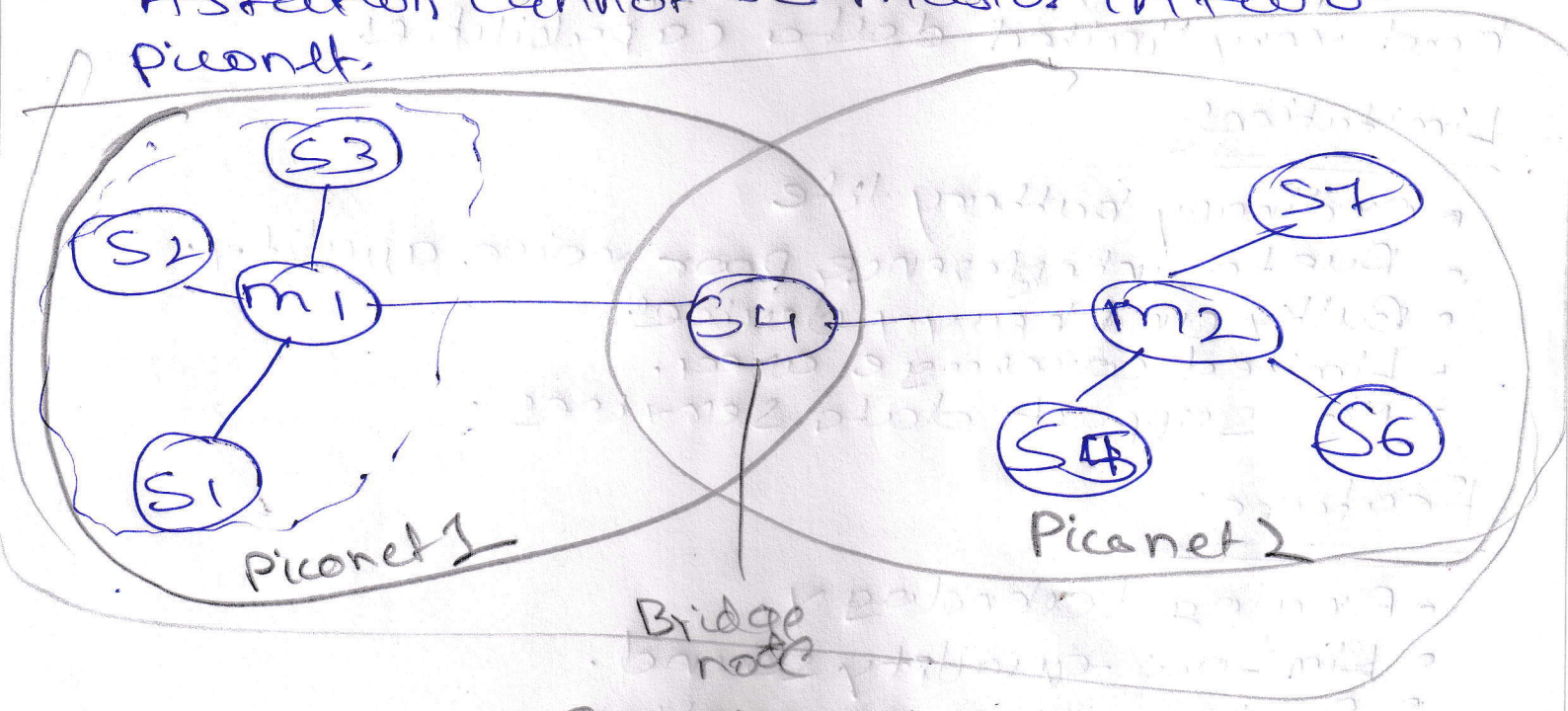


All communication is done between master and slave Salve-Slave communication is not possible.

A piconet had 7 active slave stations and 255 parked nodes. Parked nodes are secondary nodes that can't communicate until they are switched to active state.

Scatternet

- Scatternet is formed by combining various Piconets
- A slave in one piconet can act as master or primary in other piconet.
- Such a station or node can receive message from master in first piconet and deliver the message to its slaves in other piconet where it acting as master
- This node is also called bridge slave
- A station can be a member of two piconets.
- A station cannot be master in two piconet.



Scatternet

3.6 Mobile Generations : 1G, 2G, 3G, 4G, 5G.

Mobile Generations

Mobile Generations / communication keeps getting better and faster with each new generation.

They develop new standards to make sure we can do more with phones, like faster download and better videocalls.

1G (First Generation)

Introduced in 1980s. 1G was first generation of wireless technology.

It primarily offers analog voice calls and had very limited data capabilities

Limitations

- Ordinary battery life
- Due to interference, poor voice quality.
- Bulky and heavy devices
- Limited coverage area.
- No support data services.

Features

- Analog technology.
- ~~Lim~~ Low quallity sound.
- Basic voice encryption
- maximum speed = 2.4 kbps.

2G (Second Generation)

2G emerged in 1990s and brough digital voice calls, SMS (Short-message service) and basic data services like MMS (multimedia messaging service). It also introduced better security encryption.

Limitations

- Restricted mobility
- Data rate low
- Fewer features
- Less hardware capability
- User number are limited

Features

- Digital technology
- Small data services and mms system.
- Roaming was available
- Better voice call.
- Conference call was allowed.
- Speed - 64 kbps.

3G (Third Generation)

Rolled out in 2000's, 3G significantially boosted speeds, data speeds, enabling services like video call, mobile internet browsing and faster data downloads.

Limitations

- Mobile devices was costly.
- Spectrum licenses are expensive.
- To support highes data rate requires higher bandwidth.

