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Generation of Cellular Communication Technologies

1G Technology:- AMPS → Advanced mobile phone System.

↳ first generation of wireless mobile Commⁿ.

↳ Analog Signals are used.

↳ Commercially Introduced in US in 1980s.

↳ Support only Voice Calls.

[Speed → 2.4 Kbps]

Characteristics:-

↳ ① No Support for SMS or Data Services.

② Poor Voice Quality

③ Limited Battery Life.

④ No Security.



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L5: Review of generation of mobile services | 1G, 2G(GSM), 2.5G(GPRS), 3G, 4G, 5G

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Mobile Computing Lectures

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- 2. Mobile Computing Characteristics 7:21
- 3. Mobile Computing Challenges 10:47
- 4. Review of generation of mobile services | 1G, 2G(GSM), 2.5G(GPRS) 19:31
- 5. Components of Wireless Communication System | Overview 7:20
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- 18. Terms used in Cellular Network

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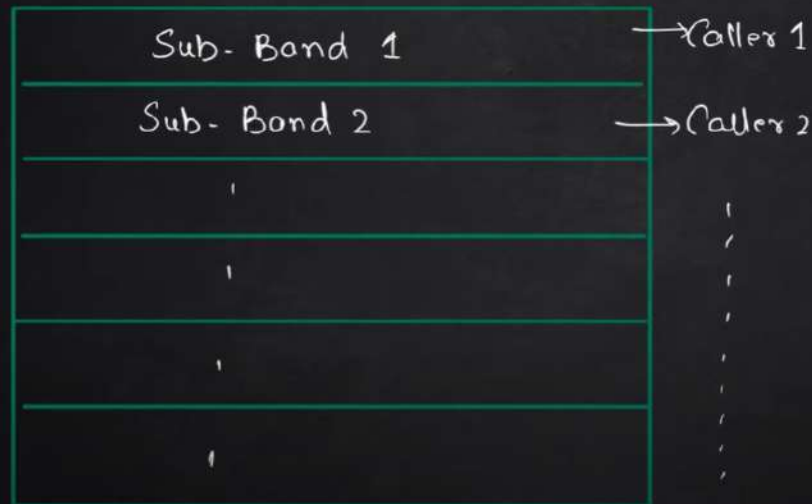
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1G Technology:-

Available Freq. Band is
Sub-divided into Sub-bands.



1G → FDMA

(Freq. division multiple Access).

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2G Technology:- ⁽¹⁹⁹¹⁾ (GSM) Global System for Mobile Communication.

- ↳ Second Generation.
- ↳ used digital Signals.
- ↳ Encoded voice and other info" digitally before transmitting them.

Benefits of Digital Transmission:-

- ↳ ① NOISE Immunity.
- ↳ ② Better Bandwidth utilization.

Characteristics:-

- ↳ ① Speed upto 64 kbps
- ↳ ② SMS, multimedia possible.
- ↳ ③ Better Quality than 1G.

2G uses → CDMA (Code division multiple access)
↳ TDMA (Time Division)
1G uses → FDMA



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2.5 Generation:-

- ↳ GPRS (General Packet Radio Service)
- ↳ Enabled web browsing, e-mail, fast upload/download speed.

$$2G + GPRS \rightarrow 2.5G$$

2.5G based on PACKET Switching
2G based on CIRCUIT Switching

} Helped in reducing the Call Cost



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3G Technology:-

- ↳ Third Generation
- ↳ Supports much higher data transmission rates.
- ↳ Increased bandwidth.
- ↳ uses Packet switching tech.
 - ↳ Call cost ↓

Characteristics:-

- ↳ ① Speed → 144kbps to 2Mbps.
- ② High speed data / voice transmission.
- ③ 3D Gaming.
- ④ Web-based appⁿ run.
- ⑤ Fast and easy transmission of audio/video files.



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4G Technology:- → IP Telephony, HD Mobile TV. ←

↳ Fast Data Rate than 3G
(10 times faster)

↳ Makes Mobile Broadband possible.

Competing
4G
Standards

Mobile WiMAX

LTE (Long Term Evolution)

Characteristics:-

↳ ① Speed → 100 Mbps and more.

② Accessibility of mobile and web apps.

③ Packet Switching.

④ CDMA multiplexing, ultra-wide band.

⑤ Carrier Freq → 15 MHz.

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Review of generation of mobile services | 1G, 2G (GSM), 2.5G (GPRS), 3G, 4G, 5G

Components of Wireless Communication System | Overview of wireless telephony

Cellular Network Introduction, Advantages, Parameters determining Size

Terms used in Cellular Network

L5: Review of generation of mobile services | 1G, 2G (GSM), 2.5G (GPRS), 3G, 4G, 5G

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5G Technology:-

↳ Fifth Generation

↳ Complete wireless Commⁿ.

