GRAPHIC ERA HILL UNIVERSITY BHIMTAL
MOBILE COMPUTING (TOE 811)CSE 8TH SEM
UNIT-3 NOTES

DATA MANAGEMENT ISSUE:

Data management technology that can support easy data access from and to mobile devices is among the main concerns in mobile information systems. Mobile computing may be considered a variation of distributed computing. The two scenarios in which mobile databases is distributed are:

1) Among the wired components, the entire database is distributed, possibly with full or partial replication
2) 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.

Here are some of the issues which arises in **data management** of the mobile databases:

1. Mobile database design – Because of the frequent shutdown and for handling the queries, the global name resolution problem is compounded.
2. Security – The data which is left at the fixed location is more secure as compared to mobile data. That is mobile data is less secure. Data are also becoming more volatile and techniques must be able to compensate for its loss. The most important thing needed in this environment is the authorizing access to critical data and proper techniques.
3. Data distribution and replication – Uneven distribution of data among the mobile units and the base stations take place here. Higher data availability and low cost of remote access is there in data distribution and replication. The problem of Cache management is compounded by the consistency constraints. The most updated data and frequently accessed data is provided by the Caches to the mobile units. It process their own transactions. There is most efficient access of data and higher security is available.
4. Replication issues – There is increase of costs for updates and signaling due to increase in number of replicas. Mobile hosts can move anywhere and anytime.
5.**Transaction models –** In mobile environment, the issues of correctness of transactions and fault tolerance are aggravated. All transactions must satisfy the ACID properties, these are atomic, consistency, isolation, and durability. Depending upon the movement of the mobile unit, possibly on multiple data sets and through several base station, a mobile transaction is executed sequentially. When the mobile computers are disconnected, ACID properties gets hard to enforce. Because of the disconnection in mobile units, there is expectation that a mobile transaction will be lived long.
6. **Recovery and fault tolerance –** Fault tolerance is the ability of a system to perform its function correctly even in the presence of internal faults. Faults can be classified in two types: transient and permanent. Without any apparent intervention, a transient fault will be eventually disappeared but a permanent fault will remain unless it is removed by some external agency.

The characterization of mobile computing is done by:

- Limiting resource availability
- Frequent disconnection
- High mobility

- Low bandwidth

7. **Location based service –** One of the most challenging tasks which must be undertaken is determining the location of mobile users, which must be undertaken in order to enable a location based service. A cache information becomes sale when clients move location dependent. Eviction techniques are important in this case.Issues that arises in location and services are:

- User Privacy
- Diverse mobile mapping standards
- Market capability
- Interoperability

8. **Query processing –** Because of the mobility and rapid resource changes of mobile units, Query optimization becomes the most complicated. That is query processing is affected when mobility is considered. There is a need to returned a query response to mobile units that may be in transit.The cost that affects the most in centralized environments is the input/output

Data Replication for mobile computers:

Data Replication in Mobile Computing

Data Replication

Data Replication in mobile computing means the sharing of information to ensure data consistency between software and hardware resources connected via the internet, to improve reliability, availability, fault-tolerance, and accessibility of data.

In simpler terms, data replication is the process of storing different copies of the database at two or more sites in order to improve data availability in less time and at a cheaper cost.

Data replication in mobile computing is a popular fault tolerance technique for distributed databases.

Advantages of Data Replication

In modern mobile computing, scenario data replication has been adopted as an efficient way to ensure data availability, integrity, and an effective means to achieve fault tolerance. Data replication not only ensures the availability of the data but also minimize the communication cost, increase data sharing, and enhance the security of sensitive data. Data replication in mobile computing also determines when and which location to store the replica of data, controlling different data replicas over a network for efficient utilization of the network resources.

Data Replication Benefits

Important benefits of data replication are as below-

- **Reliability** − Data replication provides the reliability of data. In case of failure of any site, thedatabase system continues to work since a copy is available at another site(s).
- **Reduction in Network Load** − since local copies of data are available through datareplication. Therefore, query processing can be done with reduced network usage,particularly during prime hours.
- **Data updating can be done at non-prime hours** – Due to data replication data can beupdated easily.
- **Quicker Response** − Availability of local copies of data ensures quick query processing and consequently quick response time.
- **Simpler Transactions** − Transactions require less number of joins of tables located at different sites and minimal coordination across the network. Thus, they become simpler innature.

Disadvantages of Data Replication

- **Increased Storage Requirements** − Maintaining multiple copies of data is associated with increased storage costs. The storage space required is in multiples of the storage required fora centralized system.
- **Increased Cost and Complexity of Data Updating** − each time a data item is updated, the update needs to be reflected in all the copies of the data at the different sites. This requirescomplex synchronization techniques and protocols.

Goals of data replication

Data replication is performed with the purpose of

- Increasing the availability of data.
- Speeding up the query evaluation.

Types of data replication

There are two types of data replication

1. Synchronous Replication

In synchronous replication, the replica of the database is modified immediately after changes are made in the relation table.

