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Mobile Computing

Course Teacher: Md. Rashid Al Asif (also 5th, 4th Batch & 3rd Batch)

"Sharing your notes with your batchmates can greatly benefit average and backseat students. Your 1 minute of effort can reduce the efforts of 100 minutes of others"

-Zahid Hasan, CSE 6th Batch, University of Barishal.

৬ষ্ঠ ব্যাচ,
এটা-ই সম্ভবত আমার লাস্ট প্রশ্ন সল্ভ বা নোট শেয়ার। আমি ৫ম সেমিস্টার থেকে যতটুকু পেরেছি সাধ্যমত না, নিজের সাধ্যর বাহিরে গিয়ে চেস্টা করেছি, কতটুকু পেরেছি জানিনা। শেষ বারের মত একটা কথা বলতে চাই-

আমারে মনে রাইখেন, ভুলে যাইয়েন না😊

Doc Link: Mobile Computing by Zahid

5th Final

1.

a) Mobile Computing a technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link.

The term "Mobile computing" is used to describe the use of computing devices, which usually interact in some fashion with a central information system--while away from the normal, fixed workplace. Mobile computing technology enables the mobile worker to create, access, process, store and communicate information without being constrained to a single location. By extending the reach of an organization's fixed information system, mobile computing enables interaction with organizational personnel that were previously disconnected. It provides the continuous access to the wireless network services and the flexible communication between the people. It provides the real-time business to employee communication, enhanced customers interactions, and fastest communication between the individuals. The communication occurs with the real-time wireless connection. It provides the data, audio and video access to any user, any time with a wireless enable device.

The wireless network may be WLAN, Wi-Fi, GSM, CDMA, WiMax or GPRS. There are many companies that provide the mobile computing solutions on contract and pay as you go mobile broadband plans to the home users and businesses. 'The cell phones and laptops are the most commonly used mobile computing devices. It can be referred to the two main fields portable and mobility.

Now answer the following questions:

i) What are the key aspects of Mobile Computing concerning the different application scenarios?

Mobile Computing: Aspects

- **User Mobility**
  - Users communicate “anytime, anywhere, with anyone”
  - Example: read/write email on web browser
- **Device Portability**
  - Can be connected anytime, anywhere to the network (using different mechanisms)
- **Communication Device Characteristics**
  - Fixed and wired
  - Mobile and wired
  - Fixed and wireless
  - Mobile and wireless (most interesting)
    - Most successful: GSM with more than 800 million users

Or

1. Mobility
2. Real-time connectivity
3. Wireless communication (WLAN, Wi-Fi, GSM, CDMA, WiMax, GPRS)
4. Data access and synchronization
5. Enhanced collaboration
6. Portable devices (laptops, smartphones)
7. Security
8. Variety of applications (location-based services, mobile payments, cloud services)

ii) What is an example of Mobile Computing?

:

Mobile devices

These portable devices allow users to access, store, and process data without being tied to a fixed location. Some examples include:

Smartphones:

Small phones that can make and receive calls, and often have access to cellular or wi-fi networks

Tablets: Larger than smartphones, and may or may not have wi-fi or cellular connectivity

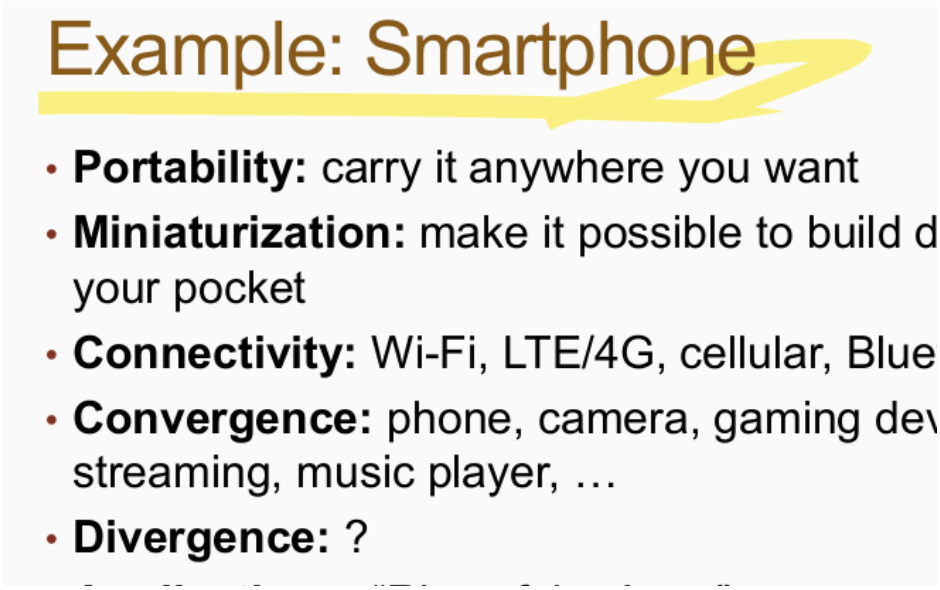
Laptops: Similar to desktop computers, but smaller and more portable

Smartwatches: Wearable devices that can extend the functionality of a smartphone

E-readers: Tablet-like devices that are designed for reading text

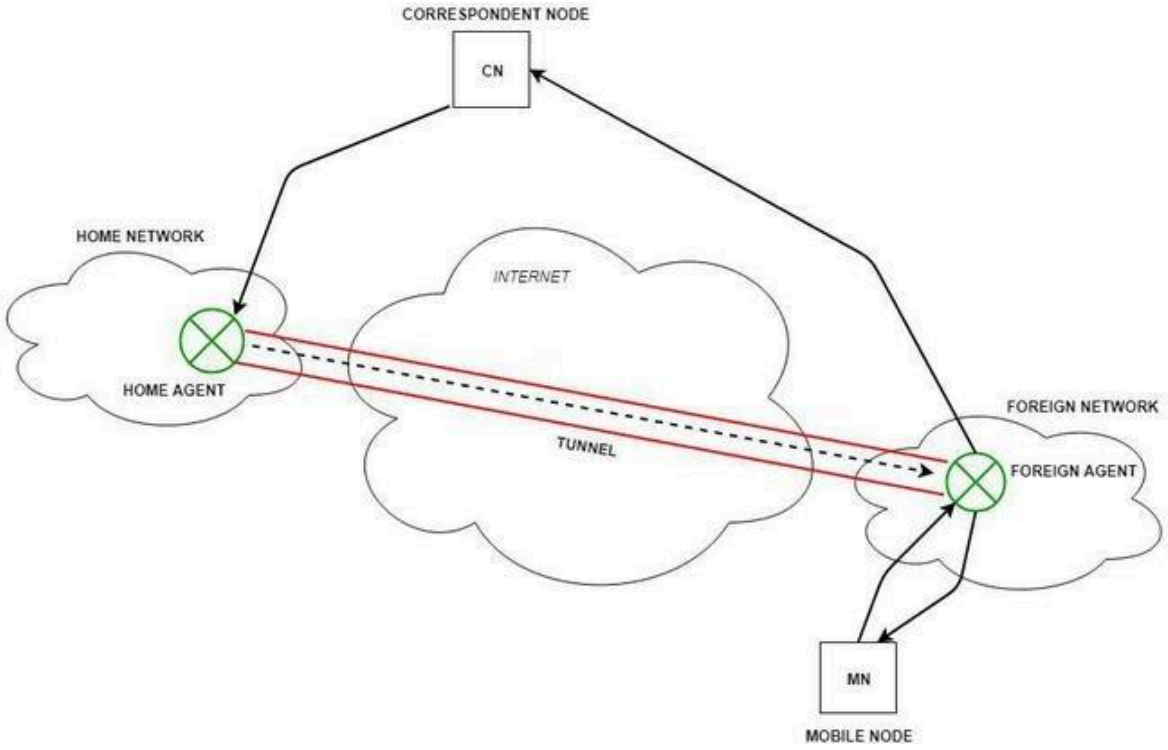
Handheld gaming consoles: Mobile devices that are designed to run games, and may have network features for social games

or,



b) Considered a scenario a person who works as a Merchandiser in the Garment Industry needs to take care of many individuals in Bangladesh and abroad. How Mobile IP works in the context of mobile devices.

Sol:



In the context of a merchandiser in the garment industry who needs to manage communication with individuals both in Bangladesh and abroad, Mobile IP provides a way for mobile devices to maintain continuous network connectivity even when moving across different networks. Here's how Mobile IP works in this scenario:

1. Home Network:
The mobile device is associated with a home network, which is where the device's permanent IP address is registered. This allows the device to have a consistent IP identity regardless of its location.

2. Foreign Network:
When the merchandiser travels abroad or moves to a different network (e.g., from Bangladesh to a foreign country), the device connects to a foreign network.
In this case, the device gets a care-of address (CoA), which is temporary and assigned by the foreign network.

3. Home Agent & Foreign Agent:

A Home Agent (HA) in the home network forwards any data destined for the mobile device to its current care-of address.
A Foreign Agent (FA) in the foreign network assists the mobile device in registering its presence in the new network.

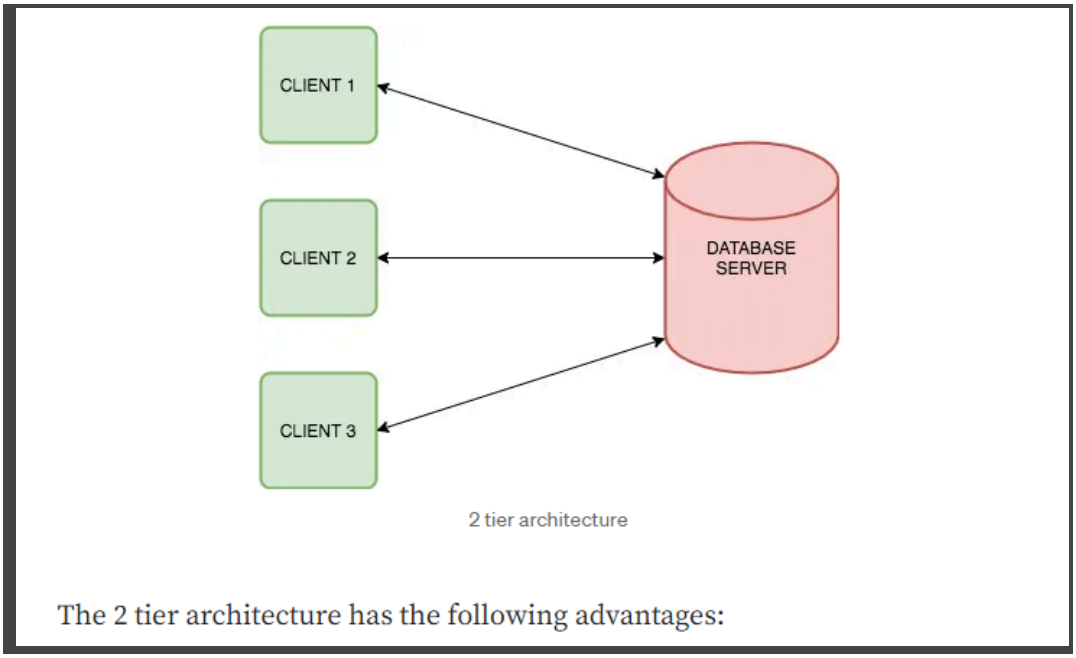
4. Tunneling:
Data sent to the device's permanent IP address (home network) is intercepted by the Home Agent and tunneled to the care-of address in the foreign network.
The Foreign Agent then forwards the data to the device. For outgoing data, the reverse path is used.

5. Seamless Connectivity:
The Mobile IP protocol ensures that the merchandiser can maintain communication, access files, and perform tasks on their mobile device without interruption, even as they move across different networks or countries.
In summary, Mobile IP allows the merchandiser to stay connected and communicate seamlessly, regardless of geographic location, by maintaining a consistent IP address while roaming across different networks.

c) Show a client-server computing architecture in which the database is at the application tier. How does this architecture differ when the application server fetches the data from the enterprise server tier?

Sol:

In a two-tier architecture with the database at the application tier:



2 tier architecture

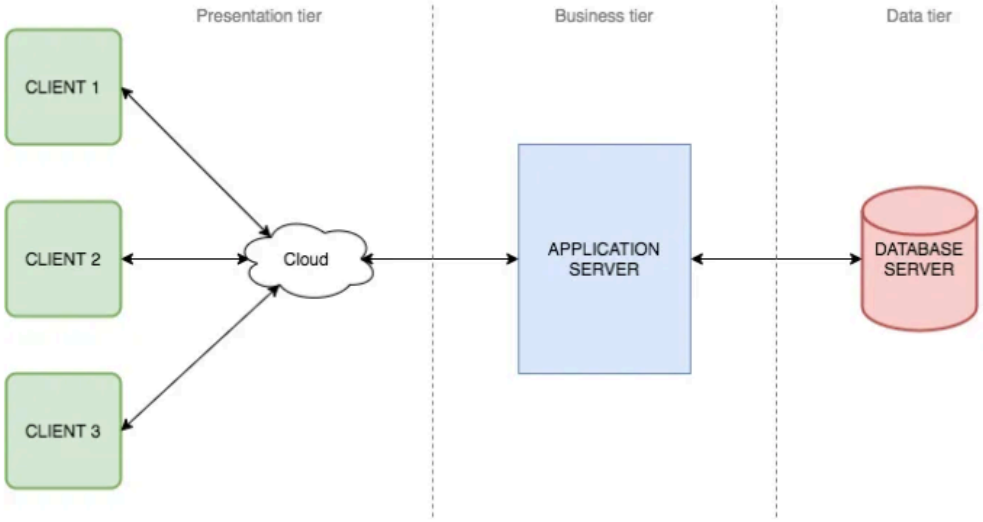
The 2 tier architecture has the following advantages:

- The client interacts directly with the application server, which also stores and manages the database.
- This setup is simple and faster for small systems but has limited scalability.

In **a three-tier architecture**, where the application server fetches data from an enterprise server:

- The application server handles business logic but connects to a separate enterprise server where the database is stored.
- This structure provides better scalability, security, and flexibility for large or distributed systems

The diagram below shows a simple representation of a 3 tier architecture.



3 tier architecture

In three-tier, the database is decoupled from the application server, improving scalability and security, whereas in two-tier, both reside together, making it simpler but less scalable.

Aspect	Database at Application Tier	Database at Enterprise Server Tier
Database Location	Database is located within the application server.	Database is hosted on a separate enterprise server.
Scalability	Limited scalability due to shared resources between the application and database.	Better scalability as the application and database servers are independent and can scale separately.
Data Access Speed	Faster data access due to local storage within the application server.	Data retrieval might introduce network latency due to communication with a separate server.
Maintenance	Maintenance can be more complex as both the application and database reside on the same server.	Easier to maintain as the database is centralized and can be updated independently from the application server.
Performance	Performance may degrade as the system scales due to shared resources.	Performance can be optimized separately for application and database tiers, ensuring more efficient resource allocation.
Security	Security is managed within a single tier, which can be easier but also less robust.	Higher security potential, as the database can have its own security protocols independent of the application tier.

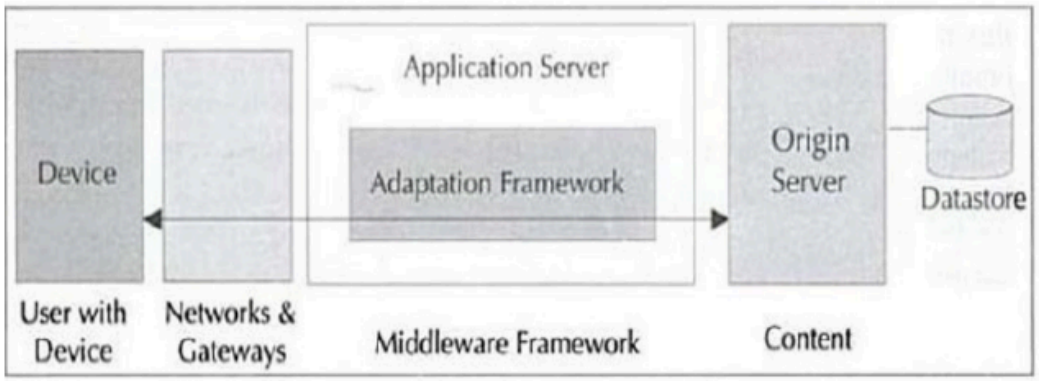
2.

a) Briefly describe the logical function of Mobile Computing.

Sol:

Logical Functions of MC

- **User with device**
- **Network**
- **Gateways**
- **Middleware**
- **Contents**



User with Device: The user interacts with their mobile device.

Network & Gateways: The device connects to networks and gateways to access data and services.

Middleware Framework: Middleware helps the device communicate with servers by adapting the requests between the device and the servers.

Application Server: Processes user requests via the middleware and sends responses.

Origin Server: Stores and retrieves content from the data store (the backend database or content storage)

b) What is Hand-off? List and explain the types of Hand-off.

Sol:

In cellular communications, handoff transfers an active call or data session from one cell in a cellular network to another. In satellite communications, it is the process of transferring control from one earth station to another. Handoff is necessary for preventing loss or interruption of service to a caller or a data session user. Handoff is also called handover.

Types of Handoff (sir 4 types poriche class e)

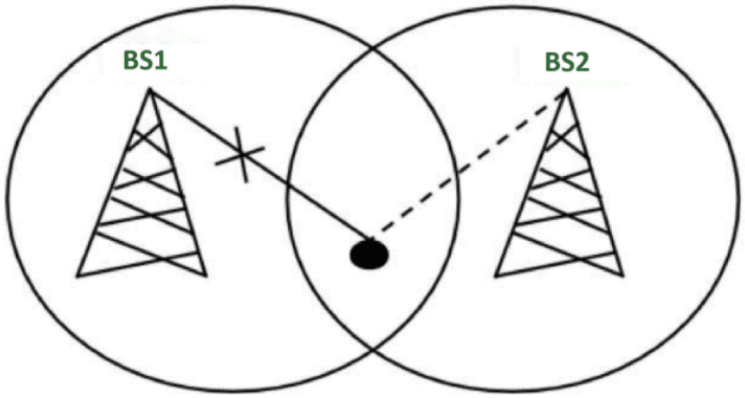
- Hard Handoff

- Soft Handoff
- Delayed Handoff
- Mobile-Assisted Handoff

Hard Handoff

When there is an actual break in the connectivity while switching from one Base Station to another Base Station. The connection quality is not that good. Hard Handoff adopted the 'break before make' policy.

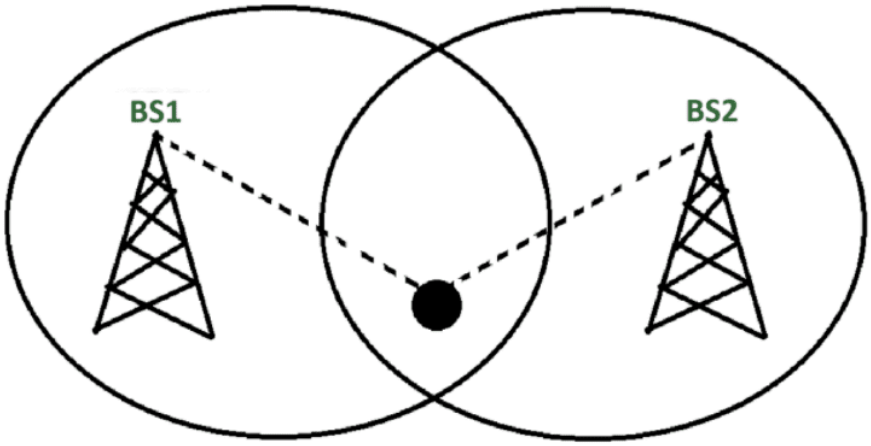
- Hard Handoff is cheaper in cost as compared to soft Handoff because only one channel needs to be active at a time.
- It is more efficient than soft handoff, that's why hard handoffs are widely implemented.
- Sometimes, a delay can be experienced while switching base stations.



Soft Handoff

Soft Handoff is a mechanism in which the device gets connected with two or more base stations at the same time. 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. High Transmission speed as more than one repeater can transmit signals.

- It has a very low delay in signals.
- It can't be implemented on devices supporting GSM or LTE networks.



Delayed Handoff

Delayed handoff occurs when no base station is available for accepting the transfer. The call continues until the signal strength reaches a threshold, and after that, the call is dropped. Generally, it happens when the user is out of the network coverage area, or at some dead spots where network reach is very low.

