Case Studies in RMAN Metrics

Anthony D Noriega, MSCS, MBA, OCP
Advanced Data Networks

ORACLE CERTIFIED PROFESSIONAL

ADN

ORACLE Technology NETWORK

Speaker Qualifications

- Independent Consultant, ADN
- Speaker at NYOUG meetings
- 24 years of IT experience
- 18 years of Oracle experience, 13 as a DBA
- RMAN experience with Oracle8i,9i, 10g, and 11g, since 1999.
- MS Computer Science, NJIT, 1993
- PhD CIS candidate, NJIT, 1997
- MBA MIS, Montclair State University, 2006

Objectives

- **Present an proven approach to RMAN time and storage space metrics that guarantees robustness in backup/recovery, disaster recovery (DR), and business continuity (BC) processes.**

- **Derive a series of technical arguments to support an DR/BC optimization methodology.**

Best Practices

- **Determine the backup window of time and related duration Establish the restore window of time and related duration**

- **Establish a process-related cost analysis**

- **Create a policy framework in order to consistently maintain archived redo log files in backup sets, or available accordingly in the file system.**

- **Discuss a tuning model for the large pool.**

Best Practices

- **Utilize available features and capabilities such as Block Change Tracking, control file auto-backup, native backup compression, or point-in-time recovery when appropriate.**

- **Establish DR/BC a historic log.**

Experimenting with RMAN

- **Production environments**
  - **With recovery Catalog**
    - **Hitachi SAN**
    - **MPP (128-,32-processor logically partitioned Solaris servers).**
    - **Maximum Availability Architecture (MAA) using Hardware Assisted Resilient Data (RAC plus Data Guard emulation).**

Experimenting with RMAN

- **Production environments**
  - **Without recovery Catalog**
    - **Undisclosed SAN architecture**
    - **MPP (16 and 32-processor Solaris servers, but comparable cohort architecture).**
    - **Oracle Data Guard in place.**

Tuning with Large Pool RMAN

- **Production environments**
  - **Linux 4-node RACs, 9i and 10g**
    - **Undisclosed SAN architecture**
    - **MPP (Linux Intel 64-bit 8/16 dual-core processor RH Linux servers).**
    - **Oracle RAC and Data Guard in place (MAA).**

Architecture Environments

- **Oracle9i**
- **Oracle10g experimental projections**
- **fast_start_mttr_target custom settings**
- **Block Change Tracking (Oracle10g/11g)**
- **Incremental backup level 0 mostly.**

The Shell

RMAN Backup shell for Oracle Instances Studied (Without a Recovery Catalog)

```
run
{
set until time =
"trunc(sysdate,'dd')-$NRETRODAYS+$HR/24+$MN/1440+$SC/86400";
crosscheck backupset of controlfile;
alter database mount ;
crosscheck backupset of database;
crosscheck backupset of archivelog all;
crosscheck archivelog all;
}
run
{
set until time =
"trunc(sysdate,'dd')-$NRETRODAYS+$HR/24+$MN/1440+$SC/86400";
restore controlfile to 'xx' until time="trunc(sysdate,'dd')-$NRETRODAYS
+ $HR/24 + $MN/1440 + $SC/86400" validate;
restore database until time="trunc(sysdate,'dd')-$NRETRODAYS + $HR/24 +
$MN/1440 + $SC/86400" validate;
restore archivelog time between "trunc(SYSDATE-$NRETRODAYS,'dd')" and
"trunc(SYSDATE-$NRETRODAYS,'dd') + $HR/24+$MN/1440 + $SC/86400"
validate;
}
exit;
EORMANV
#) | tee $LOG
```

Backup Size and Duration

Instance Name	Host Name	Average Database Size	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	Min Duration (Minutes)	Max Duration (Minutes)
Prd1	Host1	512GB	21	81	55	88
Dv1	Host2	512GB	22	99	65	90
Risk1	Host3	256GB	12	31	45	68
Uat1	Host4	300GB	30	105	45	77
Risk2	Host5	628GB	23.0	121	65	116

- **RMAN Backup Duration for Oracle Instances Studied (With a Recovery Catalog)**

