

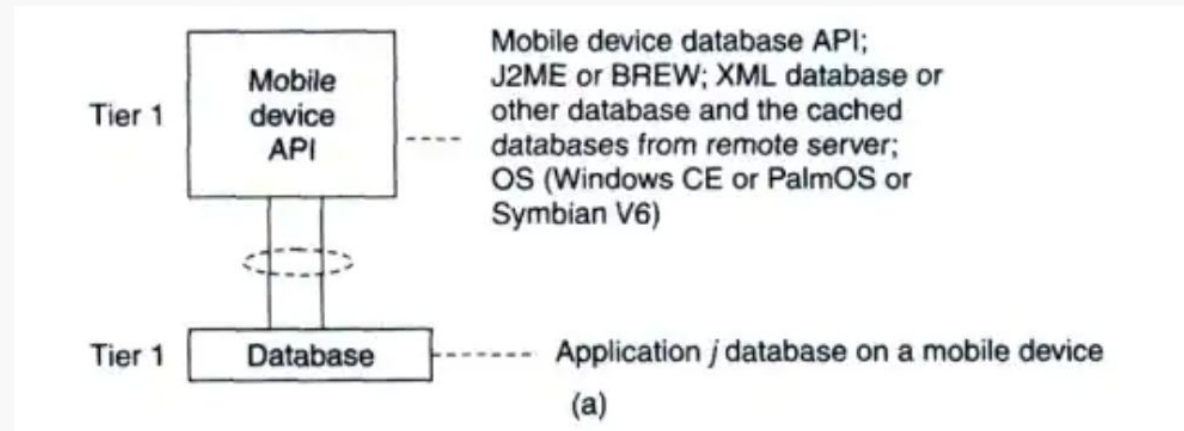
DATABASES

Introduction to database

- A database is a collection of stored records or information
- A mobile is not always connected to the server or network; neither does the device retrieve data from the server or a network for each computation
- The device caches some specific data, which may be required for future computation, during the interval in which the device is connected to the server or network

Database Hoarding

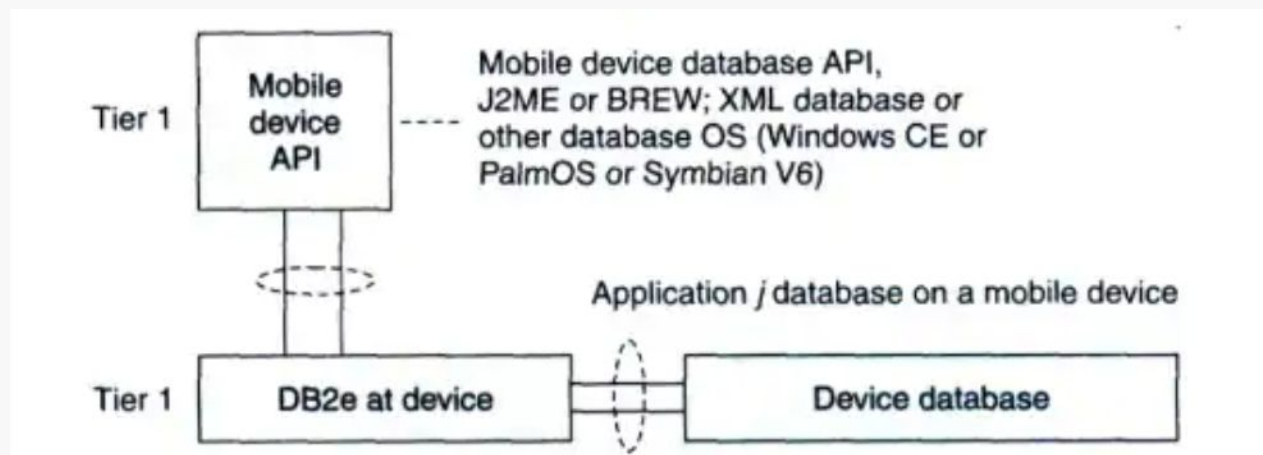
- Data base hoarding maybe done at the application tier itself



