**Database Recovery Techniques**

**Introduction**

This chapter deals with some of the techniques that can be used to recovery a database from failure.

Recovery restores a database from a given state usually inconsistent to a previously consistent state recovery techniques are based on the atomic transaction property.

All portions of the transaction must be treated as a single logical Chapter of work in which all operations must be applied and completed to produce a consistent database.

If for any reason any transaction operation cannot be completed the transaction must be aborted and any changes to the database must be rolled back.

Recovery techniques also apply to the database or the system after some type of critical error has occurred.

Backup and recovery functions constitute a very important component of today’s DBMSs.

**Data Recovery:** Process of getting data back after loss or destruction. Recovery occurs after data control mechanisms have failed**.**

**Causes of Database Failures**

1. Software - Software induced failures may be traceable to the

O.S, DBMS, S/W application programs or viruses.

2. Hardware - Hardware induced failures may include memory chip errors, disk crashes, bad disk sectors, disk full error etc

3. Programming exemptions - Application programs end-users may roll back transactions when certain conditions are defined e.g. a recovery procedure may be initiated if withdrawal funds is made when customer funds are at O or when en-user has initiated an unintended keyboard error such as pressing Ctrl c, the system detects deadlocks and aborts one of the transactions.

External factors - Backups are especially important when a system suffers complete distraction due to fire, earthquakes, floods etc. The database recovery process

**Causes of transaction failure**

1. Ways:

• Transaction induced abort e.g. insufficient memory space-time slice.

• Unforeseen transaction failure arising from bugs.

• System induced aborts e.g. when transaction manager explicitly aborts a transaction causes it to conflicts with another transaction or to break a deadlock.

2. Site failures - This occur due to failure of the local C.P.U or power supply and results in a system crash, its of 2 types:

• Total failure - all sites in a distributed database system are down

• Partial failure - Only some sites are down

3. Medium failure - Commonly caused by disk head crash. Network failure - Although most networks are reliable, a failure

may occur in the communication lines.

**8.3 Transaction and Database Recovery**

It is the role of recovery manager to guarantee at least durability and atomicity in the presence of unpredictable failures.

**Log file**

All operations on the database carried out by all transactions are recorded in the log file. In a distributed database, each site may have its own separate log.

An entry is made in the local log file each time the following commands are issued by a transaction:-

• Begin transaction

• Write (insert, delete, update)

• Commit transaction

• Abort transaction

Each log record contains:

1. Transaction identifier

2. The type of log record i.e. as listed above

3. Identifier of data object - affected

4. Before - image of the data object

5. Log management information

**Check Pointing**

The recovery manager periodically check points (dumps) and on recovery it only has to go back as far as the last check point)



**Recovery Protocols**

2. Restart Procedures - It assumes that no transactions are accepted until the database has been repaired and included.

 Emergency restart this follows when a system fails without warning e.g. due to power failure.

 Cold restart - The system is restarted from archive when the log and restart file has been corrupted.

 Warm restart - It allows controlled shut down of the system

3. Archiving - Creation of periodic back-ups.

***Levels of Backups***

 A full back up of the database of dump of the database.

 Reference backup of the database in which only the last modifications done on the database are copied.

 A back up of the transaction log only this level backup all the transaction log operations that are not reflected in the previous back-up copy of the database. The database backup is stored in a secure place usually in a different building and protected against dangers such as fire, theft flood and other potential calamities back-up existence guarantees recovery system (hardware/software) failures.

Failures that claim databases and systems are generally induced by software, hardware, program exemption, transactions and external factors.

 Generally follows a predictable scenario where first you determine the type and the extent of the required recovery.

4. Mirroring - 2 complete copies of the database are maintained online in different stable storage devices. It is used in environments with non-stop fault tolerant operations

5. Undo/Redo - It is undoing and re-doing a transaction after failure. The transaction manager keeps an active list and abort list and a commit list. These comprise of transactions that have begun, abort and committed transactions respectively.

6. 2-Phase Commit - It is used in a DBS and has 2 phases:

 **Voting phase** - where participants are asked whether or not they are prepared to commit the transaction.

 **Decision phase** where the transaction is committed.

7. 3-Phase Commit - This one has:

(i) Voting Phase

(ii) Pre-commit phase and

(iii) Decision phase

**Salvation Program**

When all other recovery techniques fail, a salvation program may be used. This is a specially designed program that scans the database after failure to assess the damages and to restore a valid state by rescuing whatever data are recognizable.

NB: Different recovery techniques (protocols) maintain different kinds of recovery data and are effective if and only if their recovery data have not also been contaminated or destroyed by the failure.