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New York Oracle Users Group

Third Quarter 2013

Third Quarter General Meeting

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Fall General Meeting – September 10, 2013
Sponsored by Axxana

AGENDA

Time	Activity	Track/Room	Presenter
8:30-9:00	**REGISTRATION AND BREAKFAST**		
9:00-9:30	**Opening Remarks** **General Information**	(single session) Auditorium	Michael Olin NYOUG President
SESSION 1 9:30-10:30	**KEYNOTE: Oracle 12c: The Gee Whiz Features You Need to Know**	(single session) Auditorium	Arup Nanda Starwood Hotels
10:30-10:45	**BREAK**		
SESSION 2 10:45 -11:45	**Big Data Demystified for Oracle Professionals**	DBA Auditorium	Arup Nanda Starwood Hotels
	Developing Mobile Applications for iOS and Android the Oracle Way	Developer Room 118	Frédéric Desbiens Oracle Corp.
SESSION 3 11:45 -12:30	**Ask the Experts Panel**	(single session) Auditorium	Michael Olin Moderator
12:30 -1:30	**LUNCH - ROOM 123 – Presentation by Axxana (www.axxana.com)**		
SESSION 4 1:30-2:30	**Managing Statistics of Volatile Tables in Oracle**	DBA Auditorium	Iordan Iotzov NewsAmerica Marketing
	ADF On-Ramp: What You Need to Know to use the Core ADF Technology Stack	Developer Room 118	Peter Koletzke Quovera
2:30-2:45	**BREAK**		
SESSION 5 2:45-5:00	**What Are Employers Looking for from IT Job Applicants?**	Room 123	Cristina Bedrosian Dice.com
	Networking Session	Room 123	NYOUG Members and Meeting Attendees

ABSTRACTS

9:30-10:30 AM KEYNOTE: Oracle 12c - The Gee Whiz Features You Need to Know

Oracle 12c is out, and so are about 450 new features. Instead of jumping head-first into the pool, learn about the key new features which provide the best bang for the buck. In this presentation, Arup (the author of the popular New Features series on OTN) will condense them into a manageable chunk describing the 12c features that are worth knowing about. Whenever possible, the concepts will be presented with live demos.

Arup Nanda has been working as an Oracle DBA for the past 17 years. Arup trains and mentors DBAs, has coauthored 4 books, written some 300 published articles (including the most popular 11g and 10g New Features Series on the Oracle Technology Network) and given numerous presentations. He is an OCP DBA, an Oracle ACE Director and a member of the Oak Table Network. In 2003, he won the coveted Oracle DBA of the Year award. Arup blogs at arup.blogspot.com.

10:45-11:45 AM DBA TRACK: Big Data Demystified for Oracle Professionals

Big Data is the future of database computing and knowing about it not just a luxury you can avoid anymore; it's necessary for survival and growth. If you have encountered the Hadoop, Hive, Map/Reduce, and Flume acronyms more often than you have the time to pause and think about them, this presentation will help. Learn about these and more in this informative session about Big Data components explained from the perspective of an Oracle professional, how they are same or different, and how they compare with RAC or parallel query.

Arup Nanda has been working as an Oracle DBA for the past 17 years. Arup trains and mentors DBAs, has coauthored 4 books, written some 300 published articles (including the most popular 11g and 10g New Features Series on the Oracle Technology Network) and given numerous presentations. He is an OCP DBA, an Oracle ACE Director and a member of the Oak Table Network. In 2003, he won the coveted Oracle DBA of the Year award. Arup blogs at arup.blogspot.com.

10:45-11:45 AM DEVELOPER Track: Developing Mobile Applications for iOS and Android the Oracle Way

Until now, taking advantage of mobile technology required adopting non-Oracle technologies with significant learning curves. In addition, the fragmented nature of the marketplace meant that developers had to master two incompatible technology stacks just to cover iOS and Android, the two dominant mobile operating systems currently available. This session will describe how a combination of Java, component-based HTML5 UI, and an MVC architecture allows developers to leverage their existing Java skills while transitioning to the new wave of enterprise mobile application development. This presentation will demonstrate how Oracle approached this challenge and show how it is possible to reuse your existing Java skills to build rich native applications that will run on both iOS and Android from a single code base.

