ASSIGNMENT-1

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(1.) compare Packet switching and circuit switching.

⇒ circuit switching:

→ In circuit switching there are 3 phases:
i) connection Establishment
ii) Data Transfer
iii) connection Released.

→ each data unit know the entire Path address which is Provided by the source.
→ data is Processed at source system only
→ Delay between data units is uniform.
→ Resource reservation is the feature of circuit switching because path is fixed for data transmission.
→ It is more reliable.
→ wastage of resources are more.
→ It is not a store and forward technique
→ circuit switching is not convenient for handling bilateral traffic.
→ Transmission of the data is done by the source.
→ congestion can occur during connection establishment time.
→ Recording of Packet is not Possible
→ There is a physical path between the source and the destination.

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⇒ Packet switching.

→ In Packet switching directly data transfer takes place.
→ each data unit just know the final destination address intermediate path is decided by the routers.
→ data is processed at all intermediate node including source system.
→ delay between data units is not uniform.
→ There is no resource reservation because bandwidth is shared among users.
→ It is less reliable.
→ Less wastage of resources as compared to circuit switching It is store and forward technique.
→ Transmission of the data is done not only by the source, but also by the intermediate routers.
→ Packet switching is suitable for handling bilateral traffic.
→ There is no physical path between the source and the destination.
→ Packet is recorded in Packet switching.
→ congestion can occur during data transfer phase, large number of Packets comes in no time.

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(2). write shanon's channel capacity formula and compare it with nyquist capacity formula.

→ shanon's channel capacity formula:

$$C = B \log_2 (1 + SNR)$$

where, C is capacity of the channel (Bits/second)
B is bandwidth of channel (Hertz)
SNR is signal to noise ratio (dB).

→ Nyquist's formula indicates that, all other things being equal, doubling the bandwidth doubles the data rate.

→ Now consider the relationship among data rate, noise, and error rate. The presence of noise can corrupt one or more bits. if data rate is increased

→ The bits become shorter in time so that more bits are affected by a given pattern of noise. Thus, at a given noise level, the higher the data rate, the higher the error rate.

→ All of these concepts can be tied together neatly in a formula developed by the mathematician claude shanon.

→ The key parameter involved in this reasoning is the signal-to-noise ratio (SNR)

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→ which is the ratio of the Power in a signal to the Power contained in the noise that is Present at a Particular Point in the transmission.

$$SNR_{dB} = 10 \log_{10} \frac{\text{signal Power}}{\text{noise Power}}$$

→ The signal-to-noise ratio is important in the transmission of digital data because it sets the upper bound on the achievable data rate. shannon's result is that the maximum channel capacity, in bits per second, obeys the equation.

(3) Case study : compare 1G, 2G, 3G and 4G technology.

⇒ 1G - First Generation mobile network

→ This was the first generation of cell phone technology
→ These are analog communication standards that were introduced in 1979 and the early to mid-1980s
→ The maximum speed of 1G is 2.4 kbps
→ It had,
Bandwidth : Analog
operating frequency : 800 MHz
Band (frequency) type : Narrow band
carrier frequency : 30 kHz

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→ It was first wireless communication with less complex network elements.

→ Limited capacity, not secure, poor battery life, large phone size, background interference are disadvantages of 1G.

→ It uses circuit switching for switching and FDMA for multiple Access system.

→ It supports only voice calls.

⇒ 2G - 2nd Generation mobile network

→ This was Digital version of 1G, radio signals used by 1G network are analog., while 2G networks are digital.

→ The speed of 2G is around 50 kbps. The max theoretical speed is 384 kbps with Enhanced Data Rates for GSM Evolution (EDGE). EDGE+ can get up to 1.3 Mbps

→ It had,
Bandwidth : 25 MHz
Operating frequency : GSM: 900MHz, 1800MHz,
CDMA: 800MHz
Band (frequency) type: Narrow band
carrier frequency : 200kHz

→ It introduced Multimedia features (SMS, MMS), Internet access and SIM.

→ It uses circuit switching for voice and Packet switching for Data

→ It supports voice calls, short messages, browsing and multipule users on single channel.

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⇒ 3G - 3rd Generation mobile Network

→ This generation set the standards for most of the wireless technology.

→ web browsing, email, video downloading, picture sharing and other smartphone technology were introduced in the third generation.

→ It were facilitate greater voice and data capacity.

→ It had:

Bandwidth: 25 MHz

Operating frequencies : 2100 MHz

Band (frequency) type: wide band

carrier frequency : 5 MHz

→ It Provides High security, International roaming with High Power consumption, High cost of spectrum licence.

→ It supports video conferencing, mobile TV and GPS

→ It uses Packet switching and CDMA for multiple Access system.

