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MOBILE PHONES (CELLULAR PHONES)

A **Mobile Phone (Cell Phone)** is an electronic communication device used to make and receive calls using **radio frequency signals (electromagnetic waves)** while the user is moving within a cellular network coverage area.

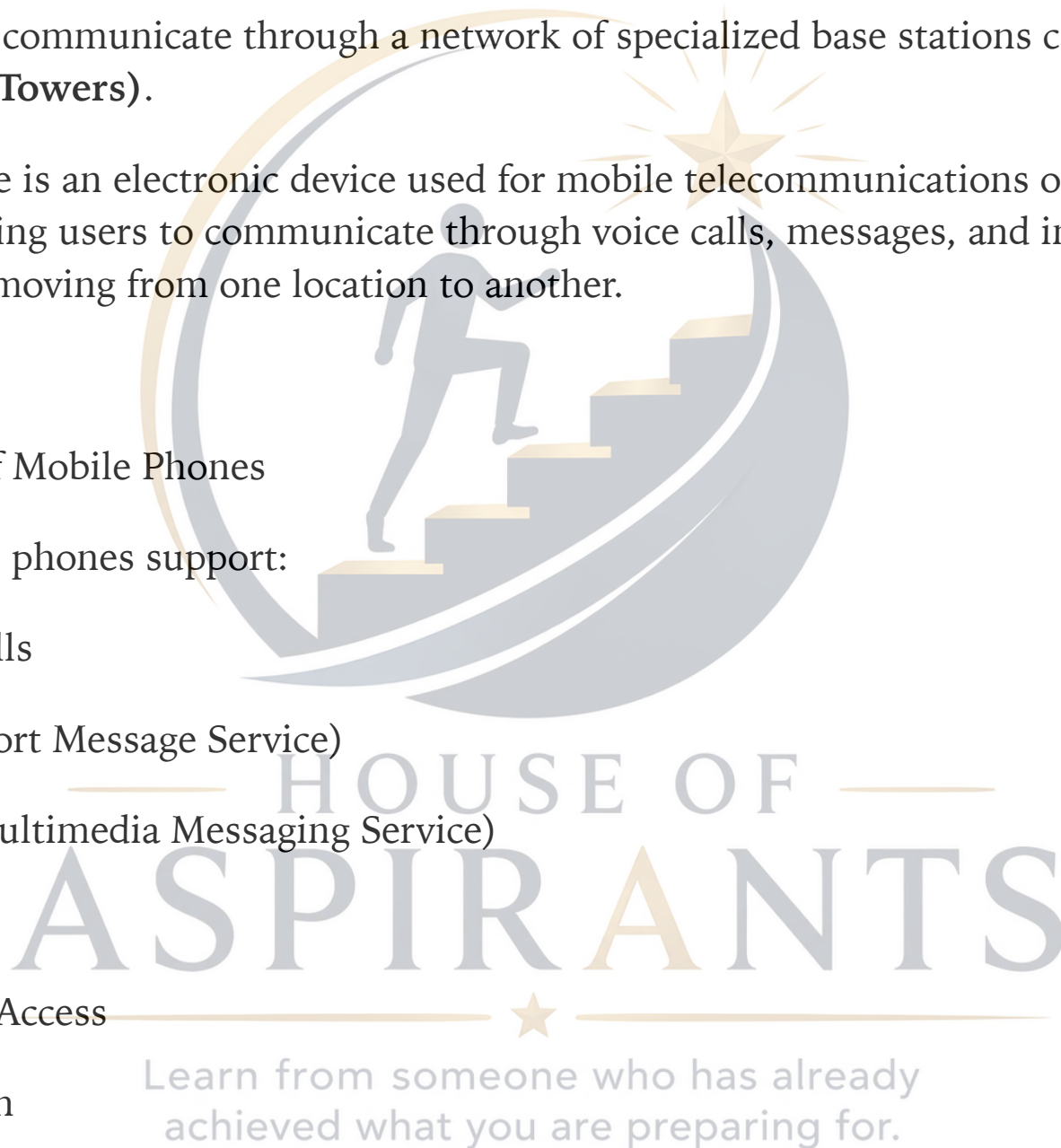
Mobile phones communicate through a network of specialized base stations called **Cell Sites (Mobile Towers)**.

