Technical Paper

List of Database Outages

Updated October 1999

Lawrence To

Center of Expertise
e-Business Support Services
Oracle Corporation

Overview

The purpose of the list of database outages matrix is to provide customers and Oracle support a resiliency checklist. If the customer is not prepared to handle these types of outages, then this indicates a potential weakness in their server configuration. This paper should be accompanied with the database recovery paper or the operation review questionnaire which discusses prevention, detection, and repair techniques for higher availability.

The outage matrix outlines most of the unscheduled and scheduled outages found in database server, network and hardware systems. The outage scenario, the predicted frequency of occurrence and the actions are described in the matrix. Some outages will be accompanied with an estimated time to recover, TTR, value which we derived from our experiences in support. However, optimal times to recover is characterized by sound practices and testing, efficient detection mechanisms, and automation of recovery which are not described in the matrix. Hopefully, this outage matrix can be used as a checklist to DBAs and system administrators to probe for potential weaknesses in system and database design prior to a fatal outage. Furthermore, preventive techniques such as hardware mirroring, security precautions, and backups are also not discussed in the matrix. Without proper prevention methodology, the probability as well as the frequency of the outage may increase dramatically.

Unscheduled Outages

Database - Control File Scenarios

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
1	**Loss or damage of single control file**	<1/year	30 seconds to 4 minutes	Shutdown Instance (abort) Change Init.ora file Startup instance Mount exclusive Start Recovery Processes Crash recovery Open DB NOTES: Steps do not include analysis of the trace.
2	**Loss of all control files**	<1/year	30 seconds to 4 minutes	Shutdown Instance (abort) Startup instance Create Controlfile Start Recovery Processes Crash Recovery Open DB NOTES: The time metric assume that the ‘alter database backup controlfile to trace’ command has been correctly edited and is available for execution.

Database - Redo Log Outages

OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS

3	**Loss of one and not all of the online redo log members of a particular group**	<1/year	Database is available.	Drop log file member Add log file member
4	**Loss of inactive archived redo log group**	<1/year	Database is available	Drop the problem redo log Add new log file group. NOTES: 1. All recovery time are quite static except for the crash recovery. 2. The addition of new redo log group can be done afterwards.
5	**Loss of an inactive redo log group that has not been archived**	<1/year	less than 5 minutes In 7.3 or higher, no downtime.	Shutdown abort Startup mount Alter database noarchivelog Drop the problem redo log Alter database open (crash recovery) Shutdown normal Startup mount Alter database archivelog Alter database open Invalidates Oracle Standby Database In 7.3 and higher, we have a new command called *alter database clear unarchived logfile* that allows you to clear an unarchived online redo log without shutting down the instance. NOTES: 1. All recovery time are quite static except for the crash recovery. 2. The addition of new redo log group can be done afterwards. 3. Cannot drop the unarchived redo log without setting noarchivelog mode.(ORA-00350) 4. Cannot set archivelog after dropping the problem redo log group since instance recovery required.(ORA-00265)
6	**Clearing a log file on production** *"alter database clear unarchived logfile"*	<1/year		No effect on Primary Database Invalidates any Oracle Standby Database
7	**Loss of current log**	<1/year	Unknown. Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Database Commence Incomplete Recovery B. Commence Disaster Recover Plan
8	**Primary Online Redo Log Corruption**	<1/year	Unknown Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Database Commence Incomplete Recovery B. Commence Disaster Recover Plan
9	**Standby Database Encounters Silent Redo Log Corruption**	<1/year	Does not affect primary database.	Primary DB is available. Standby site needs to be refreshed. Further investigation of plausible problems. Not relevant if there is no Standby database site.

Database - System Tablespace Data Files

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
10	Running out of space in system tablespace	<1/year	Unknown Dependent on time to detect and resolve or add data file.	A. Add appropriate size of data file
11	Loss of system tablespace data file	<1/year	Unknown Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Appropriate Data Files Commence Full Recovery B. Commence Disaster Recover Plan

Database - Data Dictionary

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
12	Corruption of data dictionary table	<1/year	Unknown Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Appropriate Data Files Commence Complete Recovery B. Restore Database, Commerce Point in Time Recovery C. Commence Disaster Recover Plan

Database - Rollback Segments

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
13	Loss of rollback segment data file	1/year	Unknown Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Appropriate Data Files Commence Full Recovery B. Commence Disaster Recover Plan
14	Corruption of rollback segment	<1/year	Unknown Dependent on times to restore, apply archives, open resetlogs, resync data.	A. Restore Appropriate Data Files Commence Full Recovery B. Restore Database Commerce Point in Time Recovery B. Commence Disaster Recover Plan

Database - Loss of Tablespaces containing Application Data

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
15	Loss of temporary tablespace data files	1/year	Dependent on the size of the temp tablespace. Time to recreate tablespace. Database is still available but transactions may fail due to lack of temporary space.	Primary DB is available but application queries (sort operations) may fail hence it is considered to be an outage. Recovery steps: 1. Drop current temporary tablespace. 2. Create another temporary tablespace 3. Run alter user scripts to switch to new temporary tablespace.
16	Loss of index data	2/year	Database is still available. Unknown Dependent on size of index and degree of parallelism to create the indices.	Primary DB is available; however, degradation in performance may exceed service level agreement hence it is considered to be an outage. Recovery options: A. Recreate or rebuild indexes. B. Restore and recover tablespace. C. Disaster Recovery Plan
17	Loss of table or cluster data (e.g. corruption of the table or accidental drop of table)	2/year	Unknown Dependent on size of table/cluster and object level recovery procedures. Dependent on times to restore, apply archives, open database, resync data.	Recovery options: A. Recreate tables with imports or with backup. (object level recovery plan) B. Restore and recover tablespace. C. Disaster Recovery Plan