⇒ 4G - 4th Generation mobile Network

→ 4G is very different technology as compared to 3G and was made possible to provide high speed, high quality and high capacity to users while Improving security and lower the cost of voice and data services, multimedia and internet over IP.

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→ The key technologies that have made this possible are MIMO (multiple Input multiple output) and OFDM (orthogonal Frequency Division multiplexing). The max speed of a 4G network 100 mbps.

→ It uses:
Bandwidth: 100 MHz
operating frequency: 850 MHz, 1800 MHz
Band type: ultra wide Band
carrier frequency: 15 MHz

→ It uses Packet switching and CDMA.

→ Technology used in 4G are LTE and WiMAX.

⇒ 5G - 5th Generation mobile Network

→ 5G was the next major phase of mobile telecommunications beyond the current 4G Standards.

→ Next Generation mobile Networks Alliance (NGMN) defines 5G network as:
→ several tens of megabits per second should be supported to 1000 of users
→ signaling efficiency enhanced.
→ Latency should be reduced compared to LTE.

→ The max speed of 5G is aimed at 35.46 GBPS, which is 35 times faster than 4G.

→ key technologies: massive MIMO, Li-Fi, millimeter - wave all the new technology decade could be used to give high speed to users.

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Q/0

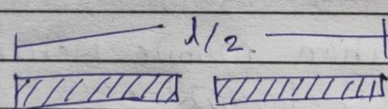
(a) Enlist the types of antennas and explain them in brief.

→ Antenna:

An antenna can be defined as an electrical conductor or a system of conductors used either for radiating electromagnetic energy or for collecting electromagnetic energy.

→ Antenna types:

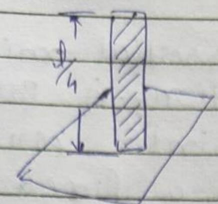
Dipoles Two of the simplest and most basic antennas are the half-wave dipole or Hertz antenna and quater-wave vertical or marconi antenna.



Half wave dipole

→ The half-wave dipole consists of two straight collinear conductors of equal length, separated by a small gap.

→ The length of antenna is one-half the wavelength of the signal that can be transmitted most efficiently.

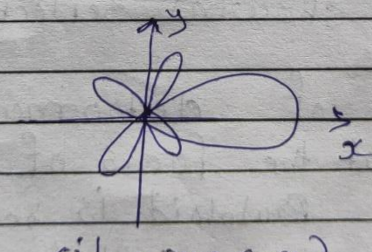


Quarter wave antenna

→ A vertical quater wave antenna is the type commonly used for automobile radios and portable radios.

Directional antenna

If multiple antennas are configured in an array of antenas, these multiple antennas can produce a directional beam.



side view (a)
Directed antenna

→ if anntennas are placed in a linear antenna array, a typical directional radiation pattern is shown in figure above. This pattern is produced from linear array where the antennas are each placed apart by a half of a wavelength.

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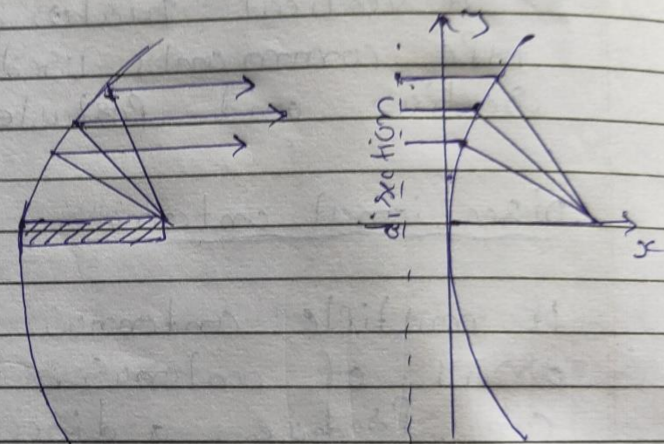
Parabolic Reflective Antenna:

→ It is used in terrestrial microwave and satellite applications. A Parabola is the locus of all points equidistant from a fixed line and a fixed point not on the line. The fixed point is called focus and the fixed line is called the directrix.



Cross Section of Parabolic antenna showing reflective Property

→ If source of electromagnetic energy is placed at the focus of the Paraboloid and if the Praboloid is reflecting surface, then the wave will bounce back in lines Parallel to the axis of the Paraboloid as shown in figure.