- Mobile device API directly retrieves the data from a database

Database Hoarding

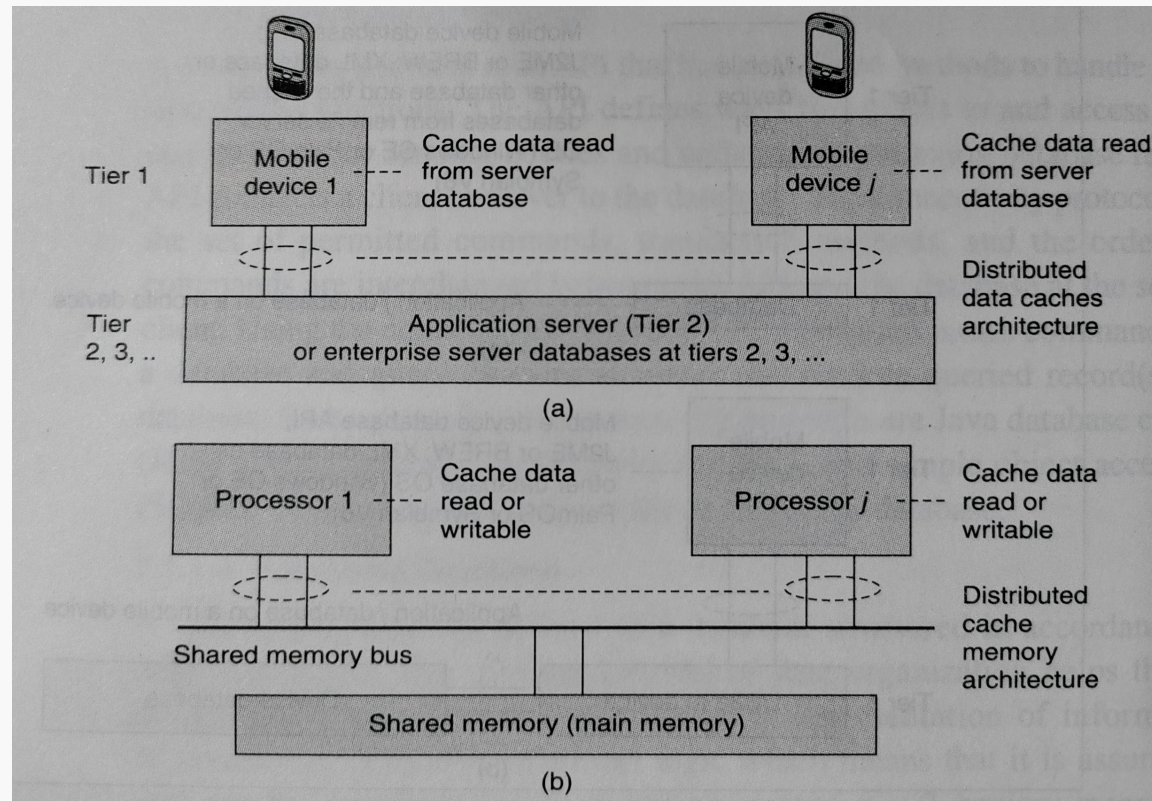
- Mobile device API directly retrieves the data from a database through a program
- IBM DB1e Everyplace is a relational database which has been designed to reside at the device



Database Hoarding

- The database architecture shown below is for two-tier or multi-tier databases.
- The databases resides at the remote servers and the copies of these databases are cached at the client tiers

Database Hoarding



Advantages and disadvantages

Advantages

- There is no access latency
- Instantaneous data access to hoarded or cached data

Disadvantages

- Consistency of the cache data with the database at the server needs to be maintained

Data Caching

- Hoarded copies of the databases at the servers are distributed to the mobile devices from the enterprise services or application databases
- The copies cached at the devices are equivalent to the cache memories at the processors in a multiprocessors system with a shared main memory and copies of the main memory data stored at different location
- Cache access protocols
- Pre-fetching

