17/12/18

Assignment-1

1.
a) Explain in detail about applications of wireless network and small history of wireless networks?

A: * Applications of Wireless networks:

→ Although many applications can benefit from wireless networks and mobile communications, particular apl'n environments seem to be predestined for their use.

1. Vehicles:

- Today's cars already comprise some, but tomorrow's cars will comprise many wireless communication systems & mobility aware applications.
- Music, news, road conditions, weather reports and other broadcast information are received via digital audio broadcasting with 1.5 Mbit/s.
- For personal communication, a universal mobile telecommunications system (UMTS) phone might be available offering voice & data connectivity with 384 kbit/s, using GSM.
- Local ad-hoc network with vehicles close-by to prevent accidents, guidance system, redundancy.
- Vehicle data from buses, high-speed trains can be transmitted in advance for maintenance.

2. Emergencies:

- Wireless networks are the only means of communication in the case of natural disasters such as hurricanes or earthquakes.
- Vital information about injured persons can be (consulted for an early diagnosis) sent to the hospital from the scene of the accident.
- Crisis, War etc.

3. Business:

- A travelling salesman today needs instant access to the Company's database: to ensure that files on his or her laptop reflect the current situation, to enable the Company to keep track of all activities of their travelling employees, to keep databases consistent.
- With wireless access, the laptop can be turned into a true mobile office, but efficient & powerful synchronization mechanisms are needed to ensure data consistency.

4. Replacement of Wired Networks:

- Wireless networks can also be used to replace wired networks, e.g., remote sensors, for tradeshows, or in historic buildings.
- Many computer fairs use WLAN's as a replacement for cabling, Other cases are wireless networks are computers, sensors or information displays in historical buiding.

5. Infotainment and more:

- Static information might be loaded via CD-ROM, DVD, or even at home via the internet. But wireless networks can provide up-do-date information at any appropriate location.
- Another growing feild of WN aph'n lia in entertainment & games to enable, e.g., ad-hoc gaming networks as soon as people meet to play together.

6. Location dependent Services:

-> Location aware services
  - What services eg., printer, fax, phone exist in the local environment.

→ Follow on Services
- Automatic call-forwarding, transmission of the actual workspace to the current location.

→ Information Services
- "push" eg:, Current Special Offers in the supermarket.
- "pop" eg:, where is the Black Forrest Cherry Cake?

→ Support Services
- caches, intermediate results, state information etc. "follow" the mobile device through the fixed network.

→ Privacy
- who should gain knowledge about the location.

→ information & support services.

7. Mobile and Wireless devices:

→ Even though many mobile and wireless devices are available, there will be many more in the future. categories are:
- Sensor, Embedded Controllers, Pager, Mobilephones, Personal digital assistant, Pocket computer, Notebook/Laptop.

* History of Wireless networks:

1794 - Optical telegraph, Claude Chappe
1831 - Faraday demonstrates electromagnetic induction
1831-79: Theory of electromagnetic feilds, wave equations.
1857-94: demonstrates with an experiment the wave character of electical transmission through space.
1896 - Gugilelmo Marconi: first demonstration of wireless telegraphy
1907 - Commercial transatlantic connections.
1915 - Wireless voice transmission NewYork - San Fransicso.
1920 - Discovery of short waves by Marconi
1926 - Train-phone on the line Hamburg - Berlin.
1928 - many TV broadcast trails
1933 - Frequency modulation
1958-84: A-Netz in Germany, NMT at 450 MHz, Start of GSM, Start of American AMPS, CT-1 Standard.
1999 - Standardization of additional WLAN's
2000 - GSM with higher data rates
2001 - Start of 3G systems.

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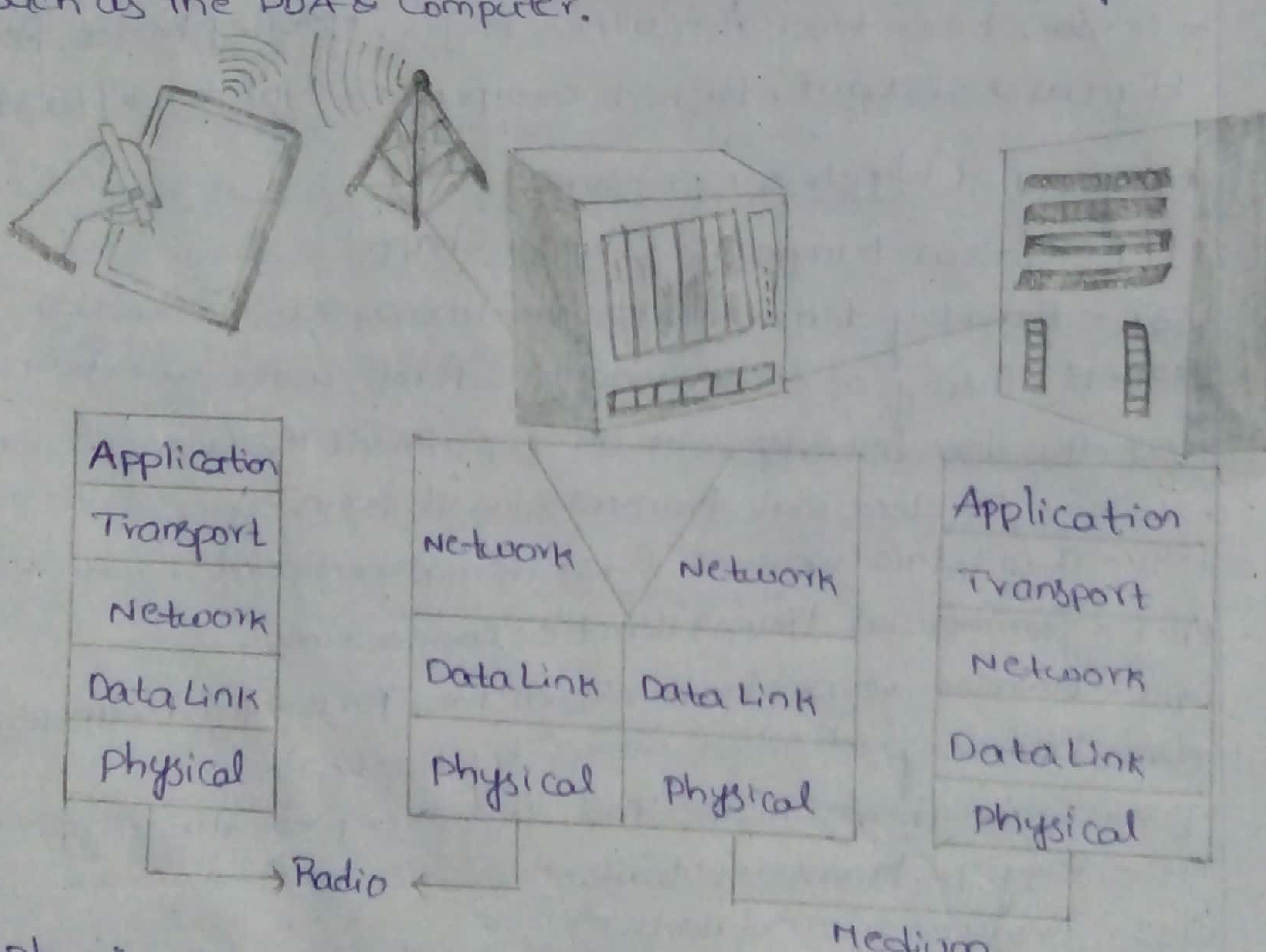
b) Discuss in detail about Simplified reference model of wireless networks?

A:

* Simplified Reference Model:

- The following figure illustrates a personal digital assistant (PDA) which provides an example for a wireless and portable device.
- This PDA Communicates with a base station in the middle of the picture. The base station Consists of a radio transceiver and an internetworking unit connecting the wireless link with a fixed link.
- The figure shows the protocol stack implemented in the System according to the reference model. End-systems, such as the PDA & Computer.



* physical Layer:

- This is the lowest layer in a communication system and is responsible for the Conversion of a stream of bits into signals that can be transmitted on the sender side.

- For wireless communication, the physical layer is responsible for frequency selection, generation of the carrier frequency, signal detection, modulation of data onto a carrier frequency and encryption.

* Data Link layer:

- The main tasks of this layer include accessing the medium, multiplexing of different data streams, correction of transmission errors and synchronization.
- The data link layer is responsible for a reliable point-to-point connection b/w two devices or a point-to-multipoint connection b/w one sender & several receivers.

* Network Layer:

- This third layer is responsible for rooting packets through a network or establishing a connection b/w two entities over many other intermediate systems.
- Important topics are addressing, routing, device location & handover b/w different networks.

* Transport layer:

- This layer is used in the reference model to establish an end-to-end connection. Topics are QoS, flow & congestion control are relevant, especially if the TP's known from the internet, TCP & UDP are to be used over a wireless link.

* Application Layer:

- Finally, the applications are situated on top of all transmission oriented layers. Topics of interest in this context are service location, support for multimedia apk's, adaptive apk's that can handle the large variations in transmissions characteristics & wireless access to the www using a portable device.

2. a) Define signal? And explain about different kinds of representation of signals?

A: * Signal:

- Signals are the physical representation of data. Users of a communication system can only exchange data through the transmission of signals.
- Signals are functions of time & location. Signal parameters represents the data values. The most interesting types of signals for radio transmission are periodic signals, especially sine waves as carriers.
- The general function of a sine wave is:

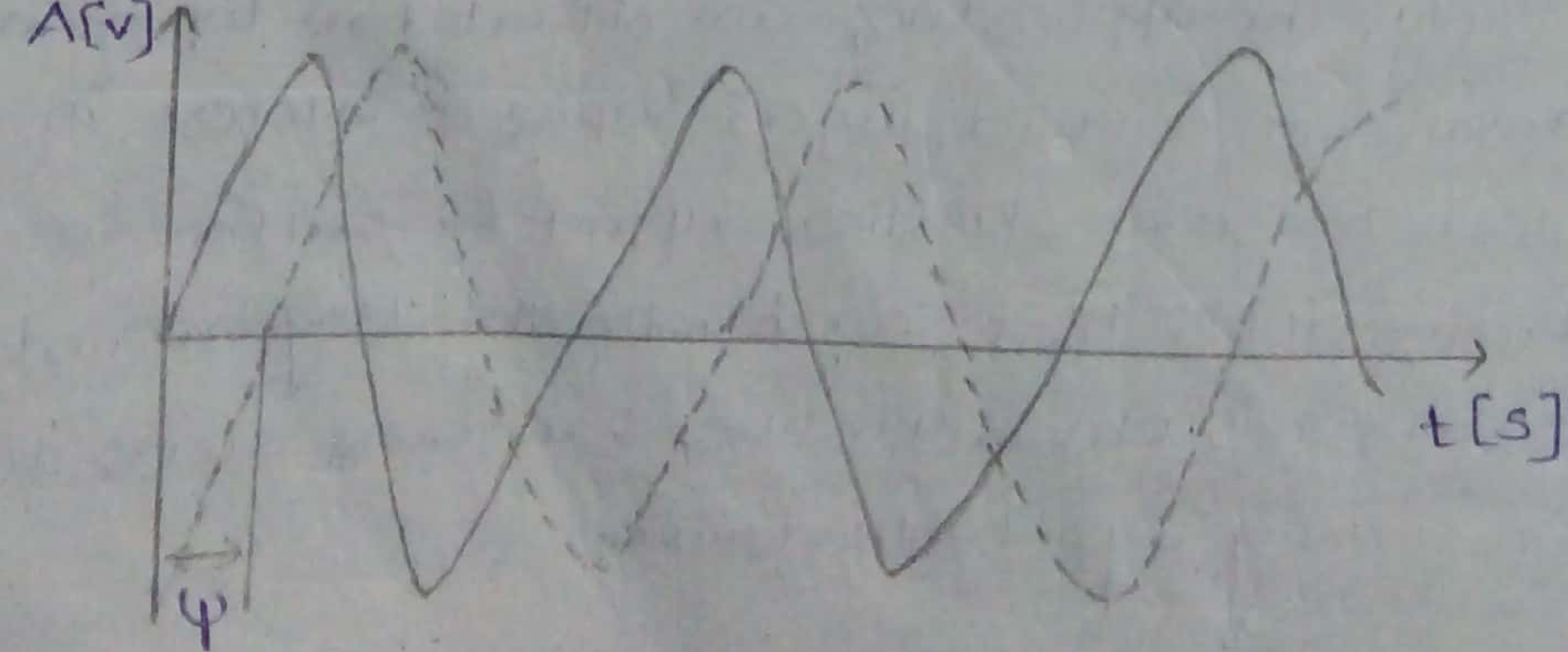
$$g(t) = A_t \sin(2\pi f_t t + \varphi_t)$$

A - Amplitude, f - frequency, φ - phase shift.

* Different Representations of signals:

a) Time domain representation:

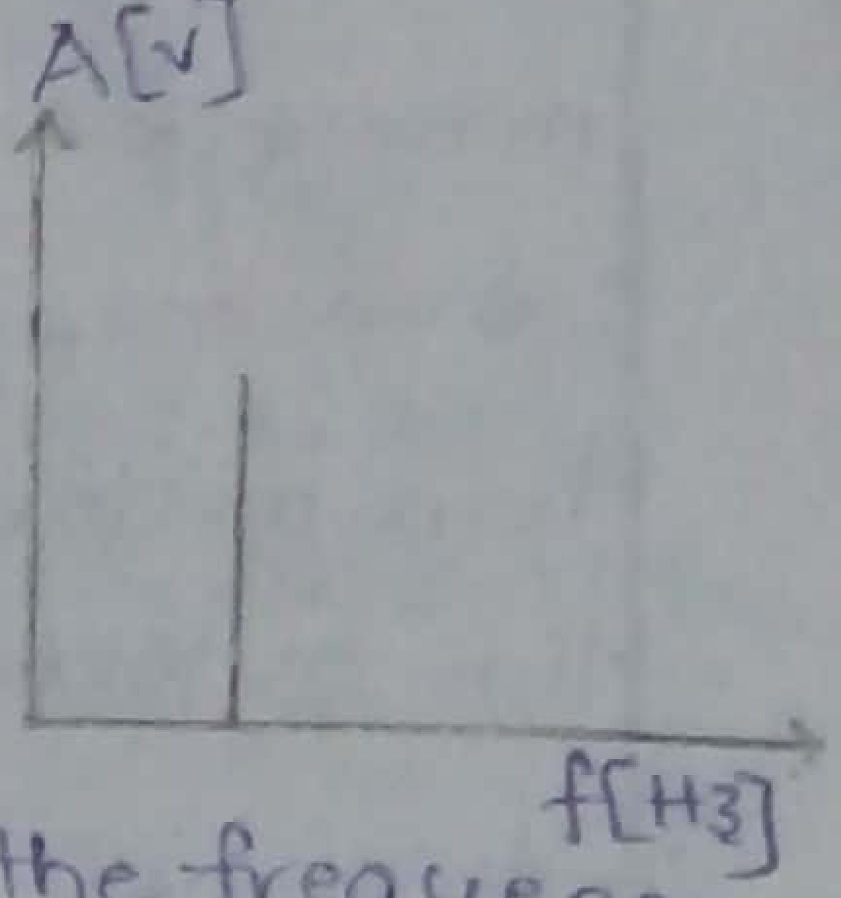
- A typical way to represent signals is the time domain.
- Here the amplitude A of a signal is shown versus time. Time is mostly measured in seconds s, amplitudes can be measured in eg., volt V.
- This is also the typical representation known from an oscillascope.



sine waves are of special interest, as it is possible to construct every periodic signal g by using only sine & cosine functions according to a fundamental equation of Fourier:

$$g(t) = \frac{1}{2}c + \sum_{n=1}^{\infty} a_n \sin(2\pi n f t) + \sum_{n=1}^{\infty} b_n \cos(2\pi n f t).$$

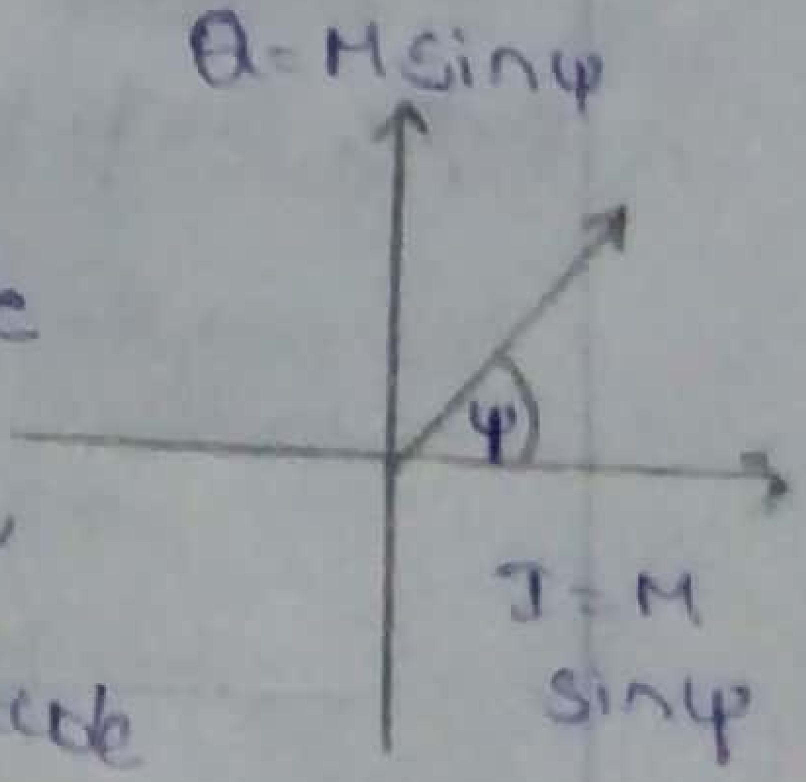
c → Direct Current (DC), a_n, b_n are coefficients are the amplitudes of nth sine & cosine function.



*Frequency Domain representation:

- Representations in the time domain are problematic if a signal consists of many different frequencies.
- A better representation of a signal is the frequency domain. Here the amplitude of a certain frequency part of the signal is shown versus frequency.
- The above figure shows one peak and the signal consists only of a single frequency part ie, it is a single sine function.
- Arbitrary periodic functions would have many peaks, known as frequency spectrum of a signal.
- A tool to display frequencies is spectrum analyzer.

* Phase Domain representation:



- A third way to represent signals is the phase domain shown. This representation, also called phase state, shows the amplitude M, of a signal & its phase φ in polar coordinates.
- The x-axis represents a phase of 0 & is also called In-Phase (I).
- A phase shift of 90° (or) π/2 would be a point on the y-axis, called Quadrature (Q).

b) Explain in detail about different kinds of antennas with radiation patterns?

A:

Antennas:

• As the name wireless indicates, this communication mode involves 'getting rid' of wires and transmitting signals through space without guidance.