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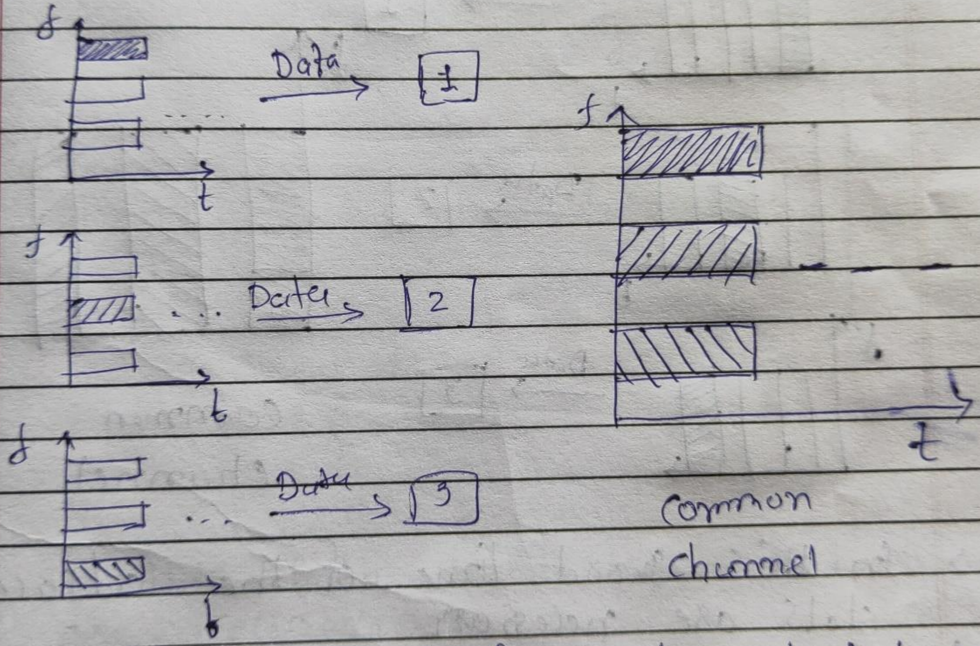
(5.) compare FDMA, TDMA, CDMA.

⇒ FDMA (Frequency Division multiple Access)

→ In this bandwidth is divided into various frequency bands. Each station is allocated with band to send data and that band is reserved for particular station for all time.



→ In this only need of guard bands between the adjacent channels are necessary.

→ Synchronization is not required.

→ The rate of data is low.

→ mode of data transfer is continuous signal

→ It is little flexible.

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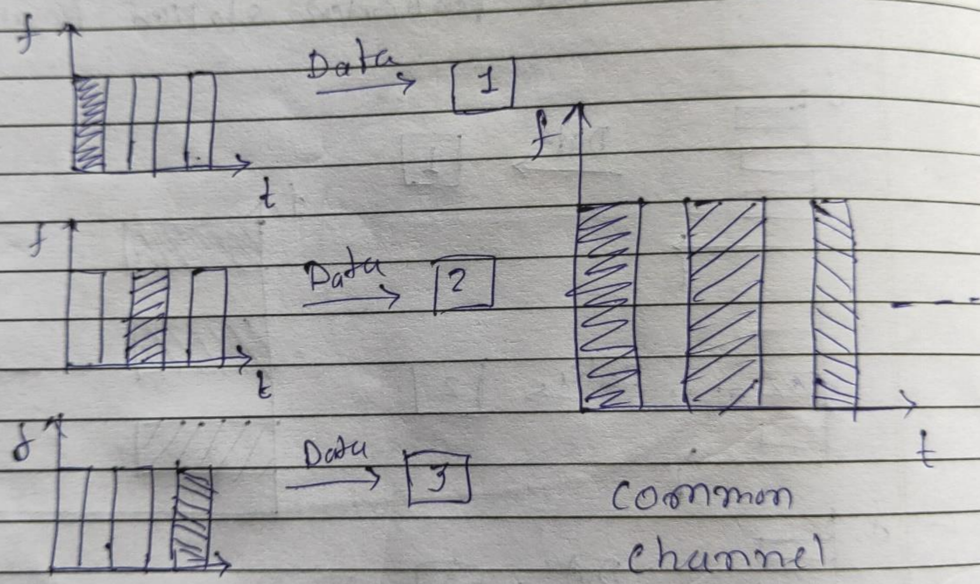
⇒ TDMA (Time division multiple Access).

→ In this bandwidth of channel is divided into various stations on the time basis. There is time slot given to each station, the station can transmit data during that time slot only.