So there is no difference between the original data and the replicated data table.

2. Asynchronous replication

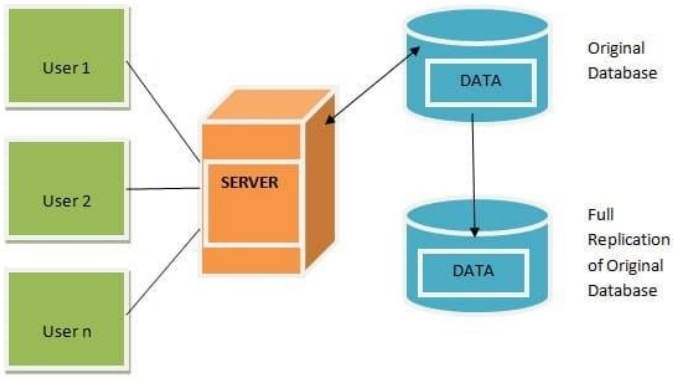
In asynchronous replication, the replica will be modified after commit action is fired on to the database.

Replication Schemes

The three replication schemes are as follows:

1. Full Replication scheme

In full replication scheme, the database is available at all the locations to ease the user in the communication network



Advantages of full replication

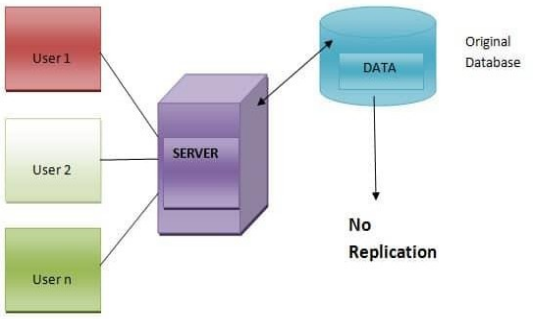
- It gives high availability of data. In this scheme, the database is available at each location.
- It supports faster execution of queries.

Disadvantages of full replication

- In a full replication scheme, concurrency control is difficult to achieve in full replication.
- During updating each and every side need to be updated therefore update operation is slower.

2. No Replication

No replication means each fragment is stored exactly at one location only.



Advantages of no replication

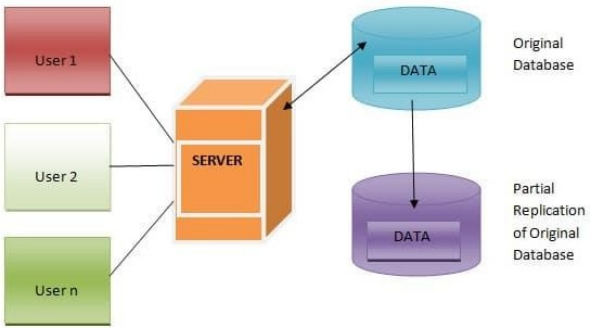
- Concurrency can be easily minimized.
- Easy recovery of data becomes easy.

Disadvantages of no replication

- Poor availability of data.
- Slows down the query execution process, because multiple clients are accessing the samedata at the same server.

3. Partial replication

A partial replication scheme means only part of the or data fragments are replicated.



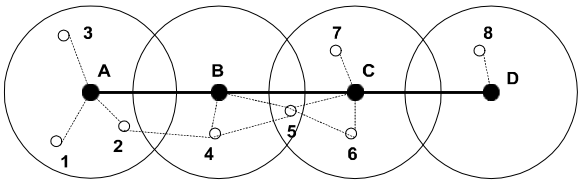
Adaptive clustering in mobile wireless networks:

Personal communications and mobile computing require a wireless network infrastructure which is fast deployable, possibly multihop, and capable of multimedia service support. The first infrastructure of this type was the Packet Radio Network (PRNET), developed in the 70'sto address the battlefield and disaster recovery communication requirements. PRNET was totally asynchronous and was based on a completely distributed architecture. It handled datagram traffic reasonably well, but did not offer efficient multimedia support.

under the WAMIS (Wireless Adaptive Mobile Information Systems) and Glomo ARPA programs several mobile, multimedia, multihop (M3) wireless network architectures have beendeveloped, which require some form of synchronous, time division infrastructure.

Figure 1, shows the cellular model commonly used in the wireless networks. A, B, C, and

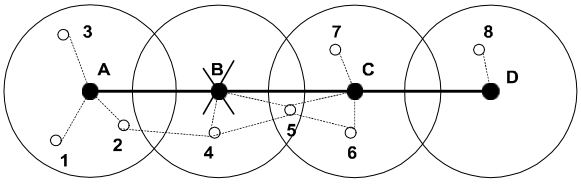
Figure 1: Conventional cellular networks (single-hop)



D are fixed base stations connected by a wired backbone. Nodes 1 through 8 are mobile nodes. A mobile node is only one hop away from a base station.Communications between two mobile nodes must be through fixed base stations and the wiredbackbone.