Frédéric Desbiens is a product manager in the Oracle Application Development Tools group. He has fifteen years of experience in the IT industry, and worked for several years as a consultant, with ample opportunity to get real-world expertise on several projects involving various Oracle technologies, such as Oracle SOA Suite and Oracle WebCenter. He co-authored the WebCenter 11g Handbook: Build Rich, Customizable Enterprise 2.0 Applications, published by McGraw-Hill.

1:30-2:30 PM DBA TRACK: Managing Statistics of Volatile Tables in Oracle

Adequate, up-to-date table and index statistics are of utmost importance for achieving optimal database performance. Even though Oracle, particularly version 12c, has ways to mitigate suboptimal execution plans, it is best to have the

optimizer deliver an excellent plan for every query every time. Oracle's default statistics gathering process collects statistics every night and over the weekend. It works fine for tables that change little over the day, but it is inadequate for tables which size or data distribution fluctuate every couple of minutes. The challenge is even greater when we are not allowed to change the application design and queries, an increasingly common situation thanks to the growing use of off-the-shelf solutions. Following a review of the benefits and the pitfalls of using dynamic sampling and locking statistics to manage statistics of volatile tables, a robust algorithm that delivers both plan stability and system flexibility is proposed. The algorithm works by allowing the statistics to change only under specific circumstances. A method for gathering statistics without issuing a commit is described in detail, along with tips for improving performance of queries involving volatile tables without changing the SQL code.

Iordan Iotzov is a senior DBA at News America Marketing (NewsCorp) with more than ten years of database administration and development experience. He has a MS degree in Computer Science, holds numerous Oracle certifications, and has worked on complex database problems across various industries, providing original and effective solutions. Iordan has presented at Hotsos, NYOUG, and BrainSurface VirtaThon, frequently participates in OTN forums and actively blogs at http://iiotzov.wordpress.com/.

1:30-2:30 PM DEVELOPER TRACK: ADF On-Ramp: What You Need to Know to Use the Core ADF Technology Stack

Developing a Java-oriented web application these days requires selecting a small set of frameworks from a dauntingly long list. Fortunately, Oracle has provided some inspiration; they are building Fusion Applications using Application Development Framework (ADF) and a core technology stack consisting of ADF Faces, ADF Business Components, and JavaServer Faces. You too can develop applications using this set of technologies and the ADF environment in JDeveloper. This presentation explains these technologies and shows what kinds of development methods you will use when working in this environment. It provides guidelines for how much you need to know about the various languages used for these technologies. It also describes and shows the files you will use to build an application and how that application will be tested and deployed to a production environment. In addition, the presentation offers advice on how to learn what you need to know before starting Java web development in JDeveloper.

Peter Koletzke is a technical director and principal instructor for Quovera in Mountain View, California, and has 29 years of industry experience. He is also an Oracle Certified Master, an Oracle ACE Director, presenter of more than 310 sessions at various Oracle users group conferences, and winner of over a dozen user group awards. Additionally, he has co-authored eight Oracle Press books about Oracle development tools.

2:45-5:00 PM Dice.com Presentation and Networking Session

Are you looking for a job as an Oracle DBA? Do you want to upgrade your current resume? Do you want to learn how to make use of the newest networking tools to enhance your career? The afternoon session will combine an inside look from Dice.com at what hiring managers want in DBAs and other IT professionals including how to optimize your resume, online footprint, and the time you spend networking. After the brief presentation, there will be time to network with Dice personnel and others with advice about how to effectively market yourself in the current IT career environment.

Christina Bedrosian is a VP of Marketing at Dice.com specializing in marketing, strategy, branding, online marketing, and search engine marketing.

Message from the President's Desk

Michael Olin

Fall, 2013

It's the Network…

For as long as I can remember, NYOUG has been promoting the chance to "network with other Oracle professionals" as an important benefit of membership. It's a bullet point that I dutifully read from the slides that we run through at the start of every general meeting. From a personal perspective, I wholeheartedly believe that the networking opportunities that I have been afforded as a member of NYOUG, even before I became an officer, have been invaluable to my career. As a consultant, I have been fortunate enough to have found work through several connections that I have made at NYOUG meetings. However, I would also have to admit that NYOUG has not done nearly enough to help our members take advantage of our network. For most of its existence, NYOUG members were mostly left to leverage this network on their own. There has always been plenty of time to meet and talk with other members during meals and breaks at our meetings. Our "Ask the Experts" sessions also give members a chance to share their technical knowledge and experience without even leaving their seats. Considering how frequently we tout the network, providing coffee and some food, or a quick tip before lunch seems to be perhaps a bit too passive an approach to helping our members make new connections.