→ In this guard time of the adjacent slots are necessary.
→ synchronization is required.
→ The rate of data is medium
→ mode of data transfers is signal in burst
→ It is moderate flexible

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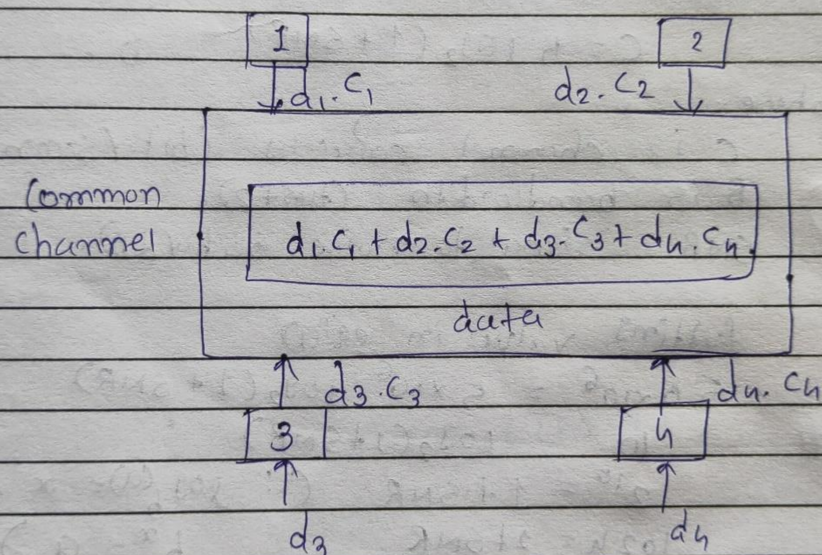
⇒ CDMA (code division multiple Access)

→ In this all the stations can transmit data simultaneously. It allows each station to transmit data over the entire frequency all the time. multiple simultaneous transmissions are separated by unique code sequence. Each user assigned with a unique code sequence.



→ In this, both guard bands and guard time are necessary

→ codeword is necessary.

→ The ~~d~~ rate of data is high

→ mode of data transfer is digital signal

→ It is highly flexible.

→ Synchronization is not required.

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$2^{10} = 2^5 \times 2^5$
$32 \times 32 = 1024$

(6.) Given a channel with an intended capacity of 50 mbps, the bandwidth of the channel is 5 MHz. what signal-to-noise ratio is required to achieve this capacity?

⇒ The signal-to-noise ratio is important in transmission of digital data. shannon's equation

$$C = B \log_2 (1 + SNR) \quad \text{--- ①}$$

where,

C is channel capacity (bits/second)
B is bandwidth (Hertz)
SNR signal to noise ratio(dB).

Putting values in eqn ①

$$50 \times 10^6 = 5 \times 10^6 \log_2 (1 + SNR)$$
$$10 = \log_2 (1 + SNR)$$
$$2^{10} = 1 + SNR \quad (\because \log_b (a) = x \text{ then } b^x = a)$$
$$1024 = 1 + SNR$$
$$\boxed{1023 = SNR}$$

SNR is reported in decibels(dB)

so,

$$SNR_{dB} = 10 \log_{10} SNR$$
$$= 10 \log_{10} (1023)$$
$$\approx 10 \times 3.0098$$
$$\boxed{SNR_{dB} \cong 30\ dB}$$

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(7) Spectrum of a channel is between 3 MHz and 4 MHz. $SNR_{db} = 24$ db then find out channel capacity and how many levels are required?

using shannon's formula,

$$C = B \log_2(1+SNR) \quad \text{— (1)}$$

$\therefore B = 4MHz - 3MHz = 1MHz$

$\therefore SNR_{dB} = 24 dB$

$10\log_{10}(SNR) = 24$

$SNR = 10^{\frac{24}{10}}$

$SNR = 251.1886$

$\therefore SNR \cong 251$

∴ if ~~signals with~~

$C = 10^6 \times \log_2(1+251)$

$= 10^6 \times 8$

$\therefore \boxed{C = 8 MHz}$

∴ if signals with more than two levels can be used: that is each signal element can represent more than one bit. with multi-level signaling, the Nyquist formula,

$$C = 2B \log_2 M \quad \text{— (2)}$$

where M is number of voltage level
C is channel capacity
B bandwidth in Hz.

Using eq^n (2)

$\therefore 8\times10^6 = 2\times10^6 \log_2 M$

$4 = \log_2 M$

$\therefore \boxed{M = 16}$

∴ 16 ~~four~~ levels required.

(8.) Write a program to find hamming distance. For ex. Hamming distance d(V1, V2) = 3, if V1 = 011011, V2 = 110001.