Mobile-Assisted Handoff

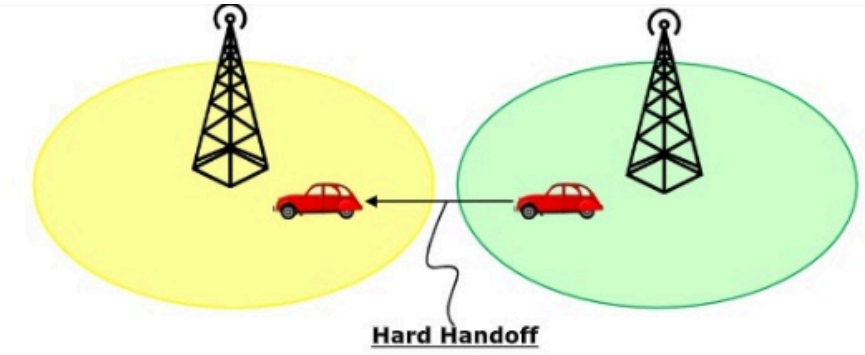
Mobile-Assisted handoff is generally used when a mobile phone helps a base station to transfer the call to another base station with better-improvised connectivity and more signal strength. This handoff is used in TDMA technique-based GSM devices.

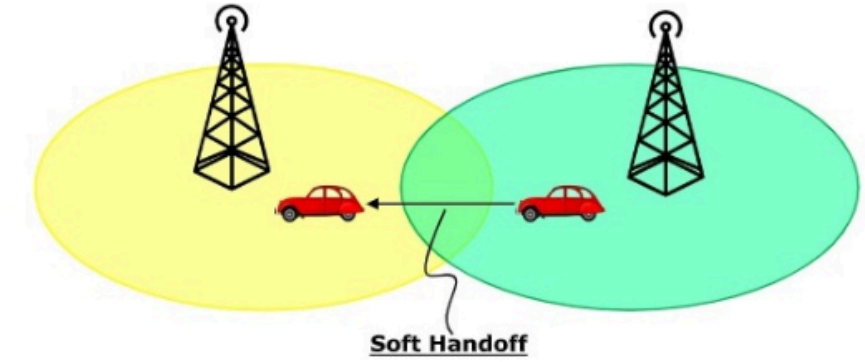
Or, optional

Types of Handoffs

There are two types of handoffs –

- **Hard Handoff** – In a hard handoff, an actual break in the connection occurs while switching from one cell to another. The radio links from the mobile station to the existing cell is broken before establishing a link with the next cell. It is generally an inter-frequency handoff. It is a "break before make" policy.
- **Soft Handoff** – In soft handoff, at least one of the links is kept when radio links are added and removed to the mobile station. This ensures that during the handoff, no break occurs. This is generally adopted in co-located sites. It is a "make before break" policy.





c) As part of the study tour, the CSE second batch visited Cox's Bazar, St. Martin's Island, and Bandarban a few years ago. One day, they were going to Teknaf from Cox's Bazar via bus. The Teknaf is a hilly region. In this journey, all mobile users have encountered many call- -drops or call discontinuations and weak network coverage. Within the context of this course, I hope you have read the terms associated with this issue. Now, answer the following questions:

i) What do you know about the cellular network? Does the cellular network offer any advantages?
A cellular network, or a mobile network, is a wireless communication system that allows mobile devices to connect to the internet, make calls, and send and receive messages.

Or, A cellular network, also known as a mobile network, is a communication network where connectivity is implemented by dividing the service area into cells.

Key advantages of a cellular network:

Wide Coverage:
Users can stay connected almost anywhere, including remote areas, due to the network of cell towers spread across a large region.

Mobility:
Seamless transition between cell towers allows for uninterrupted calls and data access while moving.

Scalability:
Networks can easily be expanded to accommodate a growing number of users and devices.

Reliability:
Cellular networks generally offer high-quality and consistent service with low interference.

Security:
Cellular networks incorporate encryption and authentication mechanisms to protect user data.

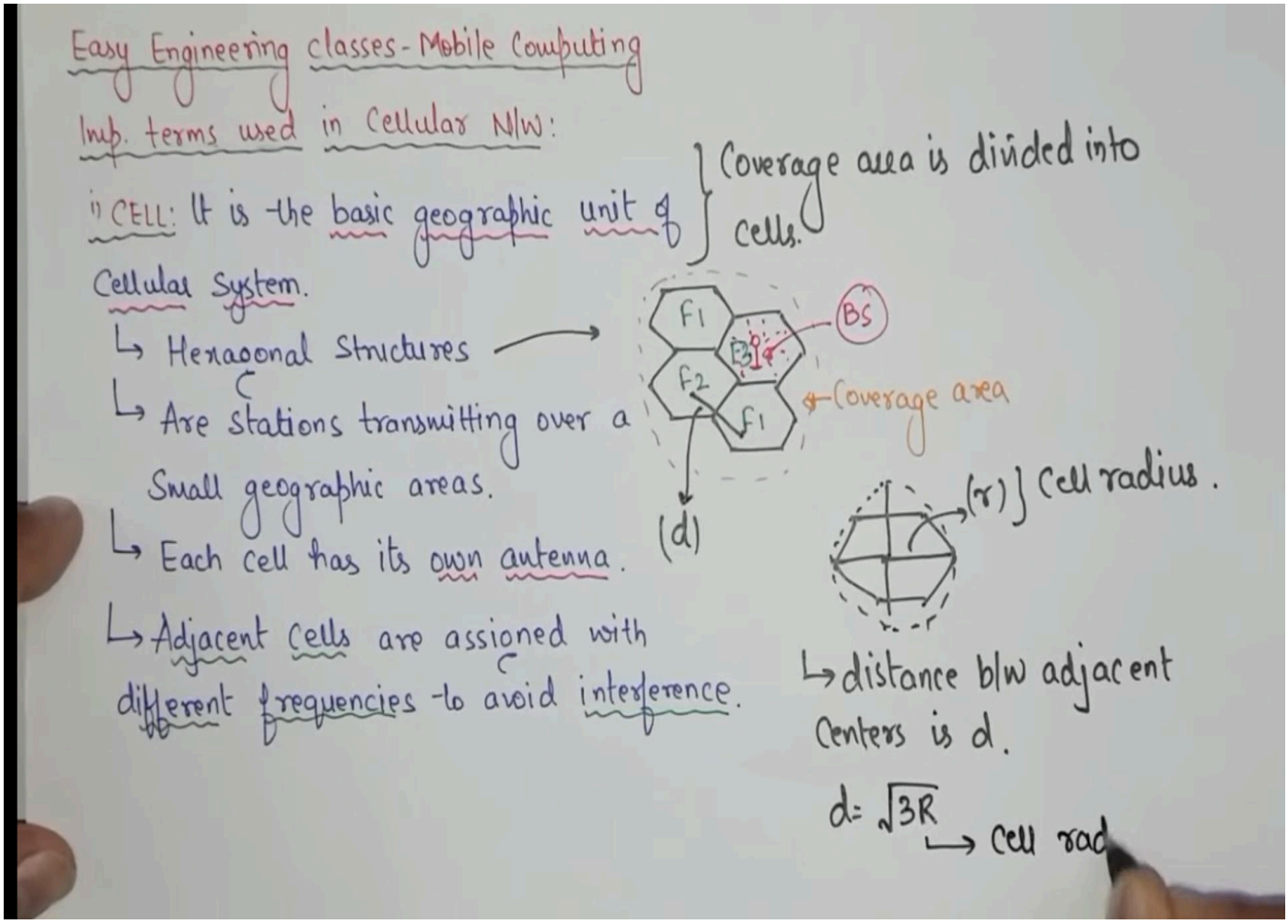
Flexibility:
Different cellular technologies can be used to cater to varying data needs, from low-power IoT devices to high-bandwidth streaming.

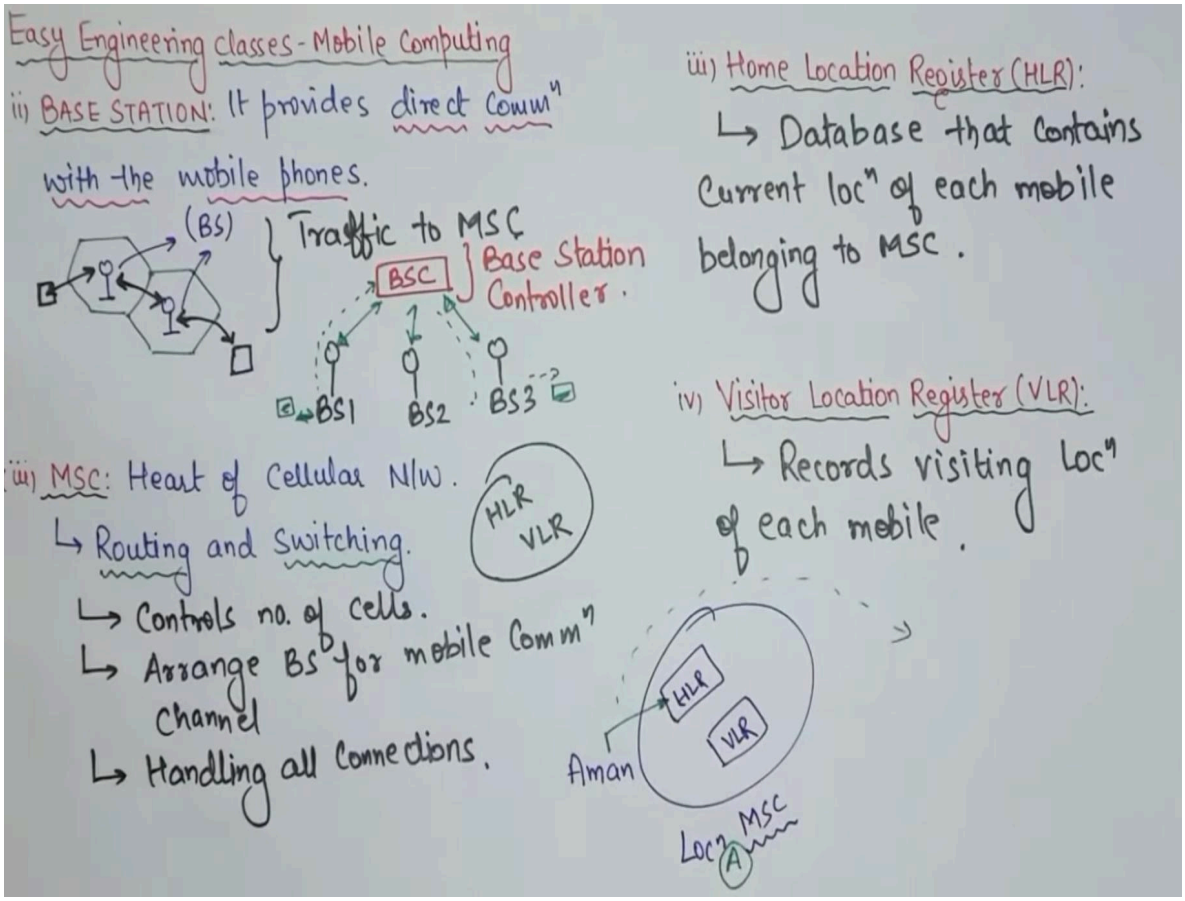
Or,

Advantages of Cellular Networks

- Mobile and fixed users can connect using it. Voice and data services also provided.
- Has increased capacity & easy to maintain.
- Easy to upgrade the equipment & has consumes less power.
- It is used in place where cables can not be laid out because of its wireless existence.
- To use the features & functions of mainly all private and public networks.
- Can be distributed to the larger coverage of areas.

ii) What components and technologies are involved in the cellular network?





Or,

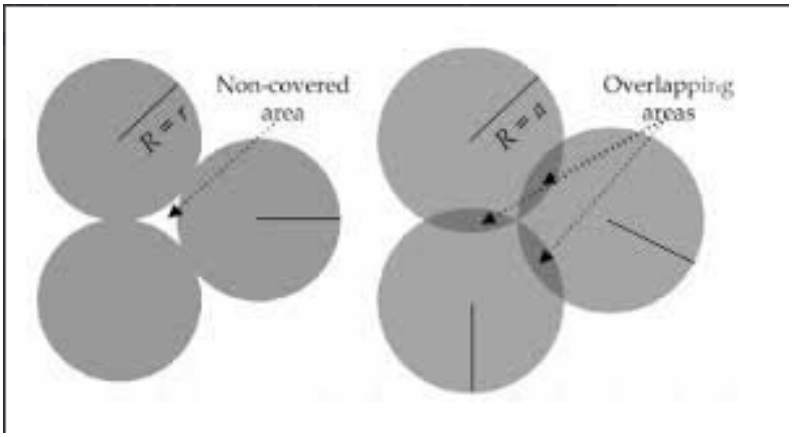
Components are:
Base Transceiver Station (BTS),
Base Station Controller (BSC),
Mobile Switching Center (MSC),
Visitor Location Register (VLR),
Home Location Register (HLR).

Cellular networks employ various technologies, including:

Frequency Division Multiple Access (FDMA),
Time Division Multiple Access (TDMA),
and Code Division Multiple Access (CDMA),
GSM.

iii) Which shape of the cell may assure maximum network coverage? How?

The geographical area is divided into small hexagonal regions called cells. It is the basic unit of the cellular system. These cells collectively provide coverage over large geographical areas. Hexagonal shapes are preferred over squares or circles in cellular architecture because they cover an entire area without overlapping.



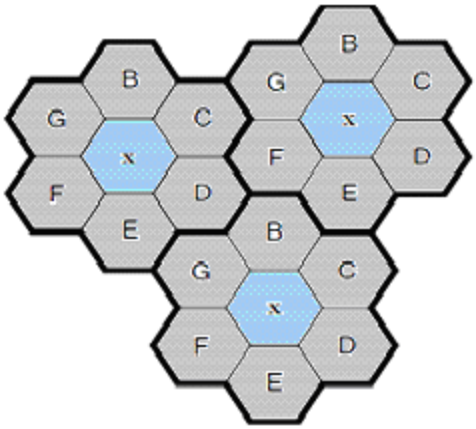
We can argue that even square-shaped systems do not overlap. This is because it requires fewer cells to represent a hexagon than a triangle or square.

Other advantages of the hexagonal cellular system:

Frequency reuse becomes possible using this shape.

The radiation pattern of the antennas used is 60 degrees which means 6 are required for the full 360 degrees coverage which is the same no. of sides, the hexagon consists.(equidistant antennae)

Minimum interference.



3.

a) What is meant by context-aware mobile computing? Write major challenges and possible Solutions.

Sol:

Context-aware mobile computing refers to a system or device (like a smartphone) that can sense its environment and automatically adjust its behavior or actions based on the surrounding conditions.

Challenges

- **Self-Awareness:**
  - Context-awareness helps technology to “get it right”
  - But context is hard to sense (quantity, subtle)
  - Computers are not self-aware like humans

  - When the system does the wrong thing
    - auto-locking car doors
    - screen saver during presentation
    - microphone amplifying a whisper

- **Intelligence**
  - Context data must be coupled with the ability to interpret it, but computers are bad at “common sense”.
  - More rules ≠ intelligence
  - More rules = more complexity, harder to understand

  - Keep **“Human in the Loop”?**
    - computers can detect, aggregate, portray information
    - allow human users to interpret and act on it
    - is this a good strategy for all context-aware systems?

- **Programming:**
  - Developers have **little experience with devices that gather the data** (e.g., gyroscopes).
  - Data gathered from a sensor **must be interpreted correctly** in order for it to be useful.
  - Context comes from various sources and in order for this data to be useful it **must be combined correctly** (i.e., the gyroscope and accelerometer working together to determine orientation).
  - The context **changes constantly in real time**.

- **Usability vs. control?**
  - **Automation** reduces the amount of work that users have to do
  - Users like the idea of a device that completes tasks on their behalf
  - However, when users use these devices they feel a **loss of control** if a device has a high level of automation

- **Privacy**
  - Should law enforcement be able to access the history of a user?
- **Correctness**
  - Errors fusing data
  - Detection errors
  - Interpretation errors
- **Complexity**
  - Difficult to develop, maintain, understand
  - Reduces accuracy of the application

- **User preferences**
  - May not match what the device does!
  - Everyone is different!
    - What is your idea of “nighttime”?
    - What is your idea of “warm”? Or “loud”?
- **Information overload**
  - Can overwhelm the user

Solution

- **Keep an appropriate level of automation (avoid uncertainty)**
  - The more automation we have, the less control we have over what is happening.
  - What happens if we give all control to machines?
  - Would you trust your phone to give you a dose of medicine?
  - Keep a balance between uncertainty and automation.

- **Avoid unnecessary interruptions**
  - Phone flashes a notification every 30 seconds
  - Eventually the user will ignore it!
- **Avoid information overload**
  - Too much information can overwhelm the user, and bog down the device
  - Example: Walking down a busy street a user's device is bombarded with suggestions of places to shop

- **Keep an appropriate level of system status visibility**
  - Allow the user to see what action the device is taking
  - Be sure the user understands *why* the device is performing the action
- **Account for the impact of Social Context**
  - A loud alert is not ideal for all situations
- **Allow for the personalization of individual needs**
  - Allow user to change location names (set a location name to "home" for example)

- **Secure the user's privacy**
  - Selling information to advertisers…is this right?
  - Giving information to the police, when does this cross the line?
  - Sharing context information with others—Facebook location

b) List two applications that are context-aware systems on your mobile phone and explain why they are context-aware.

Sol: Two applications that exemplify context-aware systems on mobile phones are:

Google Maps:

Why it's context-aware: Google Maps uses your **location data** (GPS), **time of day**, and **user movement** to provide navigation services. It adapts to real-time conditions such as traffic congestion, rerouting if there's an accident ahead, or suggesting the best transportation mode based on your current activity (e.g., walking, driving). It also provides location-based suggestions for restaurants, gas stations, and other places of interest.

Weather Apps:
Why it's context-aware: These apps use your current geographic location to provide localized weather reports and forecasts. They can send alerts for severe weather conditions imminent in your area, adapting the information displayed based on what's most relevant to your location at any given moment. This could include rain alerts, temperature changes, or storm warnings, making the information highly specific to your immediate context.

Google Assistant (or Siri)

Why it's context-aware: Google Assistant (or Siri) uses **user location**, **time**, **calendar events**, and **device activity** to provide relevant information and actions. For example, it can remind you of a meeting based on your calendar and suggest leaving early if there's traffic. It adapts to the user's environment and needs, providing smart, timely interactions.

c) Give an example of five applications that are not context-aware and how we can make them context aware.

Note: All applications must be Mobile apps such as Twitter, Instagram, Facebook, etc.

Sol:

Here are five examples of mobile apps that are not traditionally context-aware and suggestions for making them context-aware:

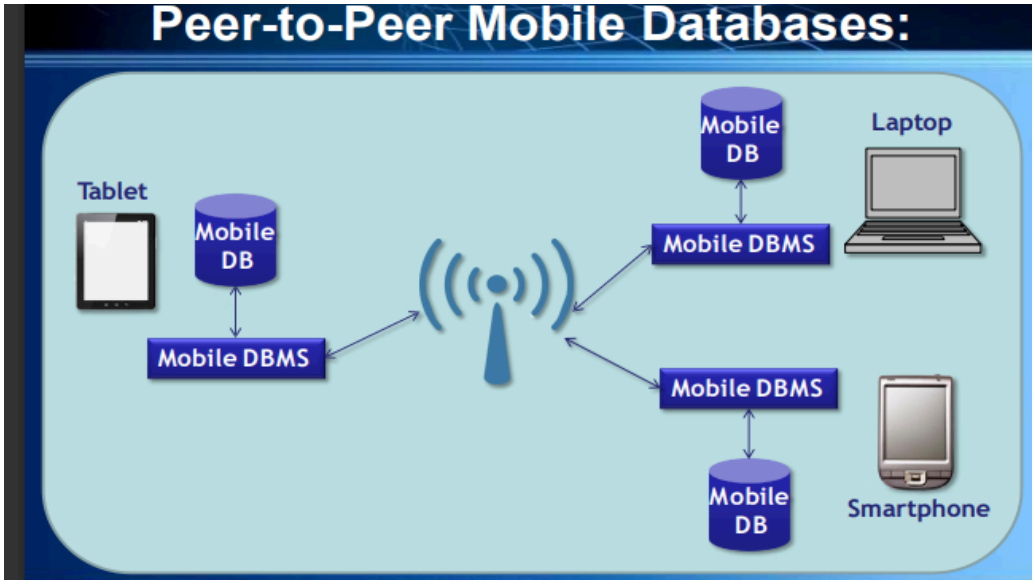
1. **Twitter**:
    - **Current state**: Twitter simply shows tweets from the people you follow without adapting to your current context.
    - **How to make it context-aware**: Twitter could adjust the content it shows based on your location or time of day. For example, it could prioritize tweets or trending topics that are relevant to your current city or country during local events or emergencies.
2. **Instagram**:
    - **Current state**: Instagram shows you a feed of posts based on its algorithm, but it doesn't consider your current context.
    - **How to make it context-aware**: Instagram could recommend location-specific filters or nearby geotags when you're traveling, or suggest content related to local events, attractions, or trends based on your location.
3. **Facebook**:
    - **Current state**: Facebook shows posts, news, and notifications without considering your environment.
    - **How to make it context-aware**: Facebook could show event suggestions based on your location, suggest nearby friends to connect with, or adapt notifications based on your activity, like muting notifications when it detects you are at work or in a meeting.