RMAN Backup Size and Duration

Instance Name	Host Name	RMAN Backup Size Range	Duration Range
Prd1	Host1	4.0GB-7.0GB	2 to 7 minutes
Prd2	Host2	3.5GB-4GB	2 to 4 minutes
Dev1	Host3	1.8GB-2.0GB	2 to 3 minutes
Dev2	Host4	5.0GB-6.0GB	5 to 9 minutes
QA1	Host5	23.0GB-24.0GB	28 to 29 minutes

- RMAN Backup Duration for Oracle Instances Studied (without a Recovery Catalog)

RMAN Backup Size and Duration

Instance Name	Host Name	Avg DB Size (GB)	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	Min Duration	Max Duration
Prod1	Host1	256	4.0	7.0	2	7
Prod2	Host2	198	3.5	4.0	2	4
Dev1	Host3	128	1.8	2.0	2	3
Dev2	Host4	248	5.0	6.0	5	9
Qa1	Host5	300	23.0	24.0	28	29

- **RMAN Backup Duration for Oracle Instances Studied (NOCATALOG expanded view)**

Backup Size Duration Line Chart
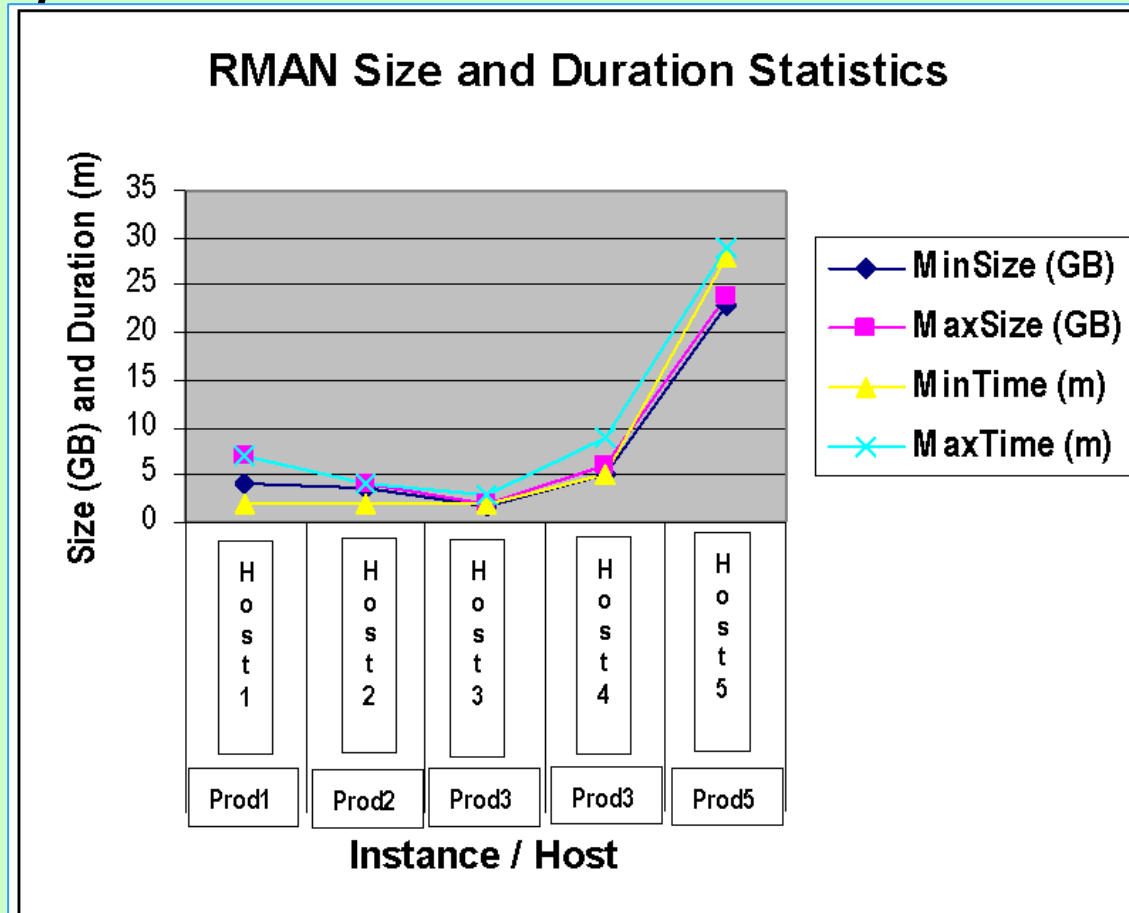
NOCATALOG Restore Metrics