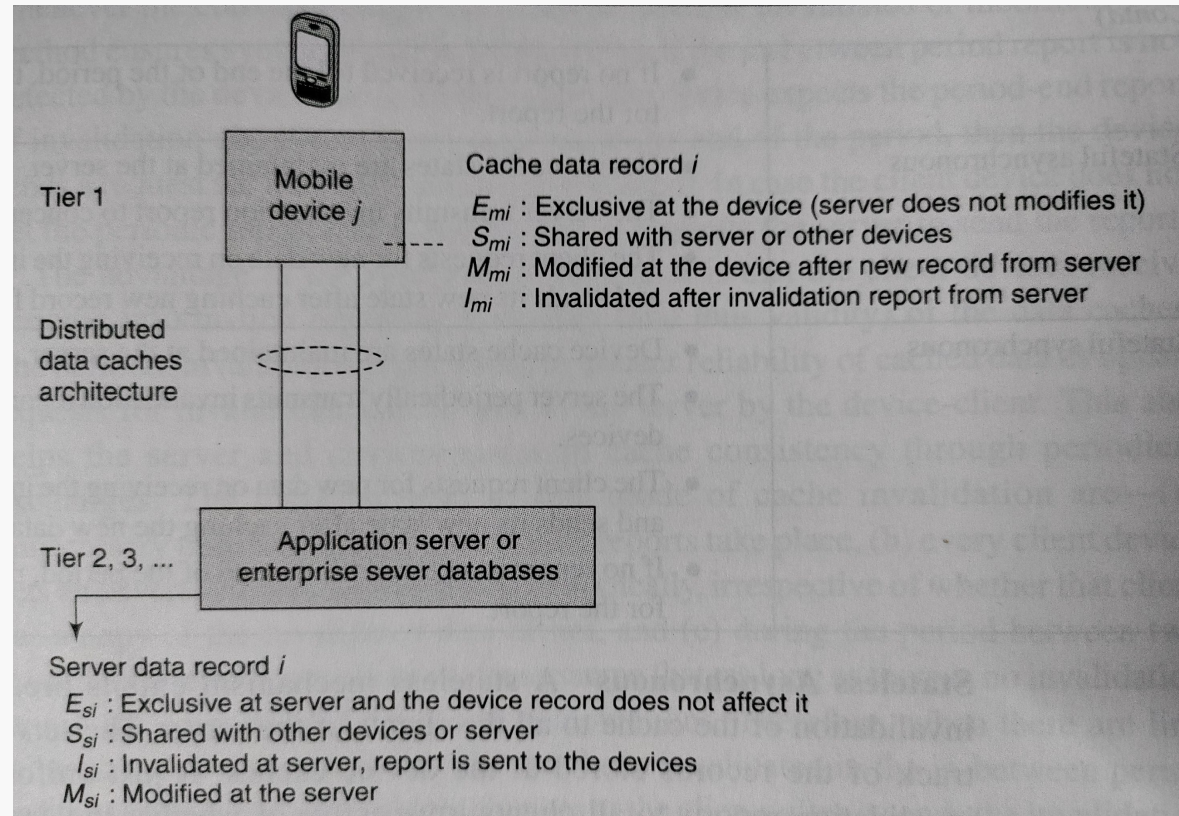
Caching Invalidation Mechanism

- A cached record at the client device may be invalidated.
- Cache invalidation is a process by which a cached data item or record becomes invalid and thus unusable because of modification, expiry, or invalidation at another computing system or server
- Used to synchronize the data at other processors whenever the cache-data is written by a processor

Caching Invalidation Mechanism

- A cache consists of several records
- The cache at the mobile devices or server database at any given time can be assigned one of the four possible tags indicating its state - modified, exclusive, shared, and invalidated(M,E,S, and I)
- M - modified
- E - exclusive
- S- shared
- I - invalid

Caching Invalidation Mechanism



Caching Invalidation Mechanism

- Cache invalidation mechanisms in mobile devices are triggered or initiated by the server
1. Stateless asynchronous
 2. Stateless synchronous
 3. Stateful asynchronous
 4. Stateful synchronous

Caching Invalidation Mechanism

Mechanism

Stateless asynchronous

Procedure

- Device cache states are not maintained at the server
- The server advertises invalidation report
- On receiving an invalidation report, the client requests for or caches the new data records

Stateless synchronous

- Device cache states are not maintained at the server
- The server periodically advertises invalidation report
- The client requests for or caches the data on receiving the invalidation report
- If no report is received till the end of the period, the client requests for the report

Caching Invalidation Mechanism

Mechanism

Stateful asynchronous

Procedure

- Device cache states are maintained at the server
- The server transmits invalidation report to concerned devices
- The client requests for new data on receiving the invalidation report and sends its new state after caching new records from the server

Stateful synchronous

- Device cache states are maintained at the server
- The server periodically transmits invalidation reports to the concerned devices
- The client request for new data on receiving the invalidation reports, and sends its new state after caching the new data
- If no report is received till the end of the period, the client requests for the report

Data Cache maintenance in mobile environments

- The time taken for the application software to access a particular record is known as access latency
- Caching and hoarding the record at the device reduces access latency to 0
- Data cache inconsistency means that data records cached for applications are not invalidated at the device when modified at the server but not modified at the device

Data Cache maintenance in mobile environments

- It can be maintained by the three methods :
 1. Cache invalidation mechanism
 2. Polling mechanism
 3. Time-to-live

Web Cache maintenance in mobile environments

- The mobile devices and their servers can be connected to a web-server
- Web cache at the device stores the web server data and maintains it in a manner similar to the cache maintenance for server data
- Web cache maintenance is necessary in a mobile environment to overcome access latency in downloading from websites due to disconnections