A mobile phone is an electronic device used for mobile telecommunications over a cellular network, allowing users to communicate through voice calls, messages, and internet services while moving from one location to another.

Key Features of Mobile Phones

Modern mobile phones support:

- Voice Calls
- SMS (Short Message Service)
- MMS (Multimedia Messaging Service)
- Email
- Internet Access
- Bluetooth
- Camera & Video Recording
- GPS Navigation
- Music Player
- Radio
- Mobile Banking
- Social Media Applications



Exam Point

Because mobile phones use a cellular network architecture, they are also called:

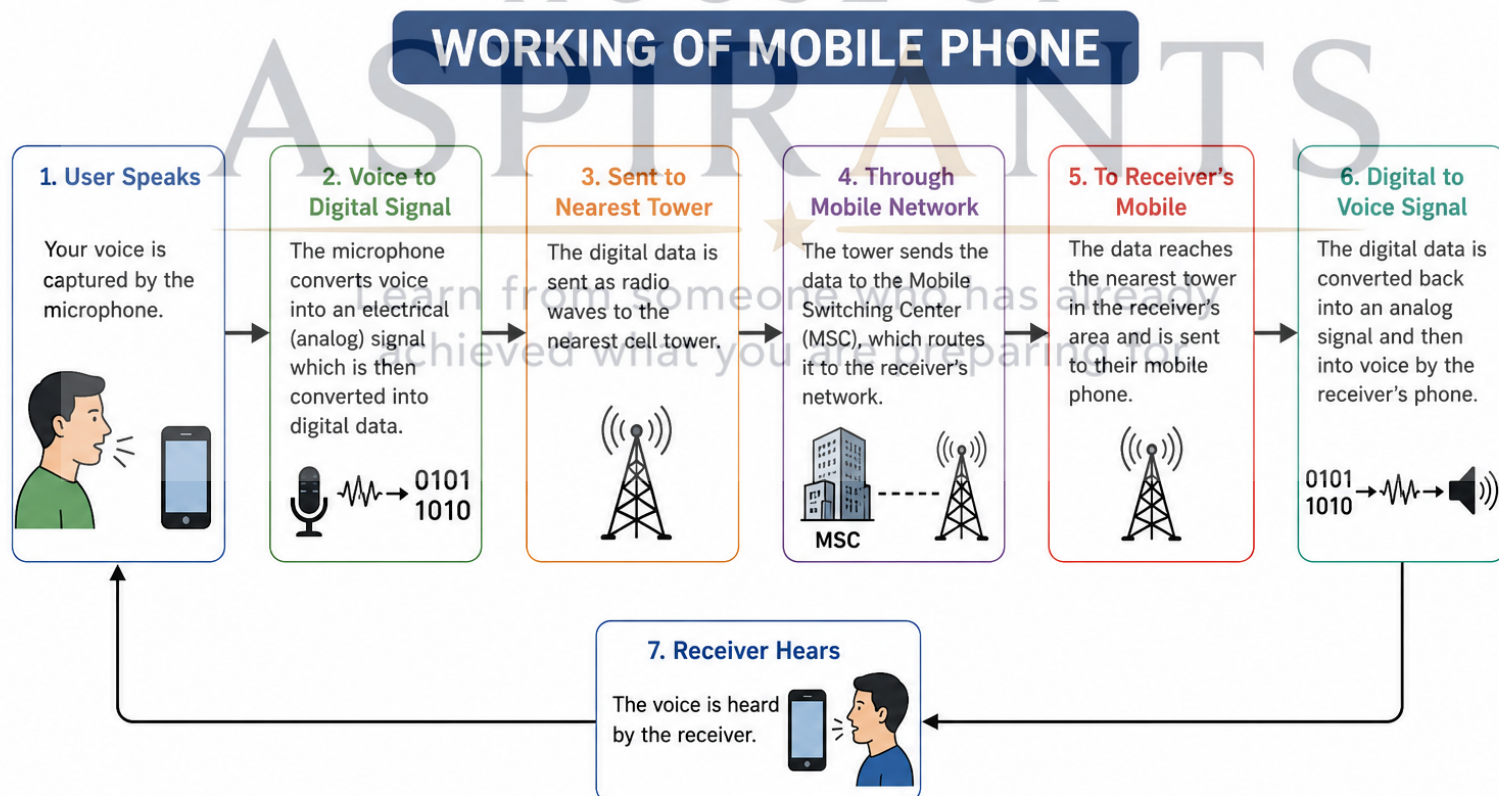
- Cellular Phones
- Cell Phones

IMPORTANT INVENTORS AND HISTORICAL FACTS

Invention	Inventor/Organization	Year
Walkie-Talkie	Donald Hings	1937
First Mobile Phone	Martin Cooper	1973
First Commercial Mobile Phone	Motorola DynaTAC 8000X	1983
First Smartphone	IBM Simon Personal Communicator	1994
First Cellular Network	Nippon Telegraph and Telephone (NTT), Japan	1979

Exam Point :Martin Cooper is known as the "Father of the Mobile Phone".

HOW MOBILE PHONES WORK



In Simple Words

Your voice → Phone converts to digital data → Sent to tower → Through network → To receiver's phone → Converted back to voice → Receiver hears.

Mobile phones communicate using **Radio Waves**.

A mobile phone converts voice into electrical signals and transmits them to nearby cell towers using radio frequencies.

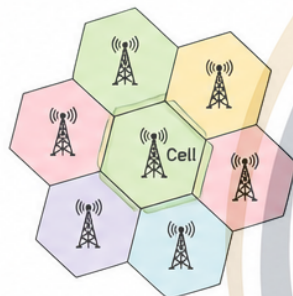