Instance Name	Host Name	MinSize (GB)	MaxSize (GB)	MinTime (m)	MaxTime (m)
Prod1	Host1	4.0	7.0	2	7
Prod2	Host2	3.5	4	2	4
Dev1	Host3	1.8	2.0	2	3
Dev2	Host4	5.0	6.0	5	9
Qa1	Host5	23.0	24.0	28	29

- **RMAN Restore Duration for Oracle Instances Studied (Without a Recovery Catalog)**

The Shell

- **RMAN Backup shell for Oracle Instances Studied (With a Recovery Catalog)**

```
74 #---------
75 rman <<EORMAN
76 connect target $SCHEMA1/$PASS1@eisqa
77 connect rcvcat $SCHEMA2/$PASS2@oem
78   run {
79     allocate channel m1 type disk;
80       sql 'alter system archive log current';
81       resync catalog;
82       change archivelog all crosscheck;
83     release channel m1;
84     allocate channel c1 type disk;
85       setlimit channel c1 kbytes ${FILESIZE};
86       backup
87         incremental level ${LEVEL}
88         format '${DFILES}_%U.rman'
89         tag = '${BACKUPTAG}'
90         (database);
91       backup
92         format '${CFILES}_%U.rman'
93         (current controlfile);
94     sql 'alter system archive log current';
95       backup
96         format '${AFILES}_%U.rman'
97         (archivelog all);
98     release channel c1;
99   }
100   list backupset of database;
101   list backupset of controlfile;
102   list backupset of archivelog all;
103 exit;
104 EORMAN
```

Backup Size and Duration

Instance Name	Host Name	Average Database Size	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	Min Duration (Minutes)	Max Duration (Minutes)
Prd1	Host1	512GB	21	81	55	88
Dv1	Host2	512GB	22	99	65	90
Risk1	Host3	256GB	12	31	45	68
Uat1	Host4	300GB	30	105	45	77
Risk2	Host5	628GB	23.0	121	65	116

- **RMAN Backup Duration for Oracle Instances Studied (With a Recovery Catalog)**

Backup Size and Duration

Instance Name	Host Name	Average Database Size	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	(Minutes) Min Duration	(Minutes) Max Duration
Prod1	Host1	512GB	21	81	81	115
Prod2	Host2	512GB	22	99	90	121
Dev1	Host3	256GB	12	31	72	89
Dev2	Host4	300GB	30	105	77	95
Qa1	Host5	628GB	23.0	121	89	125

- **RMAN Backup Duration for Oracle Instances Studied (With Backup Validation Using the Recovery Catalog)**

Backup Size and Duration

Instance Name	Host Name	Average Database Size	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	(Minutes) Min Duration	(Minutes) Max Duration
Prod1	Host1	512GB	21	81	81	115
Prod2	Host2	512GB	22	99	90	121
Dev1	Host3	256GB	12	31	72	89
Dev2	Host4	300GB	30	105	77	95
Qa1	Host5	628GB	23.0	121	89	125

- **RMAN Restore Duration for Oracle Instances Studied (With Backup Validation Using the Recovery Catalog)**

Data Collected for Analysis

Instance Name	Host Name	Avg DB Size (GB)	Rman Backup Min Size (GB)	Rman Backup Max Size (GB)	Min Duration	Max Duration	0=nocat 1=cat Cat Opt
Prod1	Host1	256	4	7	2	7	0
Prod2	Host2	198	3.5	4	2	4	0
Dev1	Host3	128	1.8	2	2	3	0
Dev2	Host4	248	5	6	5	9	0
Qa1	Host5	300	23	24	28	29	0
Prd1	Host1	512	21	81	55	88	1
Dv1	Host2	512	22	99	65	90	1
Risk1	Host3	256	12	31	45	68	1
Uat1	Host4	300	30	105	45	77	1
Risk2	Host5	628	23	121	65	116	1