⇒ Hamming distance is the number of bit positions in which two bits are different and two bits streams are equal in length.

```
#include <iostream>
using namespace std;

int main() {
    string bin1, bin2;
    cin>> bin1;
    cin>> bin2;
    Int n= bin1.length(); int count=0;
    For(int i=0; i<n; ++i)
        if(bin1[i] != bin2[i])
            ++count;

    cout<<"Hamming distance"<< count;
    return 0;
}
```

Q. For message M = 1010001101 and pattern P = 110101, find CRC.

```
                1101010110
110101 ) 101000110100000
         110101
         0111011
          110101
          0011101
            000000
            111010
            110101
            0011111
              000000
              111110
              110101
              0010110
                000000
                101100
                110101
                0110010
                 110101
                 0001110
                   000000
                   01110
```

So CRC = 101000110101110

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(10) In a CDMA network, assume there are two stations A (chip sequence: 00011011) and E (chip sequence: 00101110). Figure-1 shows two cases of both stations transmitting at the same time. Show the transmitted sequences S1 and S2 and how DSSS does the recovery at receiver.

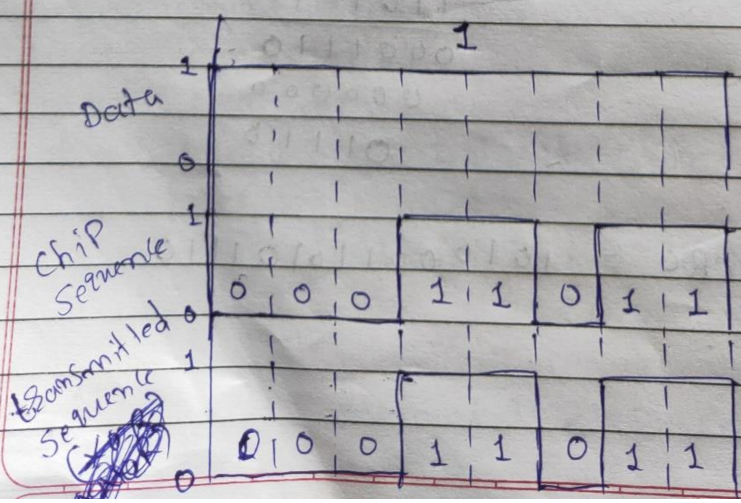
A	E
1	0
0	–

→ To Transmit 1, Tx sends its chip sequence. To Transmit 0, it sends complement of chip sequence. DSSS is commonly known as CDMA.

Case 1:

A	E
1	0

Station A Data : 1
chip sequence : 00011011



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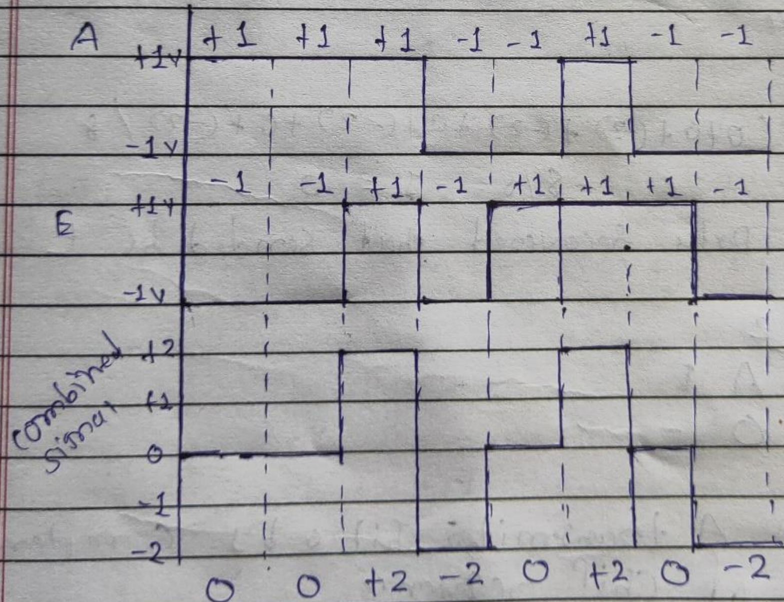
→ In bipolar notation 0 is +1 & 1 is -1
→ So A transmits bit 1 by sending
$S1 = (+1, +1, +1, -1, -1, +1, -1, -1)$

station E data: 0
chip sequence : 0010 1110

→ To send 0 we complement chip sequence : 1101 0001
→ In bipolar notation 0 is +1 & 1 is -1
→ So E transmits bit 0 by sending
$S2 = (-1, -1, +1, -1, +1, +1, +1, -1)$

→ combining all 2 signals



→ now at recovery receiver, ~~multip~~ we XOR the input bits, whereas in Bipolar notations we multiply to get the desired result

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receiving sequence 0 0 +2 -2 0 +2 0 -2

A's sequence +1 +1 +1 -1 -1 +1 -1 -1

XOR (0+0+2+2+0+2+0+2)/8.