CELLULAR NETWORK CONCEPT

CELL IN MOBILE PHONE

A **cell** is a small geographical area covered by a **base station (cell tower)** that provides mobile communication services.

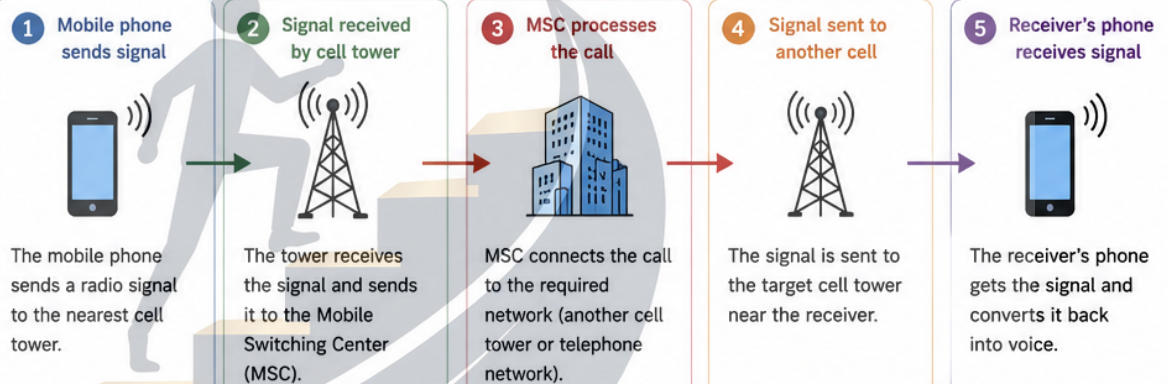
1. WHAT IS A CELL?

- A cell is a small area covered by a cell tower.
- The shape of the cell is usually hexagonal.
- The whole city or country is divided into many cells.
- Each cell uses certain frequencies to communicate with mobile phones.



Hexagon shape helps in maximum coverage and frequency reuse.

2. HOW A CELL WORKS IN MOBILE PHONE (CALL PROCESS)



3. HANDOVER (MOVING FROM ONE CELL TO ANOTHER)

When a user moves from one cell area to another, the call is transferred to the new cell with stronger signal automatically.



In current cell, signal becomes weak.

New cell tower detects stronger signal.

Call is transferred to new cell (handover).

This process happens in a few milliseconds. Call continues without disconnection.

4. FREQUENCY REUSE

The same frequencies can be reused in cells that are far apart (not adjacent). This increases the capacity of the network.



Cells with same letter use **same frequency** because they are far from each other.

KEY POINTS

- ▶ A cell is a small coverage area of a cell tower.
- ▶ Cells are usually hexagonal in shape.
- ▶ Mobile phones always connect to the nearest cell tower.
- ▶ When we move, handover occurs and call continues.
- ▶ Frequency reuse in non-adjacent cells increases network capacity.