A Simple RMAN Regression Model

```
SQL> get d:\batch\sqlAn.sql
  1  SELECT db_name,avg_db_size,max_duration,
  2  REGR_SLOPE(avg_db_size, max_duration)
  3     OVER (PARTITION BY backup_type) slope,
  4  REGR_INTERCEPT(avg_db_size, max_duration)
  5     OVER (PARTITION BY backup_type) intcpt,
  6  REGR_R2(avg_db_size, max_duration)
  7     OVER (PARTITION BY backup_type) rsqr,
  8  REGR_COUNT(avg_db_size, max_duration)
  9     OVER (PARTITION BY backup_type) count,
 10  REGR_AVGX(avg_db_size, max_duration)
 11     OVER (PARTITION BY backup_type) avgx,
 12  REGR_AVGY(avg_db_size, max_duration)
 13     OVER (PARTITION BY backup_type) avgy
 14     FROM rman_records
 15*    ORDER BY rsqr desc
SQL> /
```

DB_NAME	AVG_DB_SIZE	MAX_DURATION	SLOPE	INTCPT	RSQR	COUNT	AVGX	AVGY
Uat1	300	77	8.12163814	-271.47983	.870652924	5	87.8	441.6
Risk1	256	68	8.12163814	-271.47983	.870652924	5	87.8	441.6
Dv1	512	90	8.12163814	-271.47983	.870652924	5	87.8	441.6
Prd1	512	88	8.12163814	-271.47983	.870652924	5	87.8	441.6
Risk2	628	116	8.12163814	-271.47983	.870652924	5	87.8	441.6
dev2	248	9	4.71880492	176.924429	.58766193	5	10.4	226
dev1	128	3	4.71880492	176.924429	.58766193	5	10.4	226
prod2	198	4	4.71880492	176.924429	.58766193	5	10.4	226
prod1	256	7	4.71880492	176.924429	.58766193	5	10.4	226
QA1	300	29	4.71880492	176.924429	.58766193	5	10.4	226

```
10 rows selected.
```

Further Model Regression

```
SQL> LIST
  1   SELECT db_name,avg_db_size,max_duration,
  2   REGR_SLOPE(avg_db_size, max_duration)
  3      OVER (PARTITION BY backup_type) slope,
  4   REGR_INTERCEPT(avg_db_size, max_duration)
  5      OVER (PARTITION BY backup_type) intcpt,
  6   REGR_R2(avg_db_size, max_duration)
  7      OVER (PARTITION BY backup_type) rsqr,
  8   REGR_AVGX(avg_db_size, max_duration)
  9      OVER (PARTITION BY backup_type) avgx,
 10   REGR_AVGY(avg_db_size, max_duration)
 11      OVER (PARTITION BY backup_type) avgy,
 12   REGR_SXX(avg_db_size, max_duration)
 13      OVER (PARTITION BY backup_type) SXX,
 14   REGR_SYY(avg_db_size, max_duration)
 15      OVER (PARTITION BY backup_type) SYY,
 16   REGR_SXY(avg_db_size, max_duration)
 17      OVER (PARTITION BY backup_type) SXY
 18      FROM rman_records
 19*     ORDER BY rsqr desc
SQL> /

DB_NAME   AVG_DB_SIZE MAX_DURATION    SLOPE     INTCPT      RSQR      AVGX      AVGY       SXX       SYY       SXY
--------- ----------- ------------ --------- ---------- ---------- --------- --------- --------- --------- ---------
Uat1             300           77 8.12163814 -271.47983 .870652924      87.8     441.6    1308.8   99155.2   10629.6
Risk1            256           68 8.12163814 -271.47983 .870652924      87.8     441.6    1308.8   99155.2   10629.
Dv1              512           90 8.12163814 -271.47983 .870652924      87.8     441.6    1308.8   99155.2   10629.6
Prd1             512           88 8.12163814 -271.47983 .870652924      87.8     441.6    1308.8   99155.2   10629.6
Risk2            628          116 8.12163814 -271.47983 .870652924      87.8     441.6    1308.8   99155.2   10629.
dev2             248            9 4.71880492 176.924429  .58766193      10.4       226     455.2     17248      2148
dev1             128            3 4.71880492 176.924429  .58766193      10.4       226     455.2     17248      2148
prod2            198            4 4.71880492 176.924429  .58766193      10.4       226     455.2     17248      2148
prod1            256            7 4.71880492 176.924429  .58766193      10.4       226     455.2     17248      2148
QA1              300           29 4.71880492 176.924429  .58766193      10.4       226     455.2     17248      2148

10 rows selected.
```

