Mobile and Cell Phone Technologies

Wireless Communication

- Wireless communication involves the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors.

- Wireless communication is a broad term that incorporates all procedures and forms of connecting and communicating between two or more devices using a wireless signal through wireless communication technologies and devices.

Features of Wireless Communication

- The transmitted distance can be anywhere between a few meters and thousands of kilometers.

- Wireless communication can be used for cellular telephony, wireless access to the internet, wireless home networking, and so on.

- Wireless communication involves transfer of information without any physical connection between two or more points.

Advantages of Wireless Communication

1. Cost effectiveness

Wired communication entails the use of connection wires. In wireless networks, communication does not require elaborate physical infrastructure or maintenance practices.

2. Flexibility

Wireless communication enables people to communicate regardless of their location.

3. Convenience

Wireless communication devices like mobile phones are quite simple and therefore allow anyone to use them, wherever they may be. There is no need to physically connect anything in order to receive or pass messages.

4. Speed

Improvements can also be seen in speed. The network connectivity or the accessibility were much improved in accuracy and speed.

5. Accessibility

The wireless technology helps easy accessibility as the remote areas where ground lines can’t be properly laid, are being easily connected to the network.

6. Constant connectivity

Constant connectivity also ensures that people can respond to emergencies relatively quickly.

Eg. you move from place to place or while you travel, whereas a wired land line can’t.

OSI Model

- The International Standard Organization has a well-defined model for Communication Systems known as **Open System Interconnection.**

- This layered model is a conceptualized view of how one system should communicate with the other, using various protocols defined in each layer.

- Each layer is designated to a well-defined part of communication system.

- The OSI Model has seven layers.

OSI Model Layers

7. Application Layer (Layer-7):
This is where the user application sits that needs to transfer data between or among hosts. For example: HTTP, file transfer application (FTP) and electronic mail etc.

6. Presentation Layer (Layer-6):
This layer helps to understand data representation in one form on a host to other host in their native representation.

5. Session Layer (Layer-5):
This layer provides session management capabilities between hosts. For example, if some host needs a password verification for access and if credentials are provided then for that session password verification does not happen again.

4. Transport Layer (Layer-4):
This layer provides end to end data delivery among hosts. This layer takes data from the above layer and breaks it into smaller units called Segments and then gives it to the Network layer for transmission.

3. Network Layer (Layer-3):
This layer helps to uniquely identify hosts beyond the subnets and defines the path which the packets will follow or be routed to reach the destination.

2. Data Link Layer (Layer-2):
This layer takes the raw transmission data (signal, pulses etc.) from the Physical Layer and makes Data Frames, and sends that to the upper layer and vice versa. This layer also checks any transmission errors and sorts it out accordingly.

1. Physical Layer (Layer-1):
This layer deals with hardware technology and actual communication mechanism such as signaling, voltage, cable type and length, etc.

Multiple Access

- **Multiple access** is a technique that lets **multiple** mobile users share the allotted spectrum in the most effective manner.

- Since the spectrum is limited, the sharing is necessary to improve the overall capacity over a geographical area.
- This is carried out by permitting the available bandwidth to be used simultaneously by different users.

- The key objective in the cellular system design is to offer increased channel capacity. This is to manage as many calls as possible in a particular bandwidth with an adequate standard of quality of service.