Important Terms

Cell : Small area covered by a cell tower.

Base Station (BTS) : Cell tower that communicates with mobile.

MSC (Mobile Switching Center) : Routes calls between cells and to other networks.

Handover : Transfer of call from one cell to another, without disconnection.

A large geographical area is divided into small regions called **Cells**.

Each cell is served by a base station (cell tower).

Shape of Cell

For network planning purposes, the cell is assumed to be **HEXAGON**

Full Duplex Communication

Mobile phones support Full Duplex Communication.

Both users can speak and listen simultaneously.

MULTIPLE ACCESS TECHNIQUES

To allow many users to communicate simultaneously, cellular systems use multiple access techniques.

1. FDMA (Frequency Division Multiple Access)

Each user gets a separate frequency channel.

Features

- Different frequencies assigned to different users.
- Neighboring cells use different frequencies.

Example

User A → Frequency 1

User B → Frequency 2

User C → Frequency 3

2. TDMA (Time Division Multiple Access)

Multiple users share the same frequency but at different time slots.

Features

- Frequency divided by time.
- Each user transmits in a specific time period.

3. CDMA (Code Division Multiple Access)

All users share the same frequency but use unique codes.

Features

- More efficient than FDMA.
- Better capacity and security.

4. PDMA (Polarization Division Multiple Access)

Uses different polarization states of radio waves to separate signals.

MOBILE PHONE IDENTIFICATION CODES

Every mobile phone contains special identification numbers.

1. ESN (Electronic Serial Number)

- Unique 32-bit number
- Permanently programmed into the phone

Exam Point

ESN is permanent.

2. MIN (Mobile Identification Number)

- 10-digit number
- Derived from the mobile number

3. SID (System Identification Code)

- Unique 5-digit number
- Assigned to each cellular carrier

Example

Jio, Airtel, Vi

4 The IMEI (International Mobile Equipment Identity)

IT is a unique 15-digit number assigned to every mobile device.

It serves as an identification code that differentiates each handset from others.

This number is crucial for several reasons:

- Device Identification .
- Network Security: Mobile networks use IMEI to allow or block devices from accessing the network.
- Theft Prevention: If a phone is lost or stolen, the IMEI can be blacklisted, preventing its use with any SIM card.
- Warranty and Service
- You can usually find your IMEI by dialling *#06# on the keypad or checking the device's settings and packaging.

COMPARISON OF MOBILE CODES

Code	Full Form	Purpose
ESN	Electronic Serial Number	Identifies Phone
MIN	Mobile Identification Number	Identifies Subscriber
SID	System Identification Code	Identifies Network Provider

SIM CARD

SIM stands for: Subscriber Identity Module

A SIM card is a smart card issued by a mobile service provider(AIRTEL,JIO) that stores subscriber information.

Information Stored in SIM

- IMSI
- Phone Number
- Authentication Information
- Network Details

IMSI

Full Form :International Mobile Subscriber Identity

A unique number stored in the SIM card used to identify the subscriber.

TMSI

Full Form :Temporary Mobile Subscriber Identity

After IMSI verification, the network assigns a temporary identity called TMSI.