Web Cache maintenance in mobile environments

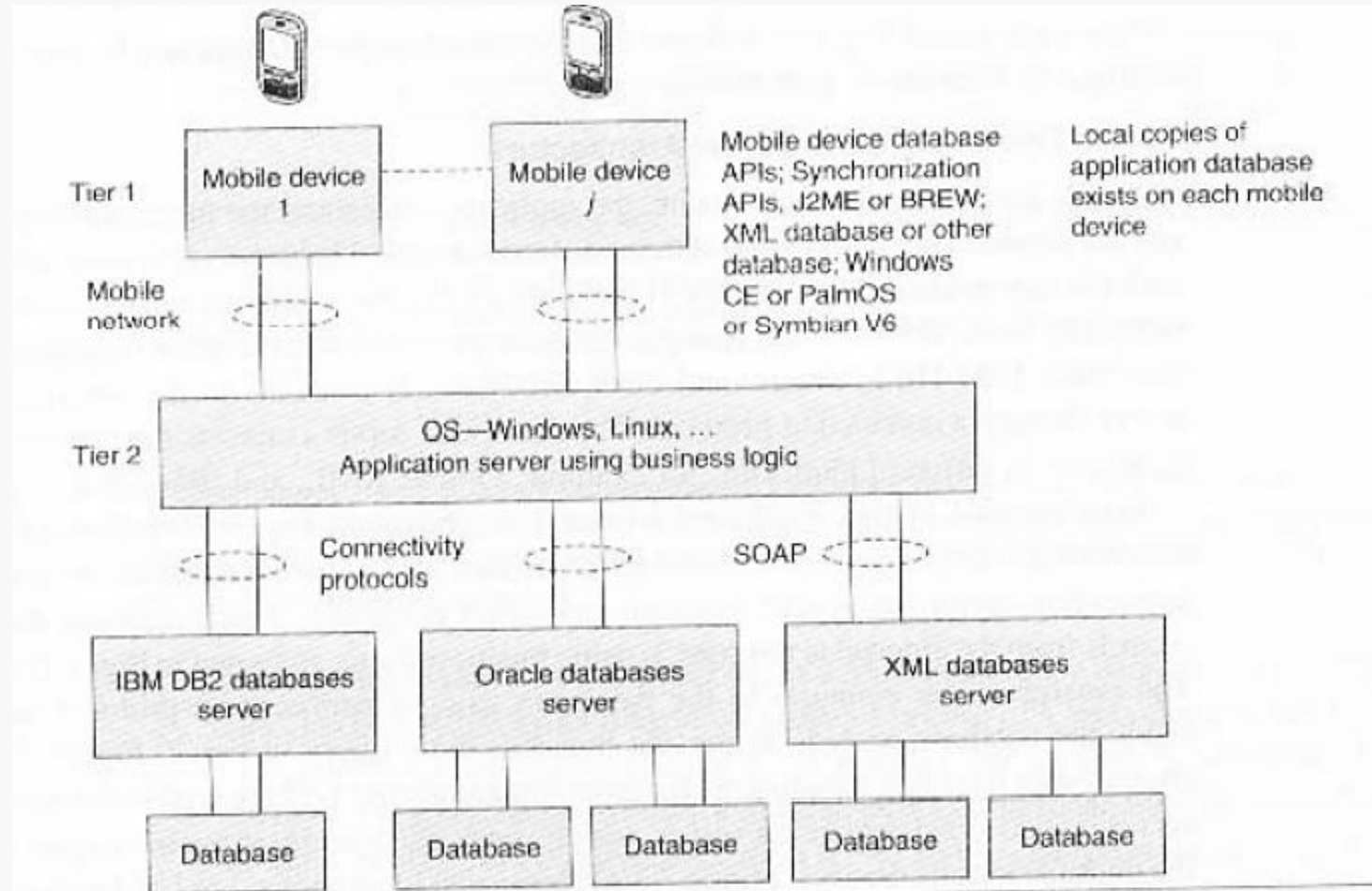
Web cache consistency can be maintained by two methods