NYOUG Gets LinkedIn

NYOUG's first formal foray into a more active role in facilitating networking was the creation of the NYOUG LinkedIn group (http://www.linkedin.com/groups?gid=1127257). To avoid the clutter that is found on many Oracle-related groups on the site, we have kept the group's membership closed. Everyone on the NYOUG mailing list was pre-approved for membership when we started the group, and requests to join the group are reviewed and generally approved within 24 hours. Membership in NYOUG is not required to join our LinkedIn group, but some sort of connection to our User's Group (you work with Oracle somewhere on the East Coast works pretty well, studying for OCP exams in Patagonia, not so much) is expected. We're approaching 500 members, which is good, but we really don't have much content, which is problematic. The Steering Committee originally thought that LinkedIn would be a great platform to allow the recruiters and others who contact the group with job opportunities to get the information to our membership, since we do not allow job postings to be placed on the NYOUG web site (http://www.nyoug.org). While there is a slow but steady stream of job postings in our LinkedIn group, the most active posters seem to be those who are either promoting training classes or their own websites and/or blogs. I think that we have been quite generous by allowing the occasional post of this nature, but several group members now require having all of their posts pre-approved to mitigate against their posting reminders for the same event every few days. We had thought that members would take advantage of this platform to start discussions regarding technical questions or seek job search advice from their peers. Perhaps this was too ambitious an expectation, as there are a multitude of other venues for this type of activity that are infinitely more active than our own little LinkedIn group. Nevertheless, it would be nice to see some more activity on LinkedIn from the hundreds of NYOUG members who took the time to join.

Rolling the Dice (with Dice.com)

One instance where the membership did come through on LinkedIn was when we posted a survey asking if you would like to have a more structured opportunity for networking at our general meetings. While we did not get a

huge response to the survey, we did get a clear answer. As a result, instead of having technical presentations during the last two sessions of the day at our September Fall General Meeting, the afternoon was devoted to networking. A message to the general questions mailbox at Dice.com regarding the possibility of having someone come to our meeting was met with an enthusiastic response. As a result, attendees at the meeting were treated to a presentation by Dice's Cristina Bedrosian about how IT professionals could manage their careers effectively in the current job market (http://www.nyoug.org/Presentations/2013/Bedrosian_Dice.com.pdf). Not only did Cristina and her colleagues from Dice provide some great insights into how hiring managers are searching for and evaluating candidates, but they also provided some very helpful tips and statistics directly related to job postings for Oracle professionals. Longtime NYOUG member, and the meeting's keynote speaker, Arup Nanda, served as a great example of how to effectively create and manage one's online presence. Bringing up several of Arup's online profiles really helped Cristina make her point about how having a consistent and up-to-date social media presence can help reinforce the information that a hiring manager gets from your resume. After a Q&A session, time was set aside (with coffee and cookies) for the attendees to get to the actual business of networking. There were both job seekers and hiring managers in attendance. Hopefully, some valuable connections were made.

Next Steps

It's impossible to leave a meeting without someone insisting on a formal enumeration of "next steps," so I might as well make my list here. The NYOUG Steering Committee is going to explore additional ways to provide more focused opportunities for networking. While not every general meeting will have the afternoon set aside for networking, we are certainly going to encourage presentations related to managing and advancing our careers. We'll also provide dedicated time for networking from time to time. We are looking for ways to expand participation in our meetings. We're going to look into spreading the word about NYOUG on Meetup.com and through a program with Google that provides non-profit organizations with targeted ad-words advertising on search results free of charge. We continue to expand our webcast offerings and are working on a redesign of our website. As always, we're looking for feedback and suggestions from our members. Please let us know what NYOUG should be doing to make sure that our group continues to be a valuable resource.