Purpose

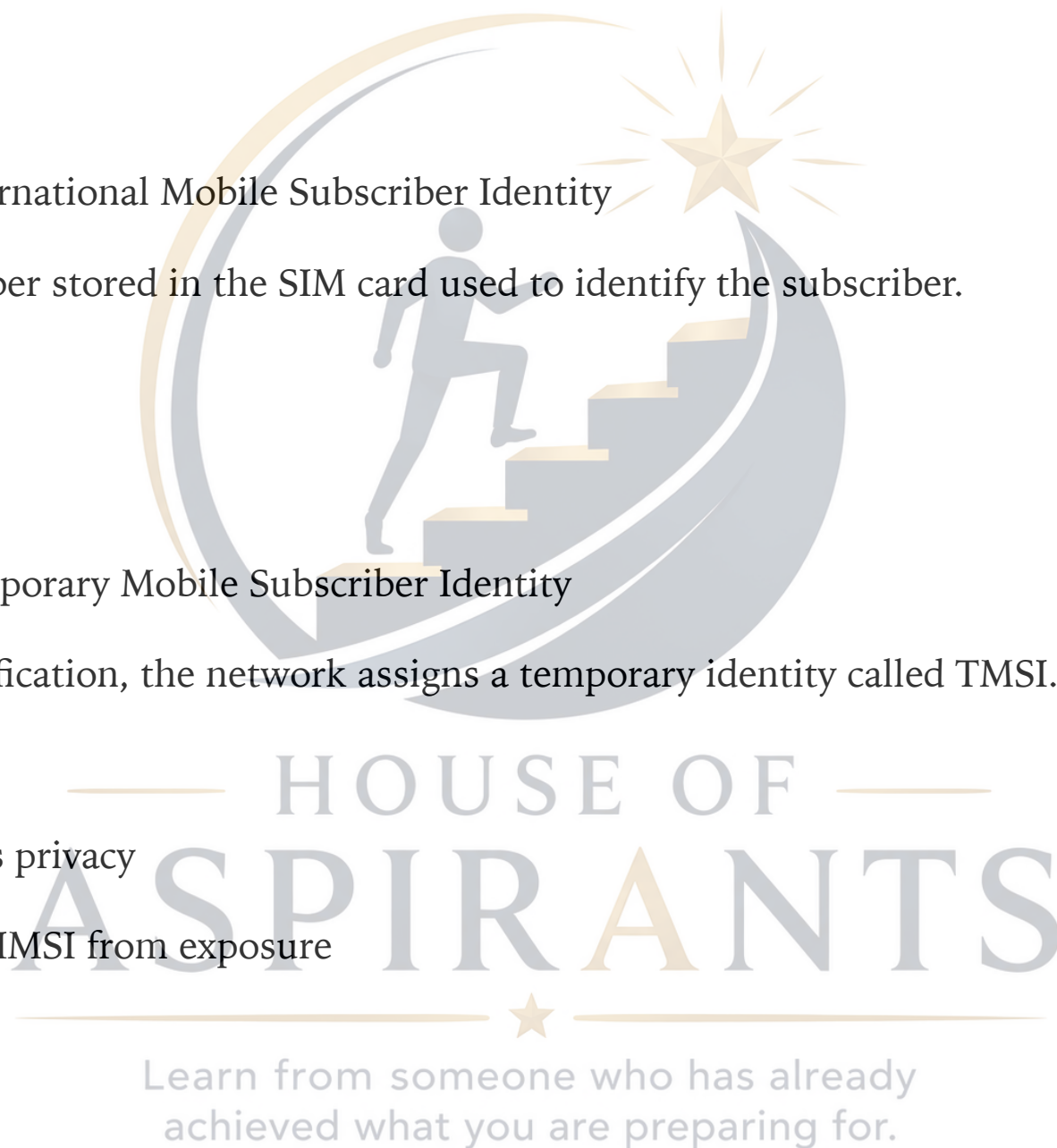
- Improves privacy
- Protects IMSI from exposure

ESIM

Full Form :Embedded Subscriber Identity Module

Features

- Built into device hardware
- No physical SIM card required
- Can be activated digitally



Exam Point

eSIM = Embedded SIM.

WHAT HAPPENS WHEN WE MAKE A CALL?

Step 1

Phone searches for a nearby control channel.

If unavailable:

"No Service" is displayed.

Step 2

Phone checks SID.

If SID matches:

Phone identifies its home network.

Step 3

Phone sends a registration request to the network.