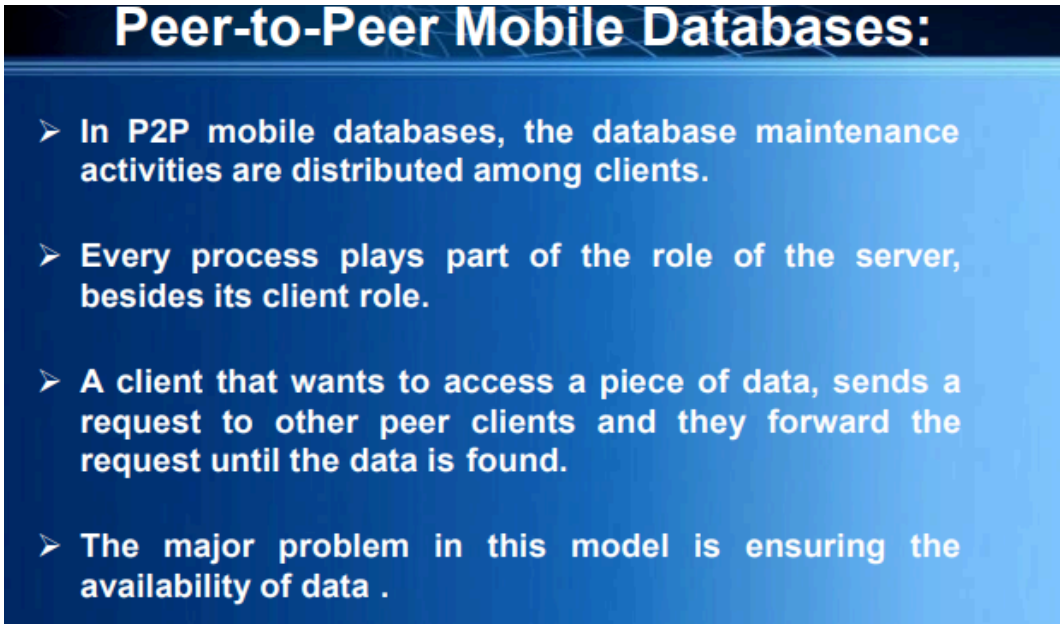
4. **Spotify**:
    - **Current state**: Spotify plays music based on your preferences and playlists but doesn't adapt to your surroundings.
    - **How to make it context-aware**: Spotify could automatically suggest or play specific playlists based on your activity (e.g., workout music at the gym, calming music in the evening) or your location (like upbeat music when walking or driving).
5. **YouTube**:
    - **Current state**: YouTube shows video recommendations based on your watch history, but it doesn't consider your context.
    - **How to make it context-aware**: YouTube could suggest content based on the time of day (e.g., short videos in the morning, longer content in the evening) or recommend location-specific content (like local news or events) when you're in a specific region.

4.

a) How do peer-to-peer mobile databases work? Explain its architecture.

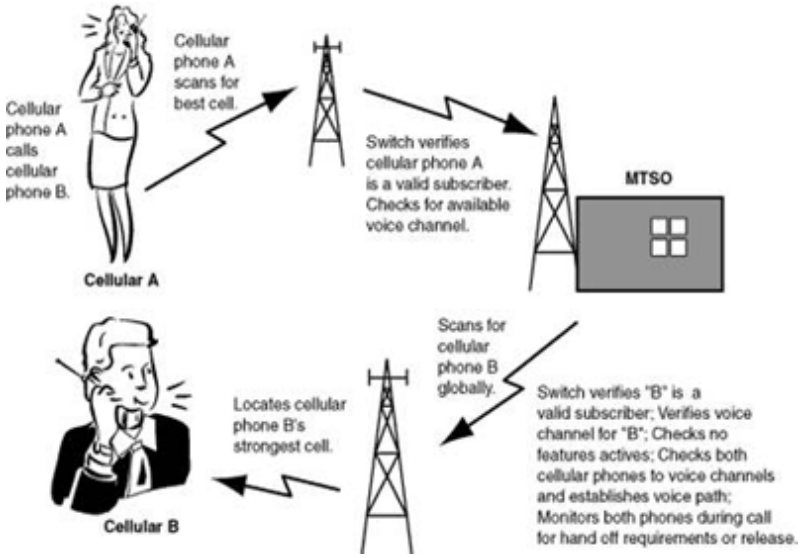
Sol:





b) What are the steps involved in the calling communication process between mobile users? Explain with diagrams.

Sol:



Dialing the Number: The user presses the desired phone number on their smartphone's keypad.

Signal Transmission: The smartphone converts the dialed number into an electrical signal and transmits it to the nearest cell tower.

Routing to Mobile Switching Center (MSC): The cell tower receives the signal and forwards it to the MSC, which acts as a central hub for managing calls within a mobile network.

Number Lookup: The MSC searches its database for the called party's phone number and location.

Connection Establishment: If the called party's phone is reachable, the MSC establishes a connection between the caller's and called party's phones.

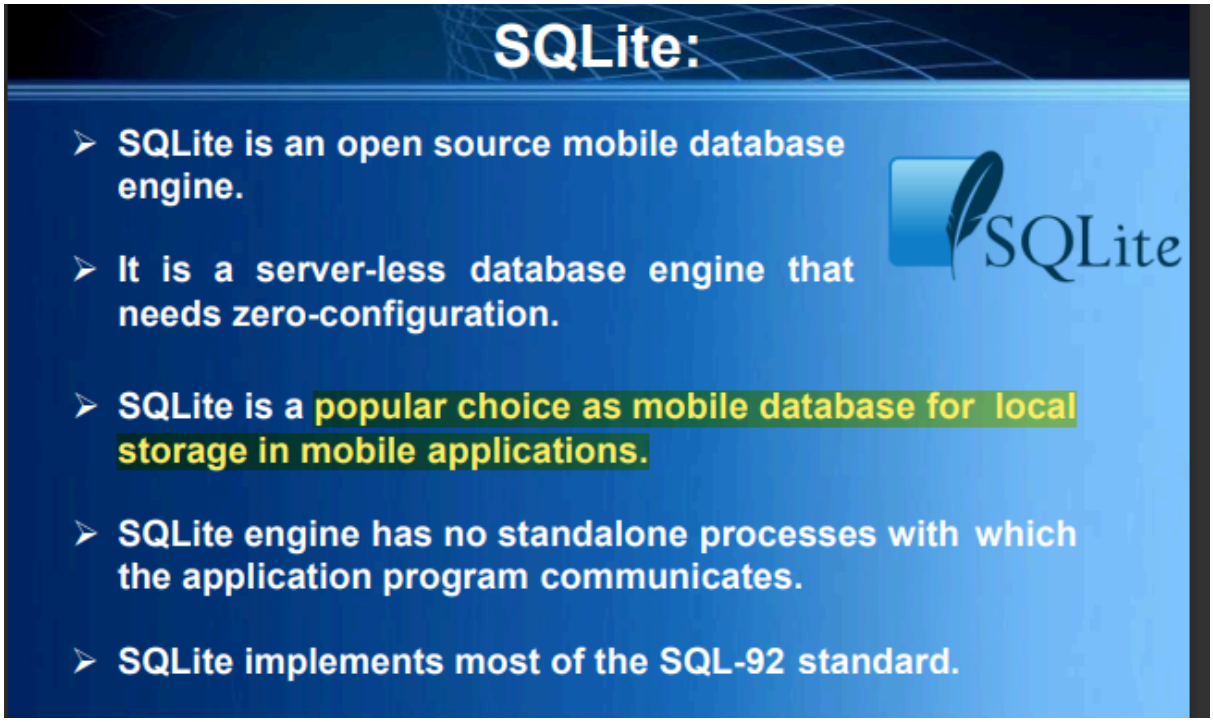
Ringing: The called party's phone starts ringing.

Answering: When the called party answers, the connection is established.

Voice Transmission: The caller's voice is converted into digital signals and transmitted over the network to the called party's phone, where it is converted back into sound.

Call Termination: When either party hangs up, the connection is terminated.

c) What database type is used most frequently in mobile devices to hold information?



1. Lightweight
2. Self-contained
3. Zero configuration
4. Cross-platform compatibility
5. Efficient for local storage
6. Reliability (transactional support)
7. No need for concurrent access
8. Open source and free

d) If a telephone system has a bandwidth of 3 MHz and every channel needs 30 KHz then calculate the number of channels per BTS.

To calculate the number of channels that can be supported per Base Transceiver Station (BTS), you can use the following formula:

$$\text{Number of Channels} = \frac{\text{Total Bandwidth}}{\text{Bandwidth per Channel}}$$

Where:

- Total Bandwidth = 3 MHz = 3000 KHz
- Bandwidth per Channel = 30 KHz

Now, plug in the values:

$$\text{Number of Channels} = \frac{3000 \text{ KHz}}{30 \text{ KHz}} = 100$$

Thus, the telephone system can support **100 c ↓ nels** per BTS.

5.

a) Draw a clear diagram of the GSM system with necessary components and describe it in detail.

Sol:

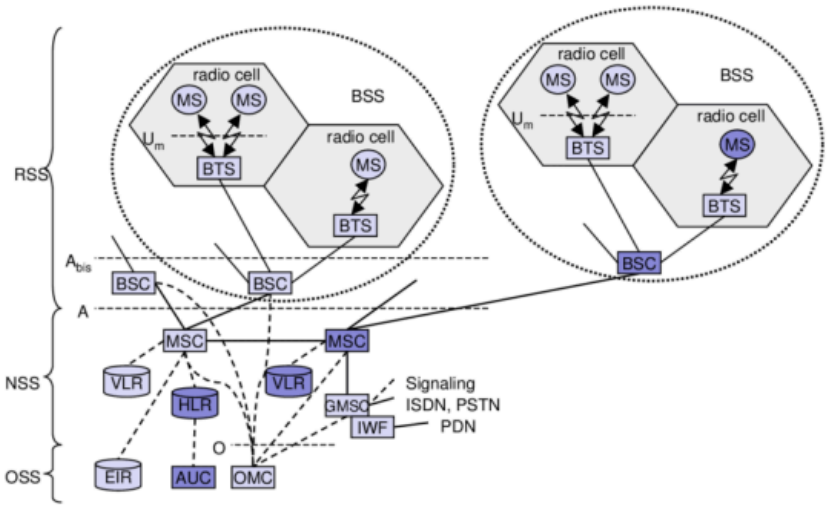
The Global System for Mobile Communication (GSM) is a globally accepted standard for digital cellular communication.

From Slide:

GSM Architecture (Cont.)

- **A GSM network comprises of many functional units**
  - Radio/Base Station Subsystem (RSS/BSS)
  - Network Switching Subsystem (NSS)
  - Operation Support Subsystem (OSS)

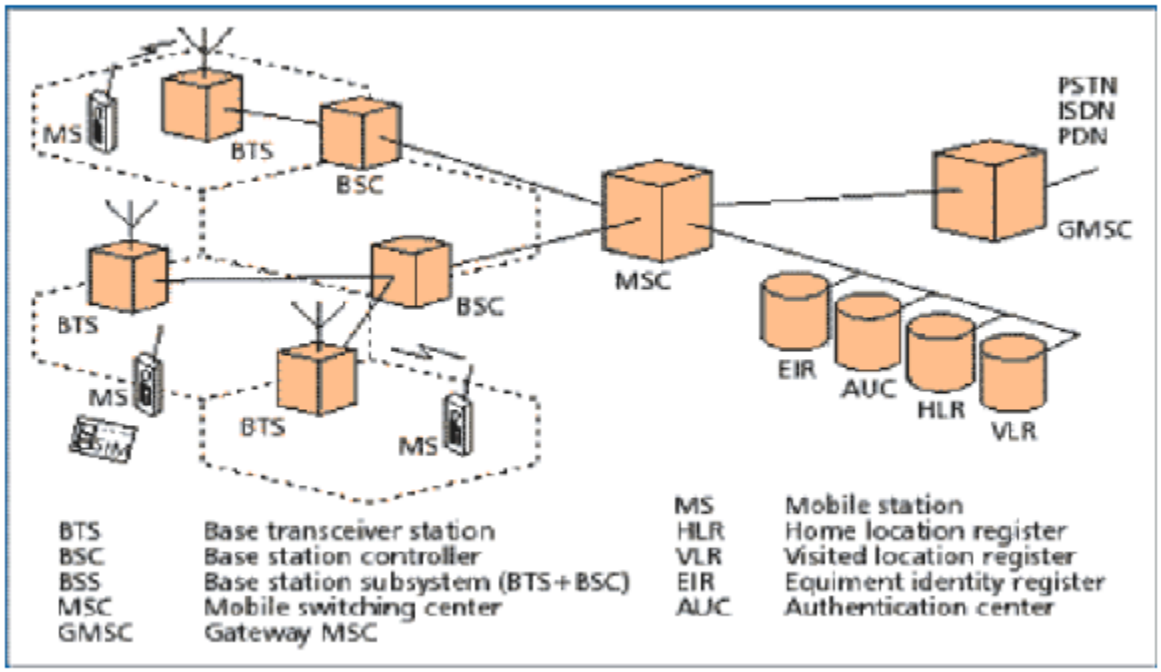
GSM Architecture



GSM Architecture

- **Additional components of the GSM architecture comprise of databases and messaging systems functions:**
  - Home Location Register (HLR)
  - Visitor Location Register (VLR)
  - Equipment Identity Register (EIR)
  - Authentication Center (AUC)
  - SMS Serving Center (SMS SC)
  - Gateway MSC (GMSC)
  - Chargeback Center (CBC)
  - Transcoder and Adaptation Unit (TRAU)
    - Data rate conversion unit

GSM Architecture



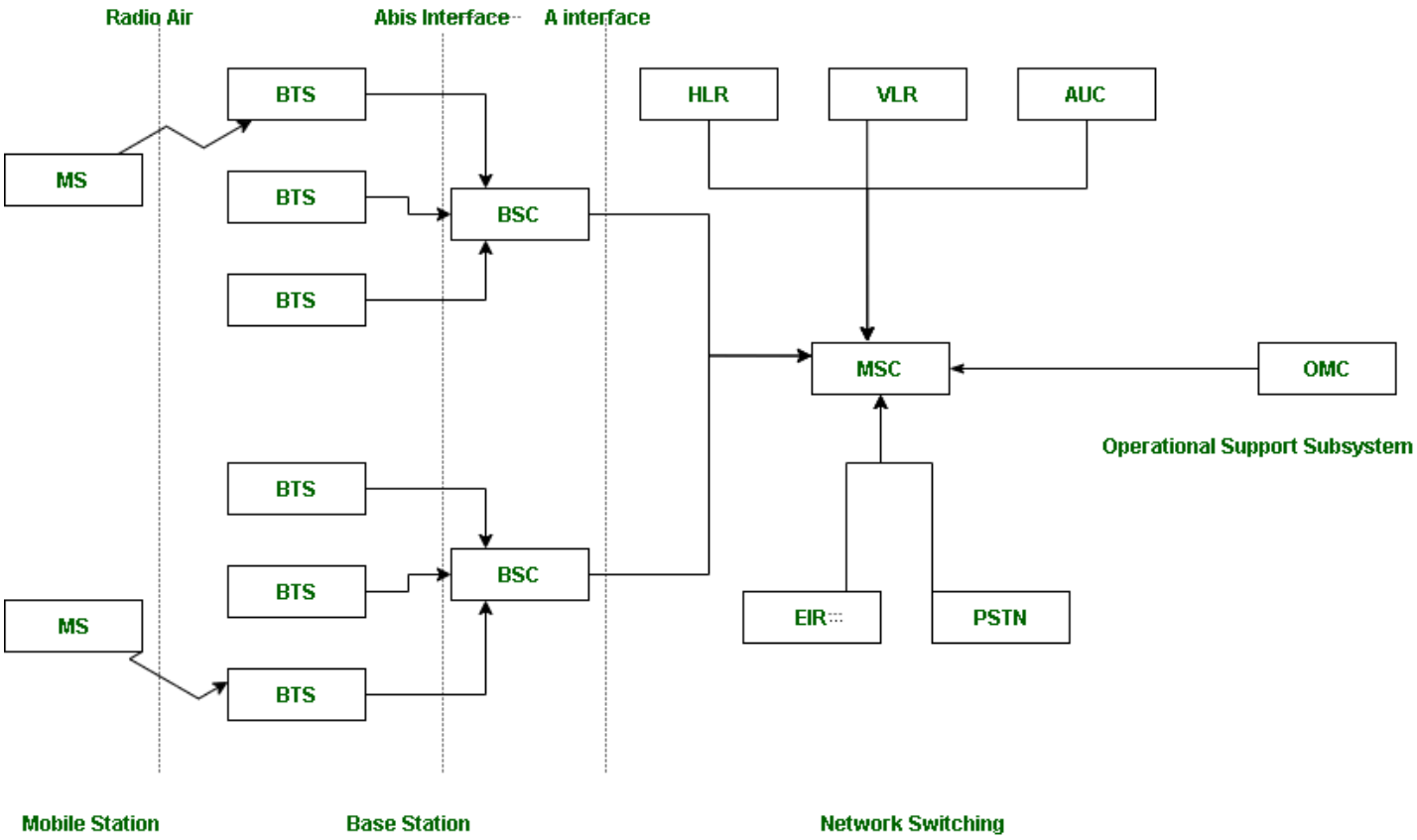
GSM Subsystem

- **Radio Subsystem (RSS)**
  - RSS = MS + BSS
  - BSS = BTS + BSC
- **Network Switching Subsystem (NSS)**
  - NSS = MSC + HLR + VLR + GMSC
- **Operation Support Subsystem (OSS)**
  - OSS = EIR + AUC

Or From Google,

The Architecture of GSM

- **BSS:** BSS stands for Base Station Subsystem. BSS handles traffic and signaling between a mobile phone and the network switching subsystem. BSS has two components **BTS** and **BSC.**
- **NSS:** NSS stands for Network and Switching Subsystem. NSS is the core network of GSM. That carried out call and mobility management functions for mobile phone present in the network. NSS has different components like **VLR, HLR** and **EIR.**
- **OSS:** OSS stands for Operating Subsystem. OSS is a functional entity in which the network operator monitors and controls the system. **OMC** is the part of OSS. Purpose of OSS is to offer the customer cost-effective support for all GSM-related maintenance services.



BTS	Base transceiver station	MS	Mobile station
BSC	Base station controller	HLR	Home location register
BSS	Base station subsystem (BTS+BSC)	VLR	Visited location register
MSC	Mobile switching center	EIR	Equipment identity register
GMSC	Gateway MSC	AUC	Authentication center

b) Explain the following GSM interfaces:

i) The radio interface (MS to BTS)

ii) BTS to BSC interface

iii) Interfaces between other GSM entities

iv) BSC to MSC interface

Sol: upore google theke je photo ta dilam otay graphically bujhano ache. Ar theory ditechi ans.

i) Radio Interface (MS to BTS):

The **radio interface** is the connection between the **Mobile Station (MS)**, which is the user's mobile device, and the **Base Transceiver Station (BTS)**, which is the cell tower. This interface is responsible for handling all the radio communications between the phone and the network. It enables voice calls, text messages, and data services to be sent and received wirelessly. Since it uses radio waves, it is susceptible to issues like signal interference or weak connectivity in areas with poor network coverage.

ii) BTS to BSC Interface:

The connection between the **Base Transceiver Station (BTS)** and the **Base Station Controller (BSC)** is known as the **Abis interface**. The BSC controls multiple BTS towers, managing their operations like handling radio resources, call handovers when users move from one tower's range to another, and power control. This interface allows the BTS to pass both signaling information and actual call or data traffic to the BSC, ensuring smooth communication and efficient use of network resources.