• We do not need any 'medium' for the transport of electro-magnetic waves.

• Somehow, we have to couple the energy from the transmitter to the out side world and, in reverse, from the outside world to the 'receiver.'

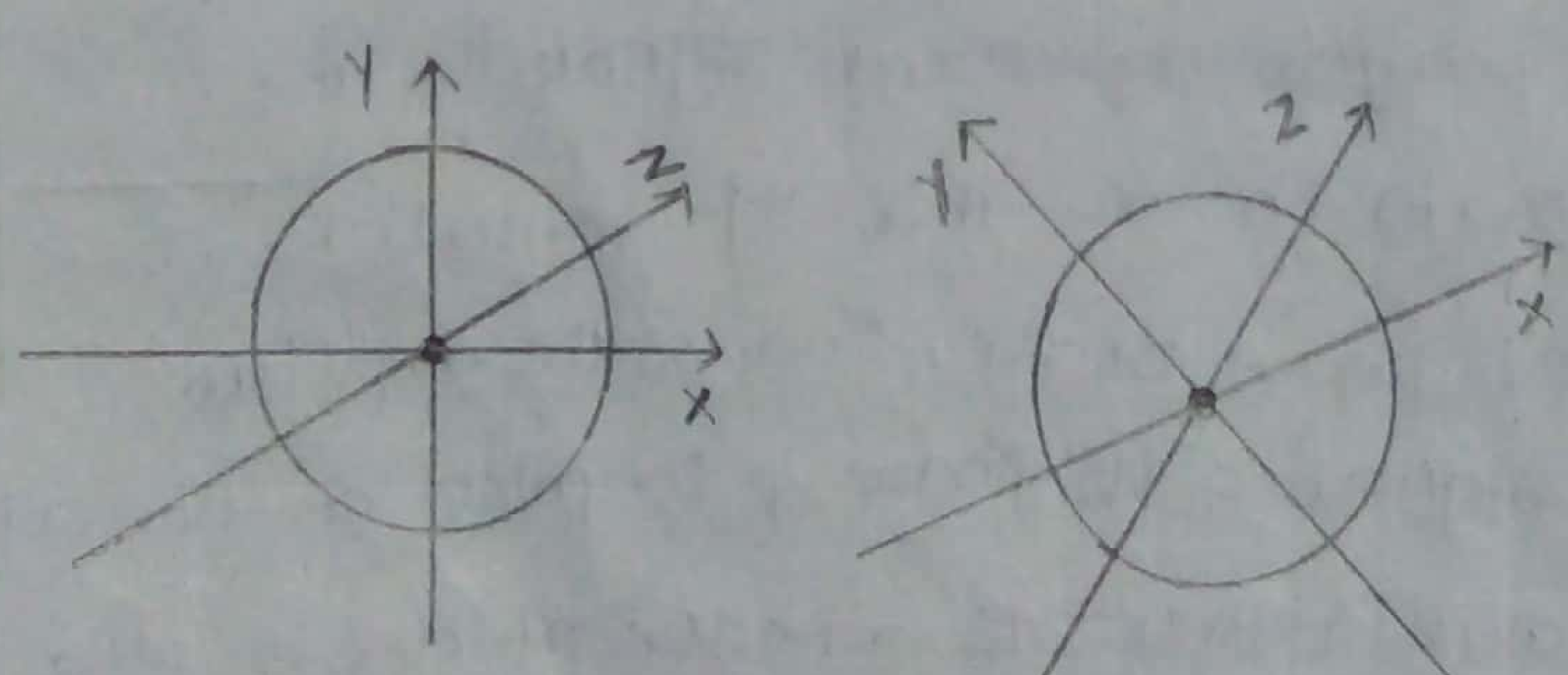
• "Antennas" couple electromagnetic energy to and from Space to and from a wire or coaxial cable.

Types of antennas:

1. Isotropic radiator:

→ A theoretical reference antenna is the isotopic radiator. a point in space radiating equal power in all directions ie., all points with equal power are located on a sphere with the antenna as its center.

→ The radiation pattern is symmetric in all directions. However, such an antenna does not exist in reality.

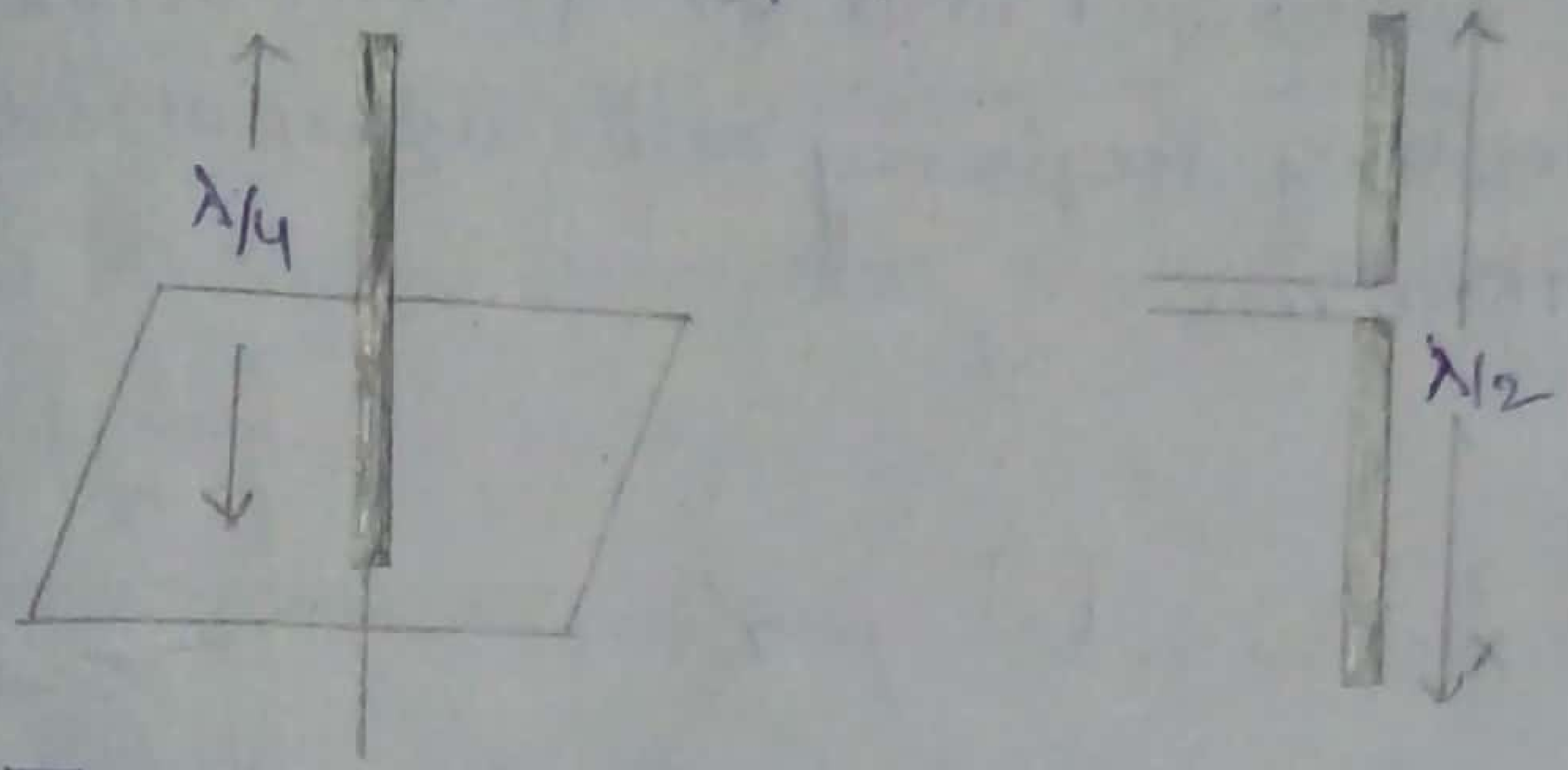


Radiation pattern of a isotropic radiator.

→ Real antennas all exhibit directive effects ie., the intensity of radiation is not the same in all directions from the antenna. The simplest one is Hertzian dipole.

2. Simple dipoles:

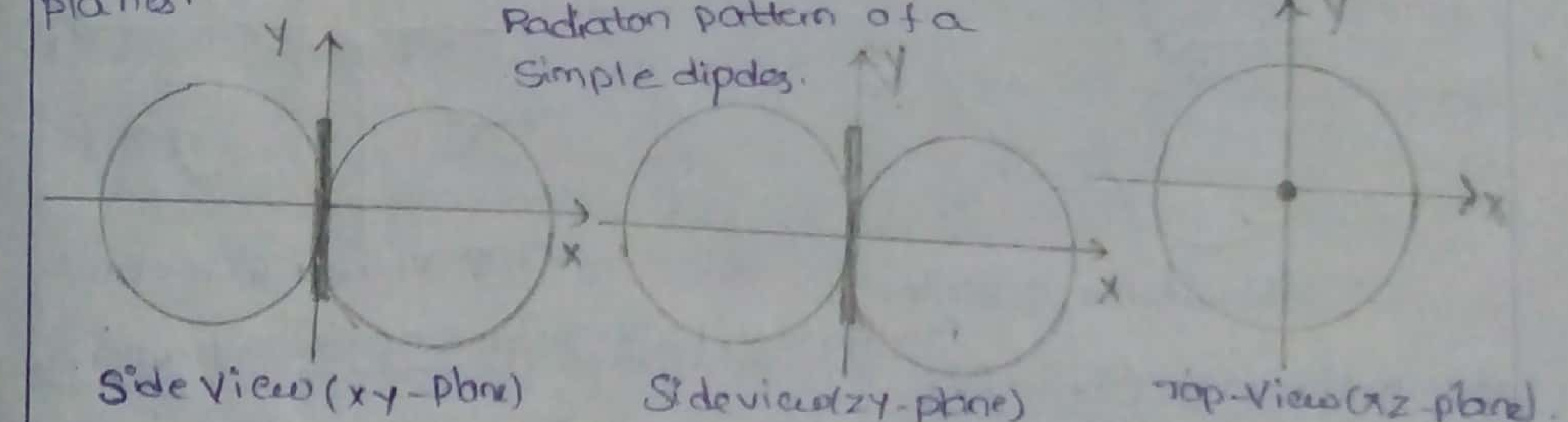
• Real antennas are not isotropic radiators but e.g., dipoles with lengths $\lambda/4$ on car roofs or $\lambda/2$ as Hertzian dipole. The shape of antenna proportional to wavelength:



→ The dipole consists of two collinear conductors of equal length, seperated by a small feeding gap. The length of the dipole is not arbitrary. ~~but~~ This is known as Marconi Antenna.

→ A $\lambda/2$ dipoles has a uniform or omni (all)-directional radiation pattern in one plane & a figure eight pattern in the other two planes.

Radiaton pattern of a Simple dipoles.



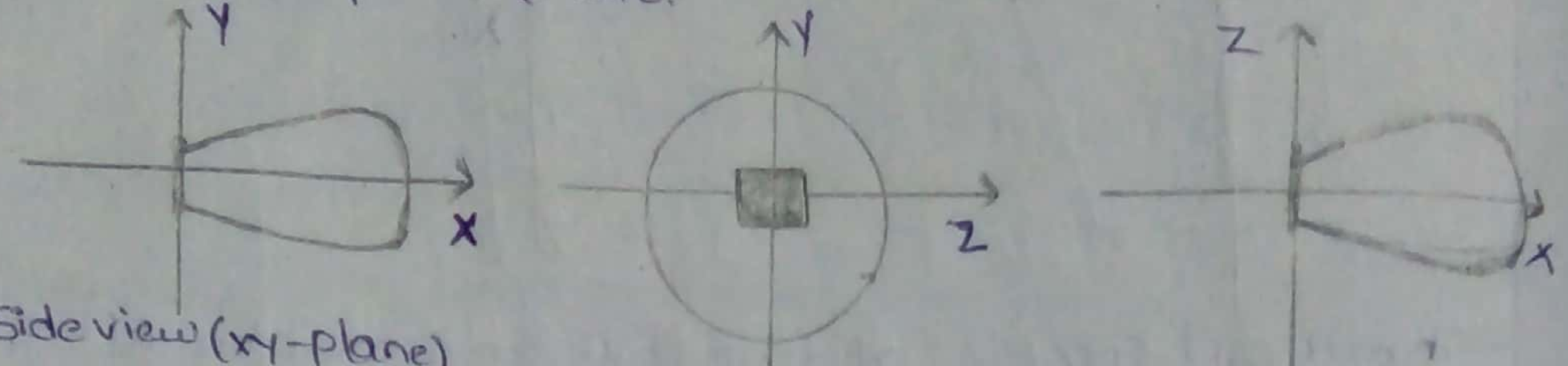
→ If an antenna is positioned e.g., in a valley or b/w buildings, an omnidirectional radiation pattern is not very useful. In this case, directional antenna's with certain fixed preferential transmission & reception directions can be used.

3. * Directed & Sectorized (Directional) Antenna's:

→ The following figures shows the radiation pattern of a directional antenna with the main lobe in the direction of the x-axis. A special eg., of a directional antennas is constituted by satellite dishes.

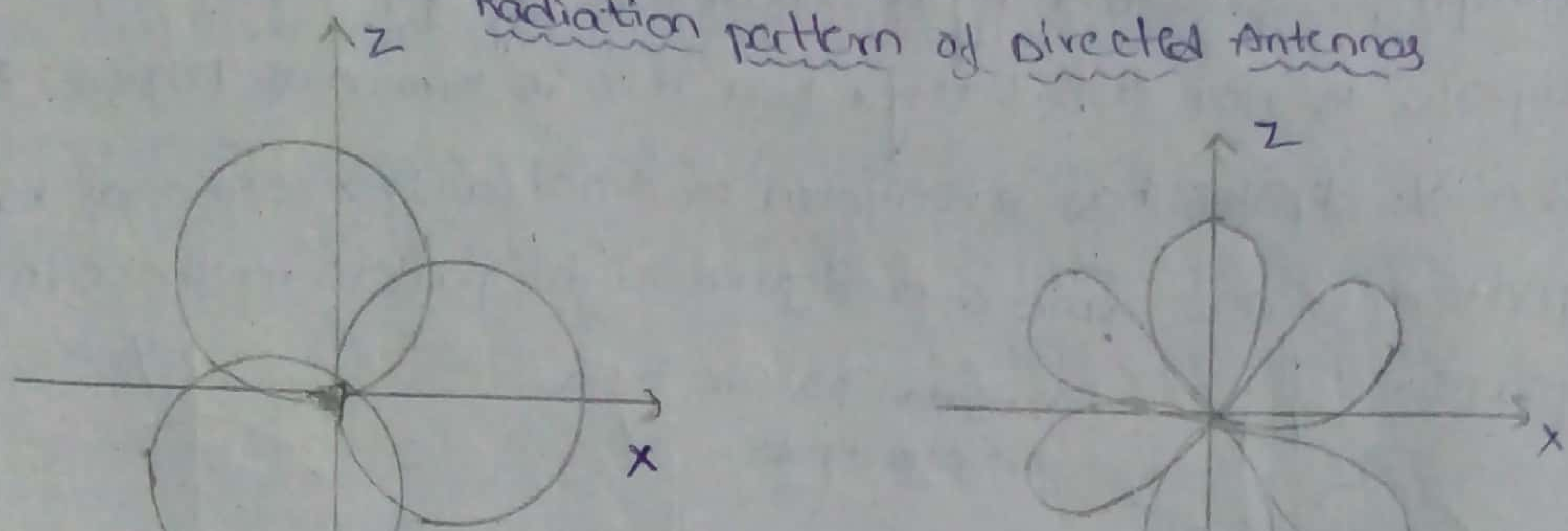
→ Directed antennas are typically applied in cellular systems as presented. Several directed antennas can be combined on a single pole to construct a sectorized antenna.

→ A cell can be sectorized into, for eg., three or six vectors, thus enabling frequency reuse as explained. The radiation patterns are:



Side view (xy-plane) Side view (yz-plane) Top View (xz-plane)

Radiation pattern of directed Antennas

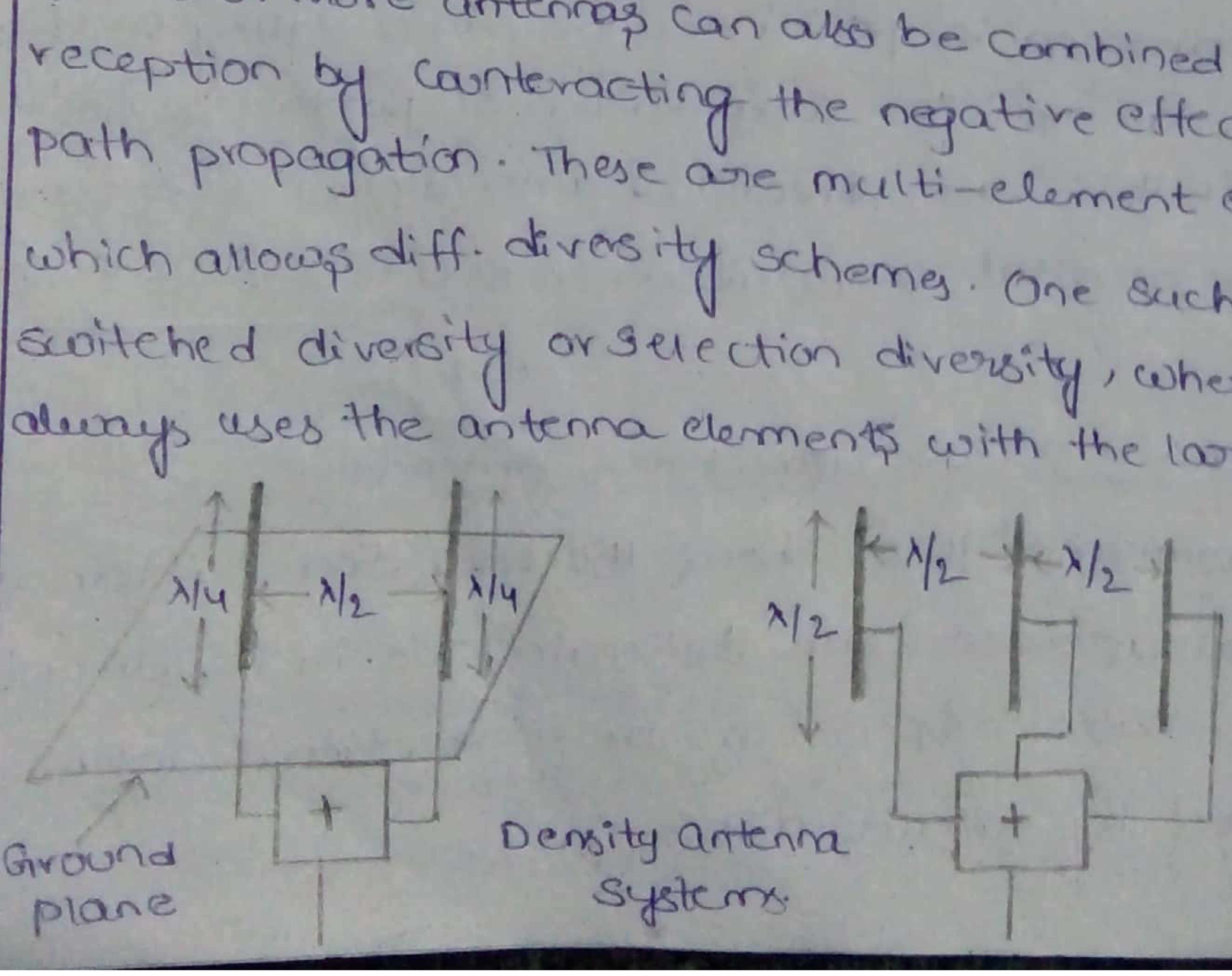


TOP view, 3 Sector. Top view, 6 Sector

Radiation pattern for sectorized antenna

4. Antennas: Diversity:

→ Two or more antennas can also be combined to improve reception by counteracting the negative effects of multi-path propagation. These are multi-element antenna arrays which allows diff. diversity schemes. One such scheme is switched diversity or selection diversity, where receiver always uses the antenna elements with the largest output.