Michael Olin
President, NYOUG

Upcoming Meeting Dates

NYOUG Fall Training Session – October 8-9, 2013 – Advanced APEX with Josh Millinger

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SAVE THE DATE: NYOUG Winter 2013 General Meeting
DATE: Tuesday December 17, 2013
LOCATION: St. John's University – 101 Murray St. New York, NY 10007

Tagging, Encrypting, and Encoding with RMAN: The Engineering of the Intelligent Backup

Anthony D. Noriega, MSCS, MBA, BSSE, OCP
President and Lead Database Consultant at ADN Research

This document introduces a general dynamic model to backup and recovery (BR) and disaster recovery (DR) operations applicable to Oracle standalone and the high-availability cluster environments, involving full, incremental, and cumulative incremental backups, with extension to database cloning for high-availability, backup tagging. and encoding for further granularity, such as but not limited to, block-level recovery, backup and restore scripting, and backup validation among others.

In principle, the focus is solely on establishing a dynamic backup capable of dynamically implementing and executing full database backup, incremental level 1, and cumulative incremental level 1 backups, with custom autodrop job instantiation, and will extend its coverage to cloning for high-availability, disaster recovery topics such as RMAN database backup tagging, and various other topics of high-value for a complete corporate backup and recovery paradigm.

In most corporate environments today, the current backup policy uses fundamental features features, but it in many instances, it does not provide a unified model to fully utilize resources and capabilities.

This model will reveal the significance of private encoding, tagging, and encryption with RMAN, not only to ensure the confidentiality of the backup, but also to commit to the highest level of data privacy and security.

Justification: Weaknesses of Existing Backup Policies

The following is a good-will analysis regarding the weaknesses of the current backup policies bases on a SWAT general perspective.

Security

Current backup policies lack the fundamental of database security and privacy, and were not implemented to attain regulatory compliance in their respective industry.

Guaranteed Restore Point

In at least a few scenarios, backup restores can fail due to the lack of proper synchronization and database activity at backup time, so recovery procedures may be needed *ipso facto*.

Integrity and Unity

In many scenarios, lack of backup integrity, as the backup depends on the availability of the entire set of archived logs in the file system for a complete or point-in-time recovery. If archived redo logs were not available in disk or tape, due to a disk crash or a tape loss or destruction, then full or point-in-time recovery of any nature would not be possible. This is more significant when a corporation's current policy utilizes the recovery catalog in the same database instance, a model historically not recommeded by Oracle, but still practised.

Lags in Backup Timeframe

Corporate statistics and random qualitative samples could show that backup models have either potential or neglected lagging timeframes due to its imperfect integrity, which include scenarios such as, in the commonest cases, tape loss or destruction and disk drive or volume damage.

Timestamps on Backup Sets and Backup Pieces

Lack of proper timestamps, in principle, prevent to identify if a backup piece belongs to a specific backup set, and if so, whether it was actually performed at a specific time. Therefore, searching for the appropriate file can only be accomplished by looking at a directory in the file system, being restricted to a folder-based component control. However, if a file is misplaced for any reason, it would not be simple to identify such a file and restore it easily to the appropriate location (folder), the only place where it might be functional.

Required Regulatory Compliance

A backup model may need to be encrypted and secured in accordance with an explicit regulatory compliance, such as Mastercard Act, HIPAA, SOX, or various others, meaning that anyone who has access to the backup could invade the company's privacy and confidentiality and restore it somewhere else without any control at all.

Backup Encryption for Regulatory Compliance

Certain regulatory compliance acts require that all data be encrypted for data privacy and integrity. Many related backup models do not apply this regulation in the fear that encryption might cause more trouble than helping data privacy and security.

Password Security

Many existing backup models using a trivial password for target and catalog backup users, violating cloud security, corporate security, and industry and government regulations.

Backup Reliability

While mant backup models are reliable, integration with third party vendors may cause for their reliability to decrease. Similarly, in some instances, backup reliability is affected by channel bandwidth, process concurrency, and inconsistent settings for parameters such as *job_queue_processes*, *db_recovery_file_dest_size*, and various others.

Integration with Other Oracle Technologies

Many existing backup models do not integrate with other Oracle technologies such as Oracle *Flashbackup*, restore points, Oracle Transparent Data Encryption (TDE), block change tracking, and other SQL and PL/SQL supplied resources.

Compression Resources and Capabilities

Most corporate backup models do not use RMAN native compression compression at any level or backup granularity, and limit themselves to OS-level compression after backup completion in many real world scenarios. This feature has been rather underutilized in practicality without justification.