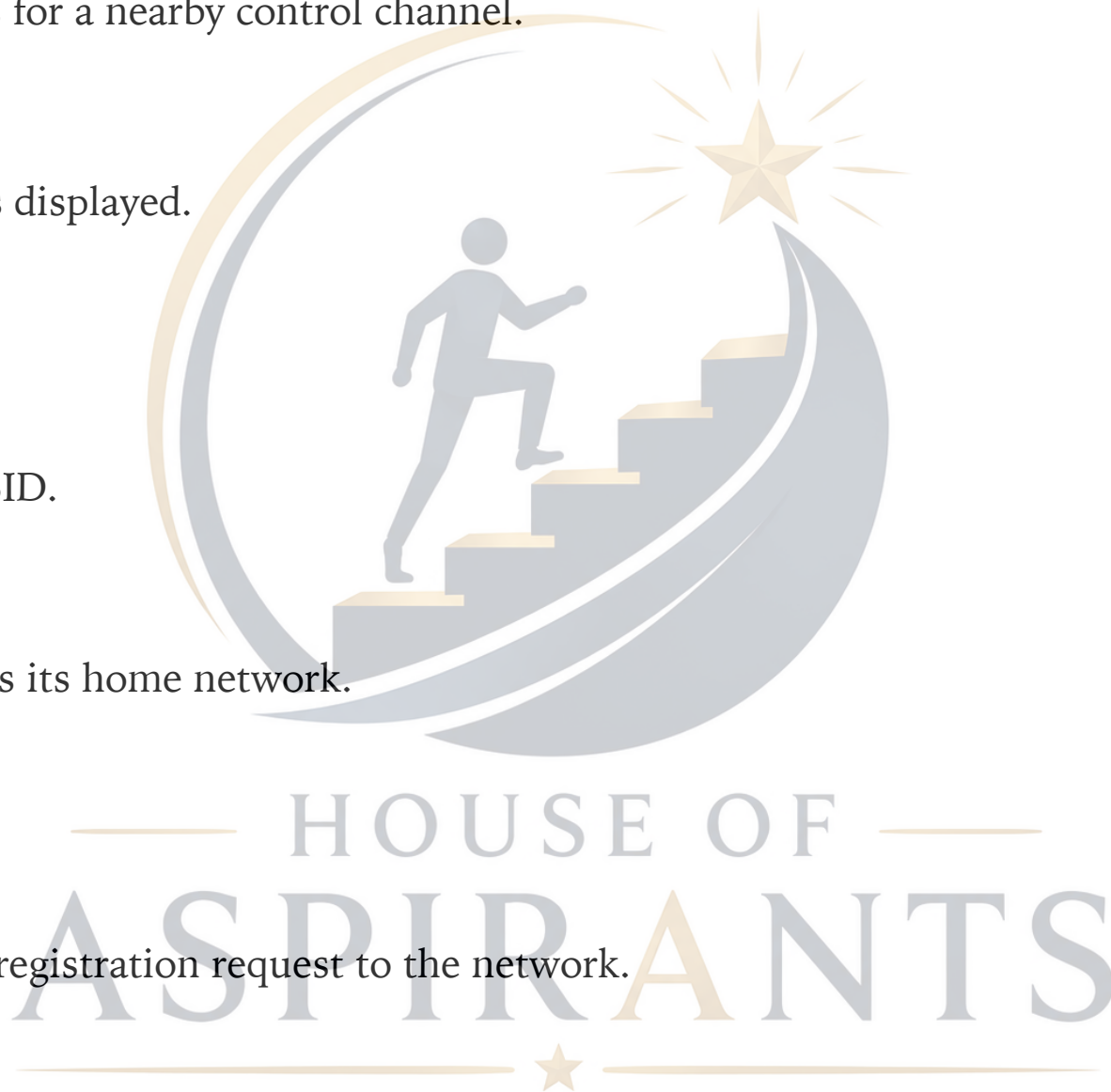
Step 4

MTSO(Mobile telephone switching office) records the phone's location.

Step 5

MTSO assigns a frequency pair.

Step 6



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Call is connected.

Step 7

If user moves into another cell:

Network performs Handoff (Handover).

Call continues without interruption.

MTSO (Mobile Telephone Switching Office)

Functions

- Call Routing
- Location Tracking
- Frequency Allocation
- Handover Management

Exam Point :MTSO is the central controller of cellular communication.

HANDOFF (HANDOVER)

The process of transferring an ongoing call from one cell tower to another without disconnecting the call.

Example: While traveling in a car, your call continues because handoff occurs automatically

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IMPORTANT MOBILE COMMUNICATION TERMS

Term	Full Form
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WAP	Wireless Application Protocol
GPS	Global Positioning System
WCDMA	Wideband Code Division Multiple Access
GSM	Global System for Mobile Communications

LTE	Long Term Evolution
VoLTE	Voice over LTE
CDMA	Code Division Multiple Access

GSM SYSTEM

Full Form :Global System for Mobile Communications

Features

- Most widely used mobile communication standard
- Digital system
- Considered a 2G technology

GSM CHANNELS

Control Channel :Used for network management and signaling.