1. Time to live mechanism
2. Power-aware computing mechanism

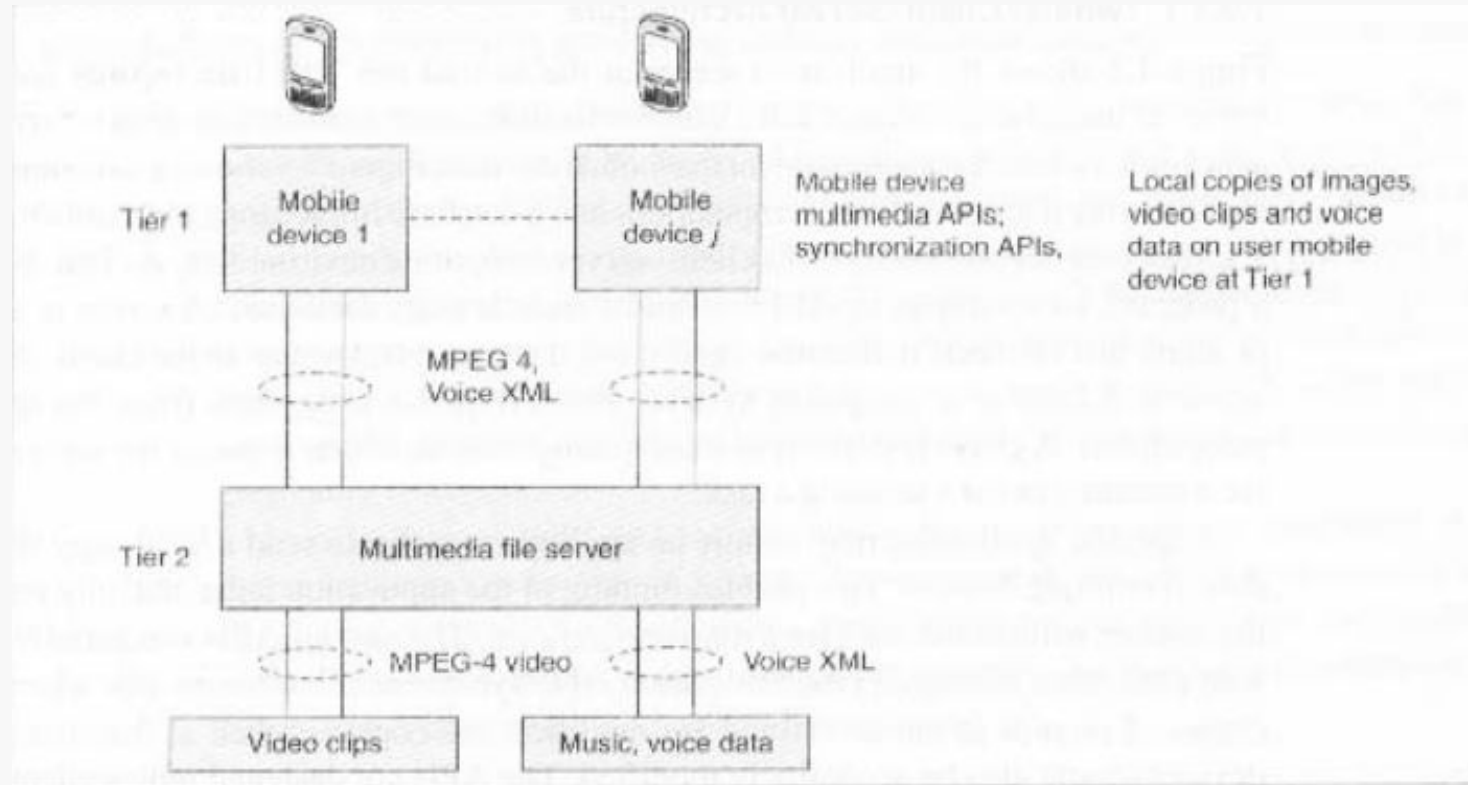
Client- Server computing

- Client- server computing is a distributed computing architecture in which there are two types of nodes- server and the clients
- The client and the server can be on the same computing system or on different computing systems.
- When the client and the server are on the same computing systems then the number of tiers, $N=1$
- When the client and the server are on different computing system on the network, then $N=2$