Density antenna systems

3.
a) Explain in detail about signal propogation?

A: *Signal Propogation:

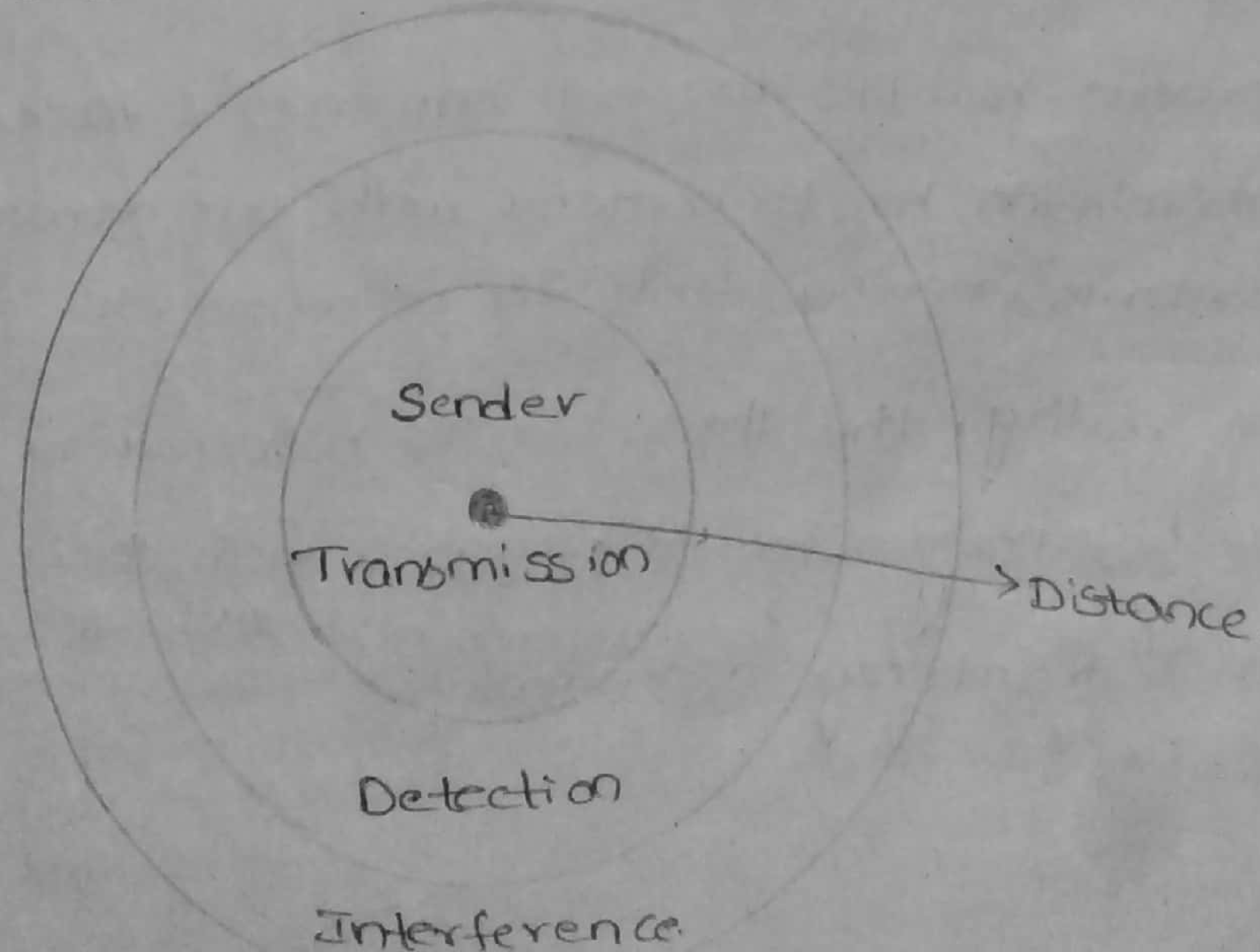
→ Like Wired networks, wireless Communication networks also have senders and receivers of signals. However, in connection with signal propogation, these two networks exhibit the considerable differences.

• In wireless networks, the signal has no wire to determine the direction of propogation, whereas signals in wired networks only travel along the wire.

• As long as the wire is not interrupted or damaged, it typically exhibits the same characteristics at each point.

• One can precisely determine the behaviour of a signal travelling along this wire, eg., received power depending on the length.

• For wireless transmission, this predictable behaviour is only valid in vaccum, ie., without matter between the sender and receiver.



Ranges for transmission, detection & interference of signals

* **Transmission Range:**

• Within a certain radius of the sender transmission is possible ie., a receiver receives the signals with an error rate low enough to be able to communicate and can also act as sender

* **Detection Range:**

• Within a second radius, detection of the transmission is possible ie., the transmitted power is large enough to differe from background noise. However the error rate is too high to establish communication.

* **Interference Range:**

• Within a third even larger radius, the sender may interfere with other transmission by adding to the background noise. A receiver will not be able to detect the signals, but the signals may disturb other signals.

→ The simple and ideal scheme led to the notion of cells around a transmitter.

• However, real life does not happen in a vaccum, radio transmission has to contend with our atmosphere, mountains, moving senders & receivers etc.

• In reality, the three circles referred to above will be bizarrely-shaped polygons with their shape being time & frequency dependent.

b) what are the different fundamental propogation behaviours depending on their frequency?

A: * Path loss of radio signals:

• In free space radio signals propogate as light does ie, they follow a straight line.

• If such a straight line exists b/w sender and receiver it is called line-of-sight (LOS).

• Even if no matter exists between sender & reciver, the signal still experiences the free space loss.

• The received power Pr is proportional to $1/d_2$ with d being the distance between sender & reciver.

• Radio waves can exhibit three fundamental propogation behaviours depending on their frequency:

• Ground Wave: (< 2 MHz)

-> waves with low frequencies follow the earth's surface and can propogate long distances. These waves are used for e.g., Submarine Communication or AM radio.

• Sky Wave: (2 - 30 MHz)

-> Many international broadcasts and amateur radio use these short waves that are reflected at the ionosphere. This way the waves can bounce back & forth between the ionosphere & the earth's surface, travelling around the world.

• Line-of-Sight: (> 30 MHz)

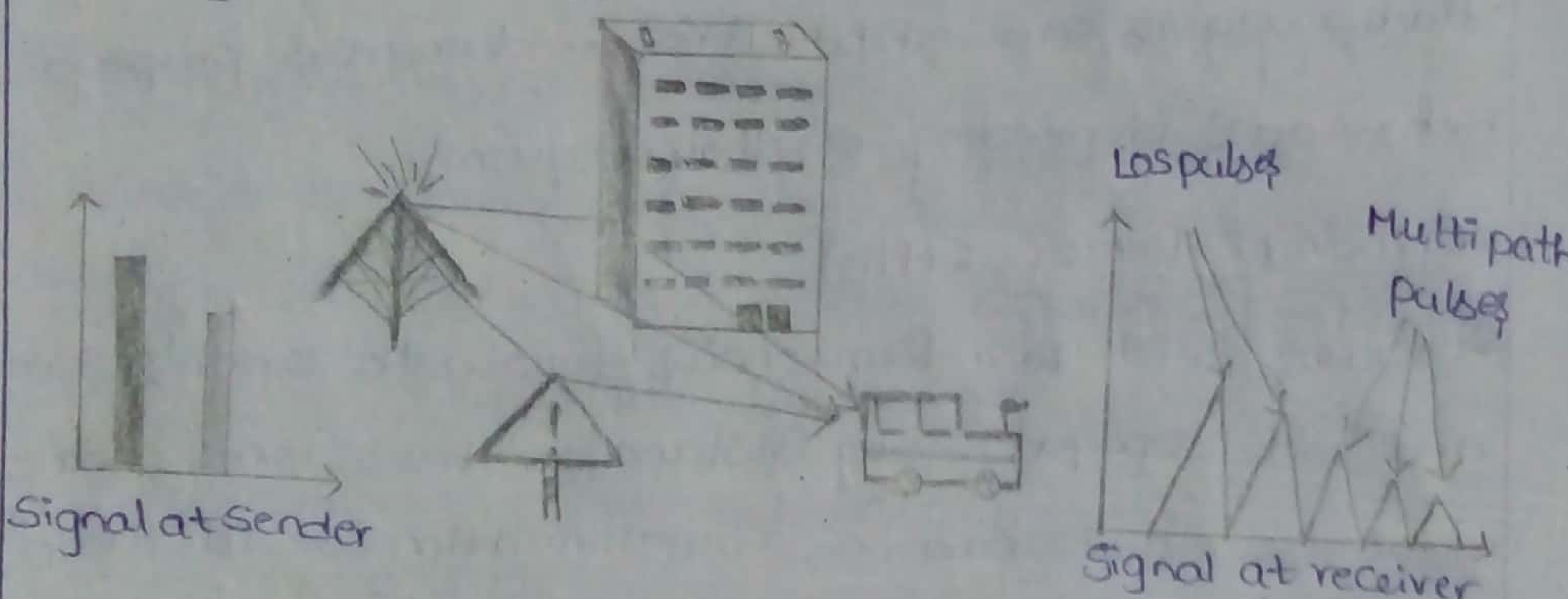
-> Mobile phone systems, Satellite Systems, Cordless telephones etc. use even higher frequencies. The emitted waves follow a (more or less) straight line of sight. This enables direct Communication with satellites or microwave links

On the ground. However, an additional Consideration for ground-based Communication is that the waves are bent by the atmosphere due to refraction.

*Multi Path propogation:

· Together with the direct transmission from a sender to a receiver, the propegation effects lead to one of the most severe radio channel impairements, called multi-path propogation.

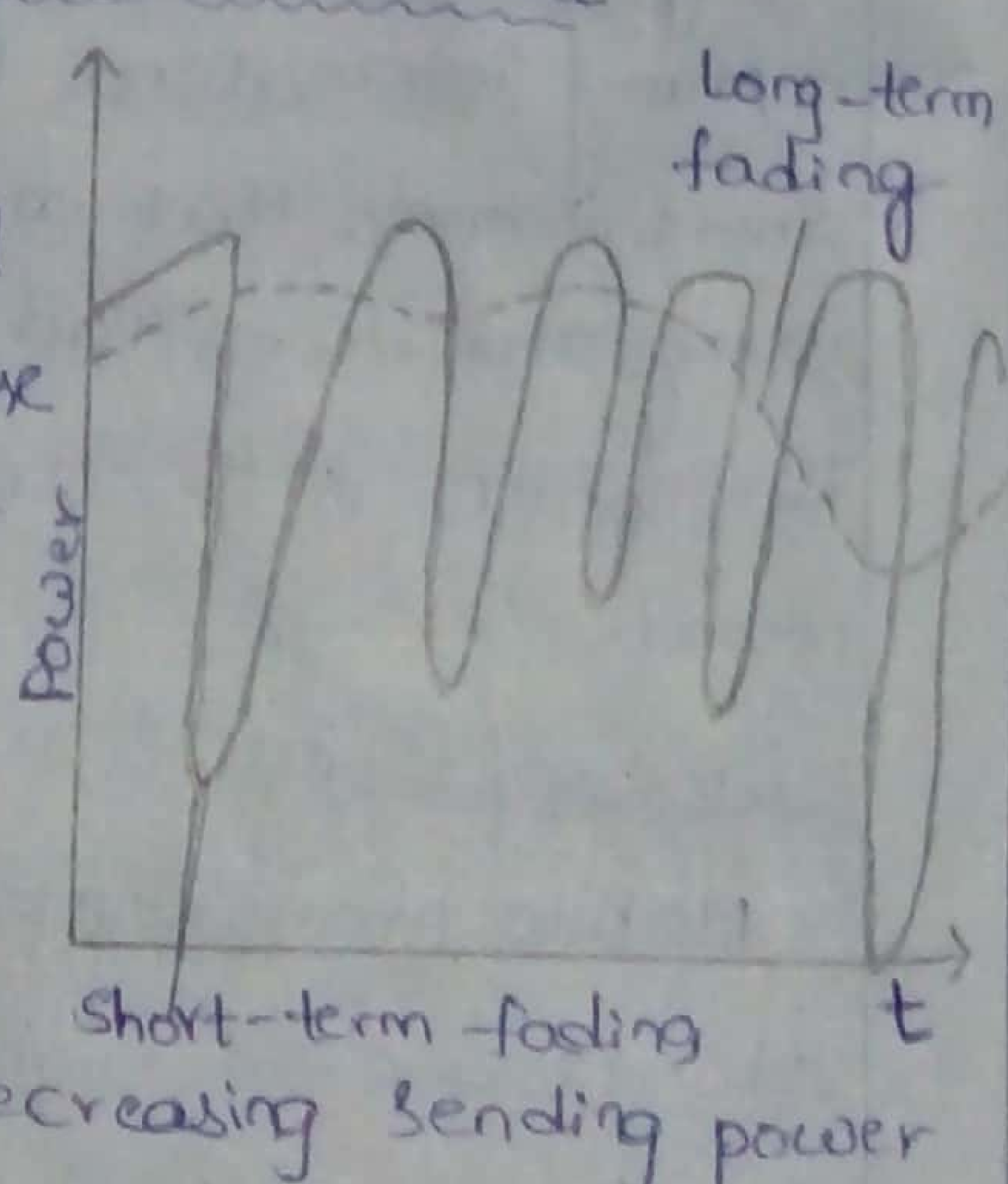
· Radio waves emitted by the sender can either travel along a straight line, or they may be reflected at a large building, or Scattered at smaller obstacles.



MultiPath propogation & intersymbol interference

*Short-term fading:

· The power of the received signal changes considerably over time. These quick changes in the received power are also called "Short-term fading".



* Long term fading:

· The sender Can componesate for long term fading by increasing/decreasing sending power so that the received signal always stays within the certain limits.

4a) Explain in detail about multiplexing mechanism with the diagramatic representation?

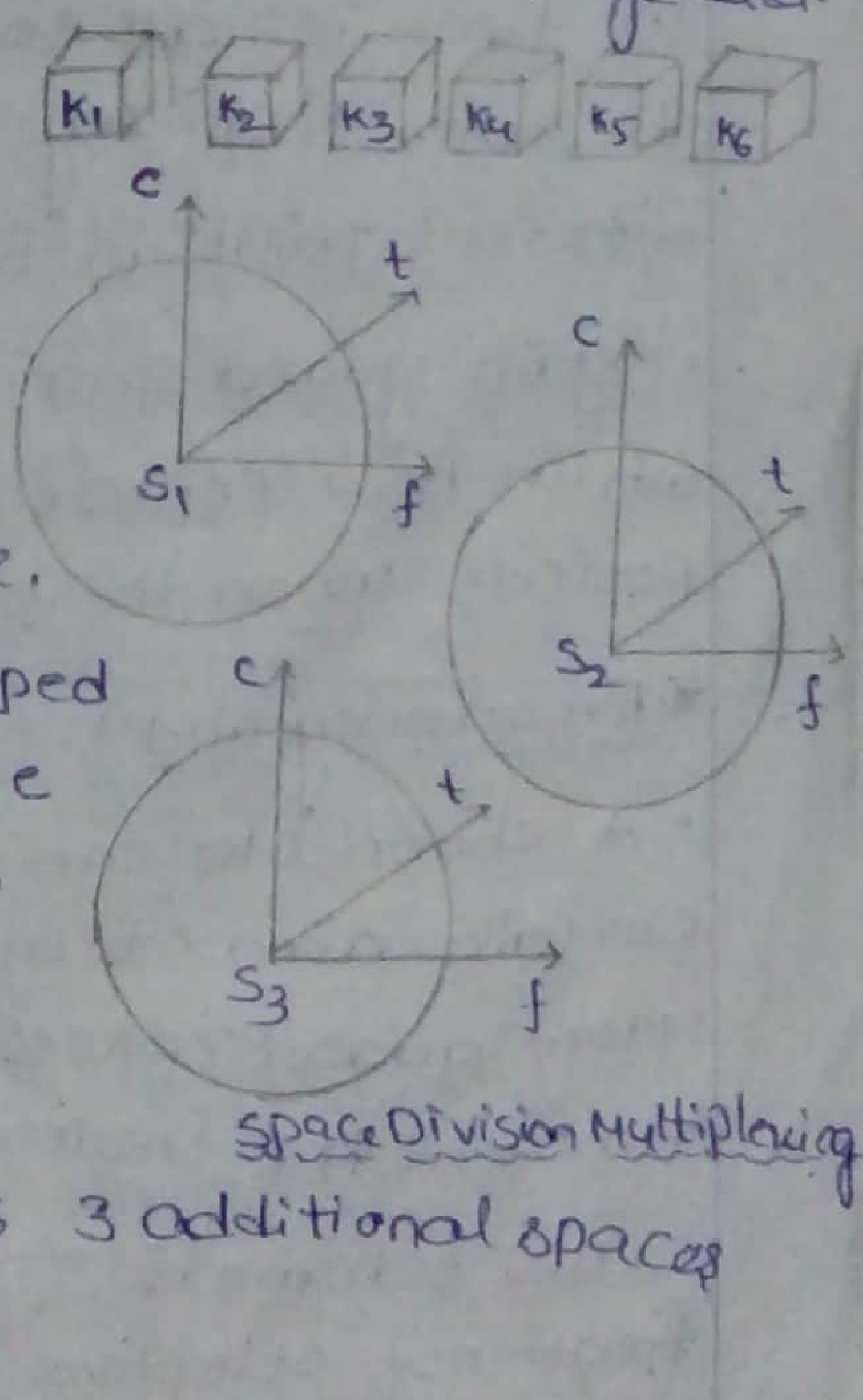
A: * **Multiplexing:**

- Multiplexing is a method by which multiple analog or digital signals are combined into one signal over a shared medium. The aim is to share an expensive resource.
- Multiplexing describes how several users can share a medium with minimum or no interference. It is carried out in four dimensions:

a) Space (S_i) b) Time (t) c) Frequency (f) d) Code (c)