8/8 = +1 = 1

Data recovered that sended by A using DSSS at receiving side

0 0 +2 -2 0 +2 0 -2

E's sequence +1 +1 -1 +1 -1 -1 -1 +1

XOR (0+0+(-2)+(-2)+0+(-2)+0+(-2))/8

-8/8 = -1 = 0

Data recovered that sended by E

→ case 2

A E

0 -

→ so A transmits bit 0 by complementing of chip sequence

A : 0001 1011

A' : 1110 0100

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→ In bipolar Notation +1 is 0 and −1 is 1
→ so A transmits bit 0 by sending
(−1, −1, −1, +1, +1, −1, +1, +1)

receiving sequence −1 −1 −1 +1 +1 −1 +1 +1

A's sequence +1 +1 +1 −1 −1 +1 −1 −1

XOR $((-1)+(-1)+(-1)+(-1)+(-1)+(-1)+(1)+(-1))/8$
$= -8/8 = -1 = 0$

Data recovered that sended by A

so if we try to recovered this message using E's sequence than

−1 −1 −1 +1 +1 −1 +1 +1
E's sequence +1 +1 −1 +1 −1 −1 −1 +1

XOR $((-1)+(-1)+1+1+(-1)+1+(-1)+1)$
$4-4=0/8=0$ error in Data

⇒ It is always the case that $-8 \le S_A(d) \le 8$ no matter what sequence of −1s and +1s comprise in Data.
⇒ and the receiving values of Data is the extreme values of +8 and −8. so if
⇒ it produce +8 then we have received 1 bit
→ if it −8 then we have received 0 bit;
otherwise, we assume that someone else is sending information or there is an error

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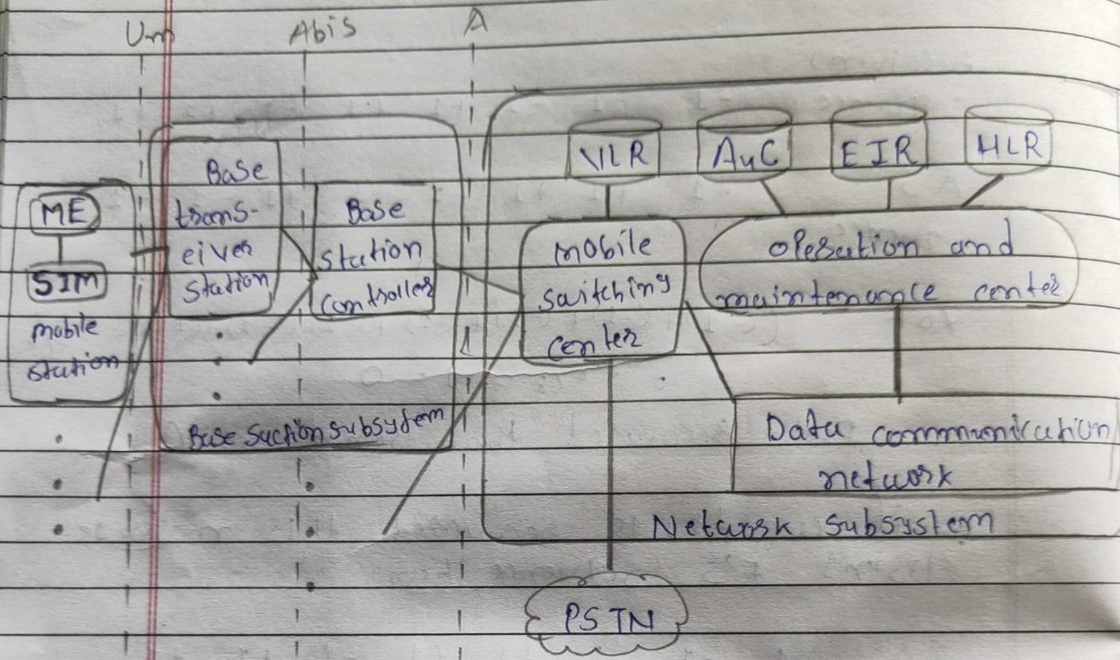
(11.) Draw GSM architecture and describe use of each of its entities.



GSM architecture

→ Figure shows the key functional elements in the GSM system. The boundaries At Um, Abis and A refer to interfaces between functional elements that are standardized in the GSM documents.

→ mobile station:

A mobile station communicates across the Um interfaces, also known as air interface, with base station transceiver in the same cell in which the mobile unit is located.

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→ The ME (mobile equipment) refers to the physical terminal, such as telephone or personal communication service (PCS) device which includes the radio transceiver, digital signal processors and the subscriber identity module.