Correlation (Variable Interaction)

	Avg DB Size (GB)	RMAN Backup Min Size (GB)	RMAN Backup Max Size (GB)	Min Duration	Max Duration	Cat Opt
Avg DB Size (GB)	1					
RMAN Backup Min Size (GB)	0.672812809	1				
RMAN Backup Max Size (GB)	0.850083343	0.856779215	1			
Min Duration	0.856536148	0.834302561	0.910370414	1		
Max Duration	0.873295324	0.804858853	0.942746843	0.981002475	1	
Cat Opt	0.706810637	0.717007196	0.867454307	0.926638071	0.945848466	1

Oracle10g Improved Adjustments

- **The number of blocks changed as a percent of the total backup (incremental policies).**

- **Global block density being backed up.**

- **The Global block density in the database being backed up.**

- **The combined effect of all previous factors.**

- **The settings of block change tracking.**

Oracle10g Improved Adjustments

- **Settings for:**
  - **Fast_start_mttr_target**
  - **Log_checkpoint_interval**
  - **Log_checkpoint_timeout**
  - **Large_pool_size**
- **V$MTTR_TARGET_ADVICE view**

Some Oracle10g RMAN Objects

```
OBJECT_TYPE     OBJECT_NAME

----------------        -------------------------------------

PACKAGE         CURSORMANAGERINTERFACE
PACKAGE         GENCURSORMANAGERINTERFACE
TYPE            GENCURSORMANAGERSEQUENCE
VIEW            GV_$RMAN_CONFIGURATION
VIEW            GV_$RMAN_OUTPUT
VIEW            V_$RMAN_BACKUP_JOB_DETAILS
VIEW            V_$RMAN_BACKUP_SUBJOB_DETAILS
VIEW            V_$RMAN_BACKUP_TYPE
VIEW            V_$RMAN_CONFIGURATION
VIEW            V_$RMAN_OUTPUT
VIEW            V_$RMAN_STATUS
```

RMAN NOCATALOG Configuration

```
Copyright (c) 1995, 2002, Oracle Corporation.  All rights reserved.

RMAN> connect target /

connected to target database: DEVTWBG (DBID=1885319376)
using target database controlfile instead of recovery catalog

RMAN> show all;

RMAN configuration parameters are:
CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 30 DAYS;
CONFIGURE BACKUP OPTIMIZATION OFF;
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP ON;
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '/opt/oracle/admin/devtwbg/ctl/devt
bg_%F';
CONFIGURE DEVICE TYPE DISK PARALLELISM 1; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO '/opt/oracle/product/9.2.0/dbs/snapcf_devtwbg.f'; # default

RMAN>
```

RMAN Session Long Operations

```
  1   select target,target_desc,message,last_update_time
  2   from v$session_longops
  3*  where last_update_time > sysdate-15/1440
anoriega@adndb1>/


TARGET   TARGET_DESC    MESSAGE                                             LAST_UPDATE_TIME
------   -----------    -----------------------------------------------    ----------------------
1303     Set Count      RMAN: incremental datafile backup: Set Count 1303: 26-jan-2006 15:44:51
                          25992 out of 25992 Blocks done

1303     Set Count      RMAN: incremental datafile backup: Set Count 1303: 26-jan-2006 15:44:51
                          10363 out of 10363 Blocks done

20       backup         RMAN: aggregate output: backup 20: 19944 out of 19 26-jan-2006 15:44:53
                         944 Blocks done

51       copy           RMAN: aggregate input: copy 51: 500 out of 500 Blo 26-jan-2006 15:44:23
                         cks done
```