Justification for a New Improved Policy and Standard

A backup policy using the engineering model presented here will introduce custom scripts easy to deploy and use, exhibiting a variety of encoding, tagging, and encryption capabilities, regarded as powerfully useful to robust IT management, corporate governance, and regulatory compliance.

In addition to this, this backup policy can correct granular errors in an existing tiered backup model, which guarantees the assurance of a perfect restore in the event of a disaster due to various points of isolated fault tolerance. This is mission critical to a fast and successful recovery with optimal MTTR value.

Furthermore, the new policy will emphasize improved reliability, data security, privacy, and confidentiality, for improved regulatory compliance. This new policy will be progressively integrated with new technologies, such as, Flashback, database restore points, advanced encryption standards with Oracle TDE, and advanced compression , among others, in the berth of a new Oracle database release. But most of all it engineers an open model capable to produce an optimal backup model with unlimited accessibility control.

Backup Specifications

Usability

A backup policy utilizing tagging, encoding, and encryption should also allow for easy administration of any backup by the average DBA. However, it should be difficult enough for a common user to understand or use, and encoded enough to encompass corporate confidentiality and privacy. These usability and relevant user interface concerns are applicable to both a command line interface (CLI), and in some instances have access to Oracle Enterprise Manager.

Functionality

The backup will provide a variety of functionality including, but not limited to:
Further backup granularity by database component, file type, backup level and type, and specific functionality requirements are discussed in the next numeral.

Backup Specific Requirements

Prepared Scripts Ready to Run

The following scripts should be provided as part of a custom corporate solution, namely:

- Full incremental level 0 RMAN backup
- Incremental Level 1 RMAN backup
- Cumulative incremental level 1 RMAN backup
- Full backup validation
- Incremental cumulative backup validation
- Full and cumulative incremental backup validation
- Full backup restore
- DBPIT/SCN (Database point in time recovery) restore
- DBPIT/SCN (Database point in time recovery) restore with validation
- TSPIT/SCN (Tablespace point in time recovery) restore
- DBFPIT/SCN (Tablespace point in time recovery) restore
- Block PIT/SCN (Block recovery) restore.

Shells

Written and executed as Bash, C, Korn, or Perl shells in Linux and Unix enviroments; batch, Powershell, or Perl script in Windows; or Oracle PL/SQL utilizing DBMS_SCHEDULER supplied package blocks used to call or invoke each one of the scripts previously described, usually as an executable.

Policies

- DBA Managers will schedule the appropriate dates and times to run both the full (incremental level 0), incremental level 1 or cumulative incremental level 1 backups.
- Backups will belong to a special consumer group category, which will permit a special authentication for batch jobs, without displaying any password.
- Backups scripts can either be stored or run from a secured or encrypted directory.
- Backups should be preferably encrypted, but IT governance rules could be implemented to keep or provide support for unencrypted backups for business reasons.

Schedule

- Full backup after midnight on a week-end day; the recommended schedule is Saturday at 00:00:00 hours local database time

- Cumulative incremental level 3 different weekdays, after midnight. For instance, recommended hours are week days, Monday, Wednesday and Friday at 00:00:00 hours local database time
- Specific days of the week and exact times are to be specified by DBA managers.

Invocation Method

The preferred method is to utilize a shell script to start the backup, but it can also be driven through a stored script or procedure or via other type of batch job. A shell call is made to run an executable or a local or stored RMAN script or a combination of both.

Backup Types Used

- Full backup (incremental level 0)
  - The full backup will run once a week over the week-end, as recommended by lead DBA management or as required by the circumstances.
- Incremental level 1
- Cumulative incremental level 1
  - This backup type will run twice during the weekdays, between full-time backups.

Backup Actions and Contents

The backup model must provide consistency and integrity in all and each one of the following database components, namely:

- Data Files
- Control Files
- Archived Redo Log (Archivelog) Files and supplemental redo logs used with block change tracking
- Spfile

The backup model should also enforce the business rules associated with guranteed restored points.

Special Features

The following features would properly characterize a good backup model, namely:

Compactness: Cohesion, Coupling, and Unity (Integrity)

The backup should have several levels of fault tolerance, but it should be compact.

Easy to Customize

Backup should only involve a few parameters, which are easy to administer by the average DBA.

Easy to Deploy

Backup policy should provide a variety of simple resources to deploy in the entire corporate environment in a seamless fashion. It is recommended that the core code of the backup be stored in an RMAN script.