→ The SIM is portable device in the form of a smart card or plug-in module that stores the subscriber's identification number.

→ Base station subsystem:

→ A base station subsystem (BSS) consists of a base station controller and one or more base transceiver stations.

→ Each base transciever station (BTS) defines a single cell; it includes a ratio antenna, a radio transceiver, and a link to base station controller.

→ Network subsystem:

→ The network subsystem (NS) provides the link between the cellular network and the public switched telecommunications networks.

→ The central element of the NS is mobile switching center (MSC). It supported by four databases that it controls.

Home location register (HLR) database:

It stores information, both permanent and temporary about each of "subscribers" that belongs to it.

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Visitor location register (VLR) database:

→ The location is determined by the VLR into which subscriber is entered. The visitor location register maintains information about subscriber that are currently physically in the region covered by the switching center.

→ It records whether or not the subscriber is active and other parameter associated with subscriber.

Authentication center database (AuC):

→ This database is used for authentication activities of the system: It holds the authentication and encryption keys for all the subscribers in both the home and visitor location registers.

→ A stream cipher, A5 is used to encrypt the transmission from the subscriber to the base transceiver.

Equipment identity register database (EIR):

→ The EIR keeps track of the type of equipment that exists at the mobile stations, and it also play role in security.

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(12) Draw and explain Android architecture.

→ Android architecture contains different number of components to support any android device needs.

→ Android software contains an open-source Linux kernel having collection of number of c/c++ libraries which are exposed through application framework services

Applications	Home, contacts, Camera Gallery, clock, calender
Application framework	Activity manager, Notification manager, Package manager
	windows manager, content providers, view system
Android Runtime	Dalvik vm, zygote, core libraries
Platform libraries	Media, Graphics, SQLite, open GL, SSL, free Type
Linux kernel	wifi driver, Display driver, Audio driver.
	USB driver, camera driver, Bluetooth driver

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⇒ Applications:

→ It is the top layer of android archit architecture. The pre-installed apps like home, contacts, camera, gallery etc and third party apps downloaded from the play store like chat app and games.

⇒ Application framework:

→ It provides a generic abstraction for hardware access and also helps in managing the user interface with application resources.

→ It includes different types of services activity manager, notification manager, view system etc.

⇒ Application runtime:

→ Android Runtime environment is one of the most important part of android. It contains components like core libraries and the Dalvik virtual machine (DVM).

→ Mainly, It provides the base for the application framework and powers our application with the help of the core libraries.

→ Like Java virtual machine (JVM), Dalvik virtual machine (DVM) is a register based virtual machine and specially designed

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and optimized for android to ensure that a device can run multiple instances efficiently.

→ It depends on the layer Linux kernel for threading and low-level memory management.

⇒ platform libraries:

→ The platform libraries includes various c/c++ core libraries and Java based libraries such as media, Graphics, surface manager, open GL etc.

→ media library provides support to play and record an audio and video formats.

→ SQLite provides database support and

→ FreeType provides font support.

→ web-kit This open source web browser engine provides all the functionality to display web content and to simplify page loading.

→ SSL (secure Sockets Layer) is security technology to establish an encrypted link between a web server and a web browser

⇒ Linux kernel:

Linux kernel is heart of the android architecture. It manages all the available drivers such as display drivers, Camera drivers, Bluetooth drivers, audio drivers, memory drivers, etc.

→ The linux kernel kernel will provide an abstraction layer between the device hardware and the other components of android architecture.

→ Security:

The linux kernel handles the security between the application and the system

→ Network stack: It effectively handles the network communication.

→ Driver model: It ensures that the application works properly on the device and hardware manufacturers responsible for building their drivers into the linux build.

(3) write the use of manifest file.

→ Every project in Android includes a manifest file, which is Androidmanifest.xml, stored in the root directory of its project hierarchy.

→ The manifest file is an important part of our app because it defines the structure and metadata of our application, its components, and its requirements.

→ some of the manifest tags that are mainly used are:

→ uses-sdk:

It used to define a minimum and maximum SDK version that must be available on a device so that our app functions properly.

→ uses-configuration:

The uses-configuration nodes are used to specify the combination of input mechanisms that are supported by our application.

→ uses-features:

It is used to specify which hardware features your application requirements. This will prevent our application from being installed on a device that does not include a required piece of hardware.

→ supports-screens: to describe support for application.

→ permission: to acess to shared application components.

→ and application to define drawable and other resources.