Listing the Backup Contents

```
RMAN> list backup;


List of Backup Sets
===================

BS Key  Type LV Size        Device Type Elapsed Time Completion Time
------- ---- -- ---------   ----------- ------------ ---------------
1023    Full    2M          DISK        00:00:01     16-JAN-06
        BP Key: 1023    Status: AVAILABLE   Tag:
        Piece Name: /opt/oracle/product/9.2.0/dbs/c-1885319376-20060116-09
   SPFILE Included: Modification time: 06-JAN-06

BS Key  Type LV Size        Device Type Elapsed Time Completion Time
------- ---- -- ---------   ----------- ------------ ---------------
1024    Full    2M          DISK        00:00:01     16-JAN-06
        BP Key: 1024    Status: AVAILABLE   Tag:
        Piece Name: /opt/oracle/product/9.2.0/dbs/c-1885319376-20060116-0a
   SPFILE Included: Modification time: 06-JAN-06
```

BACKUP LISTING

```
RMAN> list backup;


List of Backup Sets
===================


BS Key   Type LV Size        Device Type Elapsed Time Completion Time
-------  ---- -- ---------- ----------- ------------ ---------------
334      Incr 0  1G          DISK         00:00:53      19-NOV-05
         BP Key: 334    Status: AVAILABLE   Tag: WEEKLY_BACKUP
         Piece Name:
/dump1/mgnss/rmanbackup/20051119_0105/ful_alh43ia5_MGNSS
  SPFILE Included: Modification time: 03-OCT-05
  List of Datafiles in backup set 334
  File LV Type Ckp SCN     Ckp Time   Name
  ---- -- ---- ---------- --------- ----
   1    0  Incr 51691876    19-NOV-05 /data1/oradata/mgnss/system01.dbf
   5    0  Incr 51691876    19-NOV-05 /data1/oradata/mgnss/perfstat01.dbf

BS Key   Type LV Size        Device Type Elapsed Time Completion Time
-------  ---- -- ---------- ----------- ------------ ---------------
335      Incr 0  2G          DISK         00:02:00      19-NOV-05
         BP Key: 335    Status: AVAILABLE   Tag: WEEKLY_BACKUP
```
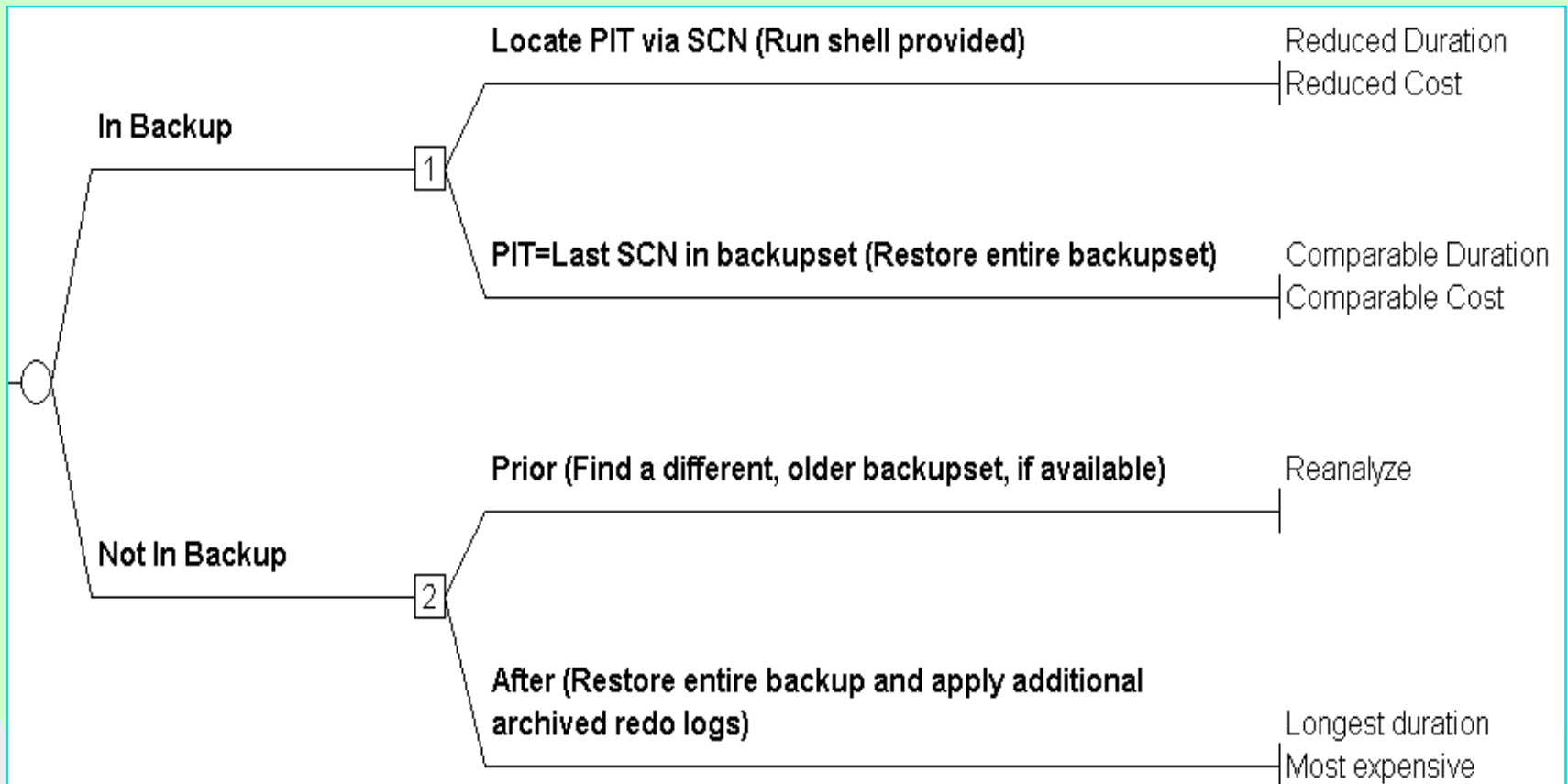
DBPITR Tree Recovery Path

