

Module 5

Mobile Databases

Dr. Geetha Mary A
Associate Professor ,
SCOPE, Vellore Institute of Technology,
Vellore

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Pearson Education, Inc. 2011, Elmasri/Navathe, Fundamentals of Database Systems, Sixth Edition



Mobile Databases

- Recent advances in portable and wireless technology led to **mobile computing**, a new dimension in data communication and processing.
- Portable computing devices coupled with wireless communications allow clients to access data from virtually anywhere and at any time.
- There are a number of hardware and software problems that must be resolved before the capabilities of mobile computing can be fully utilized.
- Some of the software problems – which may involve data management, transaction management, and database recovery – have their origins in distributed database systems.

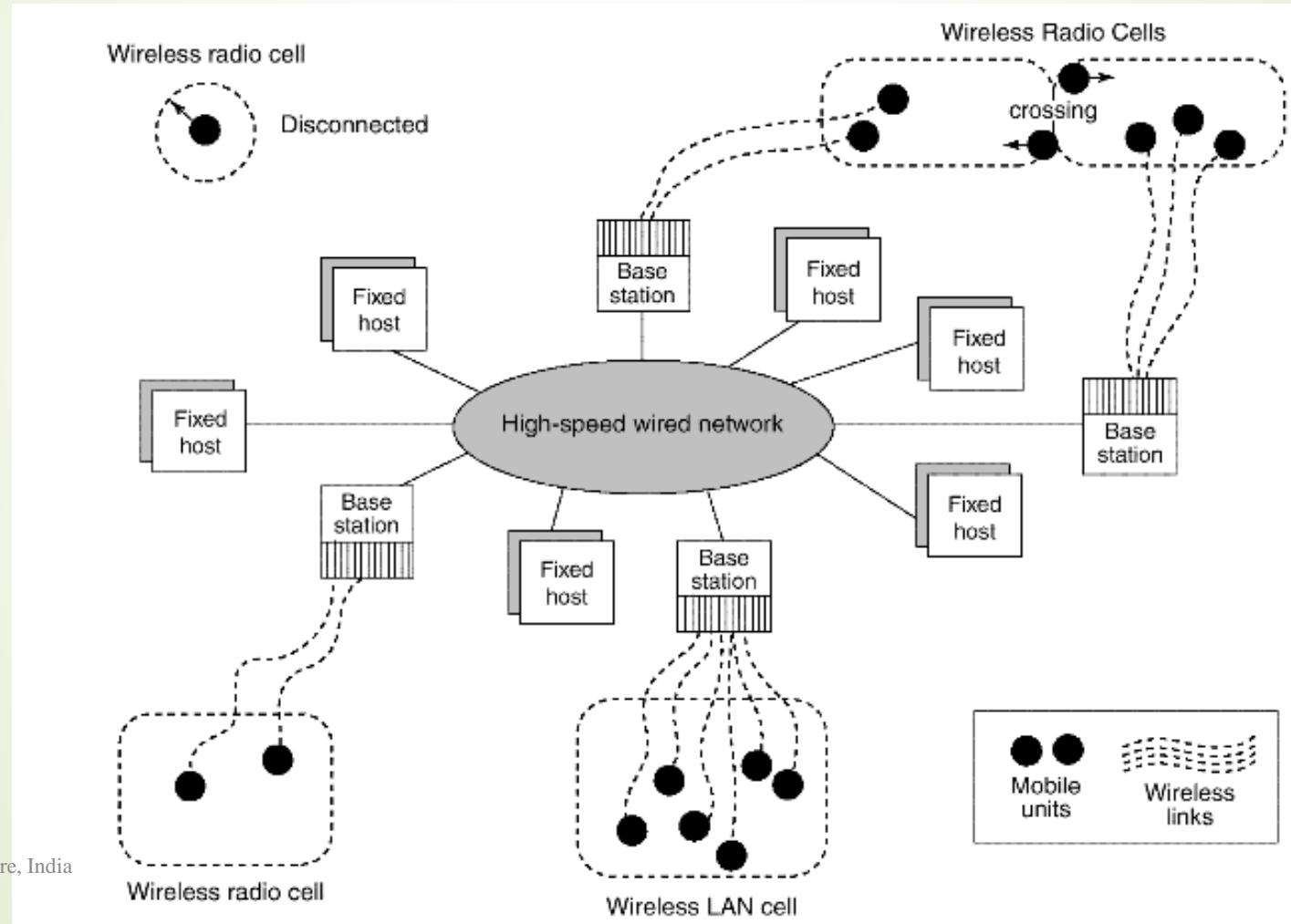


Mobile Databases(2)

- In mobile computing, the problems are more difficult, mainly:
 - The limited and intermittent connectivity afforded by wireless communications.
 - The limited life of the power supply(battery).
 - The changing topology of the network.
 - In addition, mobile computing introduces new architectural possibilities and challenges.

1. Mobile Computing Architecture

- The general architecture of a mobile platform is illustrated in Fig 30.1.





1. Mobile Computing Architecture(2)

- It is distributed architecture where a number of computers, generally referred to as **Fixed Hosts** and **Base Stations** are interconnected through a high-speed wired network.
 - Fixed hosts are general purpose computers configured to manage mobile units.
 - Base stations function as gateways to the fixed network for the **Mobile Units**.

1. Mobile Computing Architecture(3)

■ Wireless Communications –

- The wireless medium have bandwidth significantly lower than those of a wired network.
 - The current generation of wireless technology has data rates range from the tens to hundreds of kilobits per second (2G cellular telephony) to tens of megabits per second (wireless Ethernet, popularly known as WiFi).
 - Modern (wired) Ethernet, by comparison, provides data rates on the order of hundreds of megabits per second.