Easy to Maintain Throughout the Company

Mandatory backup maintenance based on resilient periodic schedule, validating and verifying the backup to guarantee its data quality and integrity.

RMAN Scripting Usage

Both the full backup (incremental level 0) and the cumulative incremental level 1 backup will be driven by customized RMAN scripts easy to deploy onto the entire corporation. Store scripting should be in place for daily use, but a copy of an equivalent non-stored script should be available at all times. Similarly, a restore script is required to render:

Flexibility

- Provide full backup restore completion, including restore of full backup (incremental level 0) and incremental level 1 or cumulative incremental level 1 backups.
- Provide database point in time recovery
- Provide tablespace point in time support

Custom Media Formatting

A custom path to default directories or SBT tape will be provided. When backing up strictly to drives, a tertiary backup to tape will be provided at the OS-level. It is recommended to keep at least a full month of consecutive tape backups, with some redundancy. This means that archived logs will be backed up both within the RMAN backup sets, and directly to tape at the OS-level through a conventional system backup or via a customize tape backup.

Backup Integrity

The current policy does not explicitly backup the archived redo logs within the RMAN backup sets, which constitutes a single point of failure to the backup consistency and unity, and all of the physical and logical locations, and business perspectives. An improvement can be made by customizing the backup to include tagged, encoded, and individual backup sets for each component.

Database Security and Data Privacy for Regulatory Compliance

These special security, privacy, and compliance features include, but are not limited to:

Business Intelligence Implementation

Timestamps

Every backup piece should be properly marked with a timestamp, upon start and completion; as well every backup set should have a similar timestamp format upon completion of the backup set. This will enable consistency with specific SCNs and flashback technologies. This is attained through OS shells such as Bash and Korn shells in Linux and Unix or through a DOS console batch file, in either scenario with the following command:

set NLS_DATE_FORMAT=DD-MON-YYYY HH24:MI:SS (without any quotation marks)

In fact, this command is placed just before starting the shell invoking the RMAN script. Thus, each backup piece start and end will be marked with a consistent visible timestamp, which highly improves the DBA's ability to analyze and use RMAN logs, and utilize them in future B/R and D/R database operations.

Backup Integrity and Fault-Tolerance

For administrative reasons, at the media level, the backup should be compact and fault tolerance, being self contained in one media type, with other backup layers tolerance levels, independently from whether the backup policy is strictly a tiered one or not. For instance, if the tape containing the archived logs is lost or destroyed, in the event of a disk drive failure affecting those logs, the RMAN backup should contain the required archived logs as close to or to the point of failure, and all along the recovery window of time.

Tagging and Encoding

Tagging should facilitate the backup type, the backup date and time, and searching for a backup set within the backup, a backup piece within the backup set, and a database file block within a backup piece. Tagging can be customized by the

corporation needs, as well, and can be modified to meet those new requirements, for any attainable business intelligence purpose.

Logging RMAN Operations

Every RMAN backup as well as other RMAN operations such as —but not limited to—backup restore, database cloning, database and tablespace point in time recovery, must have a log of every event that takes place.

Backup Restore Operations

An optimal restore policy must:

- Provide capabilities for successful full, point in time, SCN-based, or *until cancel* restores.
- Utilize at least one RMAN stored script, whenever possible
- Use tagging
- Utilize company private encoding for backup pieces
- Utilize an explicit configuration format
- Provide an easy integration with company historic backup formats
- Backup the archived redo log
- Crosscheck backup components frequently
- Supply a full incremental level 0 shell component
- Supply a cumulative incremental level 1 shell component
- Supply a incremental level 1 shell component
- Provide a unique shell encompassing the three previously mentioned shells
- Make smart usage of RMAN custom parameters such as FILESPERSET, TAG, and MAXSETSIZE, among others.
- Provide encryption support for various encryption algorithms through Oracle TDE in conjunction with encryption wallets and related encryption methods.
- Render easiness and flexibility to accept calls.

Encryption

The backup policy should support encryption in conjunction with an encryption method and algorithm selected by DBA to be used for that database instance. The backup should support encryption algorithms (e.g., MD5 and SHA1, among) provided with the Oracle database, and various encryption standards, such as DES, 3DES, and IPSEC, among others, and it should not conflict with the encryption provided with the Oracle Transparent Data Encryption (TDE) wallet through any method used.