* **Space division multiplexing:**

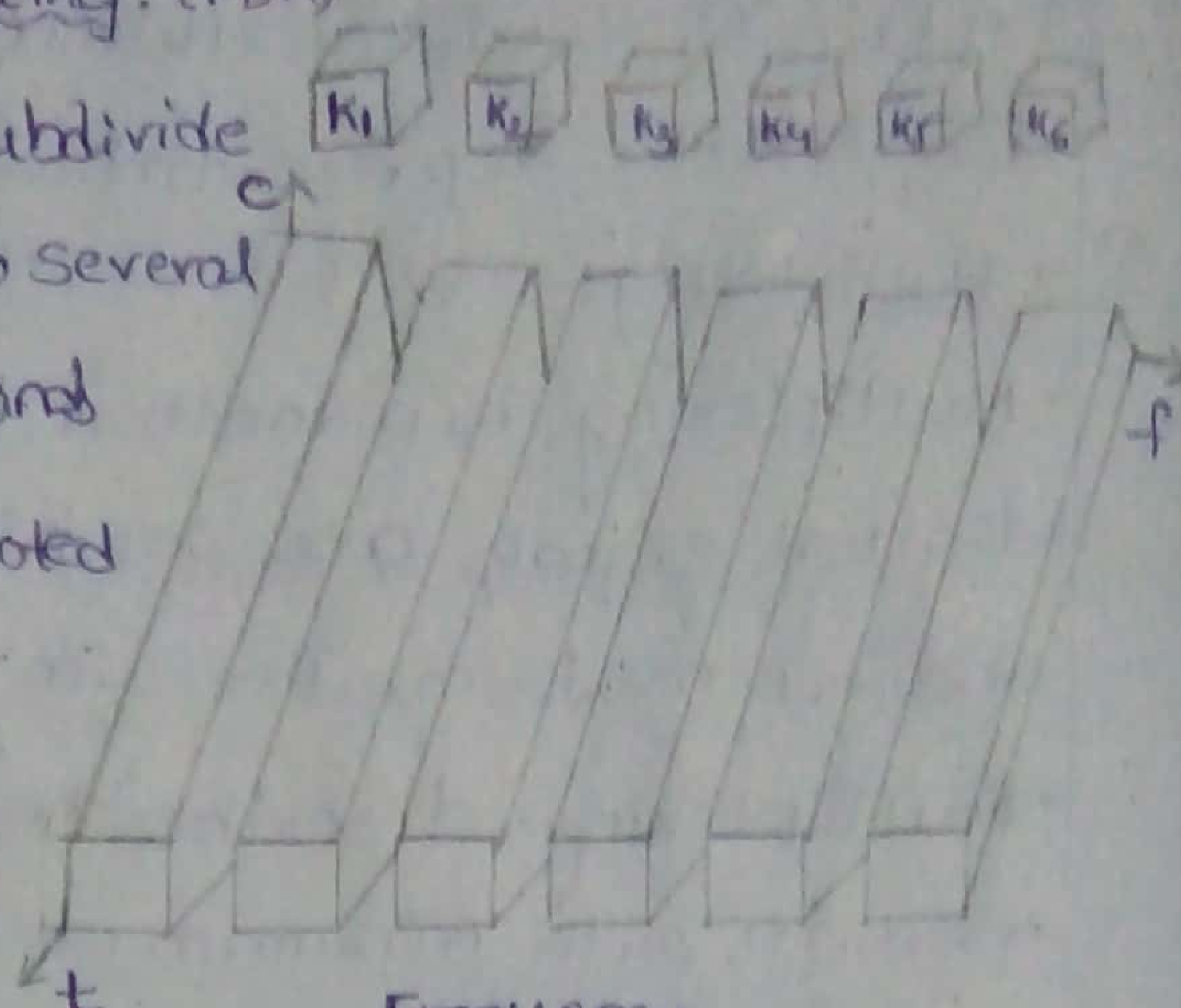
- In this feild, the task of multiplexing is to assign space, time, frequency and code to each communication channel with a minimum of interference and a maximum of medium utilization.
- The term communication channel here only refers to an association of senders & receivers who want to exchange data.
- The 6 channels k_i & a 3D coordinate system. This shows the dimensions of code c, time t & frequency f.
- The space (S_i) is represented via circles indicating interference range.
- The channels k_1 to k_3 can be mapped on to three spaces S_1 to S_3, prevent the interference range from overlapping.
- The space b/w interference ranges is called guard space.



Space Division Multiplexing

- For the remaining channels k_4 to k_6 3 additional spaces would be needed.
- This multiplexing scheme is used at FM radio stations.

* Frequency Division Multiplexing: (FDM)

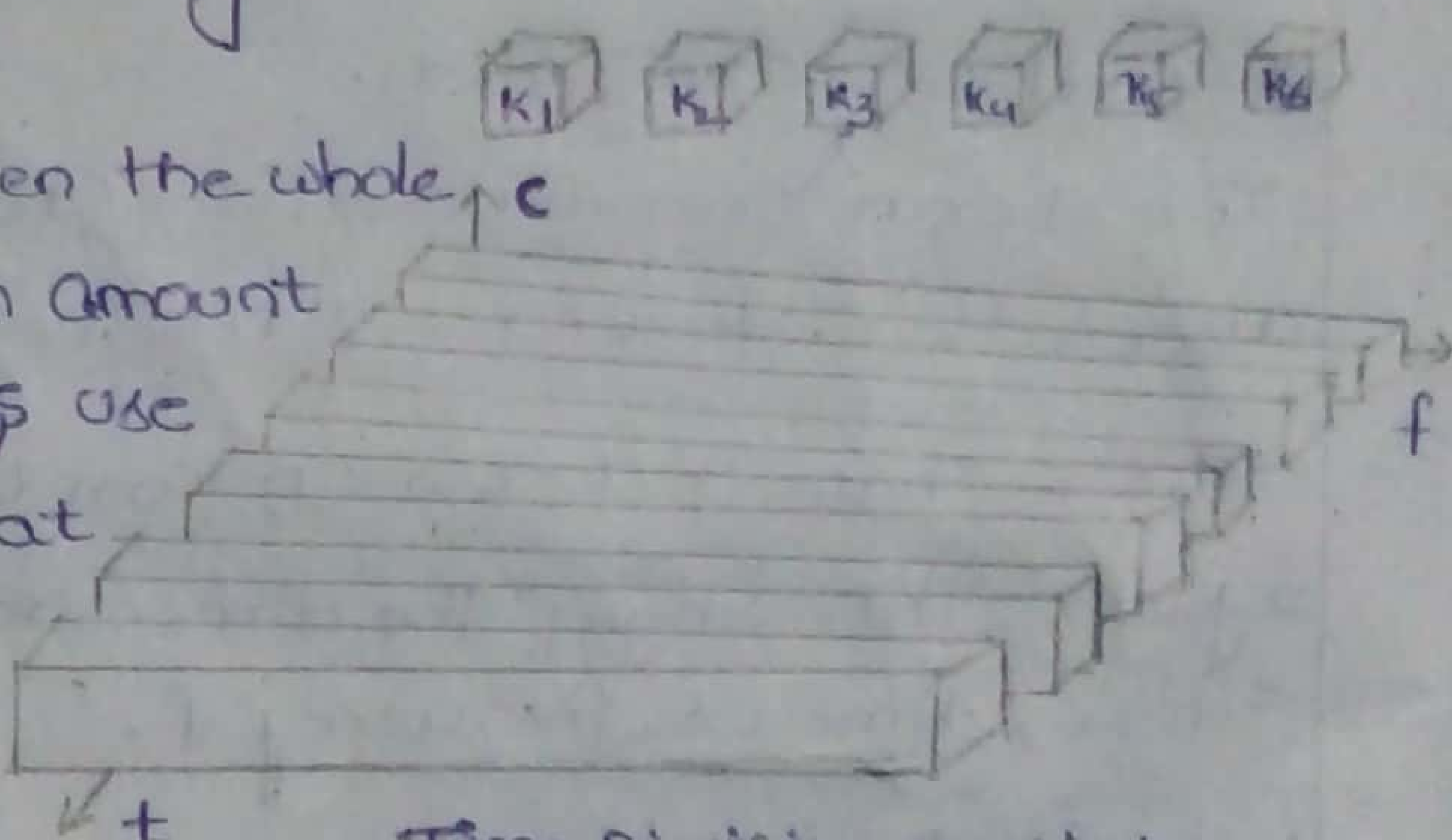


Frequency Division Multiplexing.

- FDM describes schemes to subdivide the frequency dimension into several non-overlapping frequency band
- Each channel Ki is now alloted its own frequency band.
- Senders using a certain frequency band can use this band continously.
- Again guard spaces are needed to avoid frequency band overlapping. This Scheme is used for radio stations within the same region, where each has its own frequency.

* Time division Multiplexing (TDM):

- A more flexible multiplexing scheme for typical mobile communication is TMD.
- Here a channel Ki is given the whole bandwidth for a certain amount of time i.e., all senders use the same frequency but at different points in time.

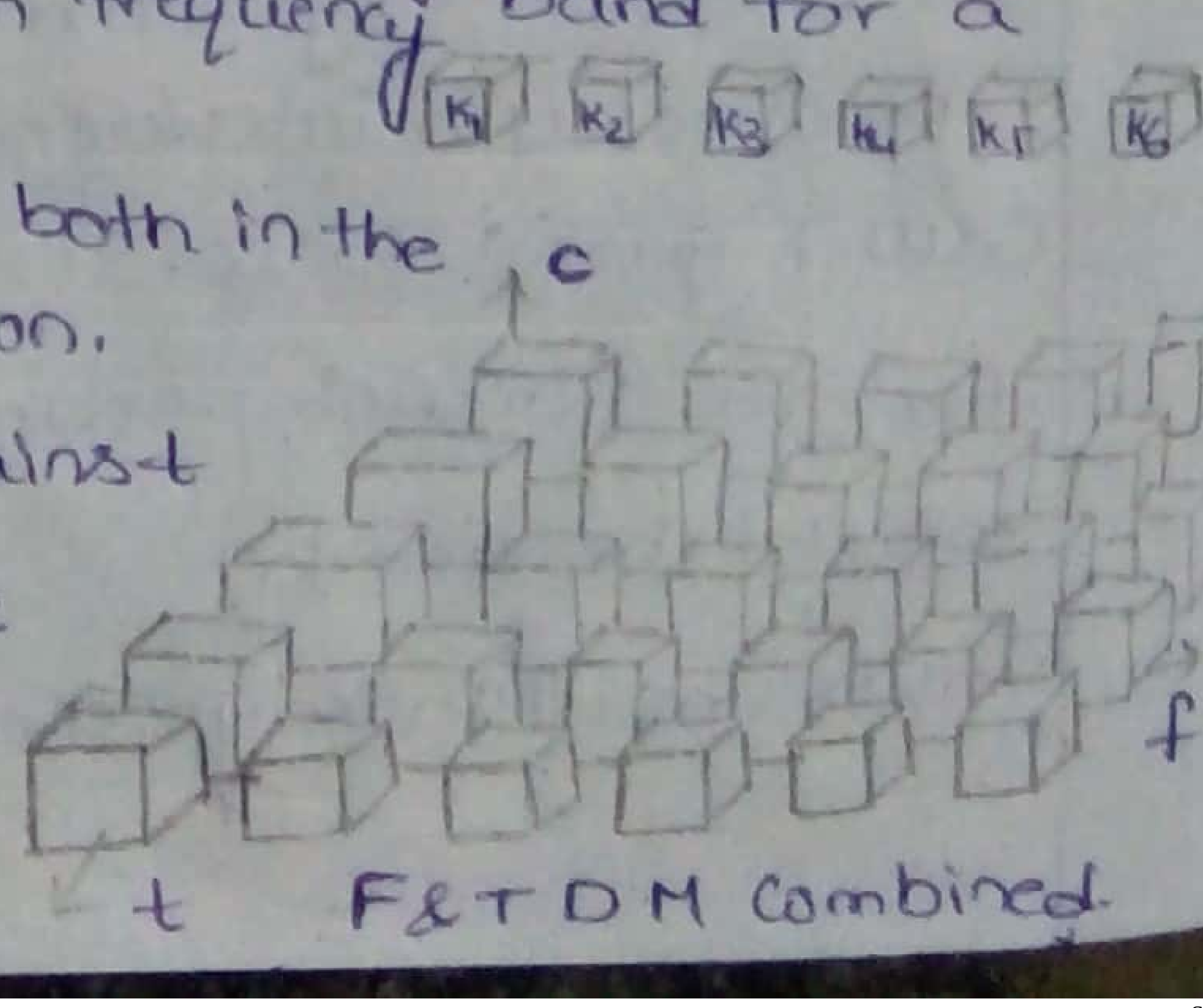


Time Division Multiplexing.

- Again guard spaces, which now represent time gaps, have to seperate the different periods when the senders use the medium.

* Frequency and Time Division multiplexing can be combined:

- A channel Ki can use a certain frequency band for a certain amount of time.
- Now guard spaces are needed both in the time & in the frequency dimension.
- This scheme is more robust against frequency selective interference i.e., a interference in a certain small frequency band.

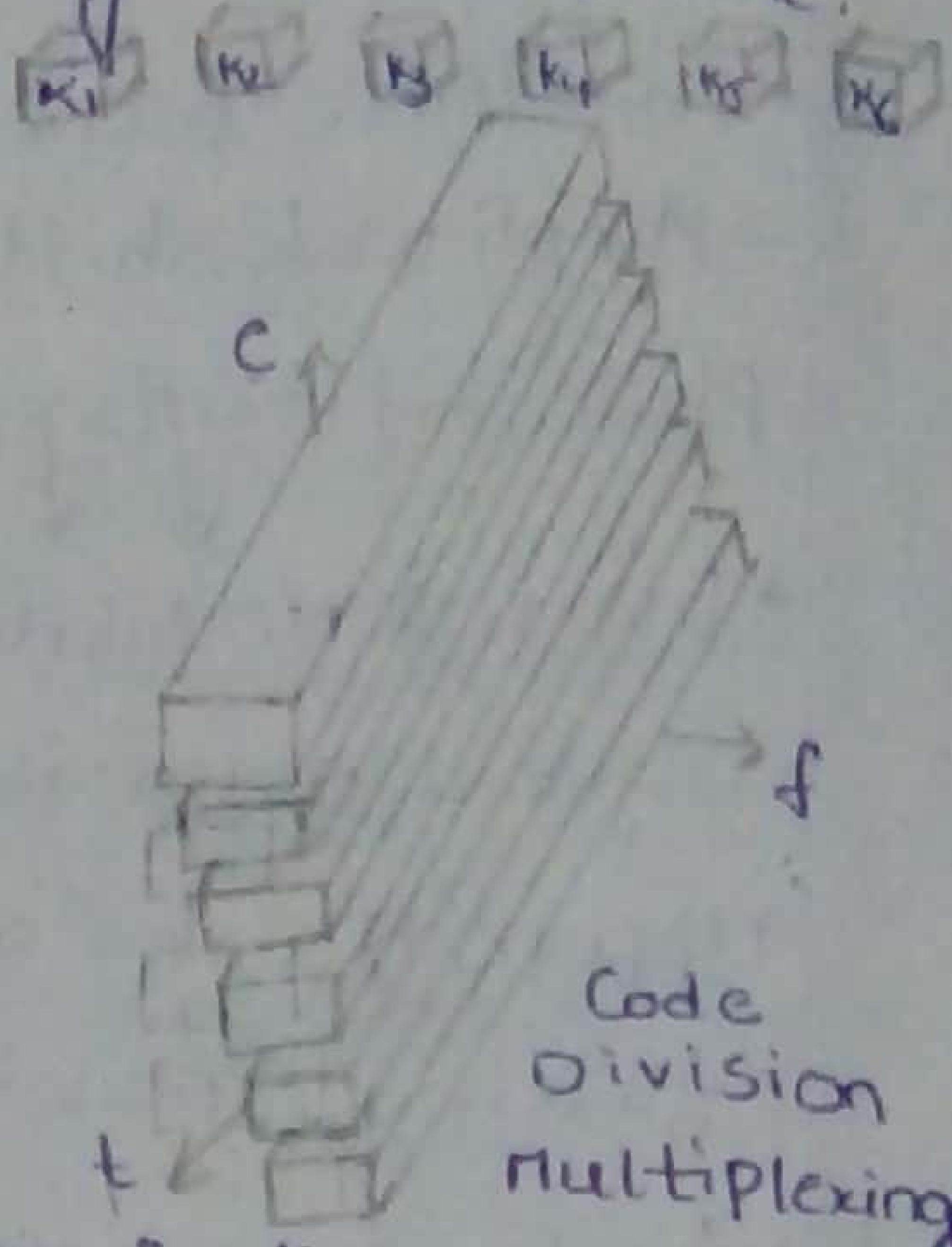


F&TDM Combined.

• A disadvantage of this scheme, is again the necessary co-ordination b/w different senders.

• One has to control the sequence of frequencies & the time of changing to another frequency. Two senders will interfere as soon as they select the same frequency at same time.

*Code Division Multiplexing:



Code Division Multiplexing

• The main advantage of CDM for wireless transmission is that it gives good protection against interference & tapping.

• Different Codes have to be assigned, but Code space is huge Compared to the frequency space.

• The main disadvantage of this scheme is the relatively high complexity of the receiver. To apply CDM, precise power control is required.

b) Describe breifly Modulation Techniques?

A:

*Modulation:

• Modulation is the addition of information to an electronic or optical carrier signal (or) Modulation is the process of varying one or more properties of a periodic waveform, called the carrier signal, with a modulating signal that typically contains information to be transmitted.

• A carrier signal is one with a steady waveform, Constant height (amplitude) and frequency.

$$g(t) = A_t \cos(2\pi f_t t + \varphi_t)$$

• This function has three parameters: amplitude 'A_t', frequency 'f_t' and phase 'φ_t', which may be varied in accordance with data or another modulating signal.

• There are four modulation techniques. They are:

• Digital to Digital, Digital to Analog, Analog to Digital and Analog to Analog.

• In wireless networks, however, digital transmission can't be used. Here, the binary bit-stream has to be translated into an Analog signal first (Digital to Analog).