1. Mobile Computing Architecture(4)

➤ **Wireless Communications –**

- The other characteristics distinguish wireless connectivity options:
 - interference,
 - locality of access,
 - range,
 - support for packet switching,
 - seamless roaming throughout a geographical region.



1. Mobile Computing Architecture(5)

➤ **Wireless Communications –**

- Some wireless networks, such as WiFi and Bluetooth, use unlicensed areas of the frequency spectrum, which may cause interference with other appliances, such as cordless telephones.
- Modern wireless networks can transfer data in units called packets, that are used in wired networks in order to conserve bandwidth.

1. Mobile Computing Architecture(6)

➤ Client/Network Relationships –

- Mobile units can move freely in a **geographic mobility domain**, an area that is circumscribed by wireless network coverage.
 - To manage entire mobility domain is divided into one or more smaller domains, called **cells**, each of which is supported by at least one base station.
 - Mobile units be unrestricted throughout the cells of domain, while maintaining information **access contiguity**.

1. Mobile Computing Architecture(7)

➤ **Client/Network Relationships –**

- The communication architecture described earlier is designed to give the mobile unit the impression that it is attached to a fixed network, emulating a traditional client-server architecture.
- Wireless communications, however, make other architectures possible. One alternative is a mobile ad-hoc network (**MANET**), illustrated in 29.2.

1. Mobile Computing Architecture(9)

➤ **Client/Network Relationships –**

- In a **MANET**, co-located mobile units do not need to communicate via a fixed network, but instead, form their own using cost-effective technologies such as Bluetooth.
- In a **MANET**, mobile units are responsible for routing their own data, effectively acting as base stations as well as clients.
 - Moreover, they must be robust enough to handle changes in the network topology, such as the arrival or departure of other mobile units.

1. Mobile Computing Architecture(10)

➤ **Client/Network Relationships –**

- MANET applications can be considered as peer-to-peer, meaning that a mobile unit is simultaneously a client and a server.
 - Transaction processing and data consistency control become more difficult since there is no central control in this architecture.
 - Resource discovery and data routing by mobile units make computing in a MANET even more complicated.
 - Sample MANET applications are multi-user games, shared whiteboard, distributed calendars, and battle information sharing.



2. Characteristics of Mobile Environments

- The characteristics of mobile computing include:
 - **Communication latency**
 - **Intermittent connectivity**
 - **Limited battery life**
 - **Changing client location**

2. Characteristics of Mobile Environments(2)

- The server may not be able to reach a client.
 - A client may be unreachable because it is **dozing** – in an energy-conserving state in which many subsystems are shut down – or because it is out of range of a base station.
 - In either case, neither client nor server can reach the other, and modifications must be made to the architecture in order to compensate for this case.
 - **Proxies** for unreachable components are added to the architecture.
 - For a client (and symmetrically for a server), the proxy can cache updates intended for the server.



2. Characteristics of Mobile Environments(3)

- Mobile computing poses challenges for servers as well as clients.
 - The latency involved in wireless communication makes scalability a problem.
 - Since latency due to wireless communications increases the time to service each client request, the server can handle fewer clients.
 - One way servers relieve this problem is by broadcasting data whenever possible.
 - A server can simply broadcast data periodically.
 - Broadcast also reduces the load on the server, as clients do not have to maintain active connections to it.



2. Characteristics of Mobile Environments(4)

- Client mobility also poses many data management challenges.
 - Servers must keep track of client locations in order to efficiently route messages to them.
 - Client data should be stored in the network location that minimizes the traffic necessary to access it.
 - The act of moving between cells must be transparent to the client.
 - The server must be able to gracefully divert the shipment of data from one base to another, without the client noticing.
 - Client mobility also allows new applications that are **location-based**.

3. Data Management Issues

- From a data management standpoint, mobile computing may be considered a variation of distributed computing. Mobile databases can be distributed under two possible scenarios:
 - The entire database is distributed mainly among the wired components, possibly with full or partial replication.
 - A base station or fixed host manages its own database with a DBMS-like functionality, with additional functionality for locating mobile units and additional query and transaction management features to meet the requirements of mobile environments.
 - The database is distributed among wired and wireless components.
 - Data management responsibility is shared among base stations or fixed hosts and mobile units.

3. Data Management Issues(2)

➤ Data management issues as it is applied to mobile databases:

- Data distribution and replication
- Transactions models
- Query processing
- Recovery and fault tolerance
- Mobile database design
- Location-based service
- Division of labor

4. Application: Intermittently Synchronized Databases

- Whenever clients connect – through a process known in industry as **synchronization** of a client with a server – they receive a batch of updates to be installed on their local database.
 - The primary characteristic of this scenario is that the clients are mostly disconnected; the server is not necessarily able reach them.
 - This environment has problems similar to those in distributed and client-server databases, and some from mobile databases.
- This environment is referred to as **Intermittently Synchronized Database Environment (ISDBE)**.

4. Application: Intermittently Synchronized Databases(2)

- The characteristics of **Intermittently Synchronized Databases (ISDBs)** make them distinct from the mobile databases are:
 - A client connects to the server when it wants to exchange updates.
 - The communication can be unicast –**one-on-one** communication between the server and the client– or **multicast**– one sender or server may periodically communicate to a set of receivers or update a group of clients.
 - A server cannot connect to a client at will.

4. Application: Intermittently Synchronized Databases(3)

- The characteristics of **ISDBs** (contd.) :
 - Issues of wireless versus wired client connections and power conservation are generally immaterial.
 - A client is free to manage its own data and transactions while it is disconnected. It can also perform its own recovery to some extent.
 - A client has multiple ways connecting to a server and, in case of many servers, may choose a particular server to connect to based on proximity, communication nodes available, resources available, etc.