Traffic Channel :Used for voice and data transmission.

OPERATING SYSTEMS IN MOBILE PHONES

ANDROID

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Based On :Linux Kernel

Developed By :Google

IOS

Developed By :Apple Inc.

Based On :Darwin Operating System

Exam Point

Android → Linux Kernel

iOS → Darwin

INTERNET SERVICE PROVIDERS (ISP)

Telenet

World's First ISP

Established in 1974.

VSNL (Videsh Sanchar Nigam Limited)

Introduced Internet services in India in 1995. It is India's First ISP

Exam Point :VSNL = First Internet Service Provider in India.

PHUBBING

Ignoring a person physically present with you because you are busy using your smartphone.

GENERATIONS OF MOBILE NETWORKS

Evolution of Mobile Communication

0G

2.75G

|

|

1G

3G

|

|

2G

4G

|

|

2.5G

5G

|

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0G (ZERO GENERATION)

Features

- Pre-cellular mobile communication
- Radio Telephones
- Installed in vehicles

Services :Voice only

1G (FIRST GENERATION)

Introduced :1979

Country :Japan

Organization :NTT(Nippon telephone and telegraph)

Features

- Analog communication
- Voice only
- Low quality

Speed :2.4 kbps

Exam Point: 1G = Analog Technology

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2G (SECOND GENERATION)

Features

- Digital technology
- Voice Calls
- SMS

- Email

Speed :64 kbps

Exam Point :2G introduced SMS.

2.5G

Technology :GPRS (General Packet Radio Service)

Features

- Packet-switched data
- Internet Access

2.75G

Technology :EDGE (Enhanced Data Rates for GSM Evolution)

Speed :Up to 128 kbps

Features

- Faster Internet

3G (THIRD GENERATION)

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Features

- High-Speed Internet
- Video Calling
- Multimedia Services

Technologies

- UMTS

- WCDMA

Speed :Up to 2 Mbps

Exam Point :3G introduced practical mobile internet and video calling.

4G (FOURTH GENERATION)

Features

- IP-based Network
- High-speed broadband
- HD Streaming
- Online Gaming

Technologies

- LTE(Long term evaluation)
- VoLTE(Voice over LTE)

Speed :Up to 100 Mbps

Exam Point :VoLTE supports voice and data simultaneously.



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5G (FIFTH GENERATION)

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Features

- Ultra-high speed
- Low latency
- Massive device connectivity
- Enhanced security

Applications

- Smart Cities
- IoT (Internet OF Things)
- Self-driving Cars
- Remote Surgery
- Artificial Intelligence

Speed : Can exceed 1 Gbps under ideal conditions.

Exam Point

5G is approximately 10–30 times faster than 4G depending on network conditions.