Multiple Access Techniques

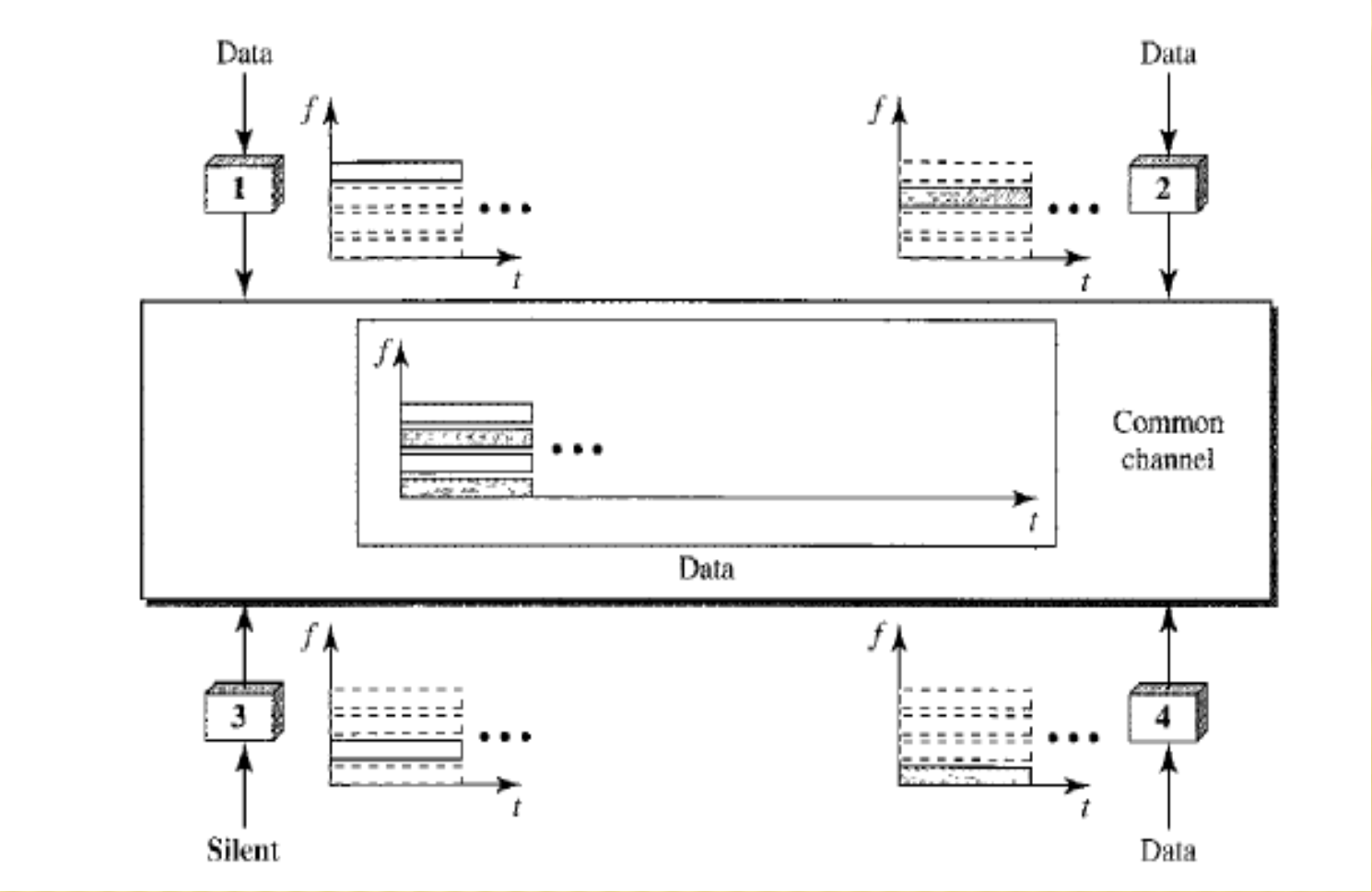
1. Frequency Division Multiple Access (FDMA)

- In FDMA available bandwidth is divided into frequency bands.

- Each station is allocated a band to send its data, means each band is reserved for a specific station and it belongs to the station all the time.

- Frequency band split into small frequency channels, and different channels are assigned to different users.
- There is possibility of crosstalk because all of them are transmitting at the same time.

Frequency Division Multiple Access (FDMA)



Disadvantages of FDM

i. The maximum flow rate per channel is fixed and small.
ii. Guard bands lead to a waste of capacity.

2. Time Division Multiple Access (TDMA)

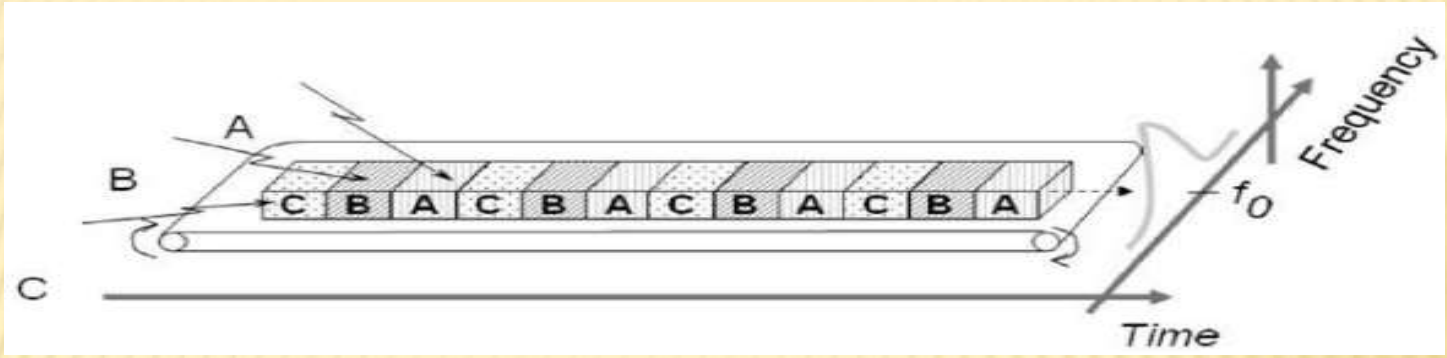
i. Time Division Multiple Access (TDMA) is a digital cellular telephone communication technology. It facilitates many users to share the same frequency without interference.