Characteristics:-

- ↳ ① Speed → 1 Gbps.
- ② Simultaneous access to various wireless tech.
- ③ Packet and Message Switching
- ④ Digital info^m services are offered.



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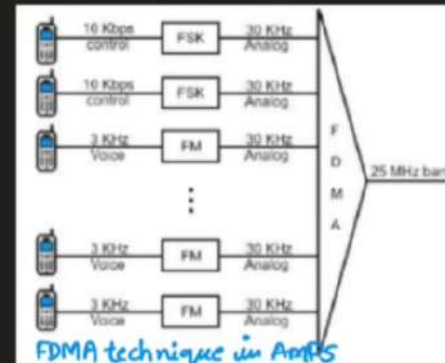
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16 limitations

- Poor voice quality
- Poor battery life
- Large phone & no security



200 to 3300 Hz
3 kHz
8w

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LESSON 3

Review of generation
of mobile services |
1G, 2G(GSM),
2.5G(GPRS), 3G, 4G,
5G

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MOBILE COMPUTING (C) COMPLETE COURSE

LECTURE 14

GSM Architecture, Features, Interfaces

| HLR, VLR, AuC, EIC Register 24:12

Second Generation Technology (2G)

- ✓ developed for digital voice communication.
- ✓ enabled service \Rightarrow text message (SMS), picture message & Multimedia message (MMS)
- ✓ Commercially launched on GSM Standard in Finland (1991)
 - \rightarrow GSM Service \rightarrow used by 2 million people \rightarrow 212 Countries.
 - \rightarrow GSM Standard \rightarrow makes International Roaming very Common b/w Mobile phone operators
 - \rightarrow 2G \rightarrow divided \rightarrow two standards \rightarrow TDMA & CDMA
 - \rightarrow make use of CODEC (Compression-DeCompression Algorithm) for compressing & multiplexing digital voice data.
- ✓ Cell phone units are smaller than 1G units.
- ✓ Less radio power, Consumes less battery power.
- ✓ Improved voice clarity & reduce noise : Digital Coding
- ✓ Provides security and safety : Digital Encryption.

Second generation (2G) & Digital Advanced Mobile phone System (DAMPS) in a communication system

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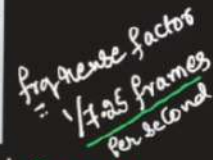
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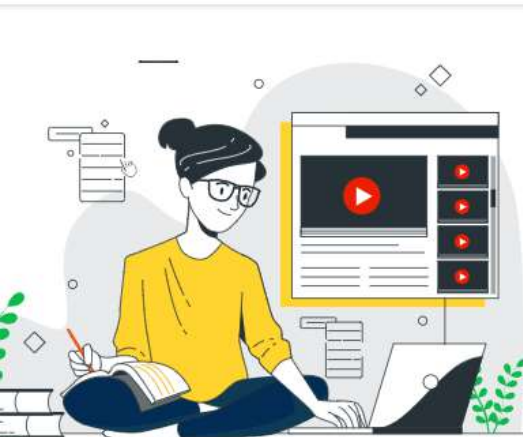
DAMPERS:



GSM:

→ GSM is used by 76% of users worldwide.





Learning Categories

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Digital Advanced Mobile Phone System

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Digital Advanced Mobile Phone System (D-AMPS) is a digital version of Advanced Mobile Phone Systems (AMPS), the original analog standard for cellular phones. D-AMPS uses a combination of time division multiple access (TDMA) and frequency division multiple access (FDMA). It adds TDMA to get three channels per AMPS channel, thus tripling the number of calls on a channel.

Features

- They are standardised by IS-54 and IS-136.
- As in AMPS, D-AMPS also uses frequencies from 800 to 900MHz for transmission. Half of the spectrum is used for sending signals and the other half is used for receiving signals.
- The frequency band is divided into 30KHz sub-bands, called channels, by FDMA.
- The channels for uplink are called forward channels and the channels for downlink are called reverse channels.
- TDMA is applied to each channel thus tripling the number of available channels.
- ✓ ● Presently, all D-AMPS channels are replaced by GSM or CDMA technology.



Trending Categories

Data Structure

Networking

RDBMS

Operating System

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Second-Generation (2G) Mobile Phones

Computer Engineering Computer Network MCA

Second generation (2G) mobile phones switched from analog system of 1G to digital system. It was commercially launched in 1991 as GSM standard in Finland. As with 1G phones, 2G phones didn't have any worldwide standardizations. 2G systems were also known as personal communications services (PCM).