In parallel with (and separately from) the single hop cellular model, another type of model, based on radio to radio packet multihopping, has been emerging to serve a growing number of applications which rely on a fast deployable, wireless infrastructure.

The classic examples are battlefield communications and (in the civilian sector) disaster recovery (fire, earthquake) andsearch and rescue. A recent addition to this set is the ''adhoc'' personal communications network, which could be rapidly deployed on a campus. the multihop requirement may also arise in cellular networks. If a base station fails, a mobile node may not be able to access the wired network in a single hop. For



example, in Figure 2, if base station B fails, node4 must access base stations A or C through node 2 or node 5 which act as wireless multihop repeaters.

In order to support multimedia traffic, the wireless network layer must guarantee QoS

(band- width and delay) to real time traffic components. Our approach to provide QoS to multimedia consists of the following two steps: (a) partitioning of the multihop network into clusters, so that controlled, accountable bandwidth sharing can be

accomplished in each cluster; (b) establishment of Virtual Circuits with QoS guarantee.

The objective of the clustering algorithm is to partition the network into several clusters.Optimal cluster size is dictated by the tradeoff between spatial reuse of the channel (which drivestoward small sizes), and delay minimization (which drives towards largesizes). Other constraints also apply, such as power consumption and geographicallayout. Cluster size is controlled through the radio transmission power.

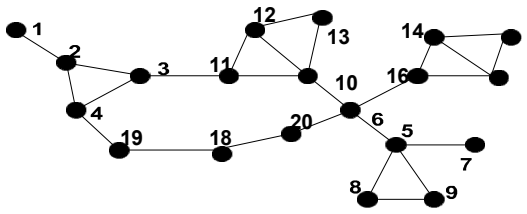
These assumptions are common to most radio data link protocols.

A1: Every node has a unique ID and knows the IDs of its 1-hop neighbors. Thiscan be provided by a physical layer for mutual location and identification of radio nodes.

A2: A message sent by a node is received correctly within a finite time by all its 1-hop neighbors.

A3: Network topology does not change during the algorithm execution.

We can find from this algorithm that each node only broadcasts one *cluster* message before the algorithm stops, and the time complexity is $O(|V|)$ where V is the set of nodes. The clustering algorithm converges very rapidly. In the worst case, the convergence is linear in the total number of nodes. Consider the topology in Figure 3. After clustering, in Figure 4,we can find six clusters in the system, which are
{1,2}, {3,4,11}, {5,6,7,8,9}, {10,12,13},{14,15,16,17}, {18,19,20}. To prove the correctness of the algorithm we have to show that: 1) every node eventually determinesits cluster; 2) in a cluster, any two nodes are at most two hops away; 3) the algorithm terminates.



CODA FILE SYSTEM:

Kindly refer the pdf .

DISCONNECTED OPERATIONS:

If all of the servers that an object resides on become inaccessible, then the client will use the cached copy of the object (if present) as a valid replica. When the client does this, it is operating in *disconnected mode* .

Disconnected mode may be the result of a network failure, or it could be the result of removing a laptop from the network. If you make sure all of the files you want to use are cached on your laptop, you can travel with it and access your files as if you were still on the network.

Unfortunately, a cache miss while operating in disconnected mode is not maskable, and you will get a connection timed out error message. Coda allows you to mark or *hoard* files with caching priorities to help keep the ones you want in the cache.

When you are in disconnected mode, you may want to checkpoint the modify log that Coda keeps of which directories have changed. Use **cfs checkpointml** to do this.

Checkpointing the modify log will ensure that changes you have made will not be lost if the cache manager crashes severely. The checkpointed log files are an identical copy of the in-memory logs that Coda uses when it re-integrates with the servers.

Coda adapts easily to low bandwidth connections like (PPP or SLIP modem links). You can use this to periodically reintegrate and cache new files when you are on a trip.

When you reintegrate after operating in disconnected mode, keep an eye on your codacon output or run the command:

```
%

tail -f /usr/coda/etc/console
```

This file will let you know if the reintegration was successful. If it was not, then the files that you modified will be put in a tar file in `/usr/coda/spool/ uid` . Reintegration fails, for example, when you modified a file in disconnected mode and someone else also modified that file on the servers.

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UNIT-3 Assignment-03

1) How do data quality issues impact decision-making processes within an organization?

2) Discuss the role of data security in effective data management practices?
3) How do emerging technologies such as big data and IoT exacerbate data management challenges?
4) What are the main challenges of data replication in mobile computing environments?
5) Explain the differences between optimistic and pessimistic replication strategies?
6) How does data replication contribute to improving data availability and resilience in mobile systems?
7) What is adaptive clustering, and how does it differ from traditional clustering approaches?
8) How do adaptive clustering algorithms dynamically adjust to changing system conditions?
9) Explain how Coda supports disconnected operation in mobile computing environments?
10) Can you provide examples of industries or applications where the Coda file system is particularly beneficial?