Model Implications on VLDBs

- **Model Variable Correlation**
- **Support for HARD, SAN-based, Dataguard, and RAC solutions.**
- **Proven metric correlation in Maximum Availability Architecture (MAA).**

Business Analysis Considerations

- **Disaster Recovery (DR)**
- **Business Continuity (BC)**
- **Backup and Recovery (BR)**
- **SDLC**
- **Overall Preparedness for any RMAN process.**

Business Analysis Considerations

- **Quality Assurance**
  - **Backupset approach**
  - **Archived redo log backup policy**
  - **Retention policy strategy.**
- **Shell Robustness throughout OS platform**
- **Shell scheduling, deployment with periodic validation and verification.**

Tuning the Large Pool for RMAN

- **Carefully identify relationships between the large pool size setting and the RMAN operation (backup/restore) duration, and the backup pieces size and the overall backup size.**

- **Large Pool Size's Oracle recommended setting is 16M.**

- **Findings are preserve standalone or using third-party tools or utilities.**
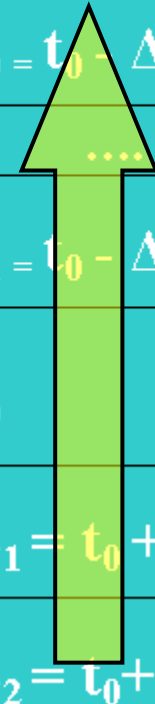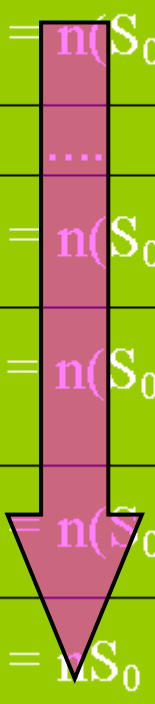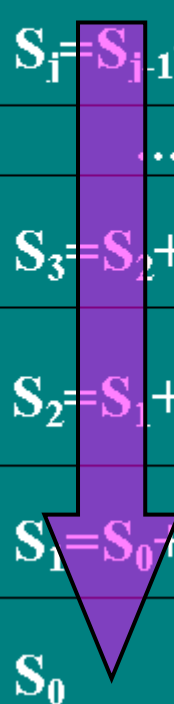
Tuning the Large Pool for RMAN