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
18	Tablespace or data file loss (e.g. loss of data file due to media failure; system or rollback tablespace do not fit in this category)	1/year	Unknown Dependent on times to restore, apply archives, online tablespace	The Primary DB is available, however the application may not be functional due to loss of a subset of data - hence it is considered to be an outage. Recovery options: A. Restore tablespace or data file from backup on Primary DB and initiate complete tablespace recovery. NOTES: The tablespace recovery time varies depending on many factors, e.g.: backup frequency, backup media, disk activity of the archive redo log directory, system throughput during the recovery, etc. The timing is the worst case since it used the largest tablespace in 3P database. Steps: - Alter tablespace offline - Restore backup datafiles - Set autorecovery on - Alter database recover automatic tablespace (apply archived redo logs) - Alter tablespace online B. Disaster Recovery Plan
19	ORA 1555 or " snapshot too old" errors in application	2+/year	Database is still available.	Primary DB is available. Reconfigure rollback segments online to prevent these errors. Analyze application profile to avoid error. Common cause is applications which fetch across commits.
20	Loss of archive files	1/year	0	Primary DB is available. Hot backup of primary needs to be initiated ASAP to provide for reliable backup. Refresh or validate disaster recovery site or strategy.
21	Database logical error	<1/year	Unknown dependent on backup/ recovery strategy.	A. Disaster Recovery Plan. B. Restore from backup and recover to a point in time prior to loss of data. In 8.0+, tablespace point in time recovery mechanisms exist. C. Object recovery such as export/import, unloader/loader, snapshots, replication, etc.
22	user error	3/year	Unknown dependent on backup/ recovery strategy	A. Object Recovery Plan B. Tablespace Point in Time Recovery (8.0+) C. Disaster Recovery Plan
23	Loss of read-only data files	<1/year	dependent on size of data files and location of files.	A. Restore READ-ONLY files from backup. B. Disaster Recovery Plan.

Scheduled Outage Scenarios

	SCHEDULED OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
24	Changing Oracle Parameters In 7.3 and more Oracle8, some parameters are dynamic and can be adjusted with the following commands: ALTER SESSION SET parameter_name = value ALTER SYSTEM SET parameter_name = value ALTER SYSTEM SET parameter_name = value DEFERRED	4/year	less than 5 minutes. time may increase or decrease depending on number of recovery processes, PCM locks, crash recovery time, etc. In 7.3 and 8.0, most parameters can be adjusted dynamically.	- Prepare init.ora parameter modifications (not included in the time metric) - DB shutdown - DB startup - Open DB (clean shutdown)
25	Oracle software upgrade - Oracle kernel update - Oracle kernel patch	1/year 4/year	less than 5 minutes dependent on the time to disconnect users and to startup and open new instance. 10 + seconds	Install Oracle's new version without affecting the original version. Follow OFA standards by creating another version directory. Rolling upgrade with parallel server environment. - DB Shutdown immediate - Instance open - Database mount - Startup The above time metrics have not include the application workload component. NOTES 1. Oracle upgrade can occur on either Primary DB or Dual Machine with minimal effect. Another directory with the new version will be created as stated by OFA. Restart after installation of new version and new Oracle Home directory is required. 2. Patch releases should be recorded and tracked. Patches should be able to be extracted if a problem occurs. The database needs to be restarted after patch has been applied. 3. CRF or standby site should be upgraded at the same time as the Primary DB. All archives of the previous version needs to be applied to the CRF site before CRF is upgraded. 4. Migration may cause the CRF or standby to be invalidated. CRF site needs to be refreshed completely. Prior to upgrade, customer should consult Oracle if there will be any plausible complications.
26	Reorganizing Tables/Clusters	1/year	dependent on size of objects and the method to load the data.	Drop objects. Recreate Objects. Unload/Load data.

27	Reorganizing/ Recreating indexes	3/year	dependent on number of rows, degree of parallelism, and if the unrecoverable option is used.	Primary DB is available but application operation is impaired, hence it is considered to be an outage. Parallel Create index with nonrecoverable option is available in 7.2 + versions of Oracle Alter index rebuild command exists in 7.3+. NOTES: Create index operation must fall below the 10 minute or would need to be scheduled during a larger allocated time.
28	Application Software Upgrade	1/year	Unknown	
29	Application Code change	3/year	Unknown	

System Outage Matrix

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
1	Primary CPU			
2	Disk Failure			
3	Controller Failure			
4	System Failure			
5	Corruption in Cache			
6	Write Back Cache			
7	Shared Disk Array			

Network Outage Matrix

	OUTAGE SCENARIO	FREQUENCY OF OCCURRENCE	PREDICTED RECOVERY TIME	ACTIONS
1	Routers			
2	Switches			
3	Repeaters			
4	Bridges			
5	Local Director			
6	Network Hub			
7	Firewall Machine			
8	Network card			

Acknowledgements

Carol Colrain, Oracle Corporation
Sameer Patkar, Oracle Corporation
Brian Quigley, Technical Writer, Oracle Corporation
Kevin Reardon, Oracle Corporation

Roderick Manalac, Oracle Corporation