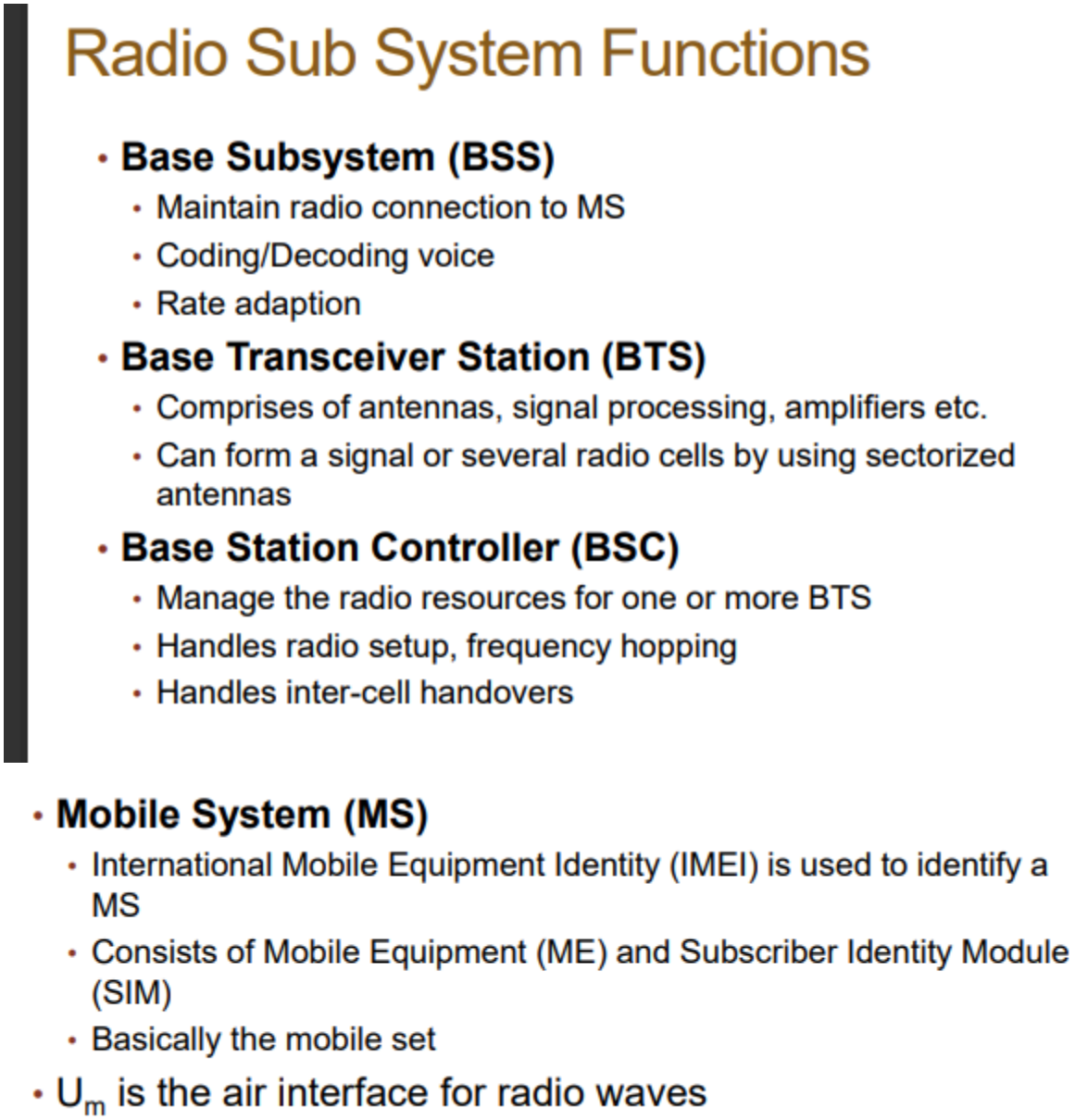
iii) Interfaces Between Other GSM Entities:

In a GSM network, there are multiple interfaces between key components that ensure the entire system works together. For example, the **BSC connects to the Mobile Switching Center (MSC)** via the **A interface**, allowing call traffic and data to flow from the cell towers to the core network. The MSC then communicates with the **Home Location Register (HLR)**, which stores subscriber details like phone numbers, billing information, and service plans. The MSC also interacts with the **Visitor Location Register (VLR)**, which tracks users when they are roaming in other networks. Each interface ensures that users can move around, make calls, and use data services seamlessly, regardless of where they are.

iv) BSC to MSC Interface:

The interface between the **Base Station Controller (BSC)** and the **Mobile Switching Center (MSC)**, known as the **A interface**, is crucial for managing communication between the radio network and the core GSM network. This interface transfers voice calls, SMS, and mobile data between the cell towers and the central switching system. It also handles essential functions like call setup, handovers between towers, and mobility management, ensuring that users can maintain an active connection as they move from one area to another, even while on a call or using data services.

Or from slide



c) What is UI? Differentiate between UX and UI.

UI stands for user interface, and UX stands for user experience. These are two different aspects of the design process that are often used interchangeably, but they have distinct meanings:

UI

The visual elements, such as buttons, icons, screens, and toggles, that a user interacts with when using a product or service. UI design focuses on the look and feel of the product.

UX

The overall experience a user has with a product or service, including how they feel about the interaction. UX design focuses on how a user interacts with a product.

Some skills that are useful for both UX and UI design include Graphic design, Project management, Research, Marketing, and Customer service.

Aspect	UX (User Experience)	UI (User Interface)
Focus	Overall user journey and satisfaction	Visual design and interaction elements
Concerned with	How the product **works**	How the product **looks**
Main Goal	Enhancing usability, accessibility, and efficiency	Creating an attractive, intuitive interface
Elements	User research, wireframes, prototypes, user flows	Buttons, icons, typography, color schemes
Involves	Problem-solving to improve user interaction	Designing layout, visuals, and interactive elements

6.

a) How Android offer protocols and platforms for mobile computing? Explain.

Protocols

HTTP(S): Used for transferring data over the World Wide Web. Android supports both HTTP and HTTPS (secure HTTP) for secure communication.

TCP/IP: TCP (Transmission Control Protocol) ensures reliable data delivery, while IP (Internet Protocol) handles addressing and routing.

UDP: A connectionless protocol used for real-time applications like voice and video streaming. UDP is less reliable than TCP but offers lower latency.

Bluetooth: A wireless communication protocol for short-range connections between devices. Android uses Bluetooth for connecting to headsets, speakers, and other nearby devices.

Wi-Fi: A wireless networking technology that allows devices to connect to the internet and communicate with each other. Android supports various Wi-Fi standards, including 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac.

NFC: Near-field communication is used for short-range, high-frequency communication between devices. It's commonly used for contactless payments and data sharing.

Platforms

Android Runtime (ART): The execution environment for Android applications. ART compiles apps into native code at installation time for improved performance.

Android SDK: A set of tools and APIs that developers use to create Android apps. It includes components like the Android Studio IDE, the Android Emulator, and libraries for various functionalities.

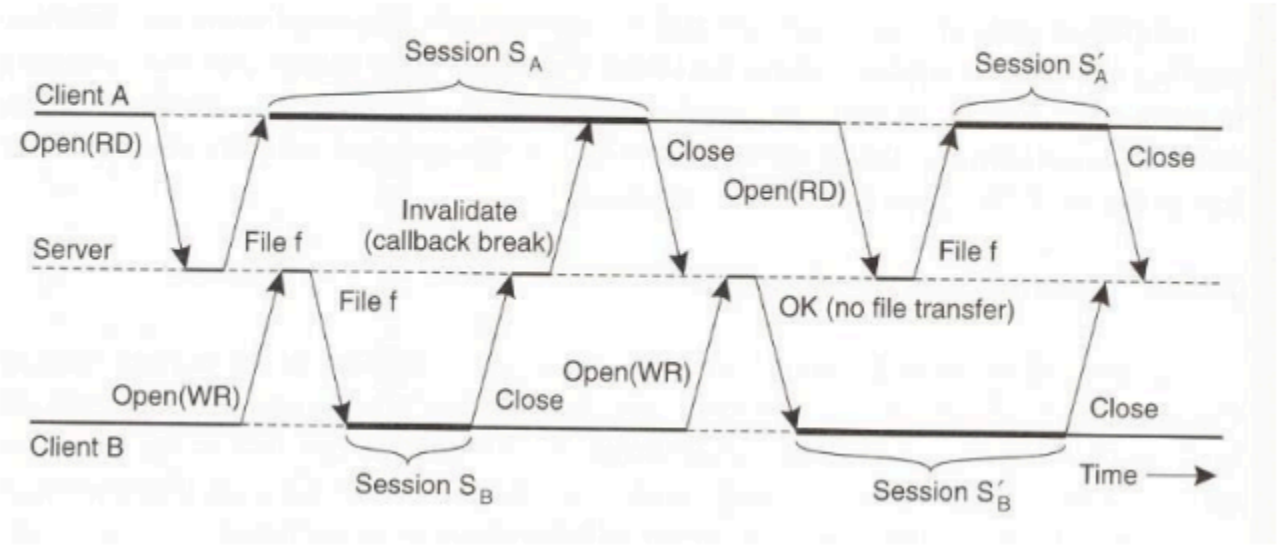
Android Framework: The core layer of the Android system that provides APIs for accessing hardware, managing applications, and handling user interactions.

Dalvik Virtual Machine (DVM): (Older versions) The previous runtime environment for Android apps, which used bytecode interpretation.

b) How is the file-sharing session handled in the Coda distributed file system? Explain with a timing diagram.

Sol:

Coda Client File Session



Sharing Files in Coda

- **When a file is opened, the entire file is transferred to the client**
  - If a client has opened file *f* for writing, another client cannot open *f*
  - If a client has opened file *f* for reading, another client can open *f* for reading or writing
- **When a file is closed, the file is transferred back to the server if it has been modified**
- **A session is treated as a transaction**
  - In the figure, session S_A is considered to have been scheduled before session S_B. Thus, client A can proceed to read its local copy despite the fact that the copy is outdated

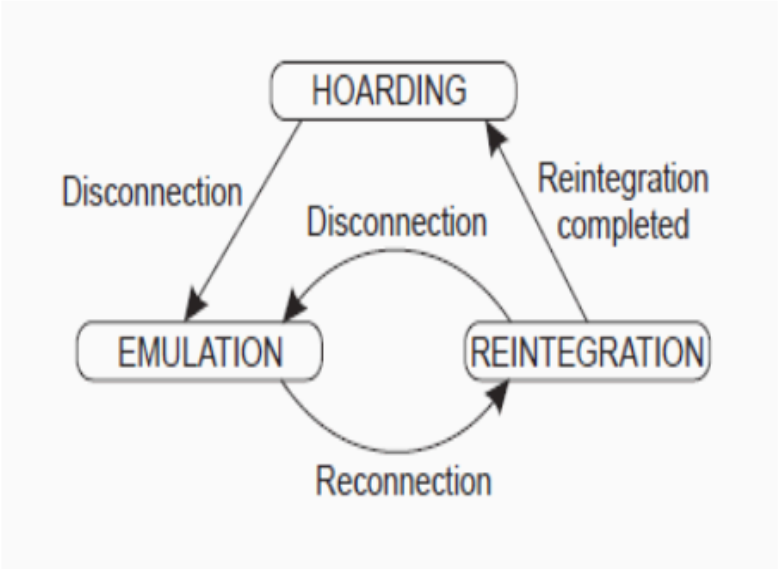
Client-Side Caching in Coda

- When a file is opened, an entire copy of the file is transferred to the client and is cached at the client
- Cache consistency is maintained by means of callbacks
  - The server keeps a callback promise for each client that has a local copy of a file
  - When a client updates its local copy of the file for the first time, it notifies the server. The server then sends an invalidation message to the other clients
    - The invalidation message is called a **callback break** because the server will then discard the **call back promise** it held for the client that received the **invalidation**

Client-Side Caching in Coda

- When a client opens a file that is still in its cache, it must check with the server if a callback promise on the file still holds. If so, the client can access the local copy of the file.

Coda Client States



Disconnected Operation in Coda

- When the client is connected to the network, it is in the HOARDING state, where it prefetches all files that it wants to access and caches them locally
- If the client becomes disconnected, it enters the EMULATION state, where all file requests are serviced locally
- When the client reconnects, it enters the REINTEGRATION state, where all updates are sent to the server
  - Conflicts are detected and resolved at the server

Summary:

The image represents a file access scenario involving **two clients** (Client A and Client B) and a **server** managing a file **f**. The file access process is shown in different **sessions** over time. Here's a simple explanation of the sequence:

1. **Client A (Session S_a)**:
    - Client A opens the file **f** for reading (Open(RD)).
    - While Client A is reading, the server notices another action is about to happen from Client B.
    - The server **invalidates** Client A's access to ensure consistency (callback break), meaning Client A can no longer access the file without an update.
2. **Client B (Session S^B)**:
    - Client B opens the file **f** for writing (Open(WR)), modifying it.
    - Once Client B finishes writing, it **closes** the file.
    - Now, Client A can try accessing the updated file.
3. **Client A (Session S'_a)**:
    - Client A tries to reopen the file for reading (Open(RD)), and the server gives the latest version of the file (no file transfer if no changes).
    - Client A reads and then closes the file.
4. **Client B (Session S'^B)**:
    - Client B opens the file again for writing (Open(WR)).
    - After writing, Client B closes the file.

c) Scalability is one of the most important design goals for developers of distributed systems. How could you measure the Scalability of a distributed system?

Sol:

Scalability

- One of the most important design goals for developers of distributed systems

Can be measured along three different dimensions

1) With respect its size
   - Means we can easily add more users and resources to the system.
2) Geographically scalable system
   - In which users and resources may lie far apart.
3) administratively scalable
   - Means it can still be easy to manage even if it spans many independent administrative organizations.

7.

a) Briefly describe the challenges and issues in implementing MANETs.

Sol:

MANET stands for Mobile Ad Hoc Network. A MANET is a wireless network of mobile devices that connect without wires and are independent of any central administration

Challenges:

- Active research is going on in Adhoc, several aspects have been explored, many problems have been arisen, still some issues to be addressed.
- Major challenges are:

  1.Scalability;

  2.Quality of service;

  3.Client server model shift;

  4.Security;

  5.Interoperation with the Internet;

  6.Energy conservation;

  7.Node cooperation;

  8.Interoperation.

Scalability

- Ad hoc networks suffer, by nature, from the scalability problems in capacity.
- In a non-cooperative network, where omni-directional antennas are being used, the through put per node decreases at a rate 1/(sqrt(N)),where N is the number of nodes.
- That is, in a network with100 nodes, a single device gets, at most, approximately one tenth of the theoretical network data rate. The problem fixed with bi directional antennas
- As the network size increases the problems like Route acquisition, service location and encryption key exchanges need to be solved.

Quality of Service

- There are many applications for transfer of Voice, live video, and file transfer.
- QoS parameters such as delay, jitter, bandwidth, Packet loss probability, and so on need to be addressed carefully.
- Issues of QoS robustness, QoS routing policies, algorithms and protocols with multiple, including preemptive, priorities remain to be addressed.

Client-Server Model Shift

- Address allocation, name resolution, authentication and the

Service location are just examples of the very basic services which are done by the servers but in ad hoc some nodes do all these and their location in the network is unknown and possibly even changing over time.

- The issue of shift from the traditional client-sever model remains to be appropriately addressed

Security

- Lack of any centralized network management or certification

authority makes these dynamically changing wireless structures leads security threats like infiltration, eavesdropping, interference, and so on.

- Security is indeed one of the most difficult problems to be solved, but it has received only modest attention so far

Interoperation with the Internet

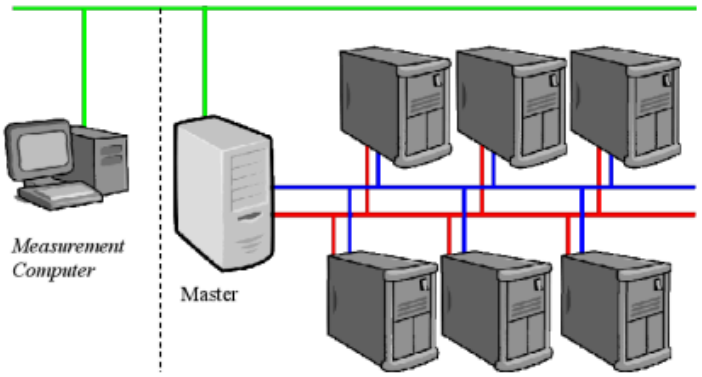
- It seems very likely that the most common applications of adhoc networks require some Internet connection.

Energy Conservation

- There are two primary research topics: maximization of life time of a single node and maximization of the life time of the whole network.
- These goals can be achieved either by developing better batteries, or by making the network terminals' operation more energy efficient.
- The first approach is likely to give a 40% increase in battery life, remaining 60% can be achieved though the design of energy efficient protocols design

b) What do you know about cluster and grid computing? Explain with the necessary diagrams.
Sol:

Cluster Computing



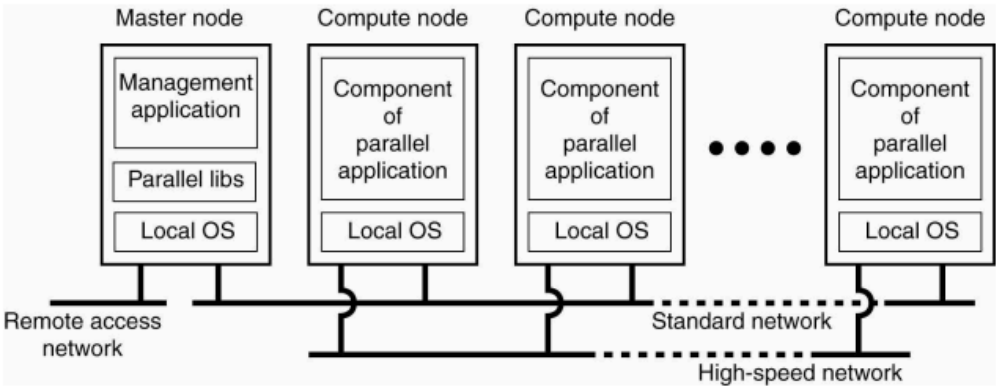
- Technique of linking two or more computers into a network (usually through LAN) in order to take advantage of the parallel processing power of those computers.

Distributed Computing systems

- An important class of distributed systems is the one used for high- performance computing tasks.
- In **cluster computing** the underlying h/w consists of a collection of similar workstations or PCs, closely connected by means of a high speed LAN.
- Here each node runs the same OS.

..

Cluster Computing Systems



Grid computing systems

- A characteristic feature of cluster computing is its homogeneity.
- A key issue in grid computing system is that resources from different organizations are brought together to allow the collaboration of a group of people or institutions. Such a collaboration is realized in the form of a **virtual organization.**

Grid Computing Systems

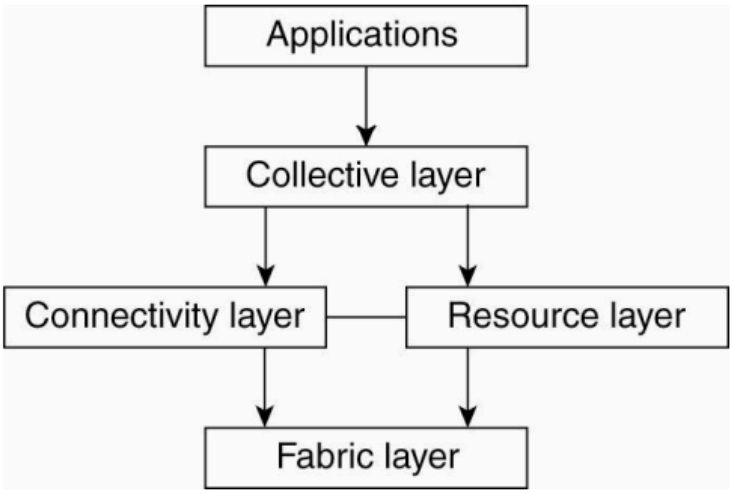


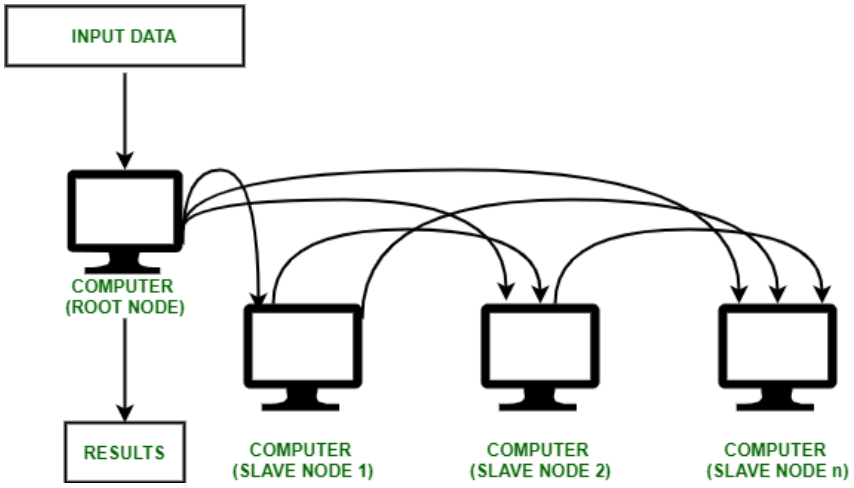
Figure 1-7. A layered architecture for grid computing systems.

Grid Computing:

- **Definition**: A more decentralized version of distributed computing that connects and uses geographically dispersed computers to solve large-scale tasks. Unlike cluster computing, grid computing resources can be heterogeneous and geographically distributed.

