

## Assignment 1

1. Explain Evolution of Cellular (Mobile Signal) Systems from 1G to 5G

→ During the early 80s, 1G started to gain popularity across the globe. During this time, we saw the first commercial cellular network using analog signals. While innovative, there were a number of issues with this first generation. Phones typically had poor battery life and poor voice quality, with dropped calls becoming the norm. Phones were also much larger during this time, which made owning and using them rather inconvenient.

### Second Generation :-

→ By the early 1990s, 2G was starting to emerge. This second generation used digital signals instead of analog and included a new digital tool for wireless transmission called Global System for Mobile (GSM), which has been improved upon over the years. The main aim here was to provide a more reliable and secure option for communication. During this time, features like SMS, conference calls, call hold, international roaming, and more were introduced and with an increased data rate, the 2G standard could be used to send and receive both text messages and emails.

### Third Generation :-

3G connection-based networks were introduced in 2001, marking the start of widespread use of the internet on mobile phones. Not long after, smartphones were introduced, offering all of the possibilities of a computer in the palm of your hand.

The advent of a 3G network with more data, video calling and mobile internet began in 1998. What we may now consider a slow network in many large municipalities was the height of technology until 4G came along. 3G networks reach 2mbps on stationary or non-moving devices and 384kbps on devices in moving vehicles.

### Fourth Generation :-

4G, or the current standard of cellular networks, was released in the late 2000s and is 500 times faster than 3G. It has been able to support high-definition mobile TV, video conferencing and much more. When a device is moving, as when you are walking with your phone or are in a car, the top speed can be 10s of mbps, and when the device is stationary, it can be 100s of mbps. The 20MHz bandwidth sector has peak capacity of 400Mbps. However, since users are sharing available sector capacity among others, observable speed experiences by users are typically in 10s - 100s of mbps.



- > While the maximum upload rate of 4G technology is 500 Mbps
- > While the maximum download rate of 4G technology is 1 Gbps
- > While it uses packet switching technique as well as message switching technique.
- > While it is lenient horizontally as well as vertically.

### Fifth Generation :-

The next generation of telecom networks (fifth generation or 5G) has started hitting the market end of 2018 and will continue to expand worldwide.

Beyond speed improvement, the technology is expected to unleash a massive 5G IoT (Internet of Things) ecosystem where networks can serve communication needs for billions of connected devices, with the right trade-offs between speed, latency, and cost.

- > Up to 10Gbps data rate
- > 10 to 100x speed improvement over 4G and 4.5G networks

Q 3 : Explain handoff strategies (Types of handoff)  
→ In cellular telecommunications, the terms handover or hand off refers to the process of transferring ongoing call or data connectivity from one Base Station to other Base Station. When a mobile moves into the different cell while the conversation is in progress then the MSC (Mobile Switching Center) transfer the call to a new channel belonging to the new Base Station.

### Types of Handoff:

#### 1. Hard Handoff:

When there is an actual break in the connectivity while switching from one Base Station to another Base Station. There is no burden on the Base Station and MSC because the switching takes place so quickly that it can hardly be noticed by the users. The connection quality is not that good. Hard Hand off adopted the break before make policy.

#### 2. Soft Handoff:

In Soft Handoff, at least one of the links is kept when radio signals are added or removed to the Base Station. Soft Handoff adopted the make before break policy. Soft Handoff is more costly than Hard Handoff.



Q 4 : Explain concept of Cell splitting, Sectoring and Microcell zone in short

-> Cell Splitting

When number of subscribers in a given area increases allocation of more channels covered by that channel is necessary, which is done by cell splitting. A single small cell midway between two co-channel cells is introduced.

Sectorizing :

It is way of increasing the capacity of the cell

-> In cell sectoring, the omni-directional antenna at the base station are required with several directional antenna, each antenna transmitting within a specified sector

-> sectorization is can expansive that all splitting

Microcells:

Cover a range of hundreds of meters e.g. in urban areas to support PCS which is another kind of mobile technology.

Given bandwidth = 33 MHz

Channel bandwidth = 25 KHz \* 2 simplex channel  
= 50 KHz/duplex channel

Total available channel =  $5300 / 50$   
= 660 channels

For  $n=4$

Total Numbers of channel available per cell =  $660 / 4$   
= 165 channel

(b) for  $n=7$

total number of channel available per cell =  $660 / 7$   
= 95 channels

(c) for  $N=2$

Total number of channel available per cell =  $660 / 2$   
= 55 channels