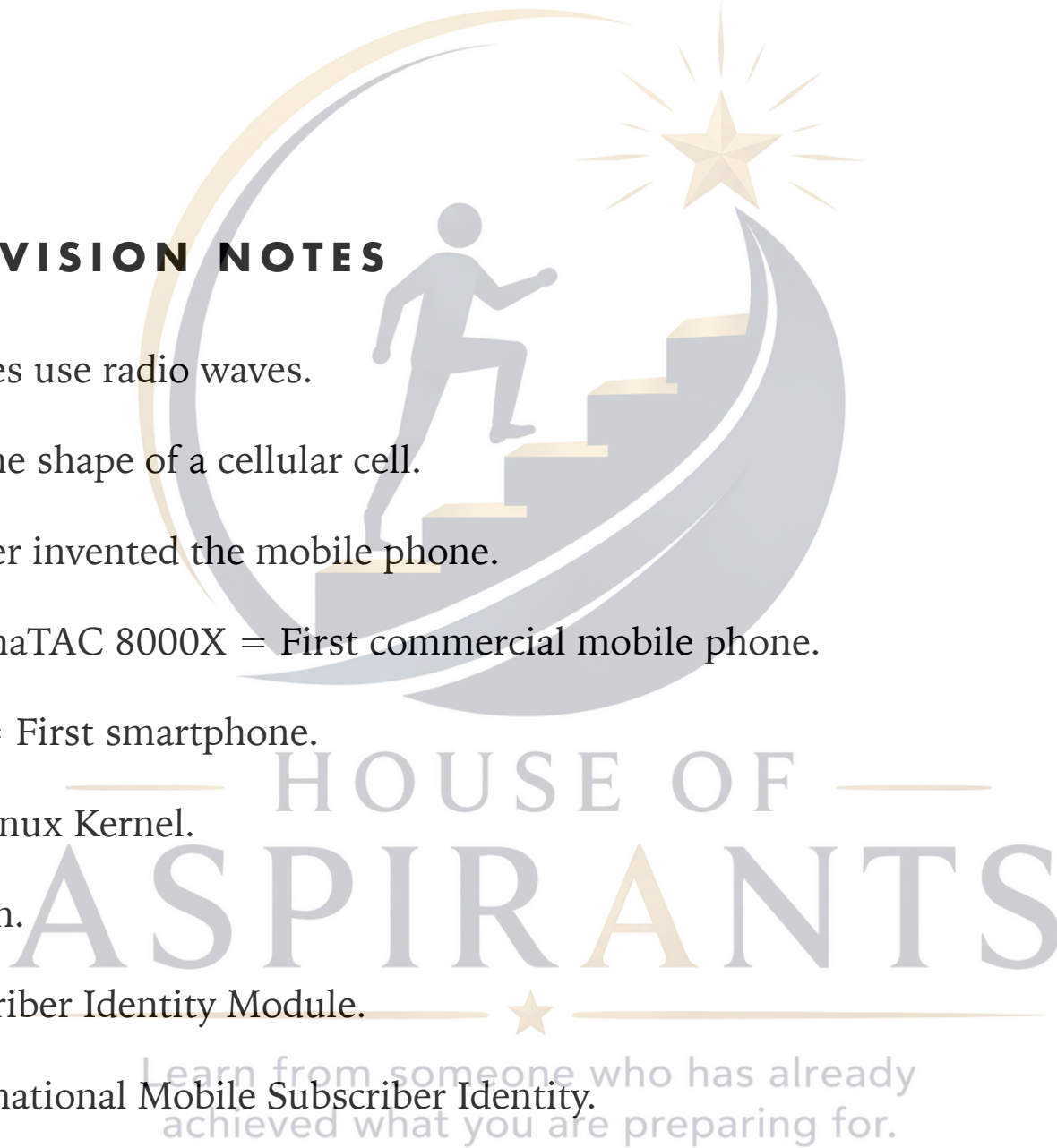
MOST IMPORTANT EXAM FACTS

1. Martin Cooper invented the mobile phone.
2. Motorola DynaTAC 8000X was the first commercial mobile phone.
3. IBM Simon was the first smartphone.
4. Hexagon is the ideal cell shape.
5. Mobile phones use radio waves.
6. Google Android is based on Linux Kernel.
7. iOS is based on Darwin.
8. GSM stands for Global System for Mobile Communications.
9. VSNL was India's first ISP.
10. Telenet was the world's first ISP.
11. IMSI is stored in the SIM card.
12. TMSI is a temporary identity.
13. MTSO controls call switching.
14. Handoff transfers calls between cells.

15. 1G = Analog.
16. 2G = Digital + SMS.
17. 3G = Mobile Internet.
18. 4G = LTE & VoLTE.
19. 5G = Ultra-fast communication.
20. Phubbing = Phone + Snubbing.

QUICK REVISION NOTES

- Mobile phones use radio waves.
- Hexagon is the shape of a cellular cell.
- Martin Cooper invented the mobile phone.
- Motorola DynaTAC 8000X = First commercial mobile phone.
- IBM Simon = First smartphone.
- Android = Linux Kernel.
- iOS = Darwin.
- SIM = Subscriber Identity Module.
- IMSI = International Mobile Subscriber Identity.
- eSIM = Embedded SIM.
- GSM = Global System for Mobile Communications.
- Wi-Fi = Wireless Fidelity.
- GPS = Global Positioning System.
- MTSO controls mobile call routing.
- Handoff transfers calls between cells.



- 1G = Analog.
- 2G = SMS.
- 3G = Mobile Internet.
- 4G = LTE.
- 5G = Ultra-fast connectivity.