From Google

Cluster Computing:

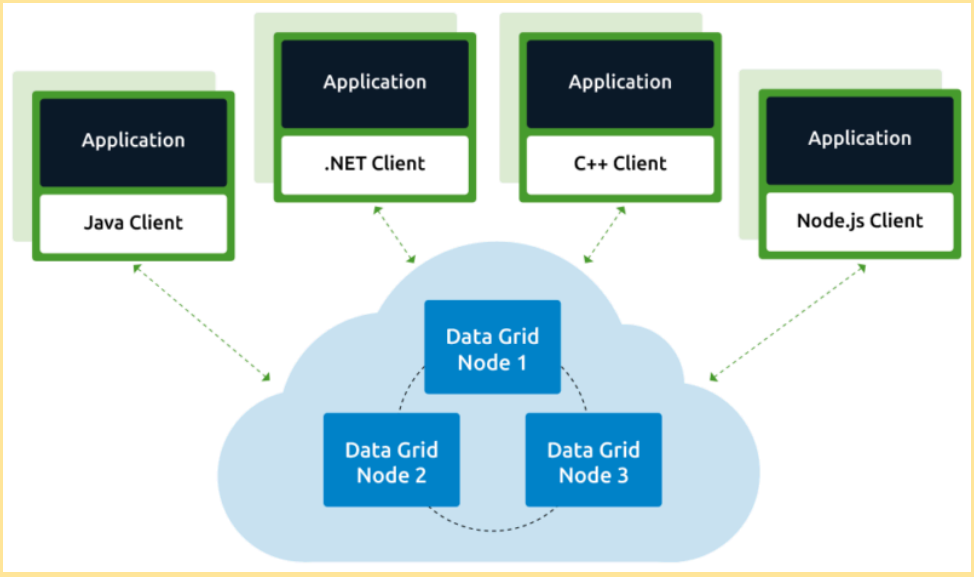


Cluster computing is a type of distributed computing that involves connecting multiple computers or servers to work together as a single computer to perform a task. The goal is to increase computational power and improve performance by breaking down large tasks into smaller parts and processing them simultaneously on different computers

All nodes in the cluster communicate directly with each other over a local network, sharing resources and balancing tasks. If one node fails, others can take over, ensuring reliability.

Often used in high-performance computing (HPC) environments, like scientific simulations, weather forecasting, or data processing.

Grid Computing:



Grid computing is a method of using multiple computers to work together as a virtual supercomputer to complete large tasks. It's often used to solve complex problems or perform large tasks that would be difficult for a single computer to handle

Unlike clusters, grid systems do not have a centralized management. Instead, different organizations can contribute computing power, and tasks are distributed among the available nodes over the internet or wide-area networks.

Typically used for tasks that require massive computational power, like searching for extraterrestrial intelligence (SETI@home) or large-scale scientific research.

Cluster Computing	Grid Computing

Nodes must be homogeneous (same hardware and OS)	Nodes can be homogeneous or heterogeneous
Computers are dedicated to the same task	Computers contribute unused resources
Computers are located close to each other.	Computers may be located at a huge distance from one another.
Computers are connected by a high speed local area network bus.	Computers are connected using a low speed bus or the internet.
Computers are connected in a centralized network topology.	Computers are connected in a distributed or de-centralized network topology.
Scheduling is controlled by a central server.	It may have servers, but mostly each node behaves independently.

Whole system has a centralized resource manager.	Every node manages it's resources independently.
Whole system functions as a single system.	Every node is autonomous, and anyone can opt out anytime.
It has Centralized Resource management.	It has Distributed Resource Management

c) Write about pervasive computing (ubiquitous computing) with an example. Mention some security and privacy issues of mobile computing.

Pervasive computing, also known as ubiquitous computing, is a concept where technology is seamlessly integrated into our everyday environments, making it invisible and unobtrusive.

Key Features of Pervasive Computing:

1. **Embedded Devices:** Computing is integrated into everyday objects like appliances, clothing, or cars.
2. **Context Awareness**: Devices can sense and adapt to their environment, providing services based on the user's current context (e.g., location, time, and activity).
3. **Interconnectivity**: Devices communicate with each other and share information to provide smarter services.
4. **Seamless Interaction:** Users interact naturally with technology, often without needing to focus on the underlying system.

Example:

In a smart home

For instance:

- The thermostat adjusts the temperature based on your daily routine or external weather conditions.
- Smart lights turn on when you enter a room and off when you leave, saving energy.
- Security cameras notify you of any unusual activity, even when you're away.

Mobile computing is subject to a variety of security threats, including:

I. **Loss or theft**: Mobile devices are small and portable, making them easy to lose or steal.
II. **Unauthorized access:** Mobile devices can be accessed by guessing or forging passwords or PINs, or by bypassing the authentication process.
III. **Malware:** Viruses and other malware can be delivered to mobile devices through communications networks. Malware can spread through Bluetooth, messaging services, and internet downloads.
IV. **Phishing:** Attackers send fake messages to trick users into sharing personal information.
V. **SIM hijacking:** Attackers use social engineering to take control of a user's phone number.
VI. **Trojans:** Malware that steals financial information and credentials.
VII. **Ransomware:** Encrypts files and demands payment for a decryption key.
VIII. **Network spoofing:** A fake Wi-Fi network can be created to grab personal information.
IX. **Spyware:** Hackers can use spyware to break into a phone and monitor everything the user does.

8.

a) Write the advantages of Distributed Systems over Centralized Systems.

Distributed Computing Systems – Advantages

- **Inherently distributed applications**
  - **Distributed DB, worldwide airline reservation, banking system**
- **Information sharing among distributed users**
  - **groupware**
- **Resource sharing**
  - **Sharing DB/expensive hardware and controlling remote lab. devices**
- **Better cost-performance ratio / Performance**
  - **Effective for coarse-grained or embarrassingly parallel applications**
- **Reliability**
  - **Non-stopping (availability).**
- **Scalability**
  - **Loosely coupled connection and hot plug-in**
- **Flexibility**
  - **Reconfigure the system to meet users' requirements**

Or,

Here are some advantages of distributed systems over centralized systems:

1. **Scalability**: Distributed systems can easily grow by adding more machines. This means they can handle more users and more data without slowing down.
2. **Reliability**: If one part of a distributed system fails, the rest can still keep working. This makes the system more reliable overall.
3. **Performance**: By spreading tasks across multiple machines, distributed systems can process information faster than a single machine.
4. **Flexibility**: Different parts of a distributed system can use different technologies and tools. This allows for easier updates and improvements.

5. **Fault Tolerance**: Distributed systems can continue to operate even if some components fail. They can reroute tasks to working parts of the system.
6. **Resource Sharing**: Resources, such as storage and processing power, can be shared among different machines. This makes it easier to use what's available efficiently.
7. **Geographical Distribution**: Distributed systems can be located in different places, which can improve access for users in various locations.
8. **Cost-Effectiveness**: Using many smaller, less expensive machines can sometimes be cheaper than relying on one powerful, expensive machine.

b) Define distributed system. What are the characteristics of a distributed system?
Sol:

Definition of a distributed system

A distributed system is:

A collection of independent computers that appears to its users as a single coherent system.

Important aspects of the definition are

1. A distributed system consists of components (computers) that are autonomous.
2. Users think they are dealing with a single system.

1.1 Definition of a Distributed System (2)

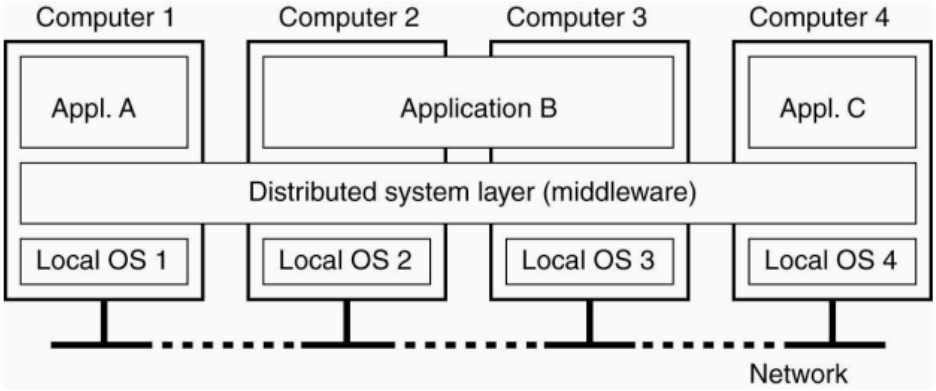


Figure 1-1. A distributed system organized as middleware. The middleware layer extends over multiple machines, and offers each application the same interface.

Characteristics of distributed system

1. One of the important characteristic is that differences between the various computers and the ways in which they communicate are mostly hidden from users.

   The same holds for the internal organization of the distributed system.

2. Users and applications can interact with a distributed system in a consistent and uniform way, regardless of where and when interaction takes place.

Or optional,

Multiple computers

I. Communication over network
II. No central control
III. Fault tolerance
IV. Resource sharing
V. Concurrency
VI. Scalability
VII. Transparency

c) A smart parking system entails an IoT-based system that transmits data about free (and occupied) parking places through a wired or wireless system via the web or mobile application. The IoT device, incorporating a controller and multiple sensors, would be spread across multiple individual parking spaces. Users would enjoy a live update of available parking places and select their convenient space.

- Identify the IoT device required for smart parking system
- Draw a block diagram with the components used in the design of smart parking

System

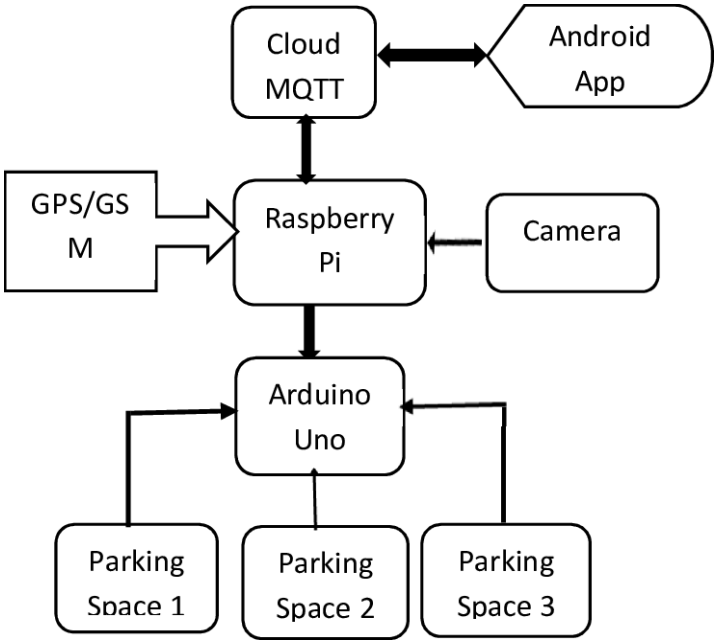
Sol:

Parking Space Sensor: This device is placed in each parking space. It can be a simple inductive loop buried beneath the pavement, a pressure sensor, or a more sophisticated device like a ultrasonic or infrared sensor.

Gateway: This device collects data from multiple parking space sensors and transmits it to the cloud or a local server. It can be a cellular modem, a Wi-Fi access point, or a wired network connection.

Cloud or Server: This central system stores and processes the data collected from the parking space sensors. It also manages user accounts and provides the interface for users to view available parking spaces.

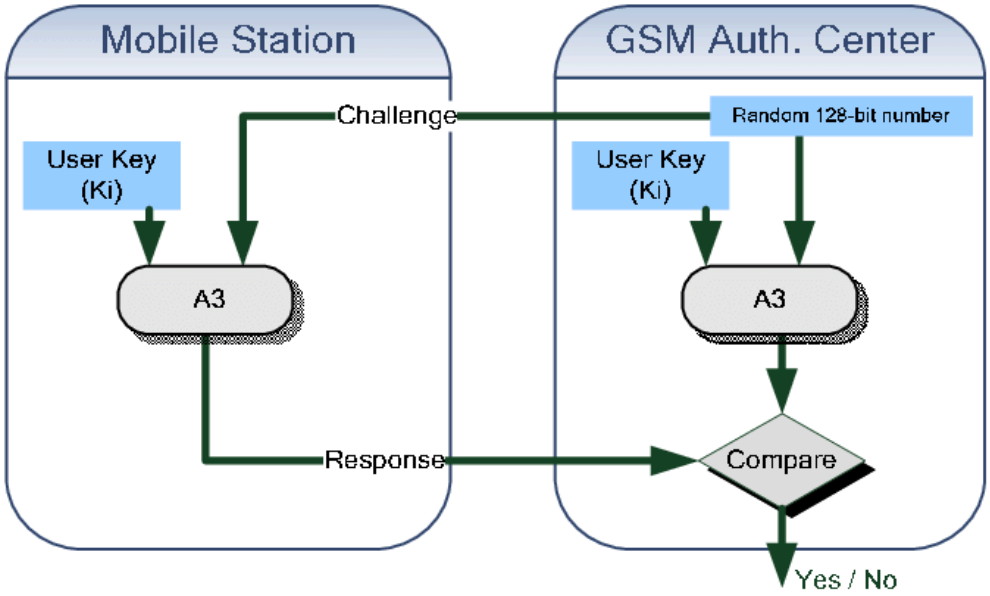
Mobile App: This application allows users to view real-time updates of available parking spaces, navigate to their chosen parking space, and potentially make payments.



4th Final

1.

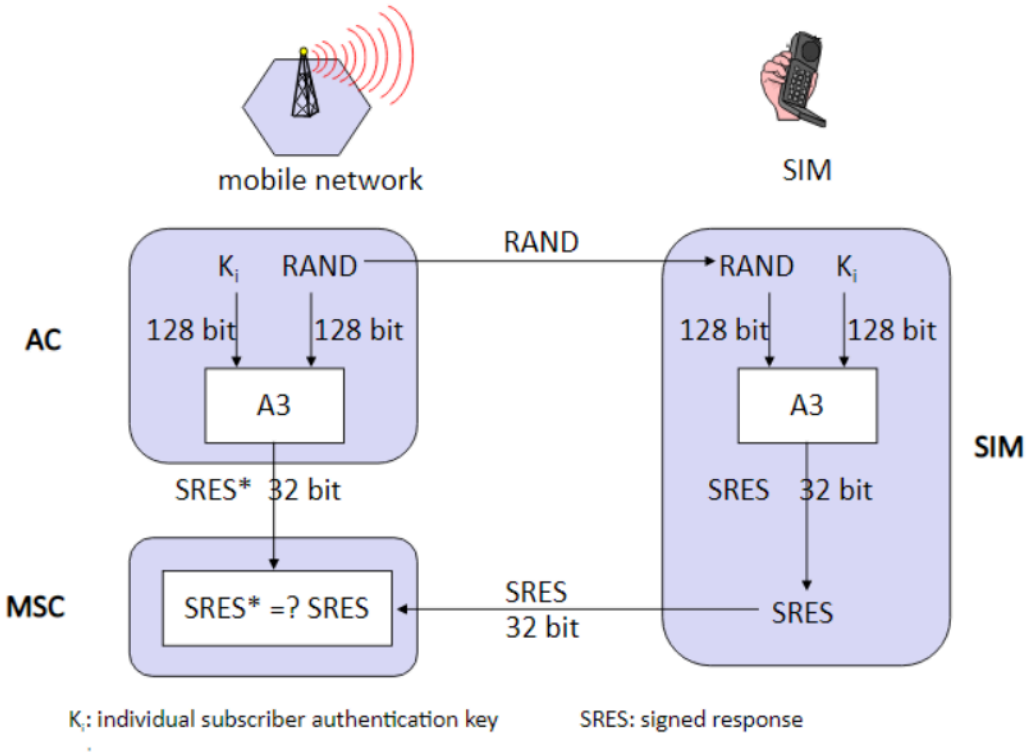
a) Explain, using a block diagram, the process of authentication in a GSM service.



Here's a simple explanation:

1. Mobile Station (Your Device):
    - It has a User Key (Ki), which is a secret key stored in the phone's SIM card.
    - The phone uses an A3 algorithm to process the User Key.
2. GSM Authentication Center:
    - The network also has the same User Key (Ki) for your phone.
    - It generates a random 128-bit number (a challenge) and sends it to the phone.
    - The Authentication Center uses its own A3 algorithm with the User Key (Ki) and the random challenge.
3. Challenge and Response:
    - The mobile station processes the challenge using the A3 algorithm and sends back a response.
    - The network (GSM Auth Center) processes the challenge in the same way and compares the results.
4. Verification:
    - If both results match, authentication is successful (Yes), and the device is allowed to connect.
    - If they don't match, the connection is denied (No).

Or,



To request for a call or to receive a call, the MS has to get authenticated. The process is as follows:

- A unique subscriber authentication key is programmed on every SIM card. The authentication center (AuC) has a list which maps Ki number with the SIM card.It is a secure database.
- When a SIM card requests for a call, a 128 bit random number is instantaneously generated by the AuC and transmitted to the SIM card.
- The A3 algorithm which is programmed inside the SIM card processes the RAND number and Ki number and generates a 32 bit output called the Signed RESponse number (SRES).
- The same process is done on the AuC side.
- The SIM card transmits this SRES number to the AuC.
- The AuC compares the received SRES with the SRES that's generated on the network side.
- The SIM is authenticated if and only if the two SRES are same.

The authentication centre contains a database of identification and authentication information for subscribers including IMSI, TMSI, location area identity (LAI), and authentication key (Ki). It is responsible for generating (RAND),response (RES), and ciphering key (Kc) which are stored in HLR / VLR for authentication and encryption processes. The distribution of security credentials and encryption algorithms provides additional security.

b) Show a client-server computing architecture in which the database is at the application tier. How does this architecture differ when the application server fetches the data from the enterprise server tier?
Sol: See 5th Batch

c) Write a short note on the following:
i) IEEE 802.11 variants ii) Threats and security in Mobile Computing

Sol:

i) IEEE 802.11 Variants:

IEEE 802.11 is a set of standards for **Wi-Fi** networks. Key variants include:

- **802.11a**: 5 GHz band, faster speeds, shorter range.
- **802.11b**: 2.4 GHz band, slower but longer range.
- **802.11g**: Combines speed of 802.11a with 2.4 GHz range of 802.11b.
- **802.11n**: Higher speeds, uses both 2.4 GHz and 5 GHz, better range.
- **802.11ac**: 5 GHz, very fast, supports multiple devices at once.
- **802.11ax (Wi-Fi 6)**: Latest, offers improved speed, efficiency, and capacity, supports dense environments.

Mobile computing is subject to a variety of security threats, including:

Loss or theft: Mobile devices are small and portable, making them easy to lose or steal.

Unauthorized access: Mobile devices can be accessed by guessing or forging passwords or PINs, or by bypassing the authentication process.

Malware: Viruses and other malware can be delivered to mobile devices through communications networks. Malware can spread through Bluetooth, messaging services, and internet downloads.

Phishing: Attackers send fake messages to trick users into sharing personal information.

SIM hijacking: Attackers use social engineering to take control of a user's phone number.

Trojans: Malware that steals financial information and credentials.

Ransomware: Encrypts files and demands payment for a decryption key.

Network spoofing: A fake Wi-Fi network can be created to grab personal information.

Spyware: Hackers can use spyware to break into a phone and monitor everything the user does.

2.

a) What is Hand-off. How the handover decision takes place in GSM depending on receiver signal strength? Explain.

Sol:

In cellular communications, handoff is the process of transferring an active call or data session from one cell in a cellular network or from one channel to another. In satellite communications, it is the process of transferring control from one earth station to another. Handoff is necessary for preventing loss of interruption of service to a caller or a data

Situations for triggering Handoff

Handoffs are triggered in any of the following situations –

- If a subscriber who is in a call or a data session moves out of coverage of one cell and enters coverage area of another cell, a handoff is triggered for a continuum of service. The tasks that were being performed by the first cell are delineating to the latter cell.
- Each cell has a pre-defined capacity, i.e. it can handle only a specific number of subscribers. If the number of users using a particular cell reaches its maximum capacity, then a handoff occurs. Some of the calls are transferred to adjoining cells, provided that the subscriber is in the overlapping coverage area of both the cells.
- Cells are often sub-divided into microcells. A handoff may occur when there is a transfer of duties from the large cell to the smaller cell and vice versa. For example, there is a traveling user moving within the jurisdiction of a large cell. If the traveler stops, then the jurisdiction is transferred to a microcell to relieve the load on the large cell.
- Handoffs may also occur when there is an interference of calls using the same frequency for communication.

Or,

In GSM, handover decisions are based on signal strength and quality measurements:

1. **Continuous Measurement**: The mobile device measures the signal strength (RSSI) of the current and neighboring base stations.
2. **Thresholds**: If the current signal falls below a set threshold while a neighboring signal exceeds another threshold, a handover is initiated.
3. **Decision Types:**
    - Hard Handover: Disconnect from the current base station before connecting to the new one.
    - Soft Handover: Maintain connections to both base stations during the transition.
4. **Execution:** The network commands the device to switch to a stronger signal, ensuring minimal disruption.

b) Write a note on Mobile IP and explain the process of IP Packet delivery.