• The three basic methods for this translation are:

→ Amplitude Shift keying (ASK), Frequency Shift keying (FSK) and Phase Shift keying (PSK).

*Digital Modulation:

• Digital data is translated into an analog signal. It is responsible for differences in spectral efficiency, power efficiency, robustness.

*Analog Modulation:

• Shifts center frequency of baseband signal up to the radio center.

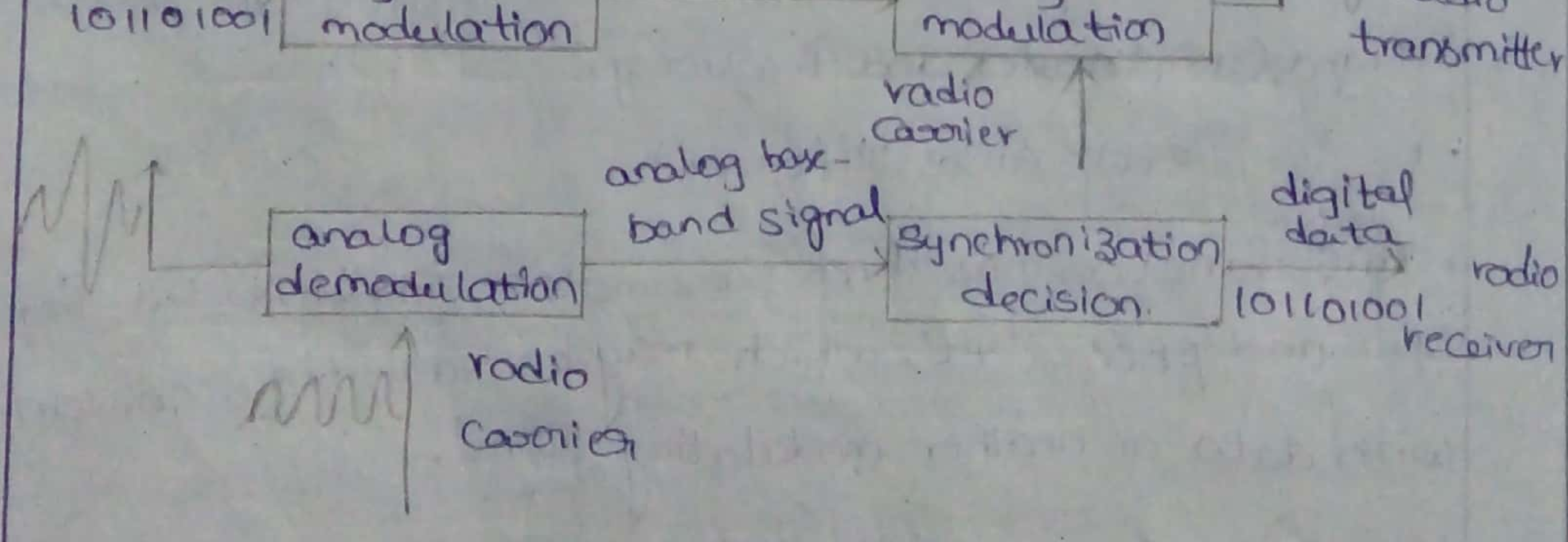
*Analog to Digital:

There are two different modulations. They are:

i) Pulse Amplitude Modulation, Pulse Code Modulation (PCM).

*Analog to Analog:

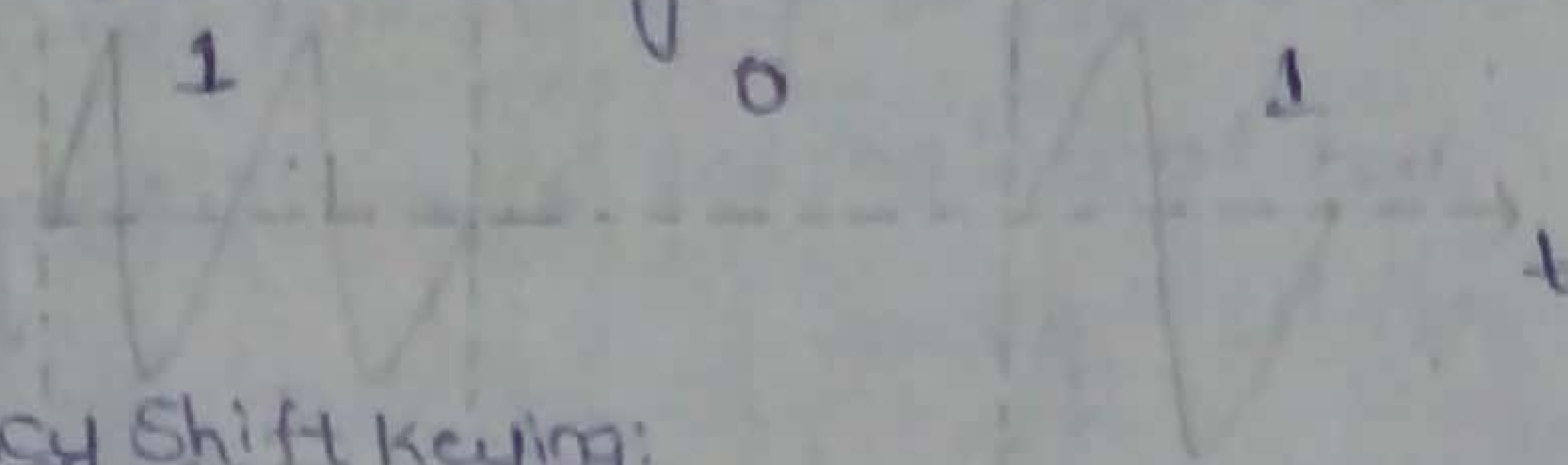
- As for digital modulation, three different basic schemes are known for analog modulation: Amplitude modulation (AM), Frequency modulation (FM) & Phase Modulation (PM).



Modulation & Demodulation

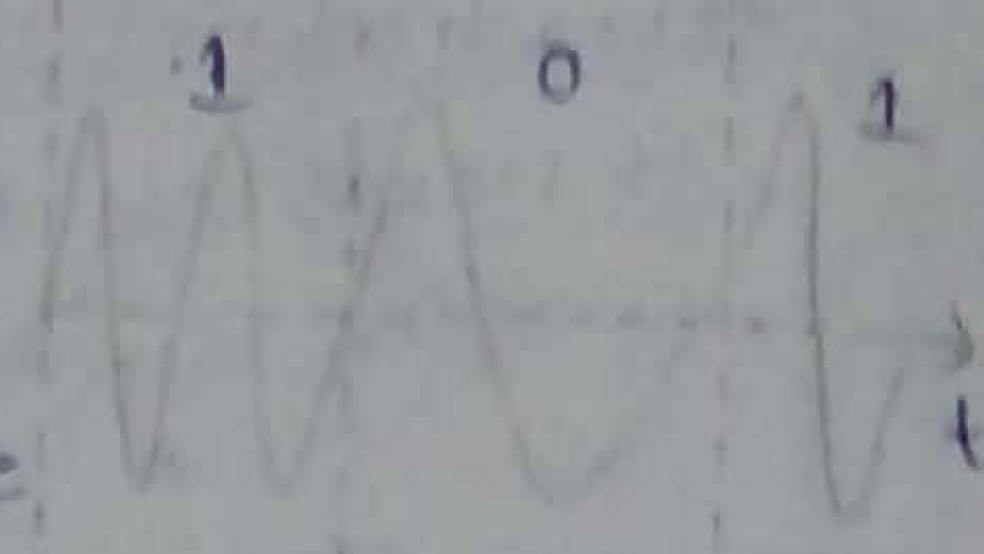
* Amplitude Shift Keying:

- Amplitude shift keying (ASK), the most simple digital modulation scheme. The two binary values 1 and 0, are represented by two different amplitudes. In the scheme require only low bandwidth, but is very susceptiable to interference.



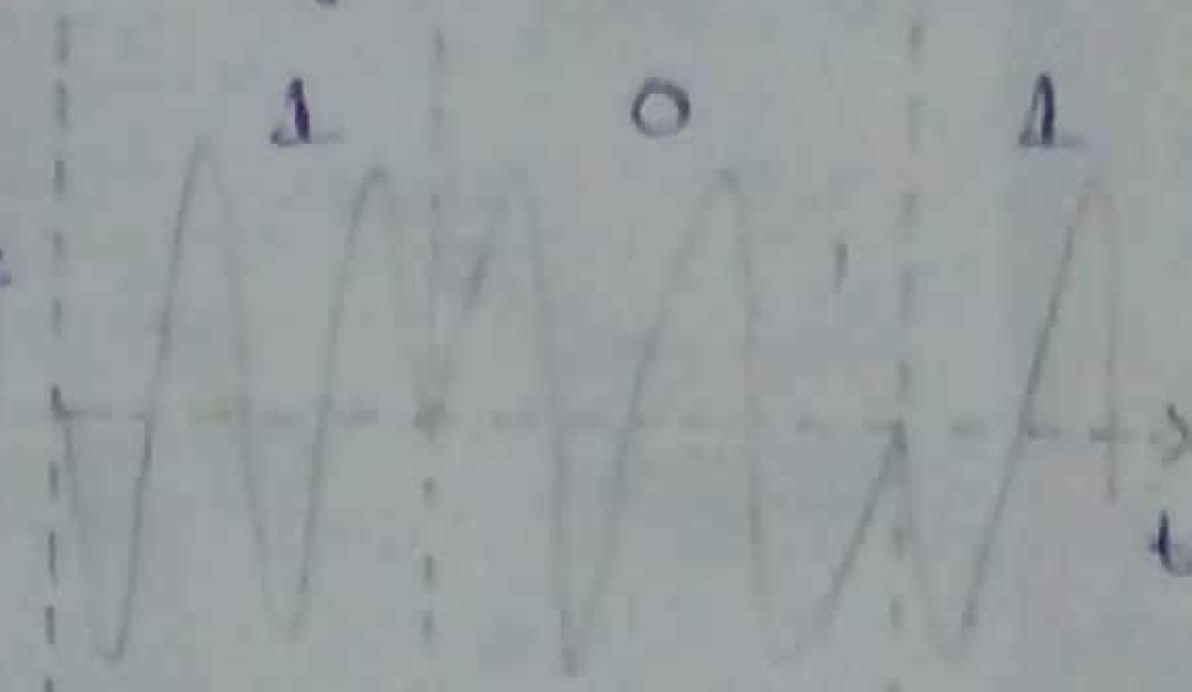
* Frequency Shift Keying:

- A modulation scheme often used for wireless transmission is FSK. The simplest form of FSK, also called binary FSK (BFSK), assigns one frequency f_1 to the binary 1 & another frequency f_2 to binary 0.

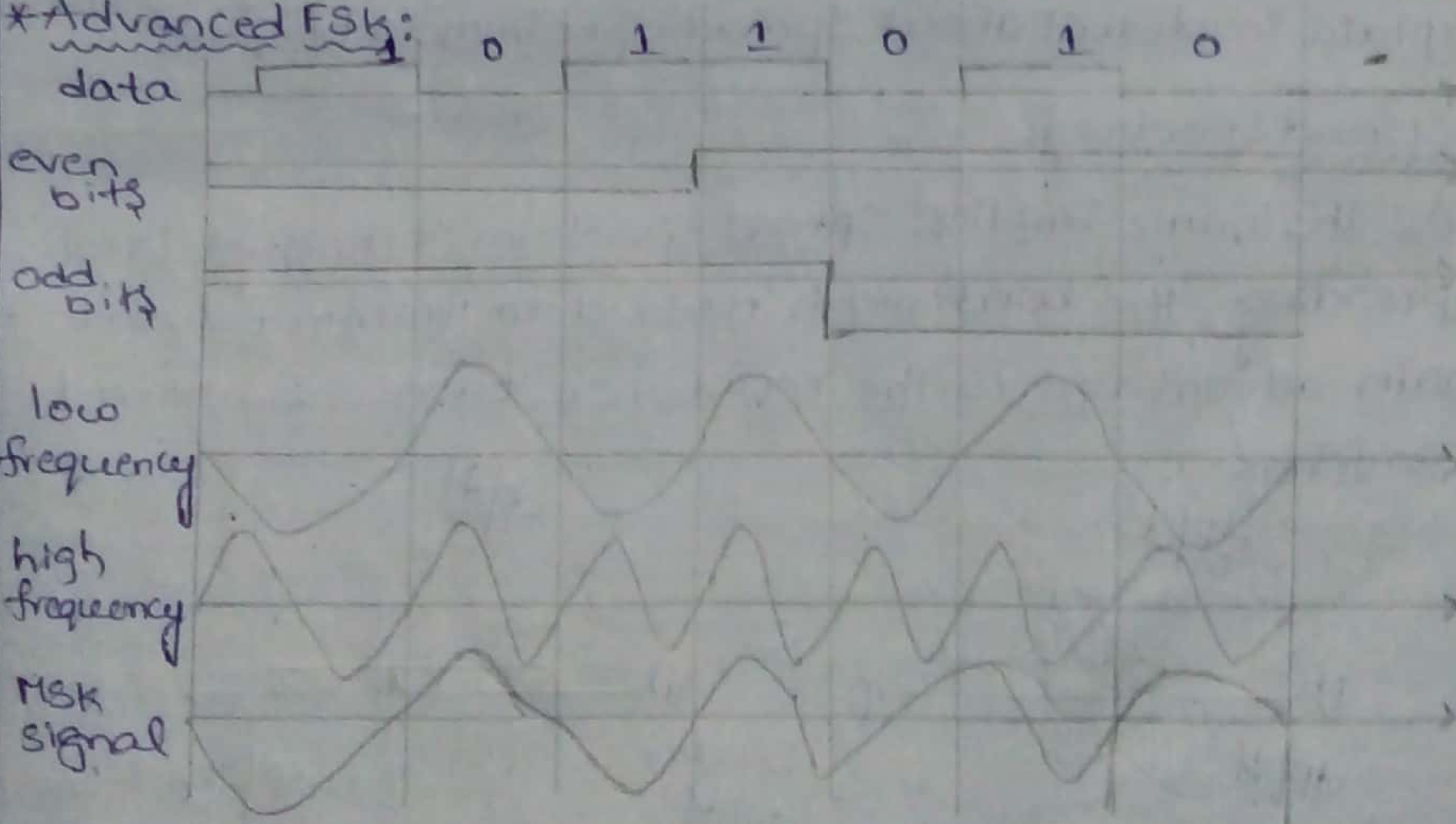


* Phase Shift Keying:

- Phase shift keying (PSK) uses shifts in the phase of a signal to represent data.
- It is more complex, robust aganist interference.



* Advanced FSK:



- Bandwidth needed to FSK depends on the distance b/w the carrier frequencies.
- Special pre-computation avoids sudden phase shifts
- Bit seperated into even & odd bits, the duration of each bit is doubled.

• Depending on the bit values the higher or lower frequency, original or inverted is choosen.

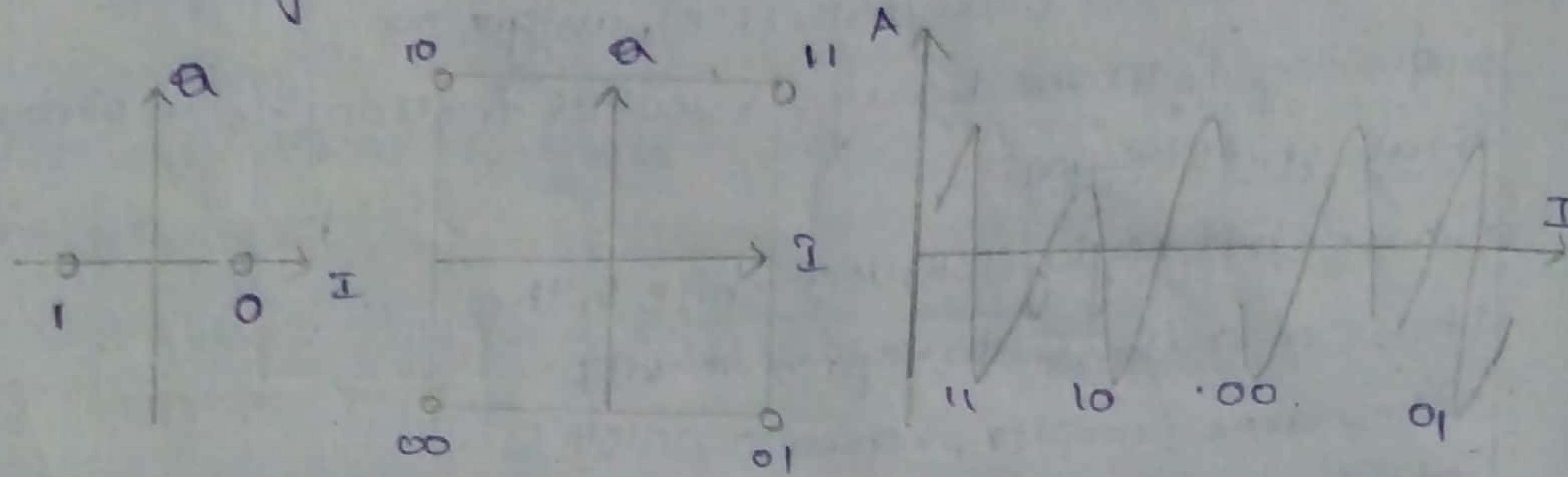
* Advanced PSK:

* Binary PSK:

If bit value 0: sine wave, if 1, inverted sinewave. It is very simple PSK, and low special efficiency. It is robust. Eg: in satellite systems.