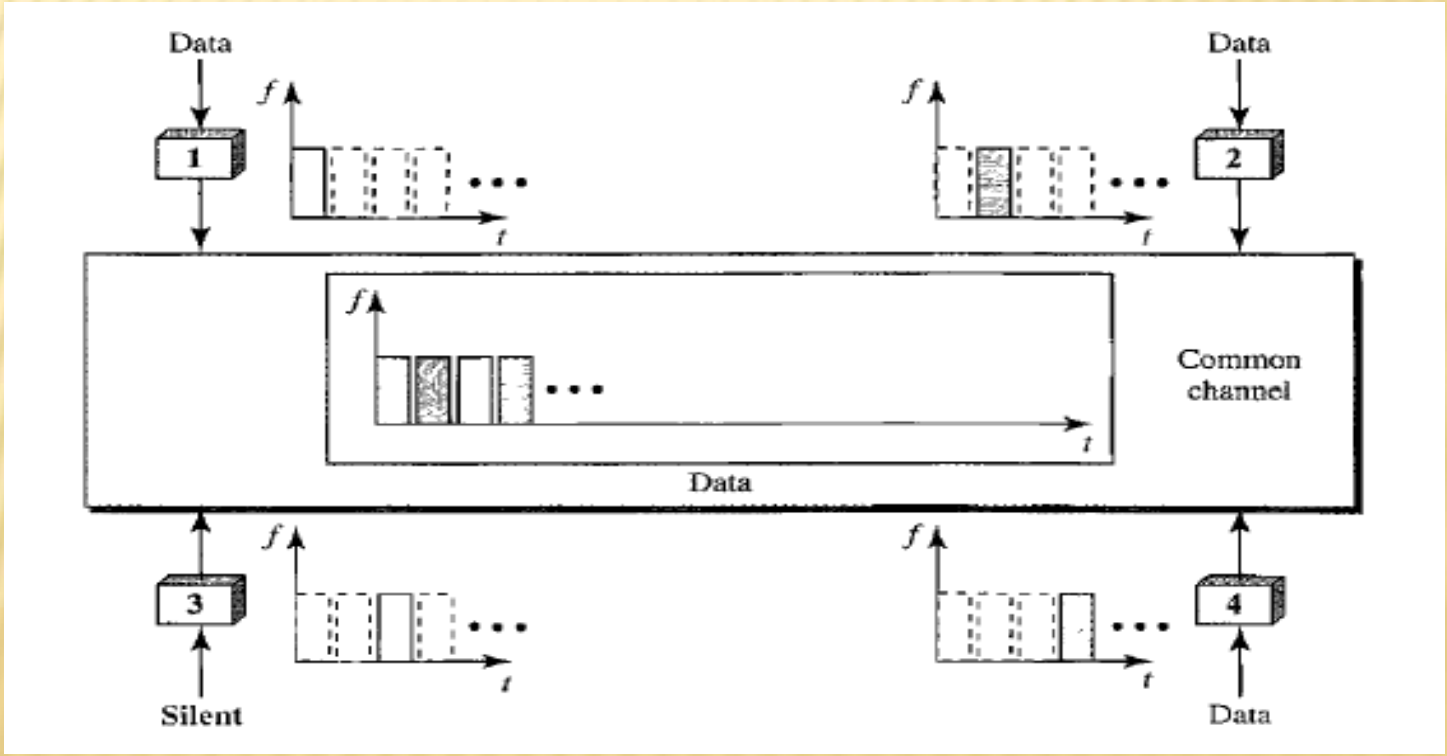
ii. Its technology divides a signal into different timeslots, and increases the data carrying capacity.

iii. Time Division Multiple Access (TDMA) is a complex technology, because it requires an accurate synchronization between the transmitter and the receiver.

Sub-bands are known as **carrier frequencies**. The mobile system that uses this technique is referred as the **multi-carrier systems**.

Time Division Multiple Access (TDMA)





Time Division Multiple Access (TDMA)

Advantages of TDMA

Here is a list of few notable advantages of TDMA −

i. Permits flexible rates (i.e. several slots can be assigned to a user, for example, each time interval translates 32Kbps, a user is assigned two 64 Kbps slots per frame).

ii. No guard band required for the wideband system.

iii. No crosstalk problem.