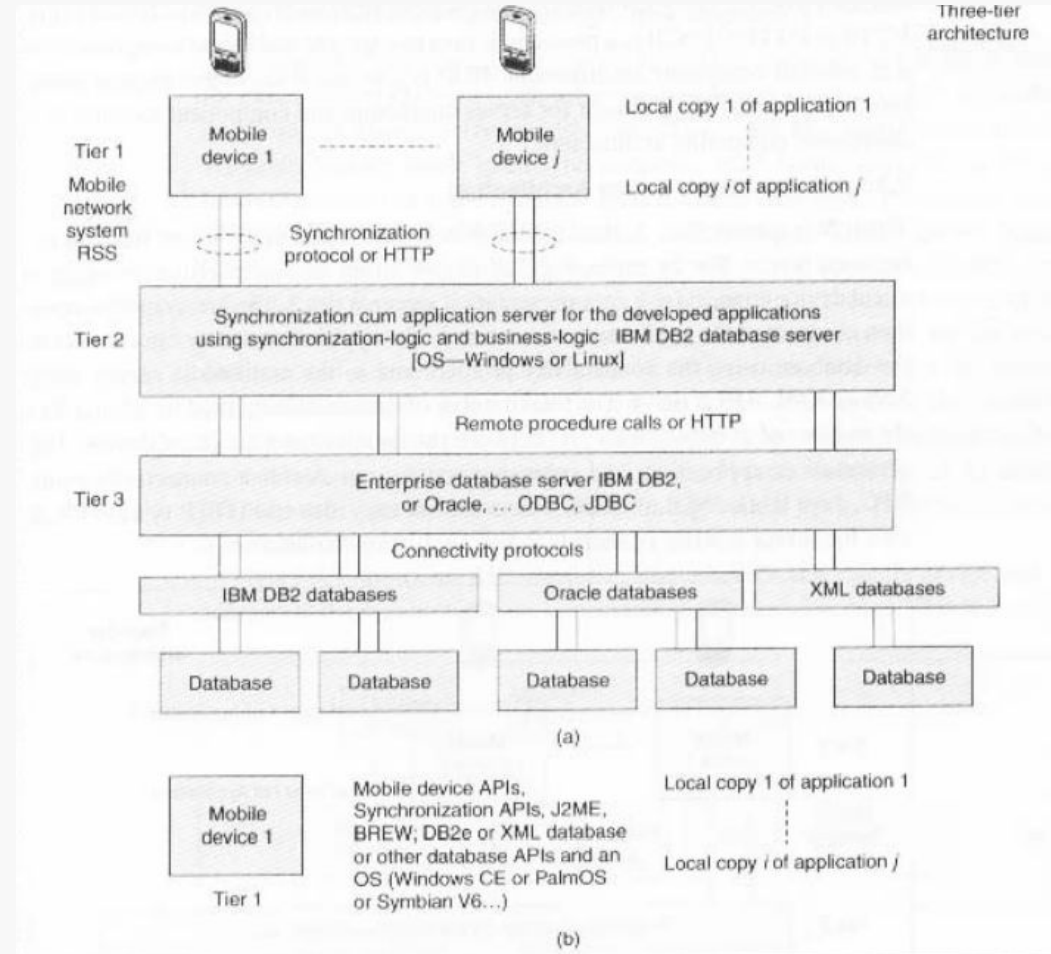
Two- tier Client-server Architecture



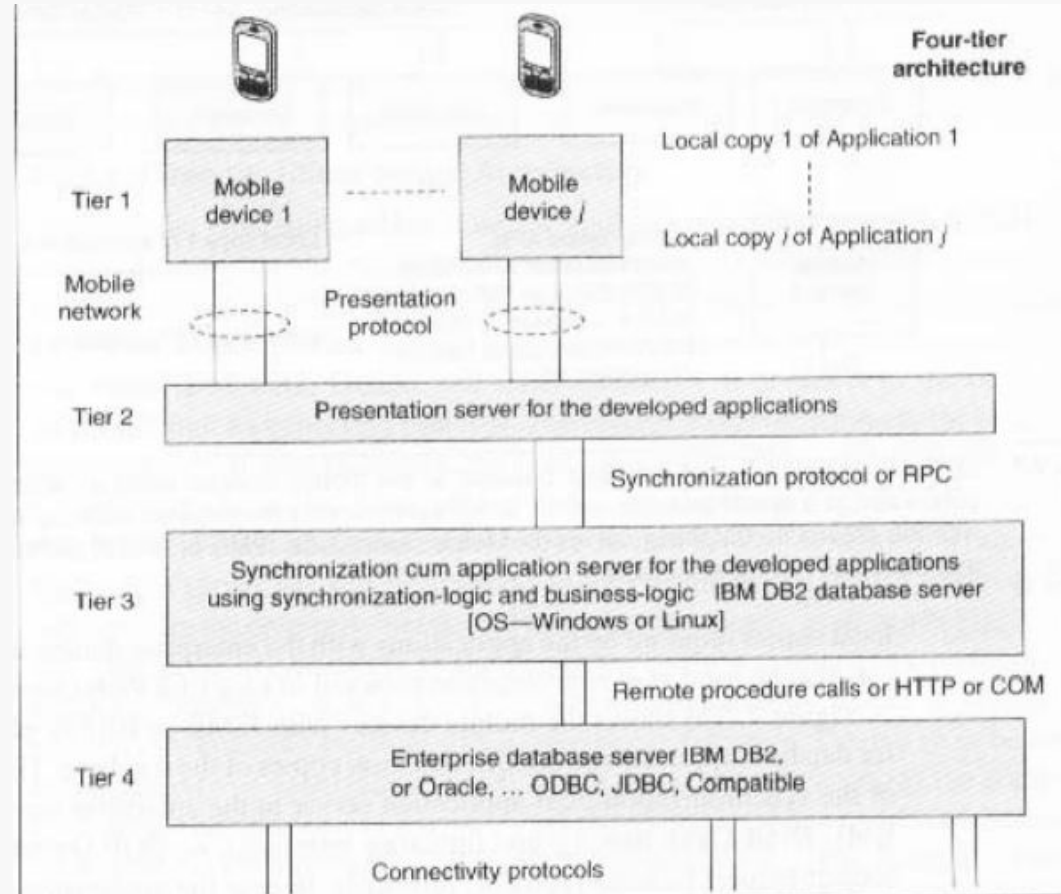
Two- tier Client-server Architecture



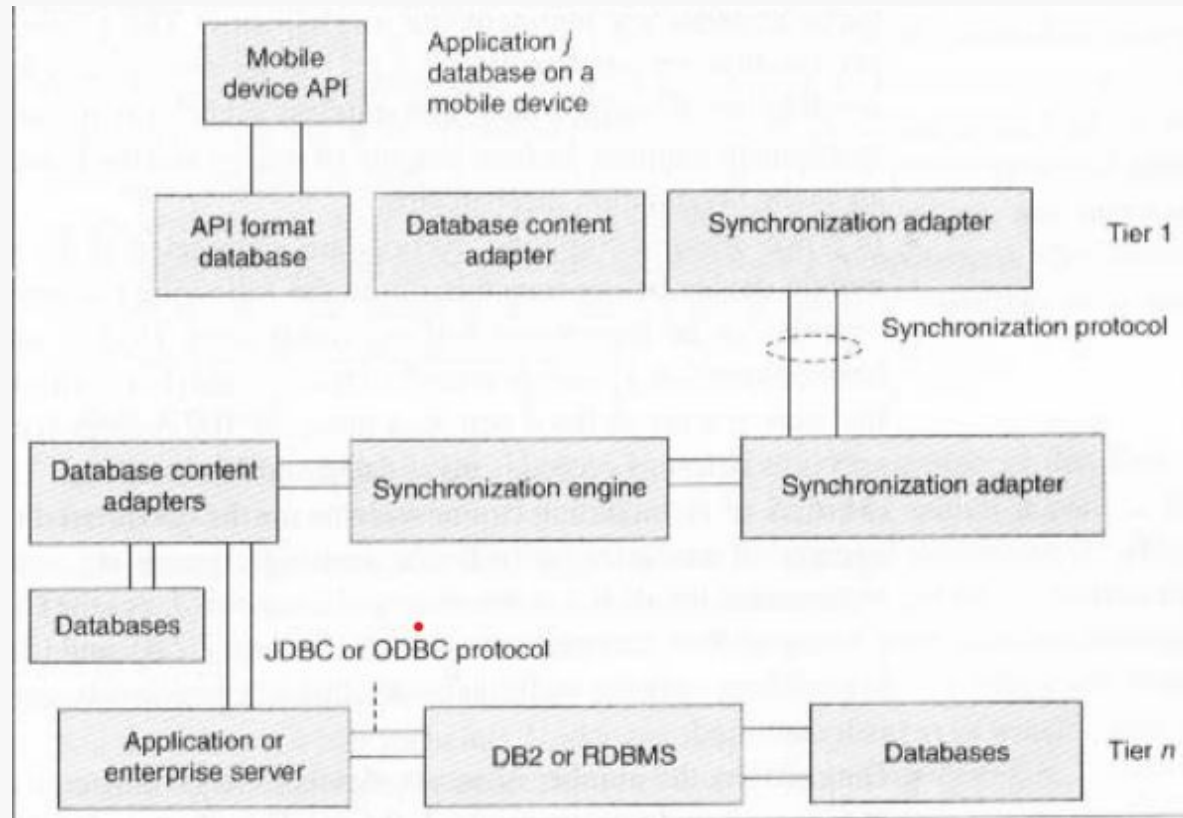
Three- tier Client-server Architecture



N- tier Client-server Architecture



Client-server Computing with adaptation



Context-aware Computing

- A context-aware computing system is one which has user, device, and application interfaces such that, using these, the system remains aware of the past and present surrounding situations, circumstances, or actions such as the present mobile network, surrounding devices or systems, changes in the state of the connecting network, physical parameters such as present time of the day, presently remaining memory and battery power, presently available nearest connectivity, past sequence of action of the device user, past sequence of applications and previously cached data records, and takes these into account during computations.