CRC Program:

```
//=========================================================================
=
// Name        : CRCparity.cpp
// Author      : SidPro
// Version     : 1.0
// Description :
/*
=>    cyclic redundancy check (CRC), which is used in networks such as LANs
and WANs.

=>    cyclic codes have a very good performance in detecting single-bit
      errors, double errors, an odd number of errors, and burst errors. They
can easily be
      implemented in hardware and software. They are especially fast when
implemented in
      hardware. This has made cyclic codes a good candidate for many
networks.

=> https://en.wikipedia.org/wiki/Cyclic_redundancy_check

*/
//=========================================================================
=



/* input - output format
 *
 * Enter Data to generate CRC: 110100101
   Enter Key: 1101

CRC code: 110100101110
 0 0 0
 */

#include <iostream>
#include <string>
#include <tuple>
using namespace std;

tuple<string,string> sender(string,string);
void receiver(string,string);

int main() {
      string keys,data;
      cout<<"Enter Data to generate CRC: ";
      cin>>data;
      cout<<"Enter Key: ";
      cin>>keys;
      tie(data,keys) = sender(data,keys);
      receiver(data,keys);
      return 0;
}
```

```
tuple<string,string> sender(string data,string keys){
	int lOfKey = keys.length(),i,j;
	int lOfData = data.length();
	int range = lOfData+lOfKey-1;
	char operation[range],temp[lOfKey];

	data.copy(operation,lOfData,0);
	for(i=lOfData;i<range+1;++i)operation[i] = '0';
//	for(i=0;i<range;++i)cout<<operation[i];

	for(j=0;j<lOfKey;++j){
		temp[j] = operation[j];
	}
	for(i=0;i<lOfData;++i){
		if(temp[0]=='1'){
			for(j=0;j<lOfKey;++j){

	if((temp[j]=='0'&&keys[j]=='0')||(temp[j]=='1'&&keys[j]=='1')){
						temp[j] = '0';
					}
					else
						temp[j] = '1';
			}
			for(j=0;j<lOfKey-1;++j){
				temp[j] = temp[j+1];
			}
			temp[j] = operation[i+lOfKey];
		}
		else{
			for(j=0;j<lOfKey;++j){
				if(temp[j]=='1'){
					temp[j] = '1';
				}
				else
					temp[j] = '0';
			}
			for(j=0;j<lOfKey-1;++j){
				temp[j] = temp[j+1];
			}
			temp[j] = operation[i+lOfKey];
		}
//		cout<<"\n"<<i<<" ";
//		for(j=0;j<lOfKey;++j)cout<<temp[j];
	}
	for(j=0;j<lOfKey-1;++j){
		data = data+temp[j];
	}
	cout<<"\n"<<"CRC code: "<<data;
	return make_tuple(data,keys);
}
void receiver(string data,string keys){
	int lOfKey = keys.length(),i,j;
	int lOfData = data.length();
	char operation[lOfData],temp[lOfKey];

	data.copy(operation,lOfData,0);
//	for(i=0;i<lOfData;++i)cout<<operation[i];
```

```
	for(j=0;j<lOfKey;++j){
		temp[j] = operation[j];
	}
	for(i=0;i<lOfData-lOfKey+1;++i){
		if(temp[0]=='1'){
			for(j=0;j<lOfKey;++j){

	if((temp[j]=='0'&&keys[j]=='0')||(temp[j]=='1'&&keys[j]=='1')){
						temp[j] = '0';
					}
					else
						temp[j] = '1';
			}
			for(j=0;j<lOfKey-1;++j){
				temp[j] = temp[j+1];
			}
			temp[j] = operation[i+lOfKey];
		}
		else{
			for(j=0;j<lOfKey;++j){
				if(temp[j]=='1'){
					temp[j] = '1';
				}
				else
					temp[j] = '0';
			}
			for(j=0;j<lOfKey-1;++j){
				temp[j] = temp[j+1];
			}
			temp[j] = operation[i+lOfKey];
		}
//		cout<<"\n"<<i<<" ";
//		for(j=0;j<lOfKey;++j)cout<<temp[j];
	}
	cout<<"\n";
	for(j=0;j<lOfKey-1;++j){
		cout<<" "<<temp[j];
	}
}
```

Hamming Distance:

```
// 'Ctrl +' to increase font size
// 'Ctrl -' to decrease font size
// 'Ctrl 0' to Reset Font size
// 'Ctrl q' for more help


// Sample code to perform I/O:

#include <iostream>

using namespace std;
```

```
int main() {
	string bin1,bin2;
	cin>>bin1;
	cin>>bin2;
	int n = bin1.length();
	int hamming_distance=0;
	for(int i=0;i<n;++i)
	    if(bin1[i]!=bin2[i])
	        ++hamming_distance;

	cout<<"hamming_distance:"<<hamming_distance;
	return 0;
}


// Write your code here
```