Advantages of 2G over 1G

- It allows voice signals to be digitized and compressed. So, they are more efficient on frequency spectrum than 1G.
- They introduced data services for mobile in form of SMS text messaging.
- Data and voice signals are digitally encrypted. So, security against eavesdropping and fraud increased manifold.
- Digital signals consume less battery power. And so mobile sets are much more energy efficient than their 1G counterparts.

Popular 2G Systems

Several 2G systems were developed, the notable among which are as follows –

- **D – AMPS (Digital Advanced Mobile Phone Systems)** : D-AMPS was a digital version of advanced mobile phone systems (AMPS) that coexisted with AMPS. It used time division multiplexing (TDM) for multiple calls.
- **GSM (Global System for Mobile Communications)** : 2G was launched through GSM. It is the most widely globally used technology. It uses frequency division multiplexing (FDM) and time division multiplexing (TDM) for handling multiple calls simultaneously.
- **CDMA (Code Division Multiple Access)** : It uses a different technology from the above and was standardized by International Standards IS-95.



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GSM Global System for Mobile Comm?

- Cellular NW.
- operates in 4 diff. frequency ranges.
- uses combination of both

FDMA and TDMA.

→ Cell Sizes in GSM NW.

- Macro:- BS antenna is installed
- Micro:- antenna height < avg. roof level
- Pico:- small cells (indoor) dia=(m)
- Umbrella:- cover shadowed regions
↳ Fill in Gaps b/w cells.

GSM Features:-

- 1) International roaming
- 2) Good Voice Quality
- 3) Handheld terminals Support
- 4) Low Service Cost
- 5) ISDN Compatibility
- 6) New features and Services

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Features of GSM

1. GSM allows the use of SIM
2. Privacy of data
3. International Roaming
4. Good voice quality
5. GSM is compatible with ISDN, PSTN

2:40 / 3:30

Features of GSM 🔥🔥



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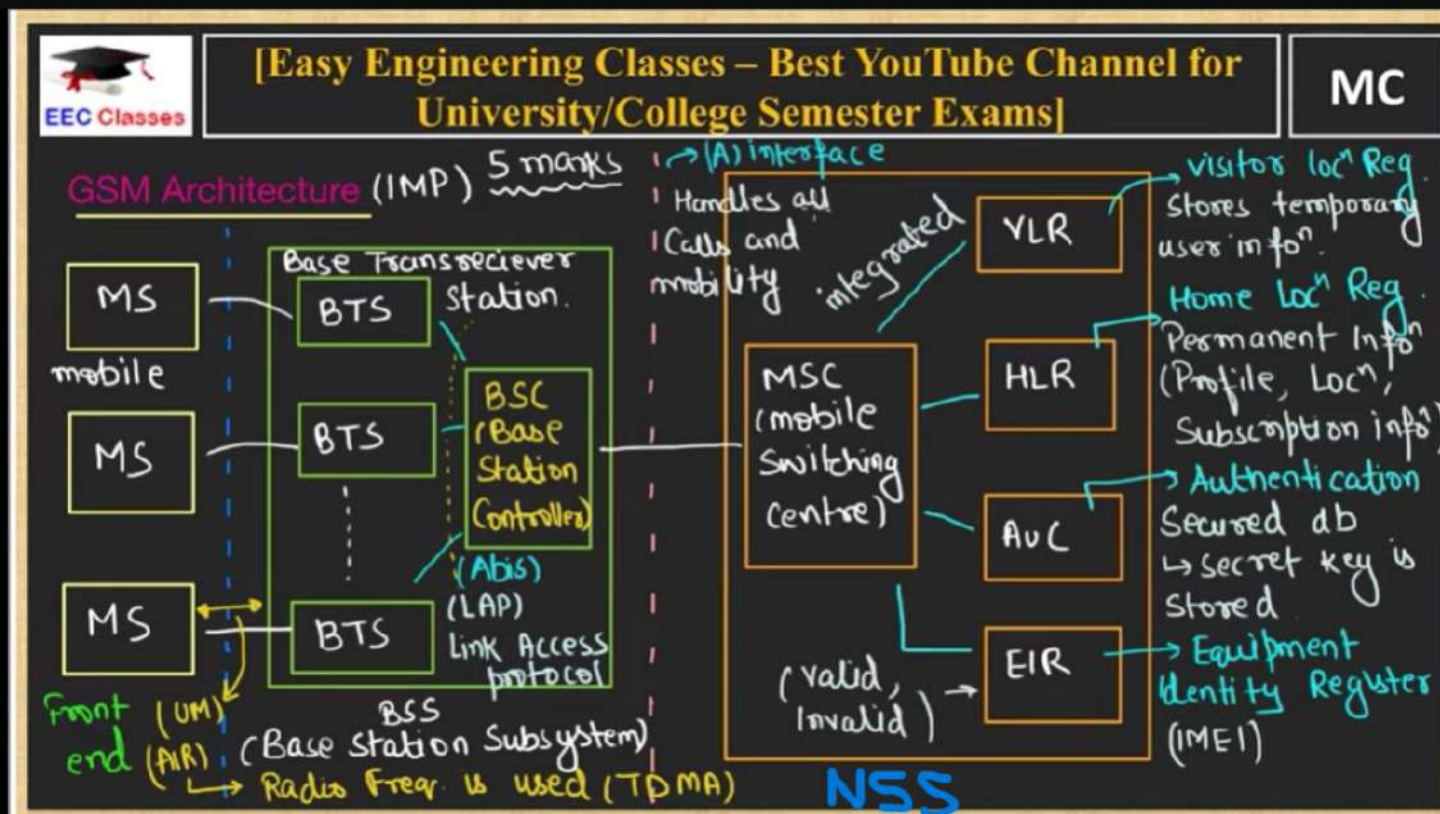
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GSM ARCHITECTURE