Features

- Enhanced ~~Analog~~ Digital technology
- Video calling
- Speed 2 mbps.
- Email
- Web browsing
- Higher data rate at low cost.
- Picture sharing
- Better voice call.
- Location tracking.

4G (fourth generation)

Deployed around 2010s, provided even faster data speeds and low latency than 3G.

It enabled advanced services like HD video streaming, online gaming, VoIP (Voice over Internet Protocol) call with better quality.

Limitations

- Expensive infrastructure, hardware, spectrum
- A comphersive upgrade is time-consuming.

Features

- 4G is LTE (Long-term Evolution) Technology.
- Higher data speed.
- Speed 100Mbps, which is 1 Gbps.
- Improved security.
- HD streaming & force calls at low cost.
- 3D TV connections.
- Video conferencing.

5G (Fifth generation)

The current evolutionary standard, 5G promises ultra-fast speeds, ultra-low latency, and massive connectivity.

It opens possibilities for innovative IOT, autonous technologies vehicles, augmented reality, remote surgery, due to high bandwidth & reliability.

Limitations

Features

- Delivers faster ultra data.
- Higher security.
- GPS tracking
- IOT.
- Better quality almost all services.
- Small cell technologies use
- Supercharged system.
- Try to fulfill customer demands -

3.3 IEEE Standards: 802.1, 802.2, 802.3, 802.4, 802.5

① **IEEE 802.1**: Standards related to network management

② **IEEE 802.2**: General standard for data link layer of OSI Reference model.
~~It is logical link control (LLC) layer~~
divides layer into two sublayers.
LLC & MAC.
LLC (Logical link control) &
(MAC) Media access control.

③ **IEEE 802.3**: Define MAC layer for bus network that use CSMA/CD. This is basis of Ethernet standard.

④ **IEEE 802.4**: Define MAC layer for Bus network that use token passing mechanism.

⑤ **IEEE 802.5**: Define MAC layer for token ring networks.

⑥ **IEEE 802.6**: Standard for MAN.

⑦ **IEEE 802.11**: Wireless Network Standards.

3.4 Wireless LANs: 802.11 Architecture MAC Sublayer, Addressing mechanism.

802.11

IEEE has defined the specifications for a wireless LAN, called ~~802~~ IEEE 802.11, which covers the physical and data link layers.

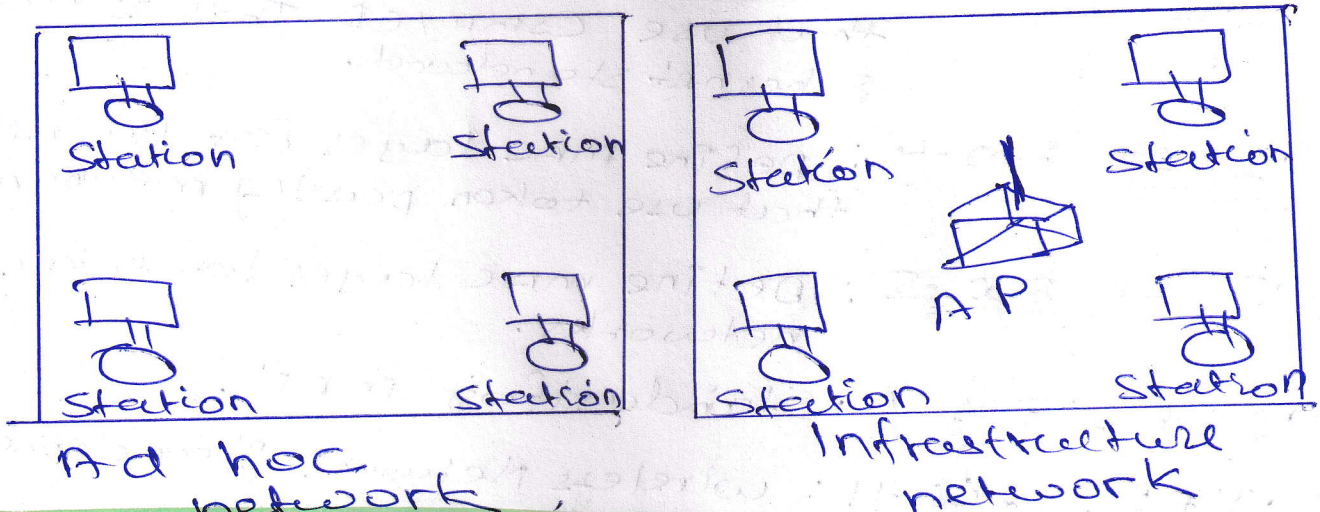
IEEE 802.11 defines two types of service

- BSS (Basic Service Set)
- ESSS (Extended Service Set)

P. T. O

① Basic Service Set (BSS)

- IEEE 802.11 defines basic service set (BSS) as building block of wirless LAN.
- A Basic service set is made of stationary or mobile wireless stations and option centreal base station, known as Access point (AP).
- Figure shows two set in standard.
  - The BSS without AP is stand-alone network
  - iscalled ad hoc architecture.
  - A network with AP is reffered as an infrastructure network.



Ad hoc network

Infrastructure network

② ESS (Extended Service Set)

An Extended Service set (ESS) is made up of two or more BSS with APs. In this case the BSS are connected through a distribution system, which is usually a wired LAN.

The distributed connects v
It uses extended service set
mobile & stationary. mobile
inside BSS. This stationar
stations are part of wire

when BSS are connected
reach of one another cc
use of an AP.

However communicatio
in two different BSSs u
two APs.