* Quadrature PSK:

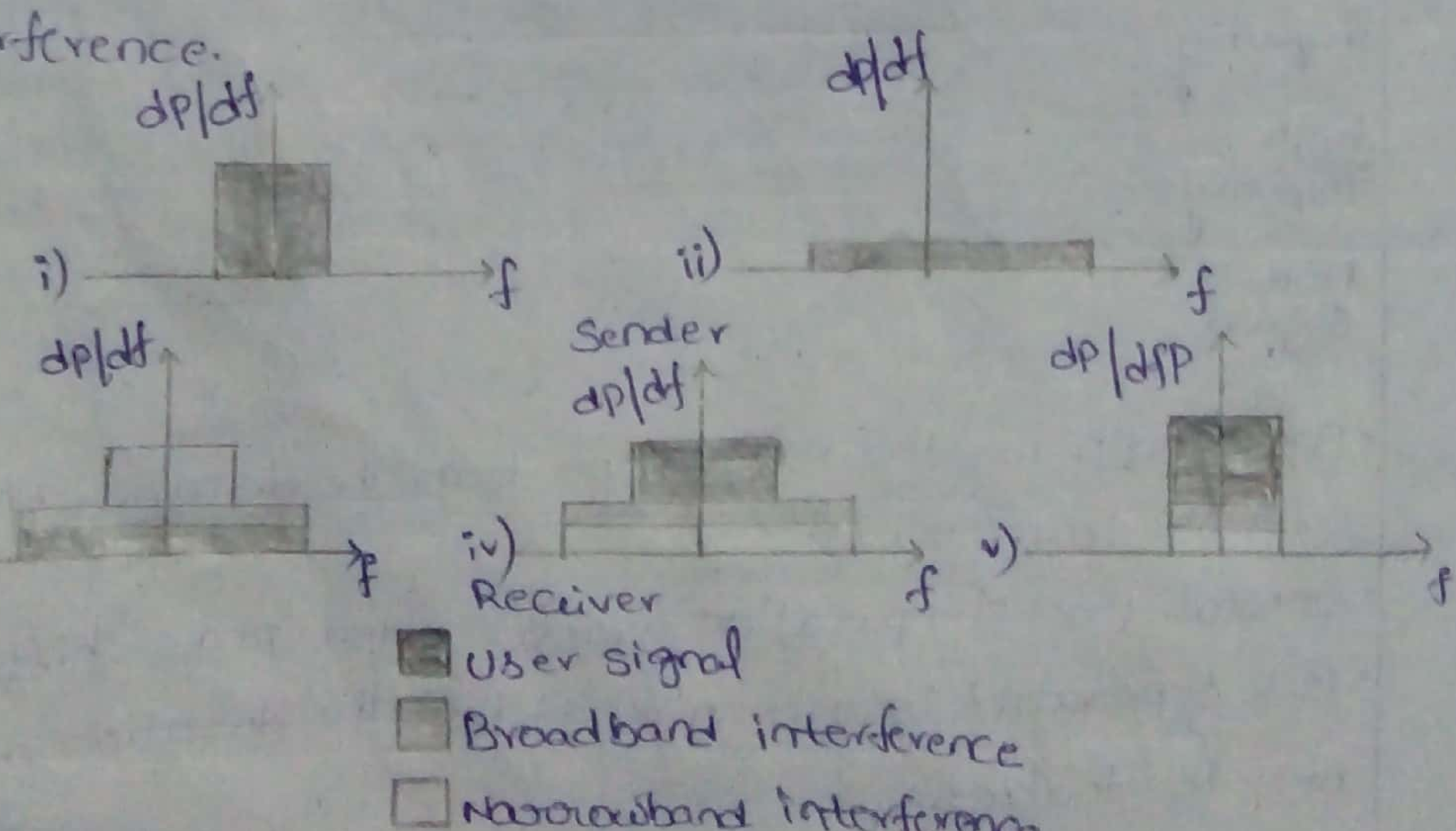
• It needs less bandwidth compared to BPSK & more complex
• It is a symbol determines shift of sine wave.



5 a) Explain in detail about Spread spectrum technique?

A: *Spread Spectrum:

• As the name implies, spread spectrum techniques involve spreading the bandwidth needed to transmit data. The main advantage is the resistance to narrowband interference.



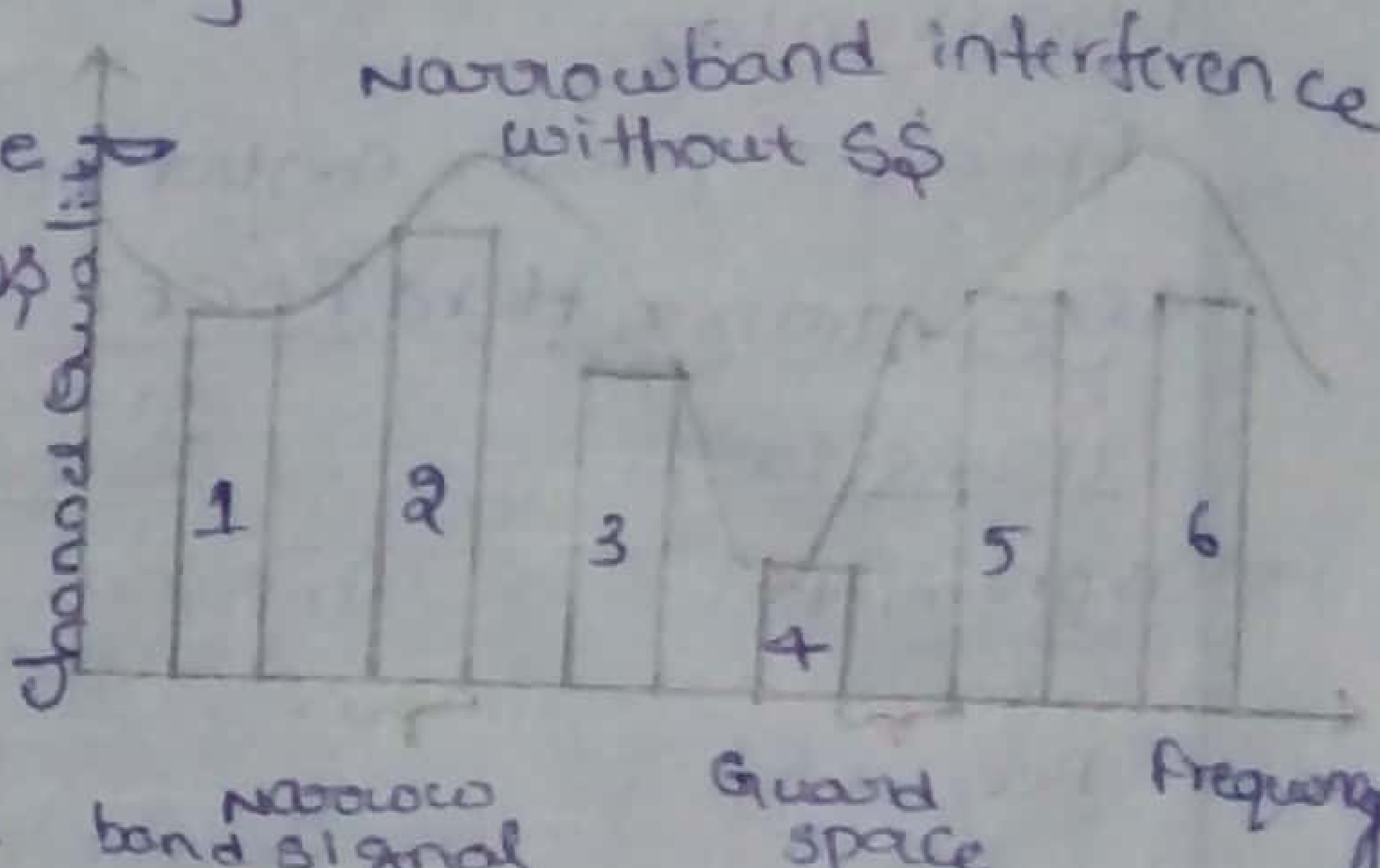
Spread spectum spreading & Despreading

i) shows an idealized narrowband signal from a sender of user data.

ii) Converts the narrow band signal into a broadband signal. The narrowband signal into a broadband signal. The energy need to transmit the sigal is the same, but it is now spread over a larger frequency range.

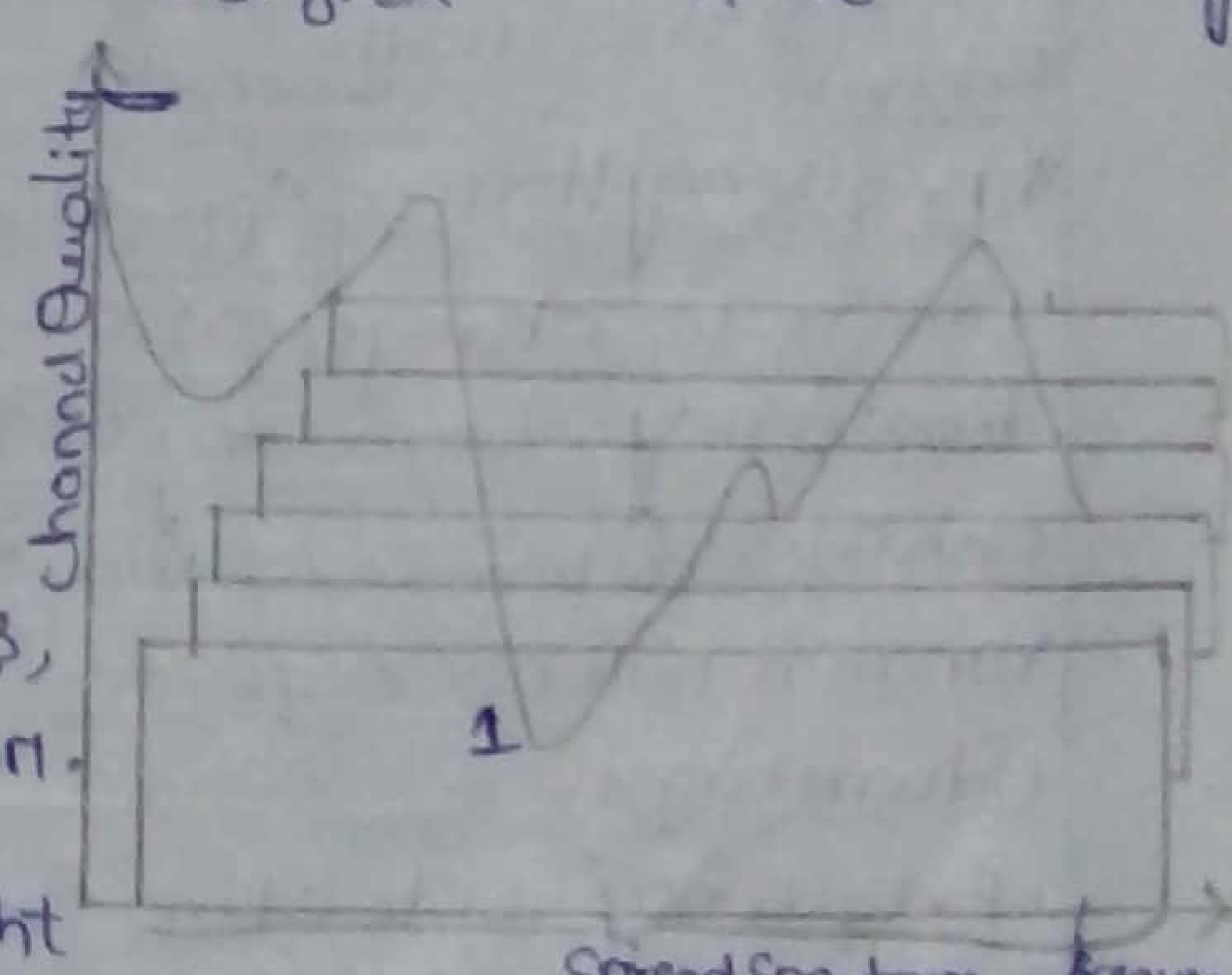
iii) The sum of interference & user signal is received. The receiver now knows how to de-spread the signal, converting the signal into a narrowband signal again.

iv) The receiver applies a band-pass filter to cut off frequencies left & right of the narrowband signal.



→ Six different channels are use FDM for multiplexing, which means that each channel has its own narrow frequency band for the transmission.

→ Depending on receiver characteristics, channels 1, 2, 5 & 6 could be received while the quality of channels 3 & 4 is too bad to reconstruct transmitted data.



→ To seperate different channels, CDM is now used instead of FDM.

→ This application shows the tight coupling of CDM & spread specturm. Features that make spread spread spectum & CDM are very attractive for military applications are the coexistence of several signals without coordination. This is used as mobile systems.

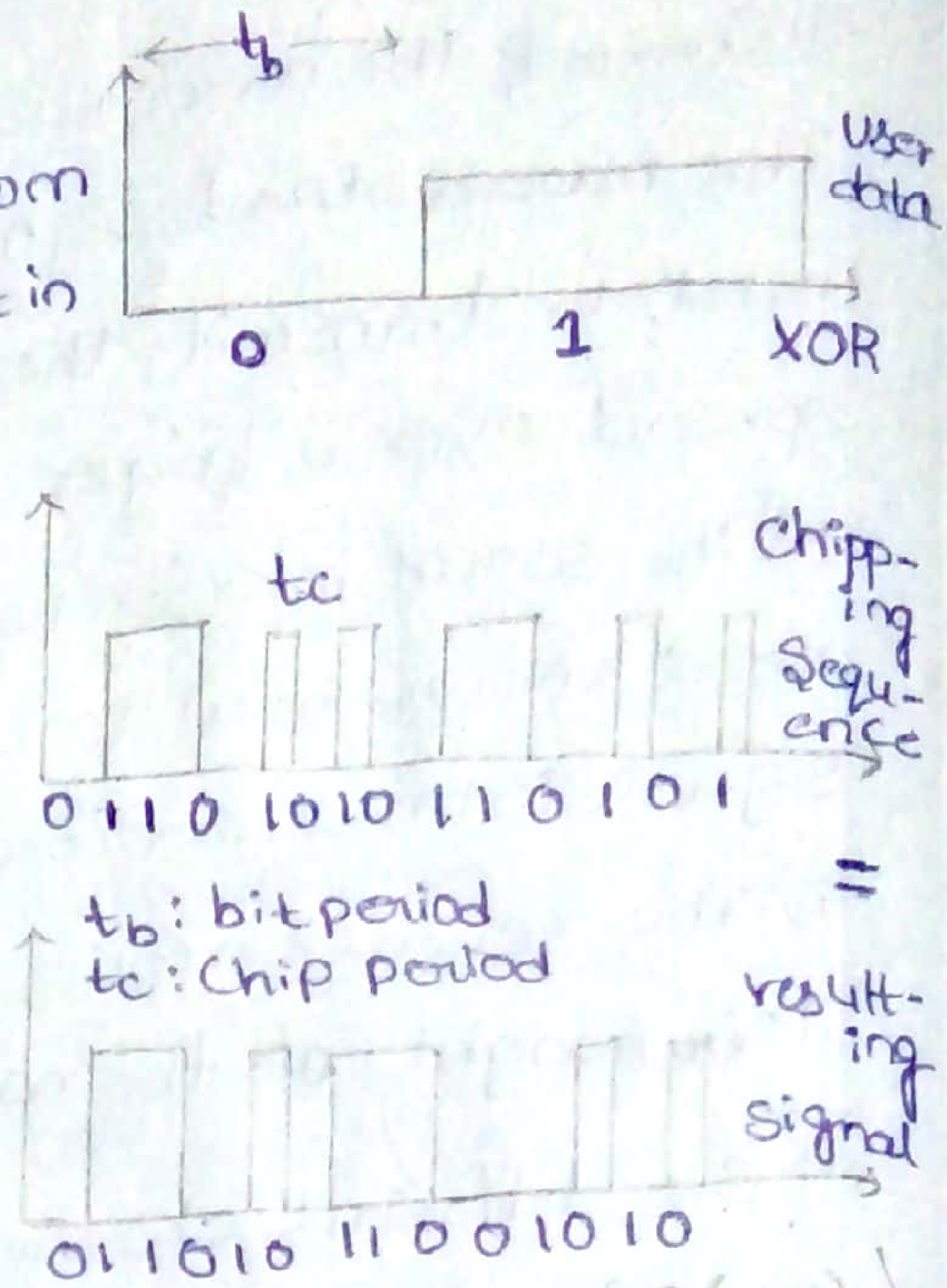
* Drawbacks:

• one disadvantage is the increased complexity of the receivers that have to de-spread a signal.

• Spread Sepectrum can be acheived in two ways:

(i) Direct Sequence spread Spectrum (DSSS):

• XOR of the signal with pseudo-random number. Many chips per bit result in higher bandwidth of the signal.



Advantages:

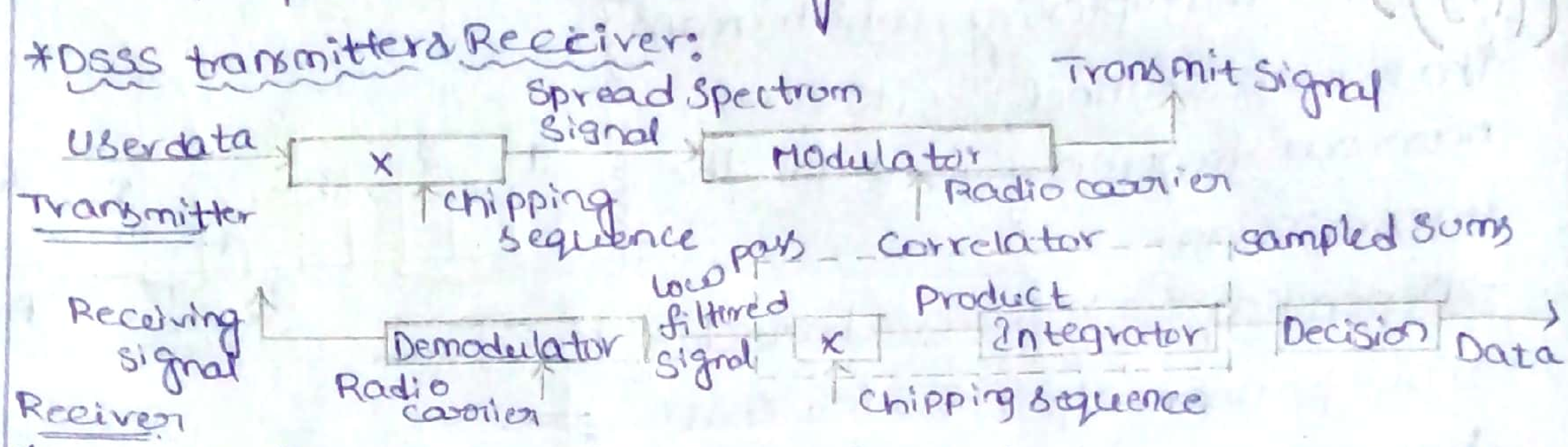
• Reduces frequency selective fading

• In cellular networks, base stations can use the same frequency range. Several base stations can detect & recover the signal.