LARGE POOL SIZE	BACKUP PIECE SIZE	ESTIMATED BACKUP SIZE $\sum_{i=1}^{n} s_i$	DURATION
$2^j M$	$S_j = S_{j-1} + j\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + j\Delta s)$	$t_0 = t_0 - \Delta t$
....	....	....	....
32M	$S_3 = S_2 + 3\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 3\Delta s)$	$t_1 = t_0 - \Delta t$
16M	$S_2 = S_1 + 2\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 2\Delta s)$	t_0
8M	$S_1 = S_0 + \Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + \Delta s)$	$t_{-1} = t_0 + \Delta t$
4M	S_0	$\sum_{i=1}^{n} s_i = nS_0$	$t_{-2} = t_0 + 2\Delta t$

Tuning the Large Pool for RMAN

LARGE POOL SIZE	BACKUP PIECE SIZE	ESTIMATED BACKUP SIZE $\sum_{i=1}^{n} s_i$	DURATION
2?M	$S_i = S_{i-1} + j\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + j\Delta s)$	$t_0 = t_0 - \Delta t$
....	....	....	....
32M	$S_3 = S_2 + 3\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 3\Delta s)$	$t_1 = t_0 - \Delta t$
16M	$S_2 = S_1 + 2\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 2\Delta s)$	t_0
8M	$S_1 = S_0 + \Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + \Delta s)$	$t_{-1} = t_0 - \Delta t$
4M	S_0	$\sum_{i=1}^{n} s_i = nS_0$	$t_{-2} = t_0 + 2\Delta t$

Tuning the Large Pool for RMAN

LARGE POOL SIZE	BACKUP PIECE SIZE	ESTIMATED BACKUP SIZE $\sum_{i=1}^{n} s_i$	DURATION
2^jM	$S_j = S_{j-1} + j\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + j\Delta s)$	$t_0 = t_0 - \Delta t$
....	....	....	....
32M	$S_3 = S_2 + 3\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 3\Delta s)$	$t_1 = t_0 - \Delta t$
16M	$S_2 = S_1 + 2\Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + 2\Delta s)$	t_0
8M	$S_1 = S_0 + \Delta s$	$\sum_{i=1}^{n} s_i = n(S_0 + \Delta s)$	$t_{-1} = t_0 + \Delta t$
4M	S_0	$\sum_{i=1}^{n} s_i = nS_0$	$t_{-2} = t_0 + 2\Delta t$

Concluding Remarks

- **Correlation between database size/backup size and duration.**
- **Factors:**
  - **Environment**
  - **Backup Validity**
- **Preparedness.**

Concluding Remarks

- **DBPITR**
- **Backup Restore/Recovery Time**
- **Reliability=MTTF/(MTTF+MTTR)**
- **Business Process Robustness**

Concluding Remarks

- **Oracle9i and Oracle10g congruent Metrics**
- **Configuration Bottlenecks**
- **Planning and Risk Analysis**
- **Block Change Tracking**
- **BR/DR/BC Business Process.**
- **The large pool size is directly proportional to the backup size and inversely proportional to the backup duration.**

Concluding Remarks

Feature/Issue	Benefit
9i to 10g Congruent Metrics	Allows for post-upgrade and multi-version DR/BC time allocation.
Configuration Bottlenecks	Initialization parameter configuration as part of OFA-driven architecture can be further optimized in 10g in relation to 9i releases. The overall benefits translate into faster performance and throughput.
Planning and Risk Analysis	Using historic backup/restore historic data can lead to overcoming unplanned process and limiting the risk involved.
Block Change Tracking	Extremely useful with incremental backups, reduces CPU cycles, and enables faster backups and shorter recovery time.
DBPITR	A parallel strategy to Flashbackup database. It is supported by RMAN with or without a recovery catalog.
Backup Time vs. Restore/Recovery Time	Although backup and restore times tend to be comparable, having gather data and statistics on duration can enhance robustness and preparedness in DR/BC processes.

Questions?

Q?...A!

Thank You

- **Please complete your evaluation form!**
- **Speaker: Anthony D. Noriega**
- **Title: Case Studies in RMAN Metrics**
- **Special Session**
- **Contact information:**
- **anthony.noriega@adnmis.com**