Time Division Multiple Access (TDMA)

Disadvantages of TDMA

- Electronics operating at high bit rates increase energy consumption.
- Complex signal processing is required to synchronize within short slots.

3. Code Division Multiple Access (CDMA)

i. Code Division Multiple Access (CDMA) is a sort of multiplexing that facilitates various signals to occupy a single transmission channel. It optimizes the use of available bandwidth.

ii. Every user access whole channel(Full bandwidth).

iii. It differs from TDMA because all stations can send data simultaneously, there is no timesharing.

iv. In CDMA, one channel carries all transmissions simultaneously.

Analogy

i. CDMA simply means communication with different codes.

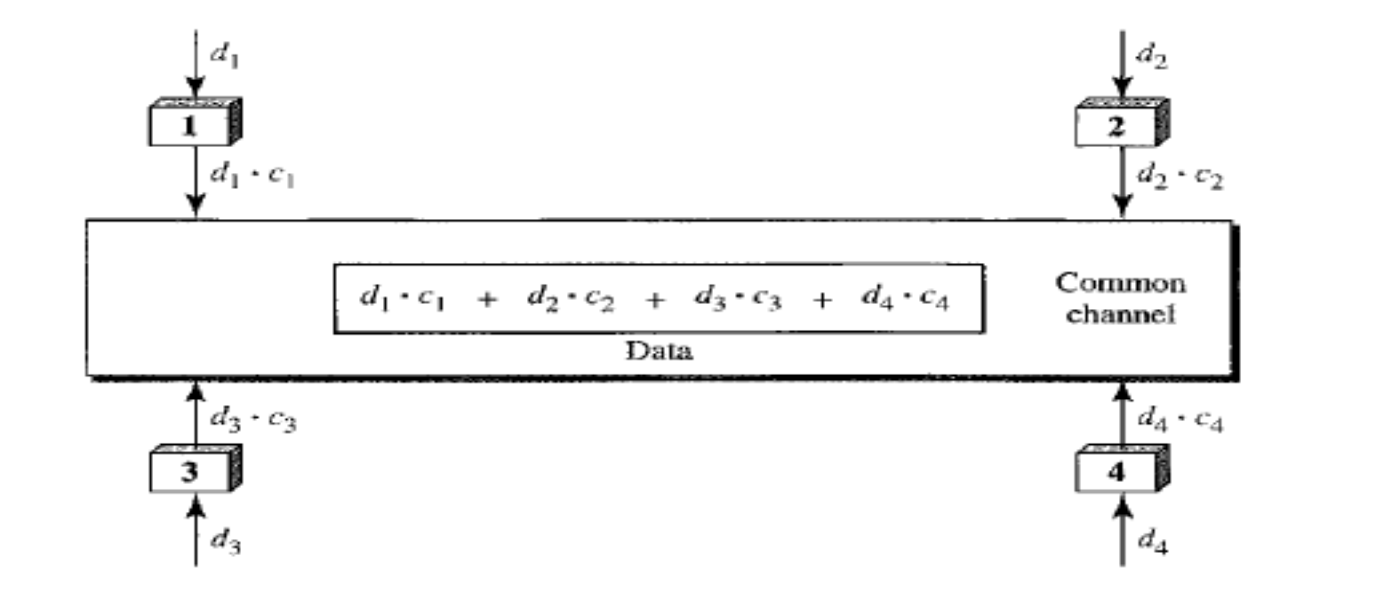
Eg. large people communicate in room with different languages.

Code Division Multiple Access (CDMA)

Idea

i. Let us assume we have four stations 1,2,3,4 connected to same channel with data d1,d2,d3,d4 respectively and code assigned to each station are c1,c2,c3,c4.

ii. Assigned codes have 2 properties:
   a. If we multiply each code by another, we get 0.
   b. If we multiply each code by itself, we get 4 (stations count)



Code Division Multiple Access (CDMA)

i. Suppose station 1 and 2 are talking to each other. Station 2 wants to hear what 1 is saying. It multiplies the data on channel by c1 (code of station 1)

Data=(d1.c1 +d2.c2+d3.c3+d4.c4) .c1
=(d1.c1.c1 +d2.c2.c1+d3.c3.c1+d4.c4.c1)
= 4.d1

To get the data station will divide the result by the number of stations i.e. in this case is 4.

ii. CDMA is based on coding theory. Each station is assigned a code, which is sequence of numbers called chips.