Disadvantage:

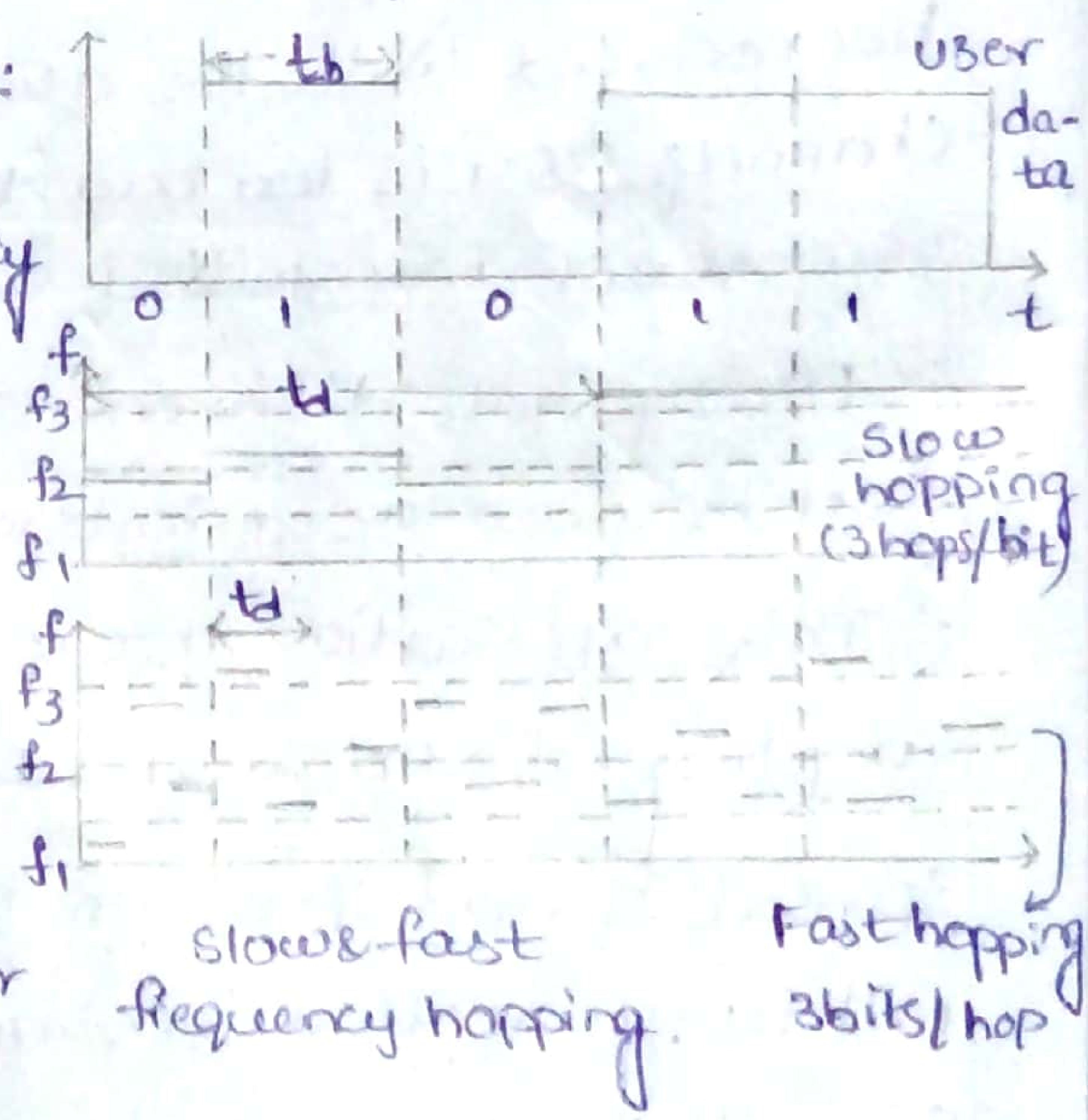
• Precise power control necessary.

*DSSS transmitter & Receiver:



* Frequency Hopping Spread Spectrum:

• Discrete changes of carrier frequency. Sequency of frequency changes determined via pseudo random number sequence.



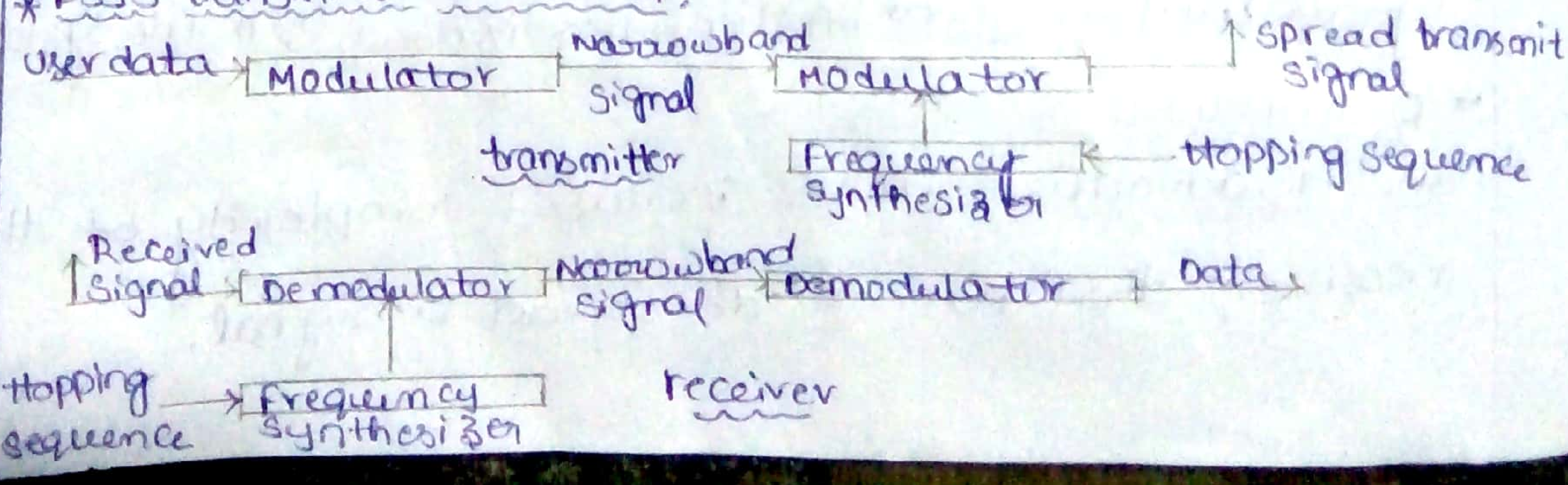
Advantages:

• Frequency selective fading & interference limited to short period, Simple implementation.

Disadvantages:

• Not as robust as DSSS & Simpler to detect.

* FSSS transmitter & receiver:



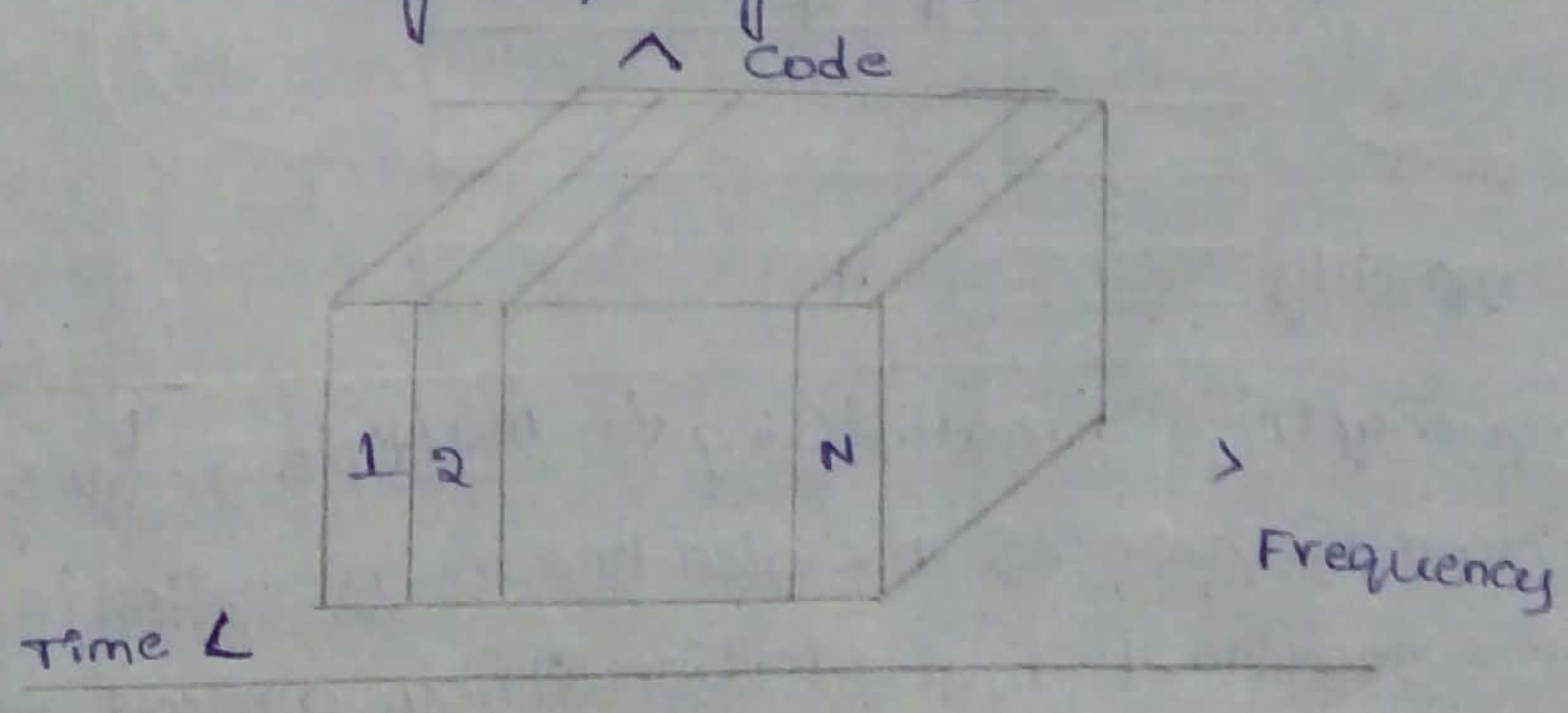
b) Explain in detail about SDMA and FDMA mechanisms?

A: * Space Division Multiple Access (SDMA):

- It is used for allocating a seperated space to users in wireless networks.
- A typical application involves assigning an optimal base station to a mobile phone user.
- The mobile phone may receive several base stations with different quality.
- A MAC algorithm could now decide which base station is best, taking into account which frequencies (FDM), time slots (TDM) or code (CDM) are still available.
- Typically, SDMA is never used in isolation but always in combination with one or more other schemes.
- The basis for the SDMA algorithm is formed by cells and the sectorized antennas which constitute the infrastuure implementing Space Division Multiplexing (SDM).

* Frequency Division Multiple Access (FDMA):

- Frequency division multiplexing (FDM) describes schemes to subdivide the frequency dimension into several non-corresponding non-overlapping frequency bands.



- FDMA is a method employed to permit several users to transmit simultaneously on one satellite transponder by assigning a specific frequency channel to each user.

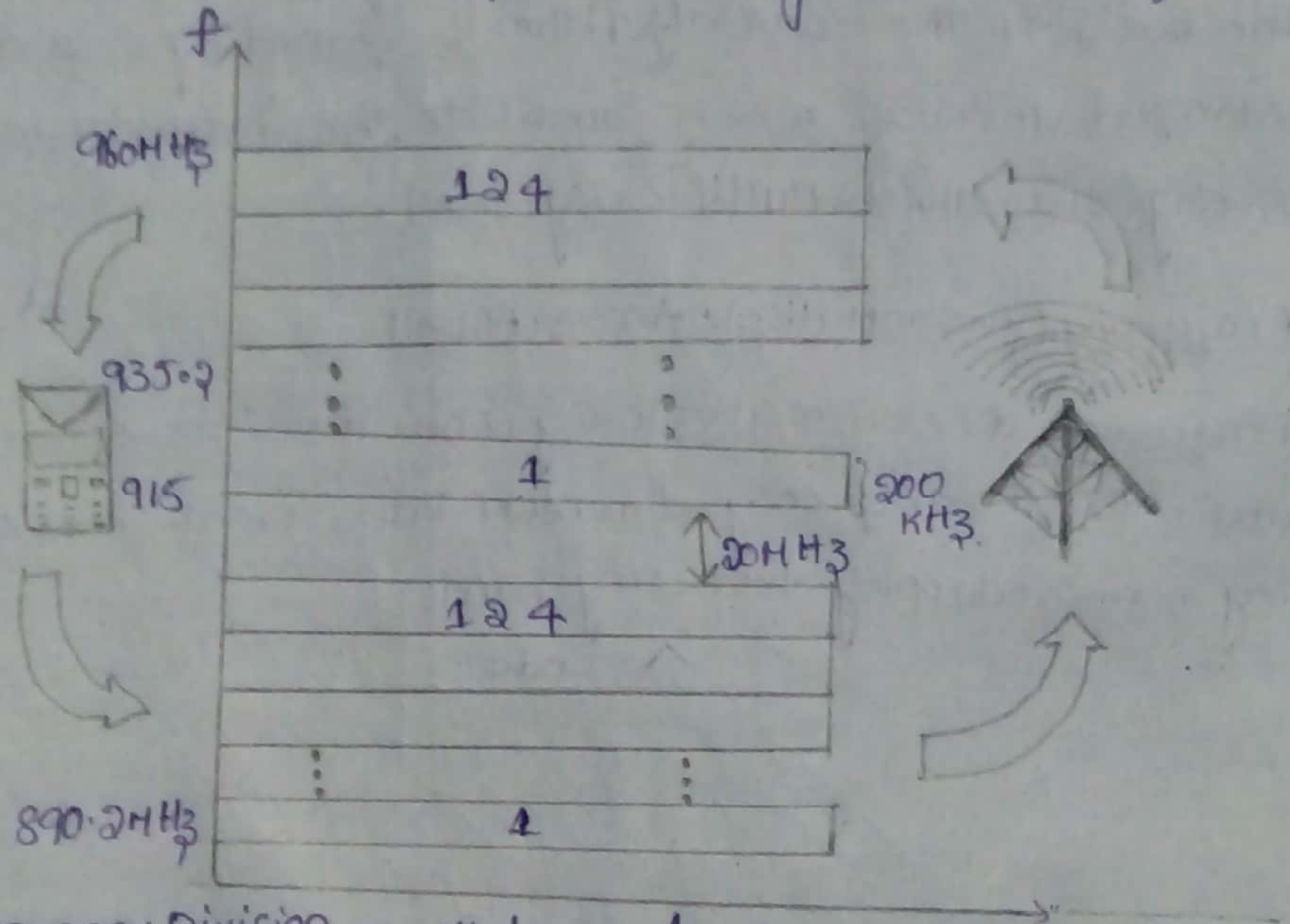
• Each Conversion gets, its own unique radio channel.

• The channels are relatively narrow, usually 30 KHz or less and are defined as either transmit or receive channels.

• A full duplex Conversation requires a transmit & receive Channel pair.

• FDM is often used for simultaneous access to the medium by base station and mobile station in cellular networks establishing a duplex channel.

• A Scheme called Frequency division duplexing (FDD) in which the two directions, mobile station to base station and vice versa are now seperated using different frequencies.



Frequency Division multiplexing for multiple access & duplex

• The two frequencies are also known as uplink i.e, from mobile station to base station & from ground control to satellite.

• The downlink from base station to mobile station or from satellite to ground control.

6(a) Discuss in detail about all TDMA mechanisms?

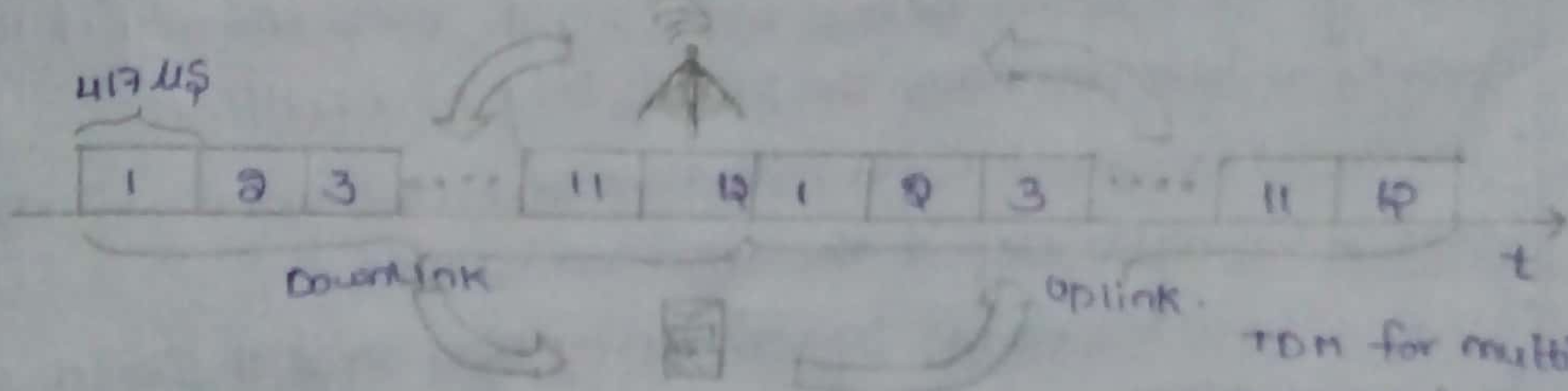
A. * Time Division Multiple Access (TDMA) techniques:

• Compared to FDMA, TDMA offers a much more flexible scheme, which comprises all technologies that allocate certain time slots for communication ie, controlling TDM.

1. Fixed TDM:

• The simplest algorithm for using TDM is allocating time slots for channels in a fixed pattern. This results in a fixed bandwidth and is the typical solution for wireless phone systems.

• The following figure shows how these fixed TDM patterns are used to implement multiple access and a duplex channel b/w a base station & mobile station. This is time division duplex (TDD).



TDM for multiple access & duplex.

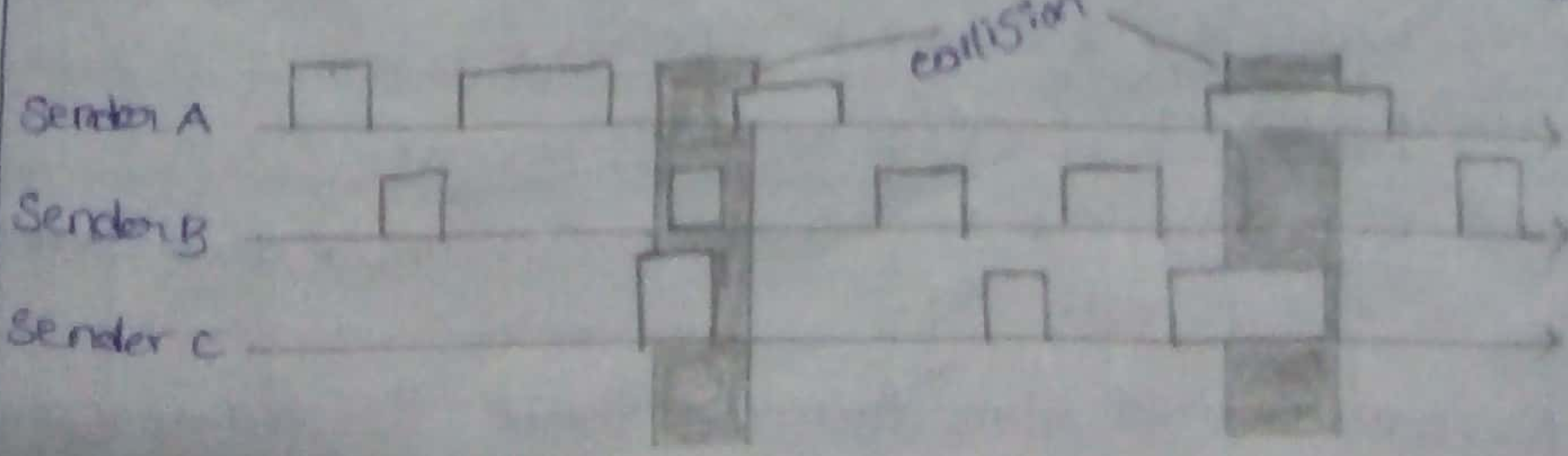
2. Classical Aloha:

• This scheme was used in ALOHANET for wireless connection of several stations.