Sol:

A mobile IP address is a dynamic IP address that allows a mobile device to maintain its network connection when it moves between networks..Mobile IP addresses are different from fixed IP addresses, which are assigned to a device and don't change frequently

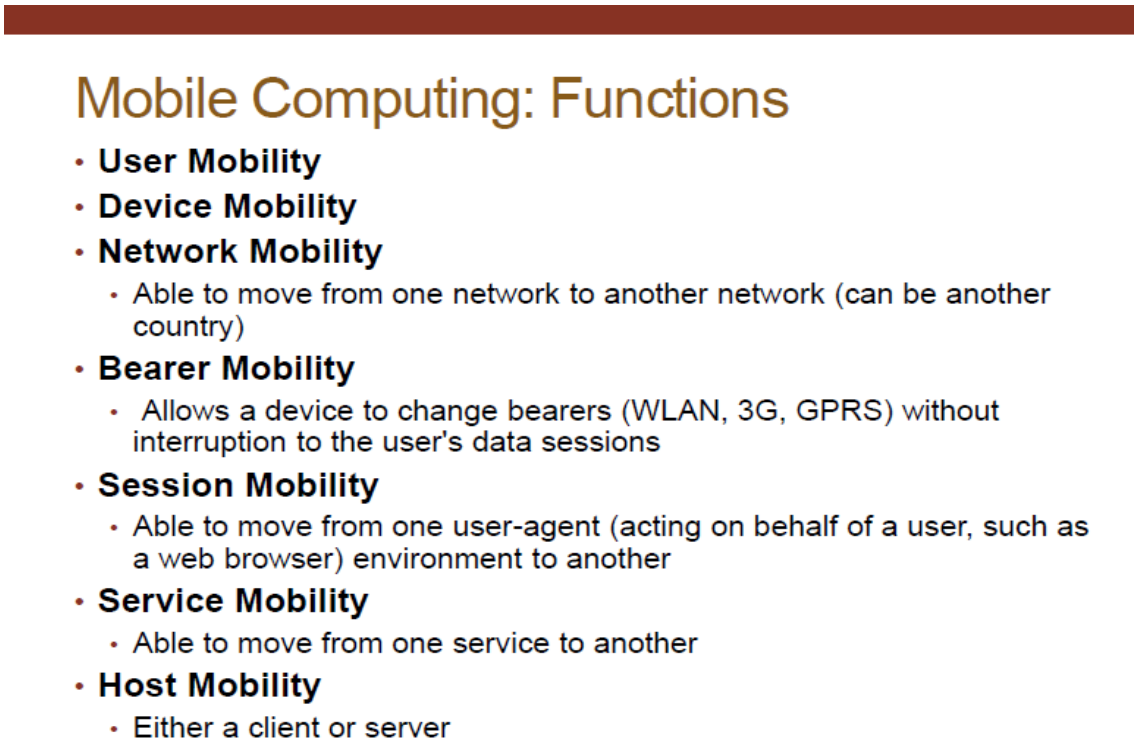
Mobile IP addresses allow users to Continue communication without dropping sessions or connections.Access and communicate with their home network while on a foreign network

The process of IP packet delivery involves several key steps:

1. **Packet Creation**: Data is divided into smaller chunks called packets, each containing a header with source and destination IP addresses.
2. **Routing**: When a device sends a packet, it uses the destination IP address to determine the best route through the network. Routers along the path inspect the packet's header and forward it based on routing tables.
3. **Transmission**: The packet travels across various networks, moving from router to router until it reaches the destination network.
4. **Reassembly**: Once the packet arrives at the destination device, the packets are reassembled in the correct order to form the original data.

5. **Acknowledgment**: The receiving device may send an acknowledgment back to the sender, confirming that the packet has been received.

c) List and explain the major functionalities of Mobile Computing.



3.

a) Differentiate between portability and mobility. Give examples of mobile and wireless devices.

Portability

Laptops are portable because they are compact and light enough to carry around, allowing users to perform tasks like browsing the internet, editing documents, and gaming. Portable hard drives are another example of portability, as they are lightweight and can store large amounts of data.

Mobility

Mobility refers to the ability to move freely and without pain or stiffness. For example, someone who is mobile can take long walks, stand for extended periods, and go about their daily life without needing to sit down.

In the context of the workplace, portability refers to the use of devices like laptops to allow employees to work remotely, while mobility refers to the use of handheld devices like smartphones and tablets to allow employees to complete tasks while on the go.

Portability	Mobility
The ability to easily carry a device or system from one location to another.	The ability to use a device or system while it is in motion or changing locations.
Focuses on the physical convenience of transporting the device.	Focuses on the device's ability to maintain connectivity and functionality while moving.
Laptops, tablets, external hard drives.	Smartphones, wearable devices (like smartwatches), GPS systems.
Not always dependent on constant network connectivity.	Typically requires continuous connectivity (e.g., cellular, Wi-Fi) while in motion.
Carrying a laptop to a different location for use.	Using a smartphone or smartwatch while walking or driving.
May need to be plugged in to use in a new location.	Usually designed to operate on battery and stay functional while moving.
Mainly refers to physical aspects of the device (size, weight).	Encompasses the device's network and operational capabilities while moving.

Example: Smartphone

- **Portability:** carry it anywhere you want
- **Miniaturization:** make it possible to build device to fit in your pocket
- **Connectivity:** Wi-Fi, LTE/4G, cellular, Bluetooth
- **Convergence:** phone, camera, gaming device, movie streaming, music player, …
- **Divergence:** ?
- **Applications:** "Rise of the Apps"
- **Digital Ecosystem:** social networks, distributed gaming, video streaming, work apps, …

b) What is meant by context-aware mobile computing? Explain with examples.
Sol: See 5th Batch

c) What are the limitations of a mobile device? What are the design constraints for application in hand-help devices? List the suggested approaches for the application designer.

- Resource constraints: Battery
- Interference
- Bandwidth
- Dynamic changes in communication environment
- Network Issues
- Interoperability issues
  - varying protocol standards
- Security constraints

Or,

Limitations of Mobile Devices

- **Screen Size:** Smaller screens compared to desktops or laptops can limit the amount of content displayed and user interactions.
- **Processing Power:** While mobile devices have become more powerful, they still have limitations compared to high-end computers, affecting performance-intensive tasks.
- **Storage Capacity:** Limited storage space can restrict the size of applications and the amount of data they can store locally.
- **Battery Life:** Battery constraints can impact the overall user experience, especially for applications that require constant connectivity or heavy processing.
- **Connectivity:** Network connectivity can be unreliable or slow, affecting application performance and functionality.
- **Input Methods:** Touchscreens, while versatile, can have limitations compared to physical keyboards and mice for certain tasks.

Design Constraints for Applications in 5 Hand-held Devices

1. **Small Screen:** Optimize layouts for efficient use of screen space, prioritize essential content, and consider responsive design for different screen sizes.
2. **Limited Processing Power:** Minimize resource-intensive operations, optimize code, and leverage cloud-based solutions for computationally demanding tasks.
3. **Limited Storage:** Design applications to be lightweight and avoid excessive local storage, consider cloud storage options for data synchronization.
4. **Battery Life:** Implement power-saving features, optimize background processes, and provide offline capabilities when possible.
5. **Connectivity Issues:** Design for offline functionality, implement caching mechanisms, and provide graceful degradation for network errors.

Suggested Approaches for Application Designers

- **User-Centered Design:** Prioritize user needs and experiences, conduct usability testing, and gather feedback to refine the design.
- **Responsive Design:** Create applications that adapt to different screen sizes and orientations for optimal user experience.
- **Performance Optimization:** Minimize resource usage, optimize code, and leverage caching mechanisms to improve application performance.
- **Offline Functionality:** Provide offline capabilities whenever possible to enhance user experience and reduce reliance on network connectivity.
- **Accessibility:** Design applications to be accessible to users with disabilities, adhering to accessibility guidelines.
- **Security:** Implement robust security measures to protect user data and prevent unauthorized access.
- **Testing and Iteration:** Thoroughly test applications on various devices and platforms, and iterate on the design based on feedback and performance metrics.

4.

a) In 2.5G/3G mobile networks, several modified TCP schemes such as indirect TCP, snooping TCP and mobile TCP are implemented. What are the impacts of data encryption on these schemes? Within in these TCP schemes, identify

- The proxy-based TCP schemes(s)
- The scheme(s) that can preserve an end-to-end TCP
- The TCP scheme that does not use data catching and retransmission between the mobile node and the access point

Sol:

Modified TCP Schemes in 2.5G/3G Mobile Networks and Impacts of Data Encryption:

Impact of Data Encryption:

In mobile TCP schemes, data encryption can complicate the handling of data at intermediate nodes (like proxies) because encrypted data cannot be easily accessed or modified by these nodes. This can affect optimizations such as caching, retransmission, and error correction, which rely on inspecting and modifying data packets.

Identifying TCP Schemes:

Proxy-Based TCP Schemes:

Indirect TCP: Splits the connection at the proxy (typically at the base station), handling TCP over the wired and wireless parts separately. The proxy acts as an intermediary between the mobile node and the network.

Snooping TCP: Uses a proxy at the base station to cache and retransmit data packets to the mobile node. The base station "snoops" on the connection to handle losses on the wireless link.

Schemes that Preserve End-to-End TCP:

Mobile TCP (M-TCP): Preserves the end-to-end TCP semantics by keeping the connection between the mobile node and the fixed host, but separates flow control for the wireless part of the connection. The data is not intercepted or retransmitted.

Snooping TCP: Although it uses caching and retransmission, the end-to-end TCP semantics remain intact as the TCP connection is not explicitly split.

Scheme that Does Not Use Data Caching and Retransmission:

Mobile TCP (M-TCP): M-TCP does not use caching or retransmission between the mobile node and the access point. It handles mobility by pausing the TCP connection during disconnection without splitting or caching data.

b) What are the services provided in a GSM system? Explain how a mobile station connects to and talks with another mobile station. How will the in-between interfaces differ when a mobile station connects to a PSTN destination?

Services Provided in GSM System:

GSM (Global System for Mobile Communications) provides several services:

Telephony Services: Basic voice calls between mobile stations or mobile stations and other networks (e.g., PSTN).
Short Message Service (SMS): Sending and receiving text messages.
Data Services: Circuit-switched data transmission for internet access or fax.
Supplementary Services: Call forwarding, call waiting, conference calling, etc.
Location Services: Tracking a mobile station's location for emergency services and other applications.

Mobile Station Communication: When a mobile station (MS) connects to another mobile station:

Connection Establishment:
The calling MS sends a request to the nearest Base Transceiver Station (BTS), which forwards it to the Base Station Controller (BSC) and Mobile Switching Center (MSC).

Routing:
The MSC checks the location of the destination MS via the Home Location Register (HLR) and Visitor Location Register (VLR). Once located, the MSC establishes a connection through the appropriate BTS to the destination MS.

Communication:
After the connection is established, both mobile stations can communicate through the MSC, BSC, and BTS.

Connection to PSTN Destination:

When an MS connects to a Public Switched Telephone Network (PSTN), the MSC routes the call to the Gateway MSC (GMSC), which interfaces with the PSTN network.

Key Difference: The connection requires additional interfaces with the GMSC and PSTN, whereas mobile-to-mobile communication remains within the GSM network's MSC.

c) From a network designer's point of view, discuss key performance requirements for future 5G mobile technology.

Key Performance Requirements for Future 5G Mobile Technology:

Higher Data Rates:

Enhanced Mobile Broadband (eMBB): Support for data rates of up to 10 Gbps to handle high-definition streaming, virtual reality, and augmented reality.

Low Latency:

Ultra-Reliable Low-Latency Communications (URLLC): Ensure latencies below 1 millisecond for applications requiring real-time communication, such as autonomous vehicles and industrial automation.

Massive Connectivity:

Support for Massive Machine-Type Communication (mMTC) to connect billions of IoT devices with scalable, energy-efficient network management.

Energy Efficiency:

Design the network to minimize power consumption, particularly for IoT devices, with extended battery life and energy-efficient protocols.

High Reliability:

Support critical applications like remote surgery or vehicle-to-everything (V2X) communications with near 100% reliability.

Network Slicing:

Enable network slicing, allowing multiple virtual networks to coexist on the same physical infrastructure, tailored to different use cases (e.g., low-latency slices for gaming and high-bandwidth slices for streaming).

Seamless Handover:

Ensure seamless mobility across heterogeneous networks (Wi-Fi, LTE, and 5G) to maintain high-quality service when users move between different coverage areas.
Security:

Enhance security protocols to ensure privacy and data protection in an environment with more connected devices, more entry points, and more data exchange.

Spectrum Efficiency:

Optimize the use of the radio spectrum with techniques like massive MIMO and beamforming to maximize throughput in congested environments.
These performance requirements aim to meet the demands of diverse applications, from ultra-fas

5.

a) Consider a homogeneous network having 20 similar machines. All the machines part of the network have the same software. The network implements a distributed computing environment. Consider a scenario where a process PI is running on a machine MI, the machine MI is a busy in handling several tasks, the distributed operating systems have an idle machine M2. Machine M2 doesn't have any information about process PI. Explain what the distributed operating system should do to migrate the process PI from machine MI to M2. Explain any assumptions
you make.

Sol:

From Bard

Migration Process:

1. **Identification of Idle Machine:**
    - The DOS on MI periodically checks the status of other machines in the network.
    - It identifies M2 as an idle machine based on its resource utilization.
2. **Process State Capture:**
    - The DOS on MI captures the complete state of process PI, including its memory, registers, and open files.
3. **Communication with M2:**

    - MI sends a migration request to M2, including the process state and necessary metadata.
4. **Resource Allocation on M2:**
    - M2 receives the migration request and allocates the necessary resources (e.g., memory, CPU time) for PI to run.
5. **Process State Restoration:**
    - M2 restores the captured state of PI, recreating its execution environment.
6. **Redirection of Network Connections:**
    - If PI has any open network connections, the DOS redirects them from MI to M2.
7. **Process Execution on M2:**
    - PI resumes execution on M2, appearing to the user as if it had always been running there.

Assumptions:

1. **Transparent Migration:** The distributed operating system (DOS) should be able to migrate processes transparently without affecting their execution.
2. **Process State Capture:** The DOS can capture the complete state of a process, including its memory, registers, and open files.
3. **Network Reliability:** The network is reliable, ensuring that messages between machines are delivered without errors or loss.
4. **Machine Compatibility:** Both machines MI and M2 have compatible hardware and software configurations.

Or, From Gpt.

Steps for Process Migration:

1. **Find and Pause the Process**:
   The DOS first identifies the process P1P_1P1 running on machine M1M_1M1 and then pauses it, capturing everything about the process (its state, memory, and other details).

2. **Copy the Process Data**:
   The system then copies all the process data, including its code and memory, from M1M_1M1 so it can move it to M2M_2M2.
3. **Send Data to M2M_2M2**:
   After copying, the process information is transferred over the network to machine M2M_2M2, where it's ready to be resumed.
4. **Start the Process on M2M_2M2**:
   Once the data arrives, machine M2M_2M2 starts running process P1P_1P1 from where it left off on M1M_1M1.
5. **Free Resources on M1M_1M1**:
   After the process has been successfully moved, the DOS clears the memory and resources on M1M_1M1 that were used by P1P_1P1, making space for other tasks.

Assumptions:

- **Same Machines**: M1M_1M1 and M2M_2M2 are the same in terms of hardware and software, so there's no compatibility problem.
- **Shared Files**: Both machines can access the same files, so the process doesn't have to worry about missing data.
- **Good Network**: The network is fast and reliable enough to transfer the process data without any major delays.
- **No Special Hardware**: The process doesn't depend on any special hardware that only exists on M1M_1M1.

This process helps balance the load by moving work from a busy machine to an idle one!

b) Scalability is one of the most important design goals for developers of distributed systems. How could you measure the Scalability of a distributed system?
Sol: See 5th Batch

c) Explain the following GSM interfaces:
i) The radio interface (MS to BTS)
iii) Interfaces between other GSM entities
ii) BTS to BSC interface
iv) BSC to MSC interface
Sol: See 5th Batch

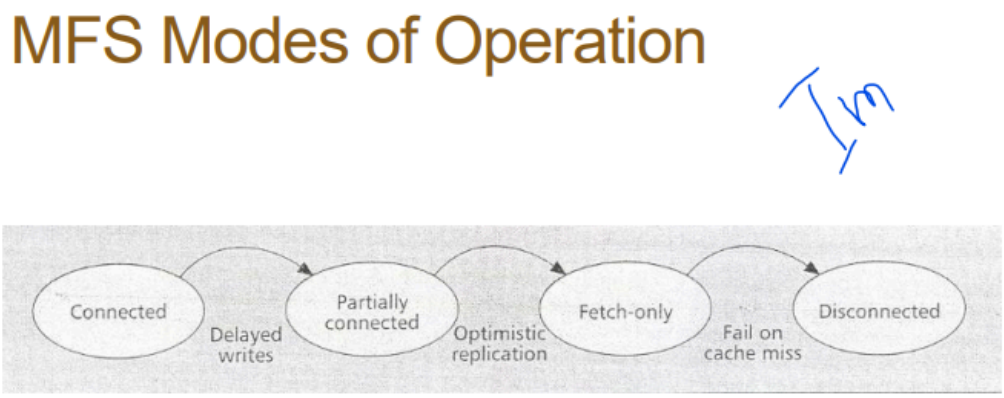
6.

a) How the file-sharing session handled in coda distributed file system? Explain with timing diagram.

Sol: See 5th Final

b) Describe the modes of operation for the Mobile File System with necessary diagrams.

Sol:



Connected: Full connection, allows delayed writes.
Partially Connected: Limited connection, uses optimistic replication.
Fetch-only: Can only read data, fails if data isn't in the cache.
Disconnected: No connection, no data access.

c) A smart parking system entails an IoT-based system that transmits data about free (and occupied) parking places through a wired or wireless system via the web or mobile application. The IoT device, incorporating a controller and multiple sensors, would be spread across multiple individual parking spaces. Users would enjoy a live update of available parking places and select their convenient space.

- Identify the IoT device required for smart parking system
- Draw a block diagram with the components used in the design of smart parking system

Sol: See 5th Batch

7.

a) What is UI? Differentiate between UX and UI.

Sol: See 5th Batch

b) Define memory management. Why it is needed?

Sol:

Memory management is the process of controlling and coordinating computer memory, assigning portions to different programs, and optimizing overall performance.

Why it is needed:

- **Efficient allocation**: Ensures each program gets the memory it needs without waste.
- **Protection**: Prevents programs from interfering with each other's memory.
- **Multitasking**: Allows multiple programs to run simultaneously.
- **Optimization**: Maximizes the use of available memory for better system performance.

c) What is the role of Reverse tunneling in route optimization? Explain.

Sol:

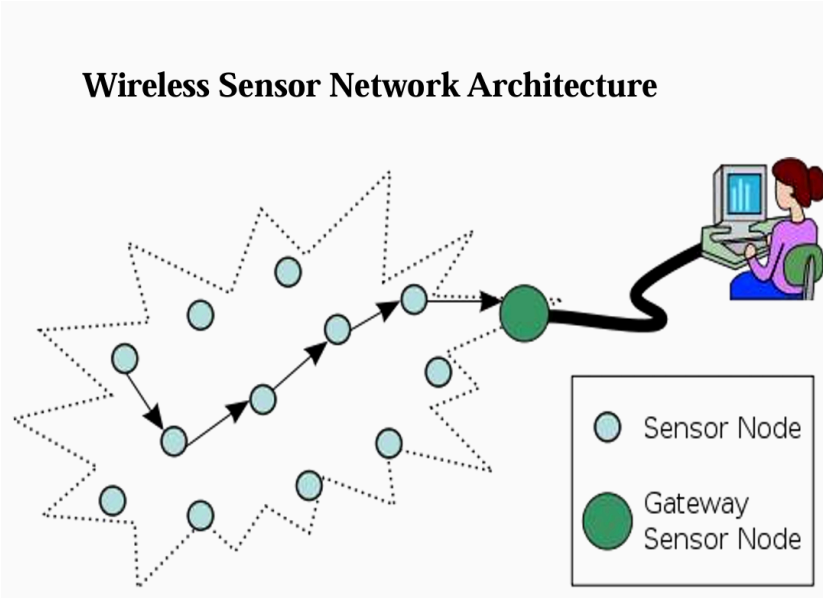
Reverse tunneling ensures data from a mobile device is sent back through the same path as incoming data. This improves routing efficiency, enhances security, and solves NAT issues, leading to more optimized and consistent network routes.

Reverse tunneling helps avoid inefficient "triangle routing" by sending data directly between the mobile node (MN) and its home agent (HA). It also maintains home network connectivity for the MN while roaming and supports private IP addresses, ensuring traffic can be routed back to the home network.

8.

a) Define sensor network.

Sol:



- sensor network
  - consists of a large number of sensor nodes
  - nodes deployed either inside or very close to the sensed phenomenon

Or,
A sensor network is a group of sensors that monitor and record conditions in different locations, and send that data to a central location for analysis, storage, and viewing. Sensor networks are made up of sensor nodes, which are basic units that have sensors, processors, memory, wireless modems, and power supplies.

b) What are the attributes of wearable computing? Explain each of them.
Sol:
Portability: Devices are lightweight and easy to carry, allowing continuous use while on the move.

Hands-free operation: Wearables allow users to interact without needing to hold or touch the device, enhancing convenience.