Context-aware Computing

- Structural Context
- Implicit and explicit context



Context-aware Computing

Context Types in Context-aware Computing

1. Physical Context
2. Computing Context
3. User Context
4. Temporal Context
5. Structural Context

Transaction Models

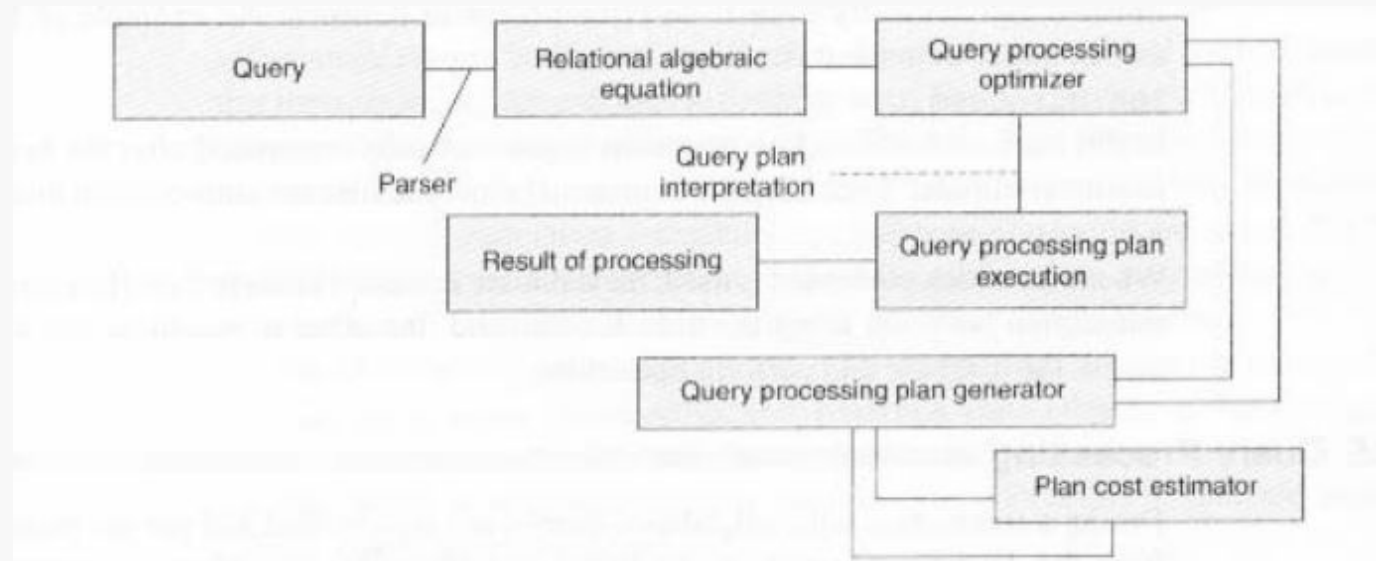
- A transaction is the execution of interrelated instructions in a sequence for a specific operation on a data
- Transaction models must maintain data integrity and must enforce a set of rules called ACID rules
 1. Atomicity
 2. Consistency
 3. Isolation
 4. Durability

Transaction Models

- Consider a base class library included in Microsoft.NET
- It has a set of computer software components called ADO.NET
 1. BeginTransaction
 2. Commit
 3. RollBack

Query Processing

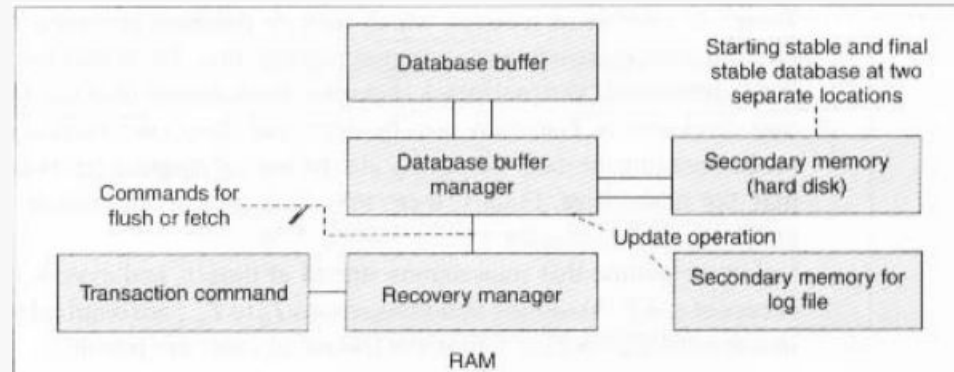
- It means making a correct as well as efficient execution strategy by query decomposition and query-optimization



Data recovery Process

- Data is non-recoverable in case of media failure, intentional attack on the database and transactions logging data, or physical media destruction
- Data recovery is possible in other cases and ensures atomicity and durability

Data recovery Process



Data recovery Process

The recovery manager uses a log file, which logs actions in the following manner

1. Each instruction for a transaction for update must be logged
2. Database read instructions are not logged
3. Log files are stored at a different storage medium
4. Log entries are flushed out after the final stable state database is stored

Data recovery Process

Each logged entry contains the following fields

- Transaction type
- Transaction id
- Operation-type
- Object on which the operation is performed
- Pre-operation and post-operation values if the object

Data recovery Process

Aries algorithm is used for recovering lost data

1. Analyze from last checkpoint and identify all dirty records in the buffer
2. Redo all buffered operations logged in the update log to finish and make final page
3. Undo all write operations and restore pre-transaction values

Data recovery Process

Recovery models

1. Full recovery model
2. Bulk logged recovery model
3. Simple recovery model

Thank You