• Aloha neither coordinates medium access nor does it resolve contention on the MAC layer.

• Instead each station can access any medium at any time.

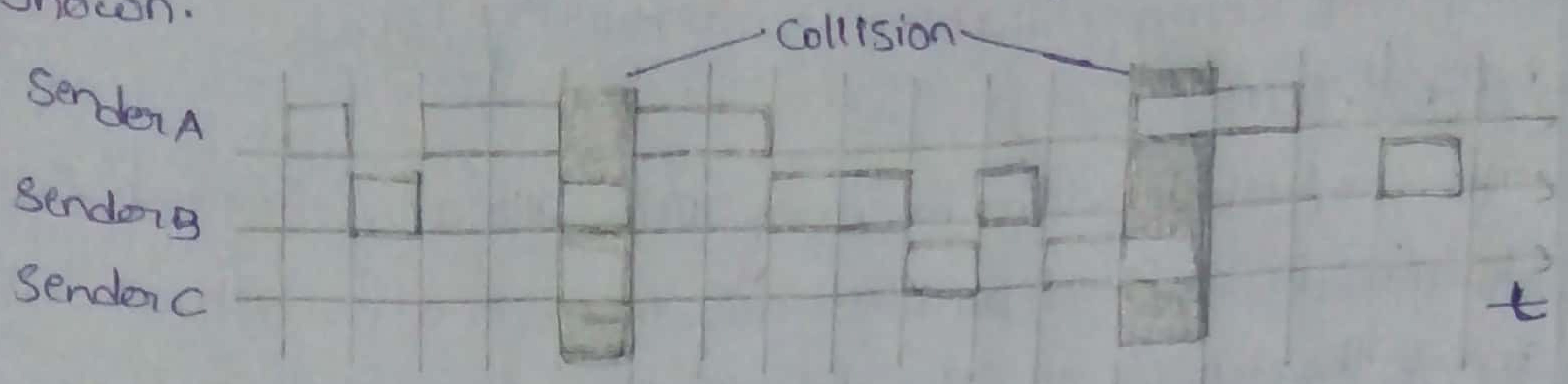
• This is a random access scheme, without a central arbiter controlling access and without coordination among the stations. If two or more stations access the medium at the same time, collission occurs & transmitted data is destroyed.



Classical Aloha multiple access

3. Slotted Aloha:

• Slotted Aloha scheme is provided by introducing of time slots. In this case all senders have to be synchronized, transmission can only start at beginning of a time slot as shown.



Slotted Aloha

4. Carrier Sense multiple Access:

• Carrier sense multiple Access is an improvement to basic aloha is sensing the carrier before accessing the medium, only if the carrier is idle decreases the probabality of a collision.

• In non-persistant CSMA, stations sense the carrier & start sending immediately if the medium is idle.

• In P-persistant CSMA, system nodes also sense the medium, but only transmit with a probability of p.

• In 1-persistant CSMA system, all stations wishing to transmit access the medium at the same time, & it becomes idle.

• The other two are CSMA/CA & EY-NMPA.

5. Demand Assigned Multiple Access:

• DAMA also called reservation aloha, a scheme for satellite systems. During a contention phase, all stations try to reserve access time for satellite transmission.

• To maintain a fixed TDM pattern of reservation and transmission, the stations have to be synchronized from time to time. It is explicit reservation.

6. PRMA packet reservation multiple access:

• PRMA is a implicit reservation scheme. Here slots can be reserved implicitly.

• A certain no. of slots forms a frame. The frame is repeated in time i.e., a fixed TDM pattern is applied.

Reservation	frame	1	2	3	4	5	6	7	8
ACDABA-F	1	A	C	D	A	B	A		F
ACDABA-F	2	A	C		A	B	A		
AC-ABAF	3	A				B	A	F	
A---BAFD	4	A				B	A	F	D
ACEEBAFD.	5	A	C	E	E	B	A	F	D

Time Slot.

t

Collision at reservation attempts.

7. Reservation TDMA:

• An even more fixed pattern that still allows some random access is exhibited by reservation TDMA.

• Each station is alloted its own mini-slot and can use it to reserve up to K data-slots. This guarantees each station a certain bandwidth and a fixed delay.

Eg: Isochronous traffic.

8. Multiple access with Collision avoidance:

• MACA presents a simple scheme that solves the hidden terminal problem, does not need a base station, & is still a random access aloha scheme but with dynamic reservation.

9. Polling:

• Where one station is to be heard by all others, polling scheme can be applied.

• Polling is a strictly centralized scheme with one master station and several slave stations.

• The master can poll the slaves according to many schemes: round robin, randomly according to reservations etc.

10. Inhibit Sense Multiple Access:

• ISMA, is used for the packet data transmission service Cellular Digital Packet Data (CDPD) in the AMPS mobile phone system is also known as digital SMA (DSMA).

• Here, the base station only signals a busy medium via a busy tone on the downlink.

b) Explain in detail about all CDMA mechanisms?

A:

* Code Division Multiplexing Access:

• CDMA systems use exactly these codes to seperate differen users in code space and to enable access to a shread medium without interference.

• Codes with certain characteristics can be applied to the transmission to enable the use of CDM.

• A Code for a certain user should have a good auto-correlation and should be orthogonal to other codes.

• Two vectors are called orthogonal if their inner product is 0, as is the case, for two vectors (2, 5, 0) & (0, 0, 17).

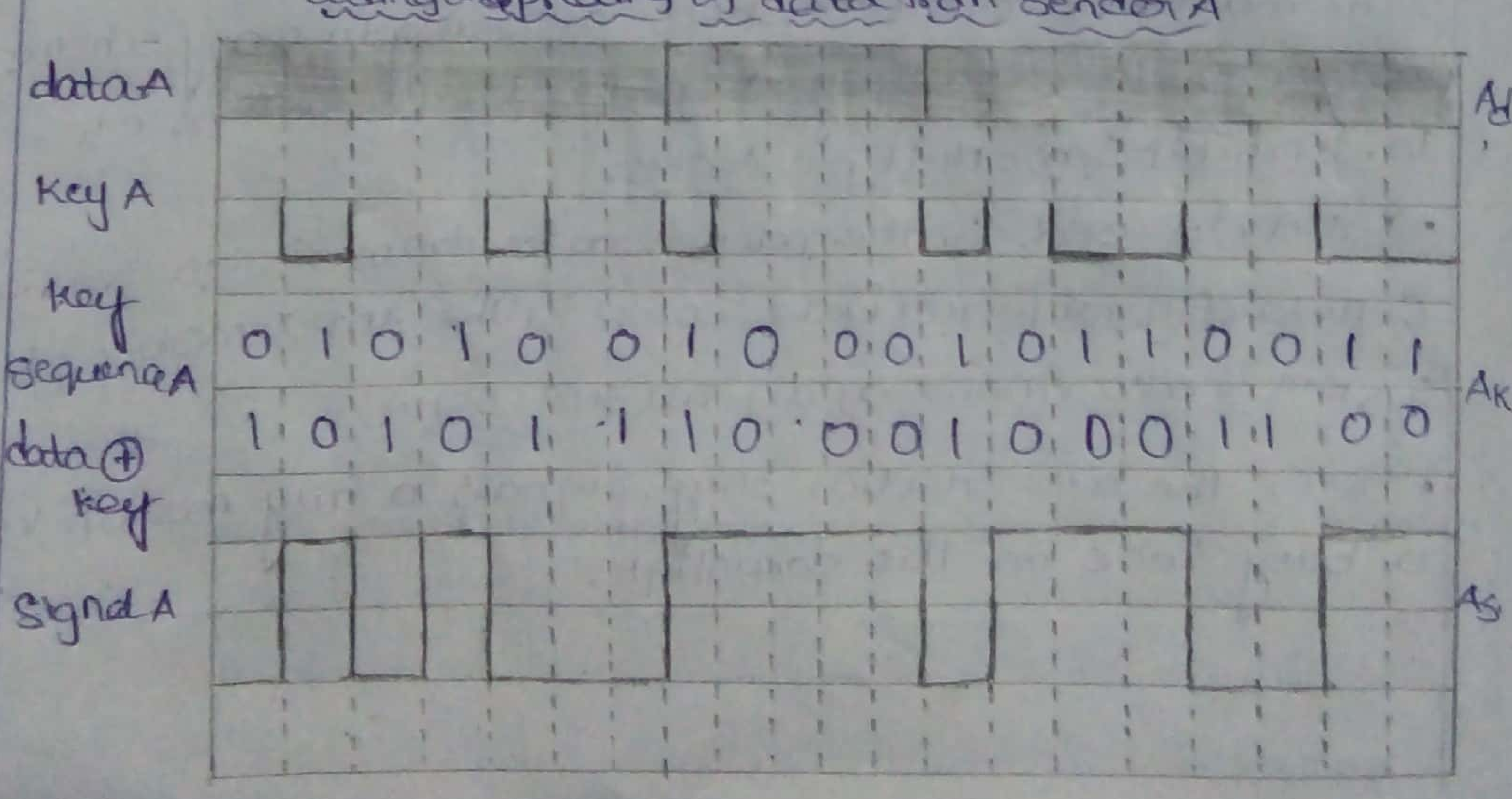
$$(2, 5, 0) * (0, 0, 17) = 0+0+0 = 0.$$

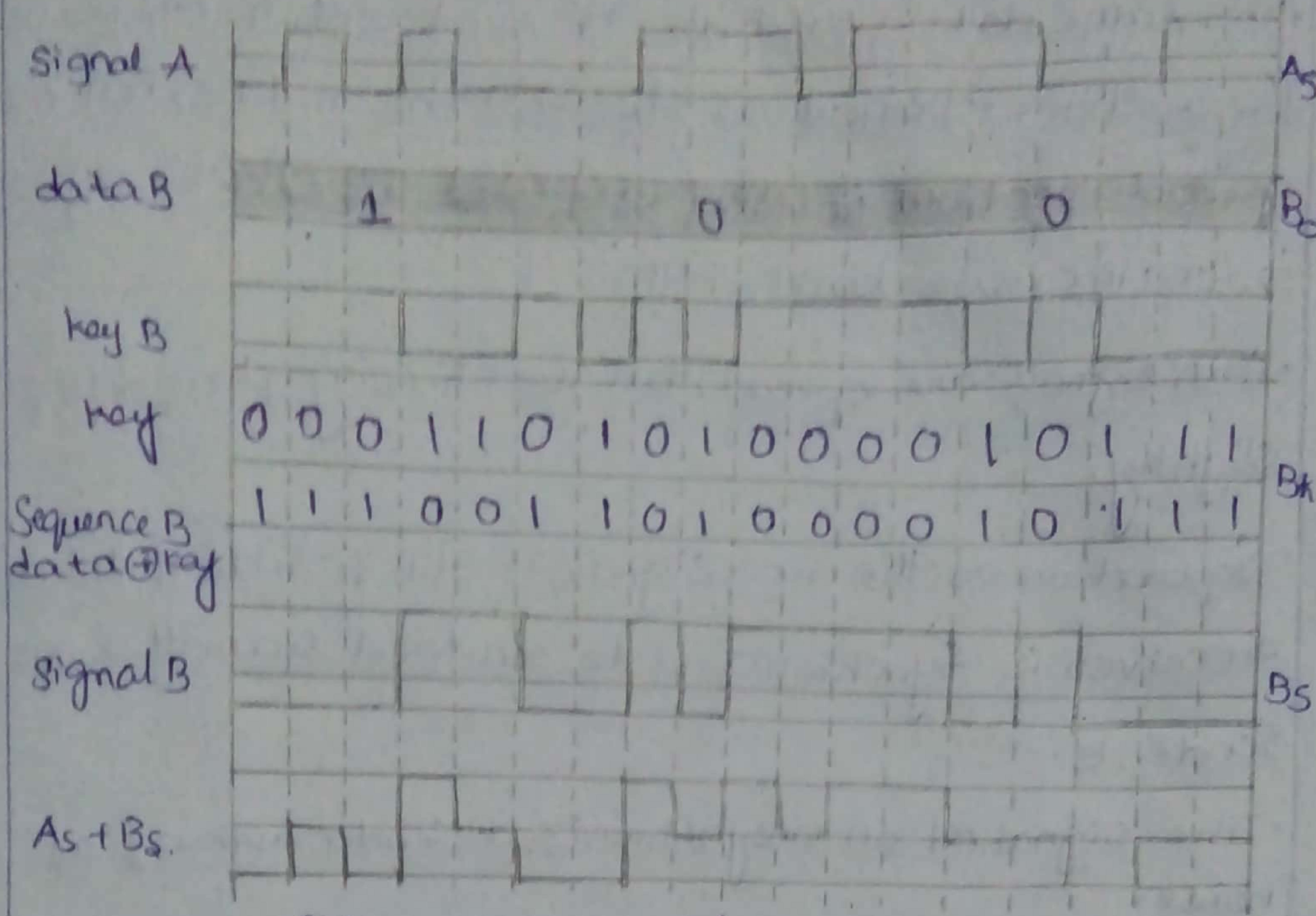
• Two senders, A&B want to send data. Both senders spread their signal using their key as chipping sequence.

• Sender A then sends the signal, sender B does the same with its data to spread the signal with the code.

• Both the signals are then transmitted at the same time using the same frequency, so, the signals superimpose in space.

Coding & Spreading of data from Sender A





Coding & Spreading of data from Sender B

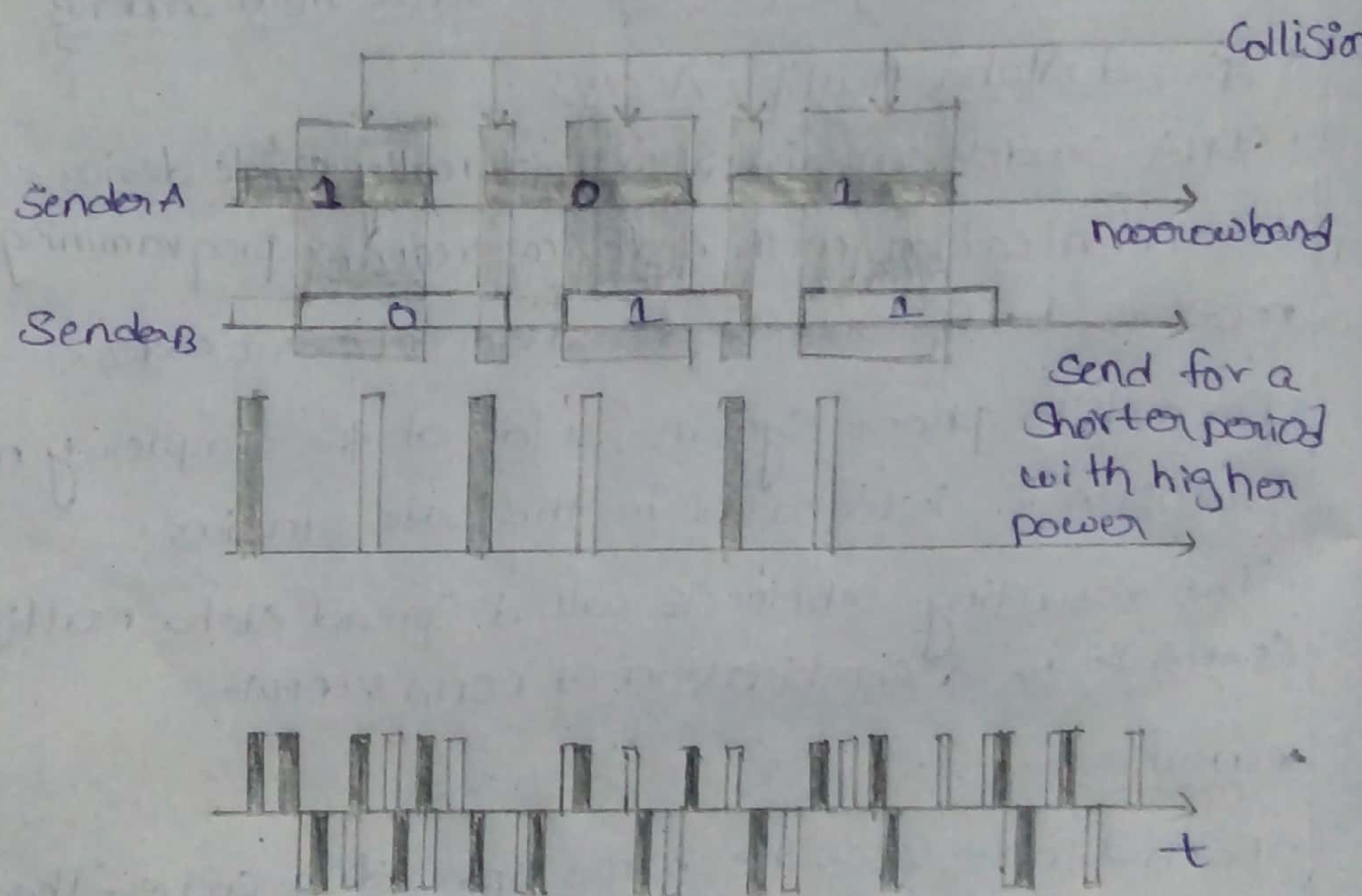
* Spread Aloha Multiple Access:

- CDMA senders & receivers are not really simple devices.
- Communication with n devices requires programming of the receiver to be able to decode n different codes.
- For mobile phone systems, a lot of the complexity needed for CDMA is integrated in the base station.
- The resulting scheme is called Spread Aloha multiple access (SAMA) is a combination of CDMA & TDMA.

* Working:

- Each sender uses the same spreading code. The standard case for Aloha cross is shown in the upper part of figure.
- Sender A and Sender B access the medium at the same time in their narrowband spectrum, so that all three bits shown cause a collision.

- The same data could also be sent with higher power for a shorter period as shown in the middle, but now spread spectrum is used to spread the shorter signals i.e., to increase bandwidth.
- Both signals are spread, but the chipping phase differs slightly.
- Seperation of the two signals is still possible if the one receiver is synchronized to sender A & another one to sender B.
- The signal of an unsynchronized sender appears as noise.



Spread Aloha Multiple Access