GSM Architecture 🔥🔥



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GSM Architecture Imp. Points:-		
Component	Functions	
BTS	Encoding, Encryption, multiplexing, modulation } Decoding, decryption	
BSC	Frequency hopping control, Traffic management, Interface, Power management, (Handoff management)	
MSC (NSS) ↳ n/w switching Subsystem	Registration, authentication, loc ⁿ update, handovers, Call routing, Call setup, Supervision.	

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OSS (Operation and Support Subsystem)

- ↳ Controls and monitors the GSM System.
- ↳ Controls Traffic load of BSS.
- ↳ Purpose of OSS is to offer the Customer Cost-effective Support for all GSM related maintenance Services.

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












































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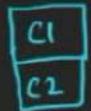
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Why Cell is Hexagonal in Shape

→ In Cellular System Land Area is divided into a regular shaped cells

Square
Circle
Hexagonal
Triangle



Criteria for cell shape:-


- ① Geometric shape ✓
- ② Area w/o overlap ✓
- ③ Area of cell should be maximum ✓

There are three Shapes that Satisfies the area without overlap condⁿ:-

→ Hexagon
→ Square
→ Triangle


Overlapping of cells →
Gap b/w cells


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MC

Why Cell is Hexagonal in Shape

↳ Circle area is highest
↳ overlapping




overlapping

Area of triangle → 17.77%
" " Square → 63.7%
" " Hexagon → 83%.


no overlapping, get proper geometric shape.


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CDMA

$C_1 = (1 \ 1 \ 1 \ 1)$
 $D_1 = -1$ $\textcircled{S_1}$
 $C_1 \cdot D_1 = (-1 \ -1 \ -1 \ -1)$

$C_2 = (1 \ -1 \ 1 \ -1)$
 $D_2 = +1$ $\textcircled{S_2}$
 $C_2 \cdot D_2 = (1 \ -1 \ 1 \ -1)$

$\leftarrow (0 \ -4 \ 0 \ 0) \rightarrow$

$C_3 \cdot D_3 = (-1 \ -1 \ 1 \ 1)$
 $D_3 = -1$ $\textcircled{S_3}$
 $C_3 = (1 \ 1 \ -1 \ -1)$

$C_4 \cdot D_4 = (1 \ -1 \ -1 \ 1)$
 $D_4 = +1$ $\textcircled{S_4}$
 $C_4 = (1 \ -1 \ -1 \ 1)$

$R_1 = \textcircled{S_1} - \textcircled{R}$
 $= (1 \ 1 \ 1 \ 1) - (0 \ -4 \ 0 \ 0)$
 $= (0 \ -4 \ 0 \ 0) = -4/4 = -1 = D_1$

$R_2 = \textcircled{S_2} - \textcircled{R}$
 $= (1 \ -1 \ 1 \ -1) - (0 \ -4 \ 0 \ 0)$
 $= (1 \ 4 \ 1 \ -1) = 4/4 = +1 = D_2$

Data bit

- $\rightarrow 0 \ (-1)$
- $\rightarrow 1 \ (+1)$

$C_1 \times C_2 = 0$
 $(1 \ 1 \ 1 \ 1) \cdot (1 \ -1 \ 1 \ -1)$
 $= 0$

$C_1 \times C_3 = 4$
 $(1 \ 1 \ 1 \ 1) \cdot (1 \ 1 \ -1 \ -1)$
 $= 4$

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