Always-on: These devices are typically active and ready for use at all times, allowing for seamless integration into daily activities.

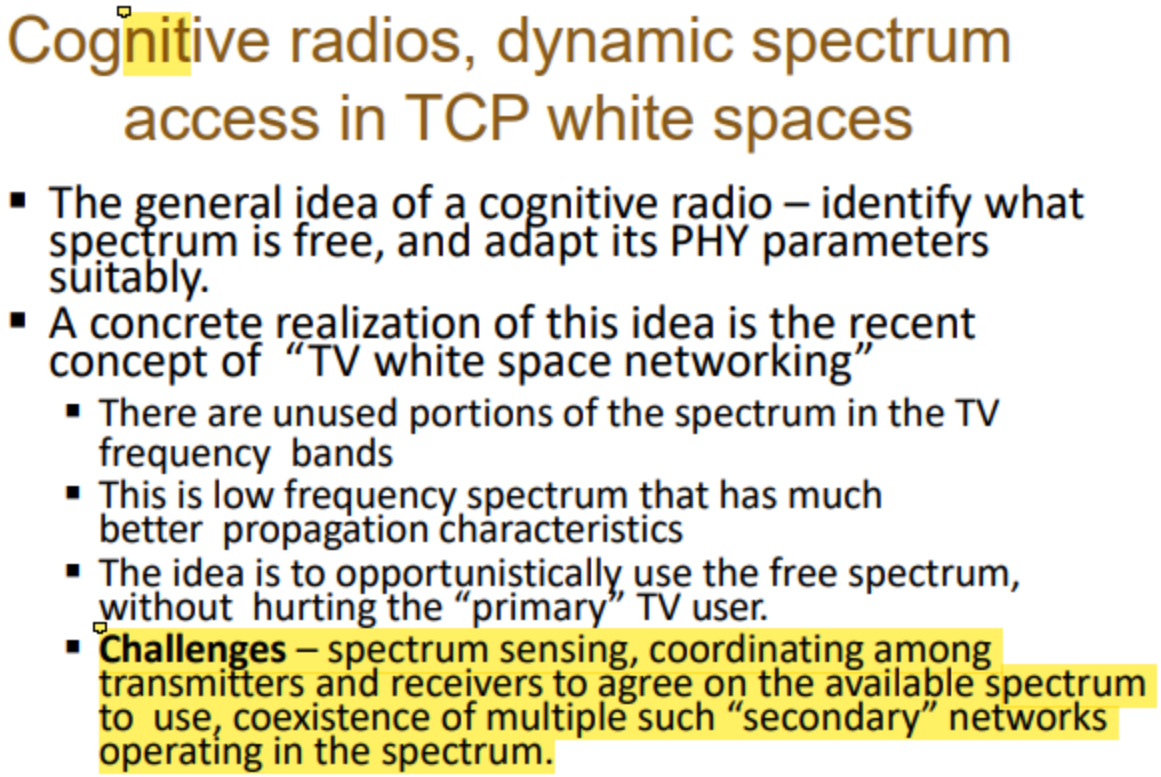
Context awareness: Wearables can sense and respond to the user's environment or physical state, adapting to provide relevant information or actions.

Connectivity: They are often connected to other devices or networks, allowing real-time data sharing and synchronization.

c) Write short note on the following:
i) Massive MIMO
ii) Pervasive computing
iii) Dynamic spectrum access
Sol:

Massive MIMO

- The idea of placing multiple antennas at transmitters and receivers to linearly scale capacity is gaining popularity.
- **Recap:** multiple antennas placed close to each other at transmitter and receiver can be used to send multiple streams of data in parallel (multiplexing mode), or improve the rate of single stream (diversity mode).
- What limits the number of antennas?
  - **Cost:** each antennas costs extra hardware to process the radio signals to/from it
  - **Form factor:** Ratio of RMS and average value. Spacing between antennas is half a wavelength. Makes is cumbersome, especially at lower frequencies (higher wavelengths)
- WiFi with 4 antennas is available now, 8 or more antennas likely in near future
- Since MIMO is mostly used for higher frequencies, propagation range is lower, so suitable for smaller (indoor) networks.



From GPT

i) Massive MIMO (Multiple Input, Multiple Output)

Massive MIMO refers to wireless communication systems that use a large number of antennas at the base station to serve multiple users simultaneously. It significantly enhances data capacity, energy efficiency, and reliability by exploiting spatial diversity and beamforming techniques. Massive MIMO is a key technology in 5G and beyond, enabling higher throughput and better spectral efficiency.

ii) Pervasive Computing

Pervasive computing, also known as ubiquitous computing, refers to embedding computational capability into everyday objects to create a seamless, integrated network of smart devices. These devices can collect, process, and share data without requiring human intervention, making computing more natural and intuitive. Examples include smart homes, wearable devices, and IoT (Internet of Things) systems.

iii) Dynamic Spectrum Access (DSA)

Dynamic Spectrum Access (DSA) is a technique that allows radio systems to adjust to the local radio spectrum environment in real time. DSA uses a variety of technologies, including Software Defined Radio (SDR) and Cognitive Radio (CR), to help networks communicate efficiently.

3rd Final

1.

a) Mobile Computing a technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link.

The term "Mobile computing" is used to describe the use of computing devices, which usually interact in some fashion with a central information system--while away from the normal, fixed workplace. Mobile computing technology enables the mobile worker to create, access, process, store and communicate information without being constrained to a single location. By extending the reach of an organization's fixed information system, mobile computing enables interaction with organizational personnel that were previously disconnected. It provides the continuous access to the wireless network services and the flexible communication between the people. It provides the real-time business to employee communication, enhanced customers interactions, and fastest communication between the individuals. The communication occurs with the real-time wireless connection. It provides the data, audio and video access to any user, any time with a wireless enable device.

The wireless network may be WLAN, Wi-Fi, GSM, CDMA, WiMax or GPRS. There are many companies that provide the mobile computing solutions on contract and pay as you go mobile broadband plans to the home users and businesses. 'The cell phones and laptops are the most commonly used mobile computing devices. It can be referred to the two main fields portable and mobility.

Now answer the following questions:

i) How does Mobile Computing work?

Sol:Mobile computing works by using wireless technologies to transmit data between devices and a central information system. Devices like smartphones, tablets, and laptops connect to wireless networks (such as Wi-Fi, GSM, or LTE) to access and share information. Users can send and receive data, make calls, and access applications without being tied to a physical location.

Or
Mobile computing enables users to access data, applications, and services through portable devices (like smartphones and laptops) while moving between locations. It works through:

1. **Mobile Devices**: Portable devices with operating systems (e.g., iOS, Android) for running applications.
2. **Wireless Communication**: Networks like 4G/5G, Wi-Fi, and Bluetooth provide connectivity without cables.
3. **Network Infrastructure**: Base stations and access points link mobile devices to the internet and other networks.
4. **Cloud Computing**: Remote servers host data and apps, allowing access from anywhere with internet connectivity.
5. **Mobile Applications**: Apps designed for mobile devices, providing real-time services.
6. **Data Synchronization**: Keeps devices up-to-date by syncing data with cloud storage.

These components enable continuous, on-the-go computing and communication.

ii) What are the characteristics of Mobile Computing?
Sol: See upp

iii) What is an example of Mobile Computing?
Sol: An example of mobile computing is using a smartphone to check emails, make video calls, or access cloud-based applications while on the go, such as when traveling or working outside the office.

b. Write a short note on the following:
i) Mobile IP
ii) 5G
iii) Threats and security in Mobile Computing

Sol:

i) Mobile IP

Mobile IP allows devices to maintain the same IP address while moving between networks, ensuring uninterrupted data communication through home and foreign agents.

ii) 5G

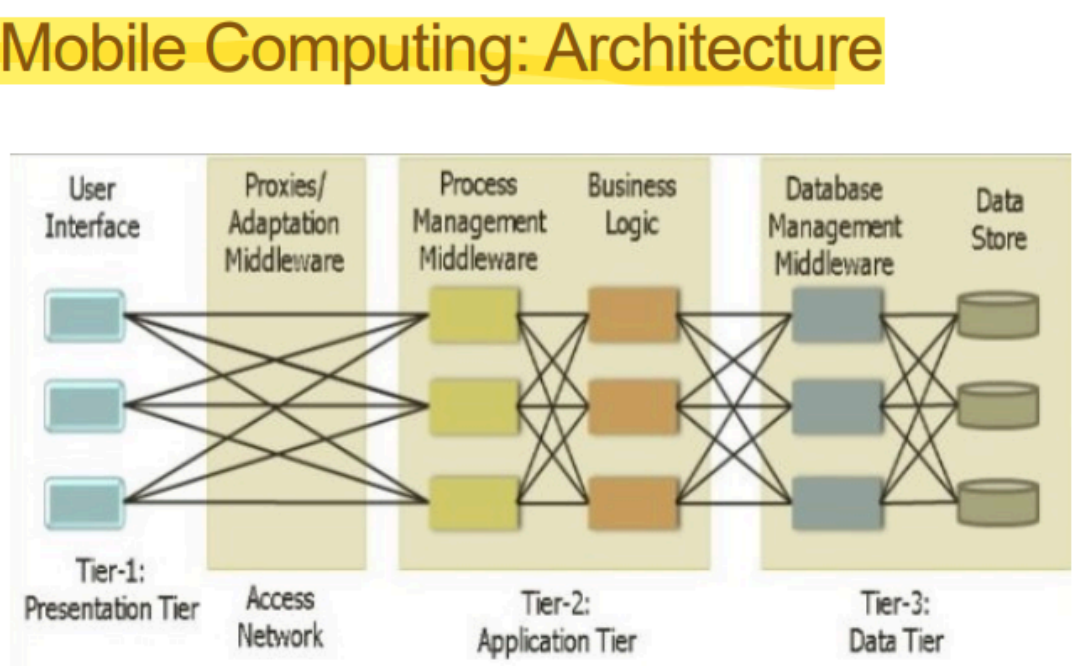
5G is the fifth generation of mobile networks, offering faster speeds, lower latency, and the ability to connect many devices, enabling innovations like smart cities and IoT applications.

iii) Threats and Security in Mobile Computing

Mobile computing faces threats such as malware, phishing, and data breaches. Security measures include encryption, multi-factor authentication, and regular updates to protect data and user privacy.

2.

a. What are the architectural components of Mobile Computing? Explain with diagrams.



Mobile Computing: Architecture

- **Presentation Layer (UI)**
  - Presents data to the user
  - Permits data manipulation and data entry
  - Requests the data form Business layer
  - Accomplished through use of Dynamic HTML and client-side data sources and data cursors

- **Business Logic Layer**
  - Acts as the server for client requests from workstations according to Business rules fetch or insert data through the Data Layer
  - Determines what data is needed (and where it is located) and acts as a client in relation to a third tier of programming that might be located on a local or mainframe computer
  - As not tied to a specific client, it can be used by all applications and can be moved to different locations, as response time and other rules require

- **Data Access Layer**
  - Made up of the DBMS that provides all the data for the above two layers.
  - Avoiding dependencies on the storage mechanisms
    - Allows for **updates or changes** without the application tier clients being affected by or even aware of the change

b. What is Hand-off? List and explain the types of Hand-off.

Sol: See 5th Batch

c. List and explain the major functionalities of Mobile Computing.
Sol: see upp

3.

a. What is meant by context-aware mobile computing? Write major challenges and possible Solutions.
Sol: See 4th Batch

(b) List two applications that are context-aware systems on your mobile phone and explain why they are context-aware.
Sol: See 5th Final

(c) Give an example of five applications that are not context-aware and how we can make them context aware.
Note: All applications must be Mobile apps such as Twitter, Instagram, Facebook, etc.

Sol: See 5th Final

4.

a. Compare between CDMA and WCDMA.

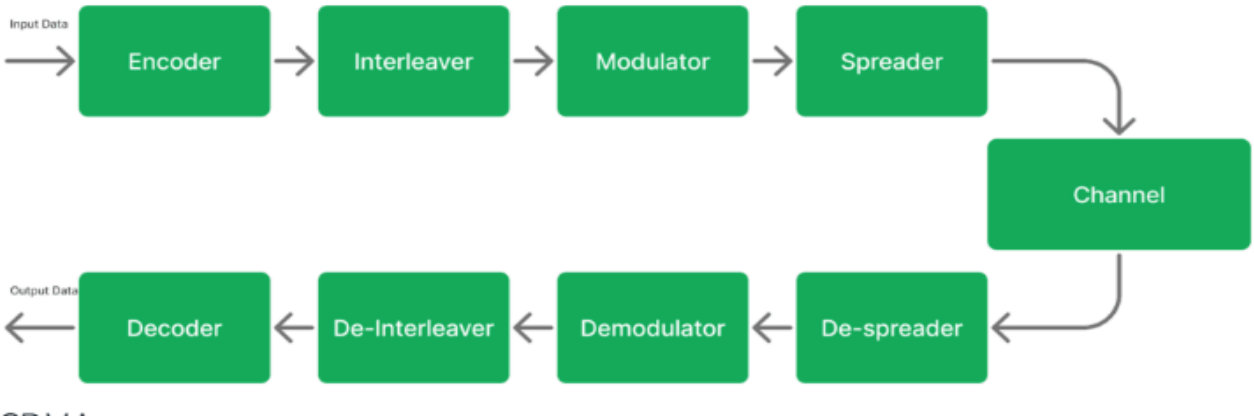
CDMA Stands for Code Division Multiple Access,
WCDMA Stands for Wideband Code Division Multiple Access

Parameters	CDMA	WCDMA

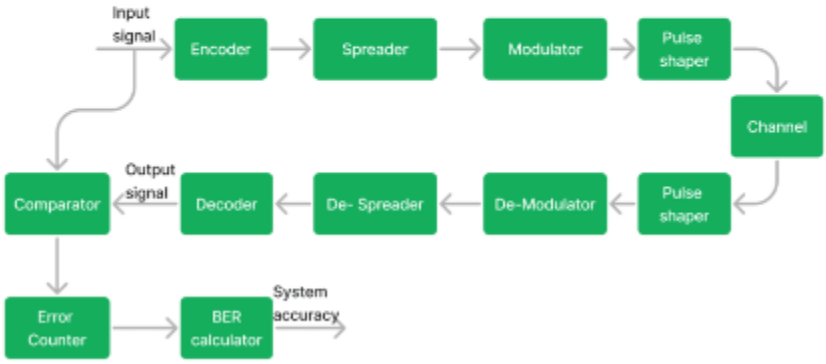
Generation	Used in 2G and 3G standards	Used in 3G standards
Technology origin	Based on IS-95 standards	Based on UMTS standards
Bandwidth	Uses a narrowband of 1.25MHz	uses a wideband of 5MHz
Data Rates	Has lower data rates of up to 384 kbps	Has Higher data rates up to 2Mbps
Frame Length	Variable frame lengths used such as 5ms, 10ms, 15ms, 20ms	Standard Frame length of 10ms is used

Power Control	Has power control at 800Hz	Has faster power control at 1500Hz
Chip rate	Has a chip rate of 1.2288 Mcps	Has a higher chip rate of 3.84 MCps
Network Capacity	Lower network capacity	higher network capacity
Channelization methods	Fixed-length Walsh codes used	OVSF codes used

Given Below is the Block Diagram of CDMA



Given Below is the Block Diagram of WCDMA



b. What are the steps involved in the calling communication process between mobile users? Explain with diagrams.

Sol: See 5th Batch

c. Define cellular network. If a telephone system has a bandwidth of 3 MHz and every channel needs 30 KHz then calculate the number of channels per BTS.

Sol: See up

5.

a. Draw clear diagram of the GSM system with necessary components and describe it in detail.

Sol: See 5th Batch

b. Explain the following terms:
i) Base Station (BS)
ii) Home Location Register (HLR)
iii) Visitor Location Register (VLR)
iv) Mobile Agents
Sol:
Here are some definitions for base station, home location register, visitor location register, and mobile agents:

Base station
A transceiver that connects mobile phones to the telephone network. In a computer network, it can also connect computers to a local area network or the internet.

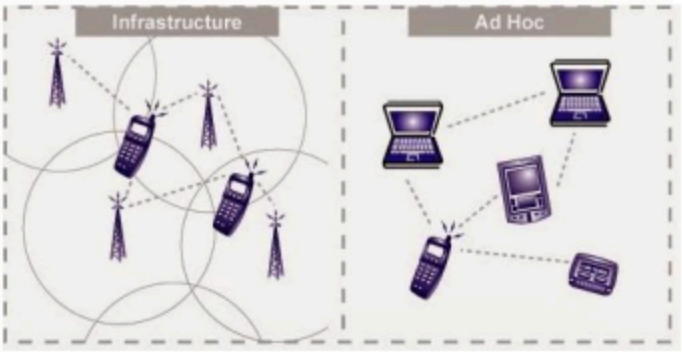
Home location register (HLR)
A database that stores permanent subscriber records, including subscription information and some location information.

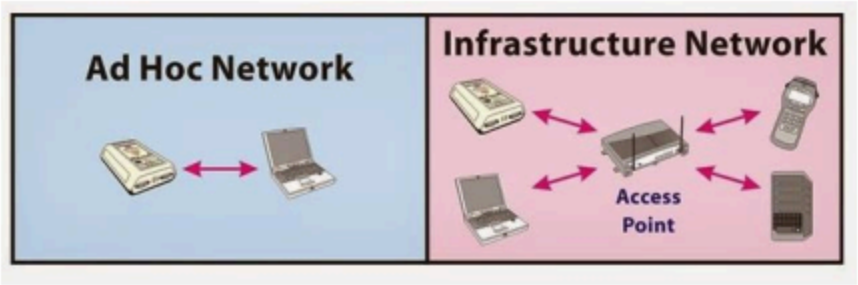
Visitor location register (VLR)
A database that stores temporary information about roaming subscribers. The VLR uses temporary identifiers (TMSI) instead of permanent identifiers (IMSI) to protect the identity of mobile subscribers.

Mobile agents
A type of software agent that can move from one computer to another within a network. Mobile agents are characterized by autonomy, social ability, learning, and mobility.

c. What is the difference between infrastructure and ad-hoc networks?
Sol:

Ad Hoc Model





Infrastructure Vs Ad Hoc Network

Infrastructure networks	Ad-hoc wireless networks
Fixed infrastructure	No infrastructure
Single-hop wireless links	Multi-hop wireless links
High cost and time of deployment	Very quick and cost-effective
Reuse of frequency via channel reuse	Dynamic frequency sharing
Nowadays applications: civilian, commercial	Nowadays applications: military, rescue
High cost of network maintenance	Maintenance operations are built-in
Low complexity of mobile devices	Intelligent mobile devices are required
Widely deployed, evolves	Still under development in commercial sector

6.

a) List and describe channel allocation techniques.

Sol:

There are several channel allocation techniques, including:

Fixed channel allocation (FCA): Permanently assigns a set of channels to each cell.

In this allocation scheme, there is no interference between the users since each user is assigned a fixed channel. However, it is not suitable in case of a large number of users with variable bandwidth requirements.

Dynamic channel allocation (DCA): Assigns channels to cells on demand based on current conditions, such as traffic load and interference.This allocation scheme optimises bandwidth usage and results is faster transmissions.Dynamic channel allocation is further divided into centralised and distributed allocation.

Hybrid channel allocation (HCA): A combination of FCA and DCA, with some channels being fixed and some dynamic.

b) Describe the modes of operation for the Mobile File System with necessary diagrams.
Sol: See 4th Batch

c) What are near and far terminal? Write problems cause by near and far terminals.
Sol:

In wireless communication:

- **Near terminal**: A device close to the base station.
- **Far terminal**: A device farther away from the base station.

Problems caused:

1. The **Near-Far Problem** happens when a device close to the base station sends a strong signal that overpowers a weaker signal from a farther device, making it hard for the base station to hear the distant device.
2. **Signal Interference** occurs when the strong signal from the nearby device disrupts the communication of the farther device, causing poor connection quality for the distant device.

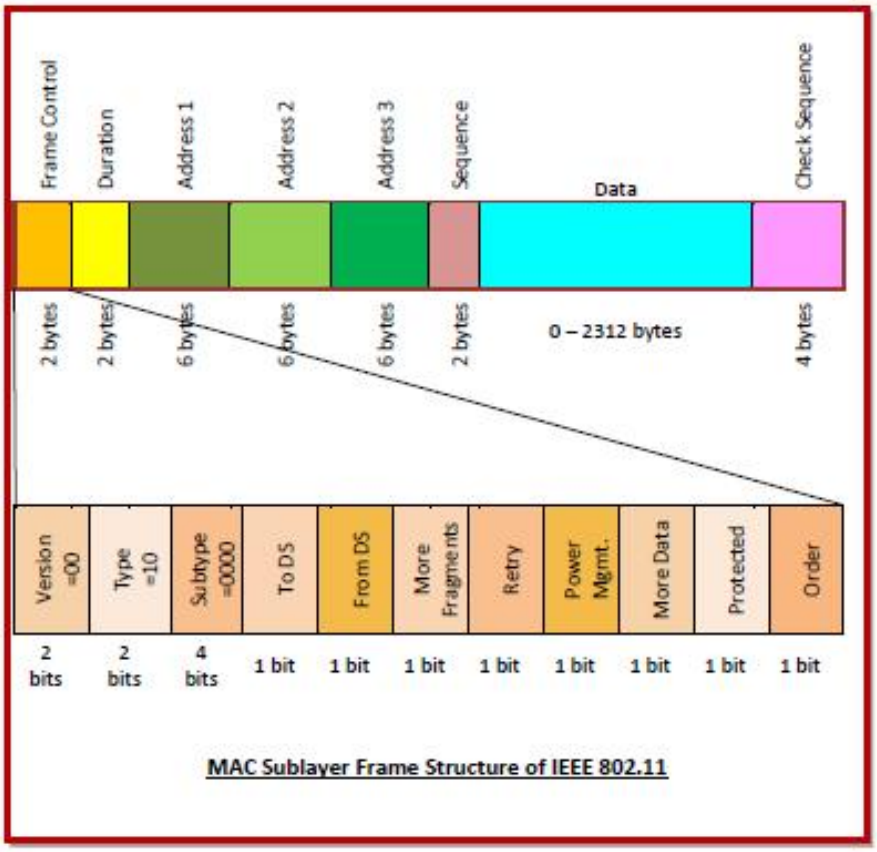
7.

a) What are the functions of authentication and encryption in GSM?
Sol: See 4th Batch

b) Draw and describe the basic packet structure of an IEEE 802.11MAC.

MAC Sublayer Frame Structure of IEEE 802.11

The main fields of a frame in WLANs as laid down by IEEE 802.11 are as depicted in the following diagram –



MAC Sublayer Frame Structure of IEEE 802.11

Kalo kom kora gula sub field Frame control er

Frame Control –It is a 2 bytes starting field composed of 11 subfields. It contains control information of the frame. The 11 subfields are –

Protocol version – The first sub-field is a two – bit field set to 00. It has been included to allow future versions of IEE 802.11 to operate simultaneously.

Type – It is a two-bit subfield that specifies whether the frame is a data frame, control frame or a management frame.

Subtype – it is a four – bit subfield states whether the field is a Request to Send (RTS) or a Clear to Send (CTS) control frame. For a regular data frame, the value is set to 0000.

To DS – A single bit subfield indicating whether the frame is going to the access point (AC), which coordinates the communications in centralised wireless systems.

From DS – A single bit subfield indicating whether the frame is coming from the AC.

More Fragments – A single bit subfield which when set to 1 indicates that more fragments would follow.

Retry – A single bit subfield which when set to 1 specifies a retransmission of a previous frame.

Power Management – A single bit subfield indicating that the sender is adopting power-save mode.

More Data – A single bit subfield showing that sender has further data frames for the receiver.

Protected Frame – A single bit subfield indicating that this is an encrypted frame.

Order – The last subfield, of one – bit, informs the receiver that to the higher layers the frames should be in an ordered sequence.

Duration – It is a 2-byte field that specifies the time period for which the frame and its acknowledgement occupy the channel.

Address fields: There are three 6-byte address fields containing addresses of source, immediate destination and final endpoint respectively.

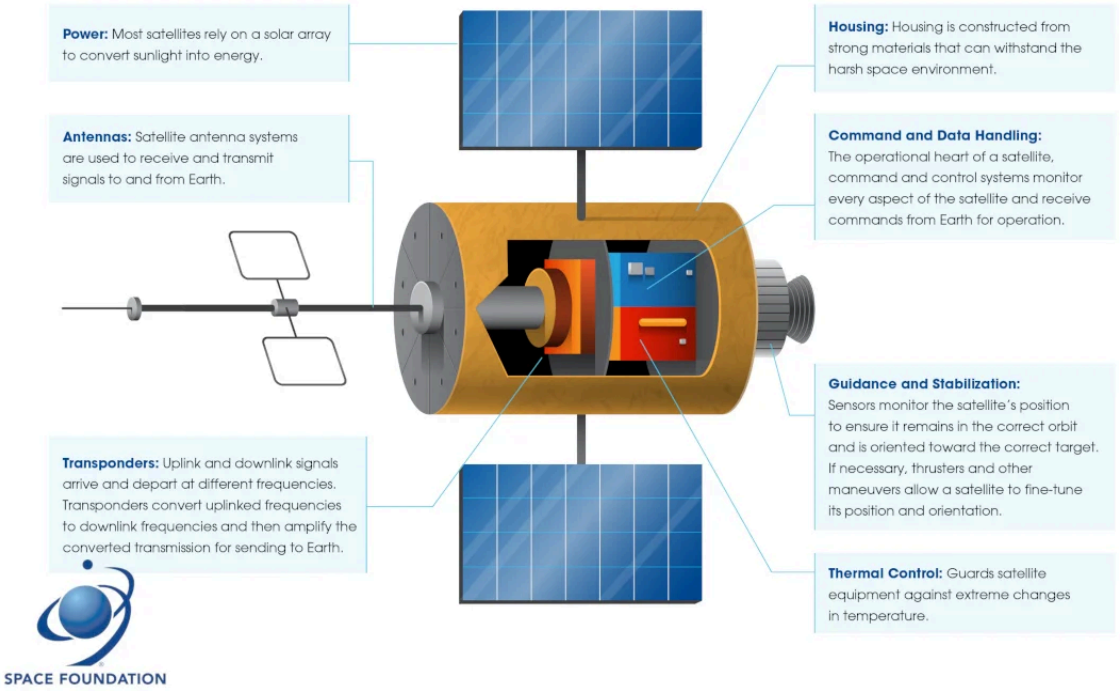
Sequence – It a 2 bytes field that stores the frame numbers. It detects duplicate frames and determines the order of frames for higher layers. Among the 16 bits, the first 4 bits provides identification to the fragment and the rest 12 bits contain the sequence number that increments with each transmission.

Data – This is a variable sized field that carries the payload from the upper layers. The maximum size of data field is 2312 bytes.

Frame Check Sequence (FCS) – It is a 4-byte field containing error detection information.

c) Explain major components of satellite communication system.

Sol:



Antennas: Satellite antenna systems are used to receive and transmit signals to and from Earth.

Command and Data Handling: The operational heart of a satellite, command and control systems monitor every aspect of the satellite and receive commands from Earth for operation.

Guidance and Stabilization: Sensors monitor the satellite's position to ensure it remains in the correct orbit and is oriented toward the correct target. If necessary, thrusters and other maneuvers allow a satellite to fine-tune its position and orientation.

Housing: Constructed from strong materials that can withstand the harsh space environment.

Power: Most satellites rely on a solar array to convert sunlight into energy.

Thermal Control: Guards satellite equipment against extreme changes in temperature.

Transponders: Uplink and downlink signals arrive and depart at different frequencies. Transponders convert uplinked frequencies to downlink frequencies and then amplify the converted transmission for sending to Earth.

8.

a) What is UI? Differentiate between UX and UI.
Sol: See 5th Batch

b) How Android offer protocols and platforms for mobile computing? Explain.
Sol: See 5th Batch

c) What is the role of Reverse tunneling in route optimization? Explain.
Sol: See 5th Batch

5th mid 1

1. Write a short note on the following: i) HLR i) VLR iii) Mobile IP iv) GSM System

i) HLR (Home Location Register)

The Home Location Register is a central database used in mobile networks. It stores important information about mobile subscribers, including their phone numbers, services they subscribe to, and their current location within the network. The HLR helps manage calls and messages by ensuring that the network knows where each user is at any given time.

ii) VLR (Visitor Location Register)

The Visitor Location Register is a temporary database that stores information about mobile users when they are in a different area from their home network. When a user travels, the VLR keeps track of their current location and services, allowing them to make and receive calls and messages. Once they return to their home area, the VLR updates the information back to the HLR.

iii) Mobile IP

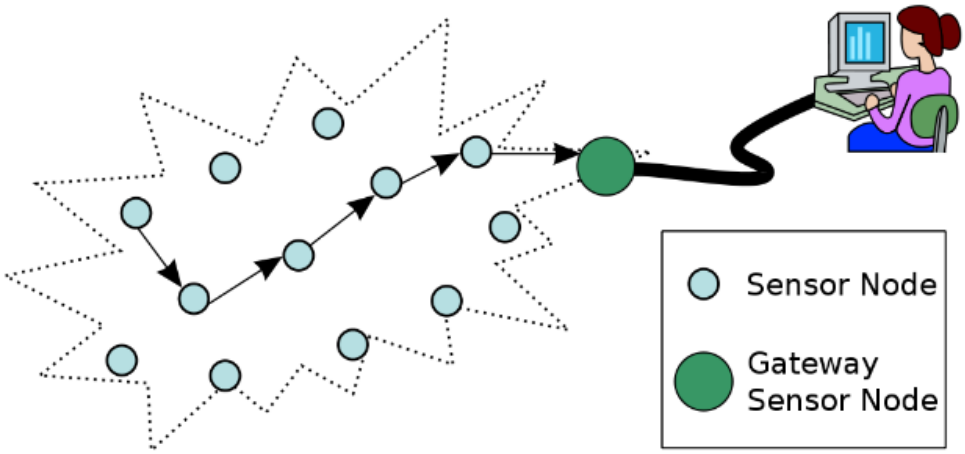
Mobile IP is a communication protocol that allows mobile devices to maintain the same IP address while moving between different networks. This means that when you change locations (like switching from home Wi-Fi to a café Wi-Fi), your device can stay connected without losing its ongoing sessions. Mobile IP helps ensure continuous access to the internet and services without interruptions.

iv) GSM System (Global System for Mobile Communications)

GSM is a widely used mobile communication system that enables phones to connect and communicate over a network. It allows for voice calls, text messaging, and data services. GSM uses a set of standards to ensure compatibility across different devices and networks. It operates by dividing the coverage area into cells, each served by a base station, which helps manage connections efficiently. GSM is known for its reliability and widespread use globally.

2. Write the differences between Infrastructure networks and Ad-hoc wireless networks.
Sol: See up

3. Design a wireless sensor network system (component-level) for smart farming.



Architecture for a WSN

Special addressing requirement

- Local unique addresses
- Data-centric
- *Example: Each node has an unique number.*

Attribute-based naming architecture

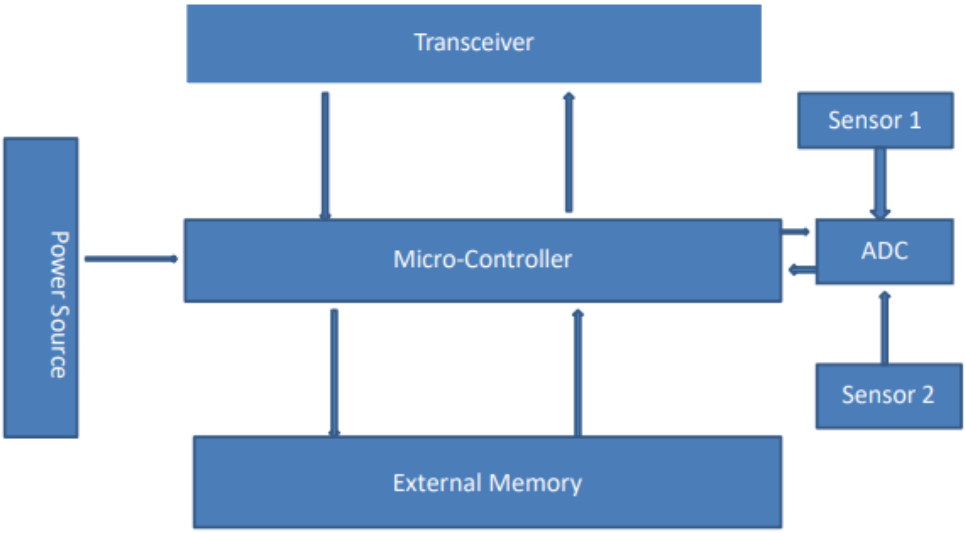
- Data is named by one or more attributes.
- *Example: Each node is distinguished by an attribute – GPS sensors are practical for this.*

Wireless Sensor Node

- sensor
  - A transducer
  - converts physical phenomenon e.g. heat, light, motion, vibration, and sound into electrical signals
- sensor node
  - basic unit in sensor network
  - contains on-board sensors, processor, memory, transceiver, and power supply
- sensor network
  - consists of a large number of sensor nodes
  - nodes deployed either inside or very close to the sensed phenomenon

27

Architecture of Sensor Node



4. What do you know about cluster and grid computing? Explain with the necessary diagrams.

Sol: See upp

5. Write down the pitfalls of distributed computing over centralized computing.

Pitfalls when Developing Distributed Systems

False assumptions made by first time developer:

- The network is reliable.
- The network is secure.
- The network is homogeneous.
- The topology does not change.
- Latency is zero.
- Bandwidth is infinite.
- Transport cost is zero.
- There is one administrator.

Or,

Disadvantages of Distributed Systems

I. Complexity
II. Network Dependency
III. Data Consistency Challenges
IV. Security Concerns
V. Increased Overhead
VI. Cost Considerations
VII. Data Integrity Issues

6. Write about pervasive computing (ubiquitous computing) with examples. Mention some security and privacy issues of mobile computing.

Sol: see upp

4th mid 1

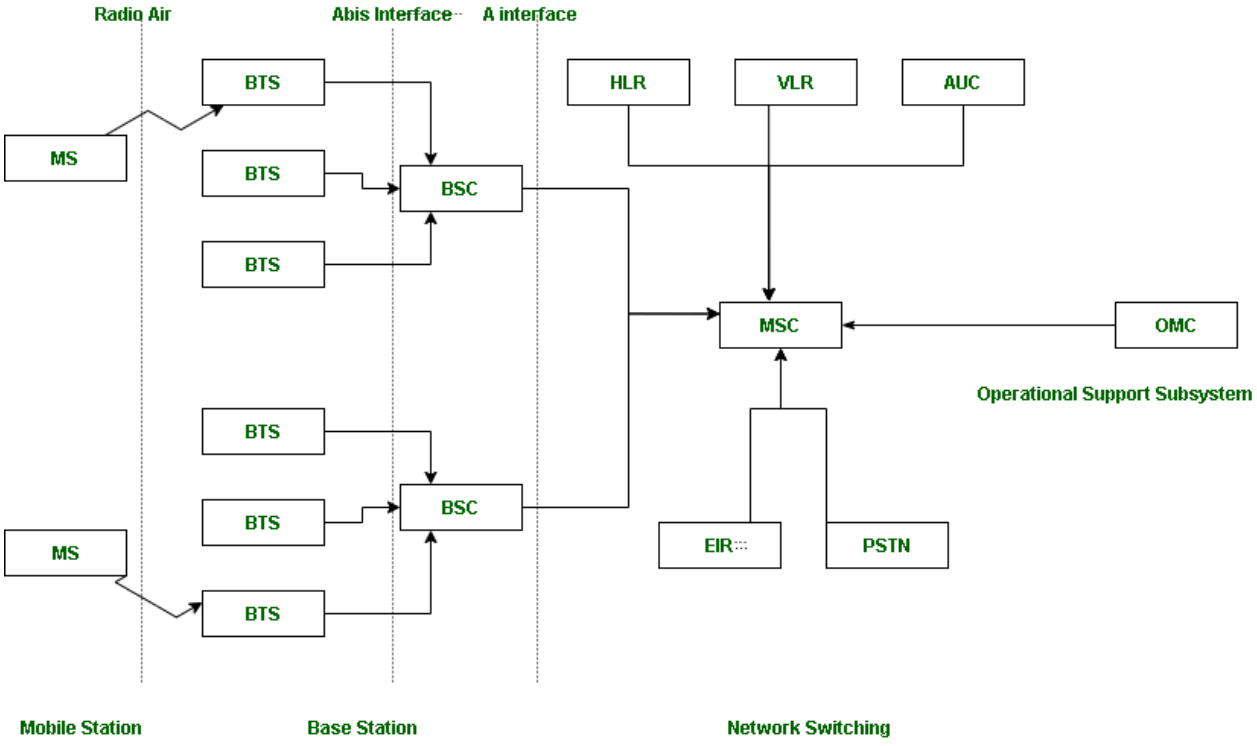
1. Write a short note on the following: i) Mobile Agent, and ii) Context-aware Computing
i) Mobile Agent
Sol: See up

2. Briefly describe the logical function of Mobile Computing.
Sol: See up

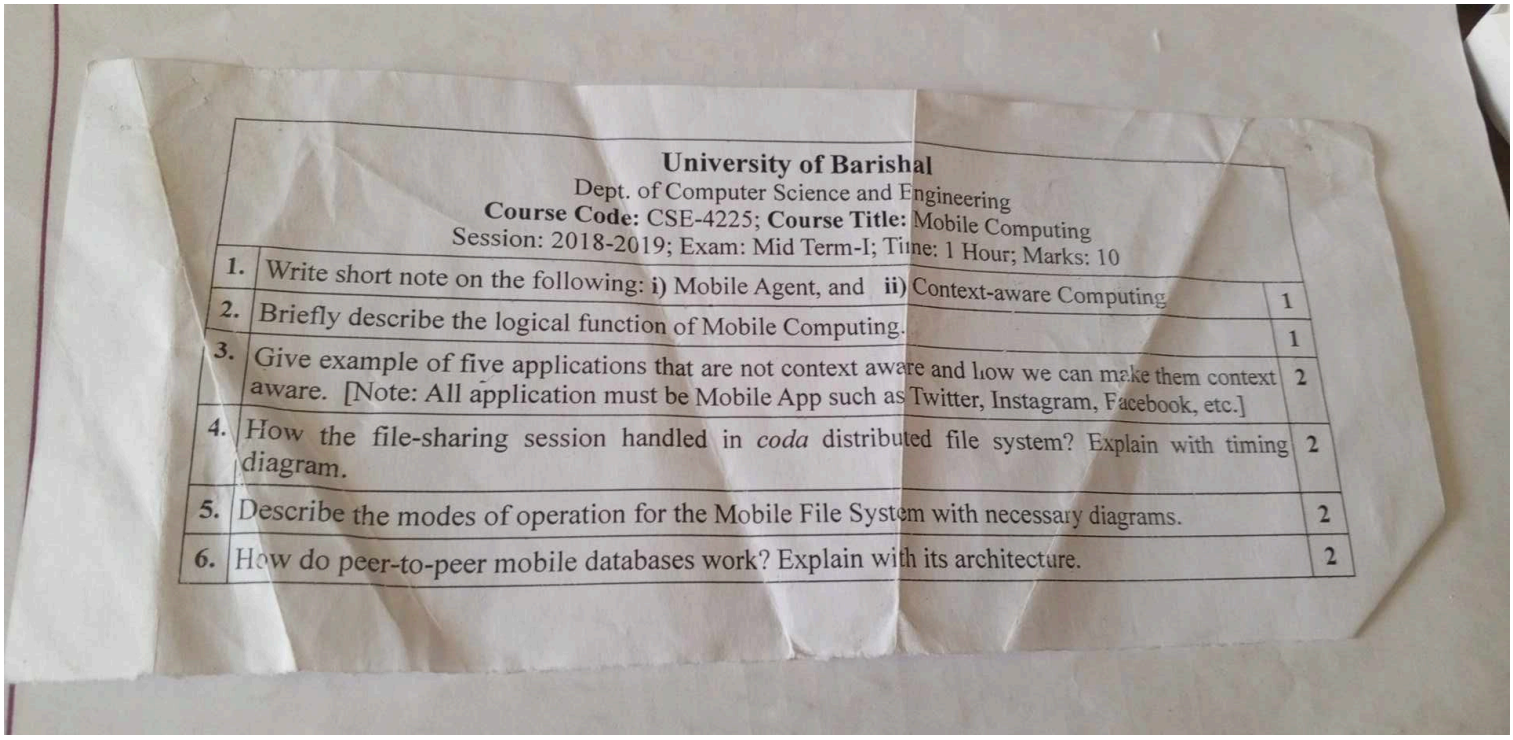
3. How does the handover decision take place in GSM depending on receiver signal strength? Explain.

Sol: See up

4. Draw the architecture of cellular networks.



6th Batch Mid



University of Barishal
Dept. of Computer Science and Engineering
Course Code: CSE-4225; **Course Title:** Mobile Computing
Session: 2018-2019; Exam: Mid Term-I; Time: 1 Hour; Marks: 10

1.	Write short note on the following: **i)** Mobile Agent, and **ii)** Context-aware Computing	1
2.	Briefly describe the logical function of Mobile Computing.	1
3.	Give example of five applications that are not context aware and how we can make them context aware. [Note: All application must be Mobile App such as Twitter, Instagram, Facebook, etc.]	2
4.	How the file-sharing session handled in *coda* distributed file system? Explain with timing diagram.	2
5.	Describe the modes of operation for the Mobile File System with necessary diagrams.	2
6.	How do peer-to-peer mobile databases work? Explain with its architecture.	2

Sol: See up

GOOD LUCK!