Compression

Backup compression at various levels —from BASIC to LOW, to MEDIUM, to HIGH— should be available, in accordance to the company's dynamic needs. It is recommended to license high level compression with Oracle Corporation.

Other Recommendations

- Could be synchronized with Oracle FLASHBACK technologies and database restore points
- Should print exact timestamp when a backup piece is starts to being backed up
- Could use block change tracking.

Basic Practices

Proposed Backup Scheduling

BACKUP TYPE	LEVEL	WEEK DAY(S)	START TIME	ESTIMATED DURATION
FULL	INCREMENTAL LEVEL 0	SATURDAY	MIDNIGHT	4 HOURS
CUMULATIVE	INCREMENTAL LEVEL 1	MONDAY, WEDNESDAY, FRIDAY	MIDNIGHT	4 HOURS

Table 1. Proposed Backup Schedules

When scheduling a Oracle database RMAN backup, Lead DBA should follow a few basic principles, namely:

- Ensure that the backup schedule does not conflict with any other processes, including non database operations, such, webcasts, videoconferences, and other processes affecting network bandwidth or constraining SAN or NAS or other high availability interconnects, thus, affecting RMAN channels
- Ensure that a properly time-stamped log of all backup process actions takes places accordingly
- Ensure that both database and OS accounts have the appropriate privileges and credentials to run the backup job.

Supplied Shells, PL/SQL and RMAN Scripts

The following RMAN, PL/SQL and RMAN scripts are provided in accordance to the following business process model, as described in the diagram shown by "Exhibit 2. Backup Workflow".

The diagram summarizes the core RMAN backup processes as follows:

- Creating RMAN directories (a one time action)
- Creating the proposed SP_RMANLINE procedure, main procedure used to run the backup within the PKG_UTL_RMAN extended package in compact mode.
- Using the *SP_CALLRMANLINE* stored procedure or setting equivalent PL/SQL block to call the *SP_RMANLINE* stored procedure.
- Running the *grantall.sql* SQL script in order to grant the appropriate privileges to directories and procedures and other required objects.
- OSCommand PL/SQL stored function or procedure and Oscommand Java stored procedure to run OS-level commands, more practical in Linux and Unix environments, where the file mode must be stated. This is not required for Windows, since a batch file is an executable by default.

Although the diagram does not include a comprehensive structure of the PKG_UTL_RMAN package, it is hereby included below.
The backup's proposed original package headers (constructors) are presented, as follows:

```
CREATE OR REPLACE PKG_UTL_RMAN IS
    FUNCTION  sf_setOSconfig();              -- Sets on which operating system platform
                                                backup will run on
    FUNCTION  sf_generateTag();              -- Generates custom rman tag
    FUNCTION  sf_setCustomLineParam();       -- Customizes parameter portion of
    FUNCTION OsCommand_Run();                   -- Java-based PL/SQL external stored function
    PROCEDURE OsCommand_Exec();                 -- Java-based PL/SQL external stored procedure
    PROCEDURE sp_custom_rmanline1();         -- Customized version of RMAN backup
                                                (sp_rmanline procedure)
```

```
   PROCEDURE sp_call_custom_rmanline1();  -- entry point for default rman backup
   PROCEDURE sp_setPrivs();               -- Privilege setting for custom backup
   PROCEDURE sp_setCredentials();         -- Sets OS level credentials for

   PROCEDURE sp_changePwd();              -- Admin password changing and user
                                             management
   PROCEDURE sp_changePrivs();            -- Changes DBa privileges in general
   PROCEDURE sp_addPrivDBA();             -- Adds a privileged DBA to use the RMAN
                                             backup utility
   PROCEDURE sp_validatebkp()             -- Validates a backup or restore.
   PROCEDURE prc_master_restore()         -- Custom backup restore with many options.
   PROCEDURE sp_rmanline1();              -- Default RMAN backup
   PROCEDURE sp_callrmanline();          --  entry point for default rman backup
END PKG_UTL_RMAN;
```

Exhibit 1. Proposed RMAN Backup Utility (Package Headers/Constructors Skeletal)

On a daily basis, it is expected for the SP_RMANLINE() procedure to run the backup after being invoked by SP_CALLRMANLINE(). Once the backup is deployed, there should be no DBA interaction, other than optionally monitoring the running jobs and consistently reviewing the RMAN logs.

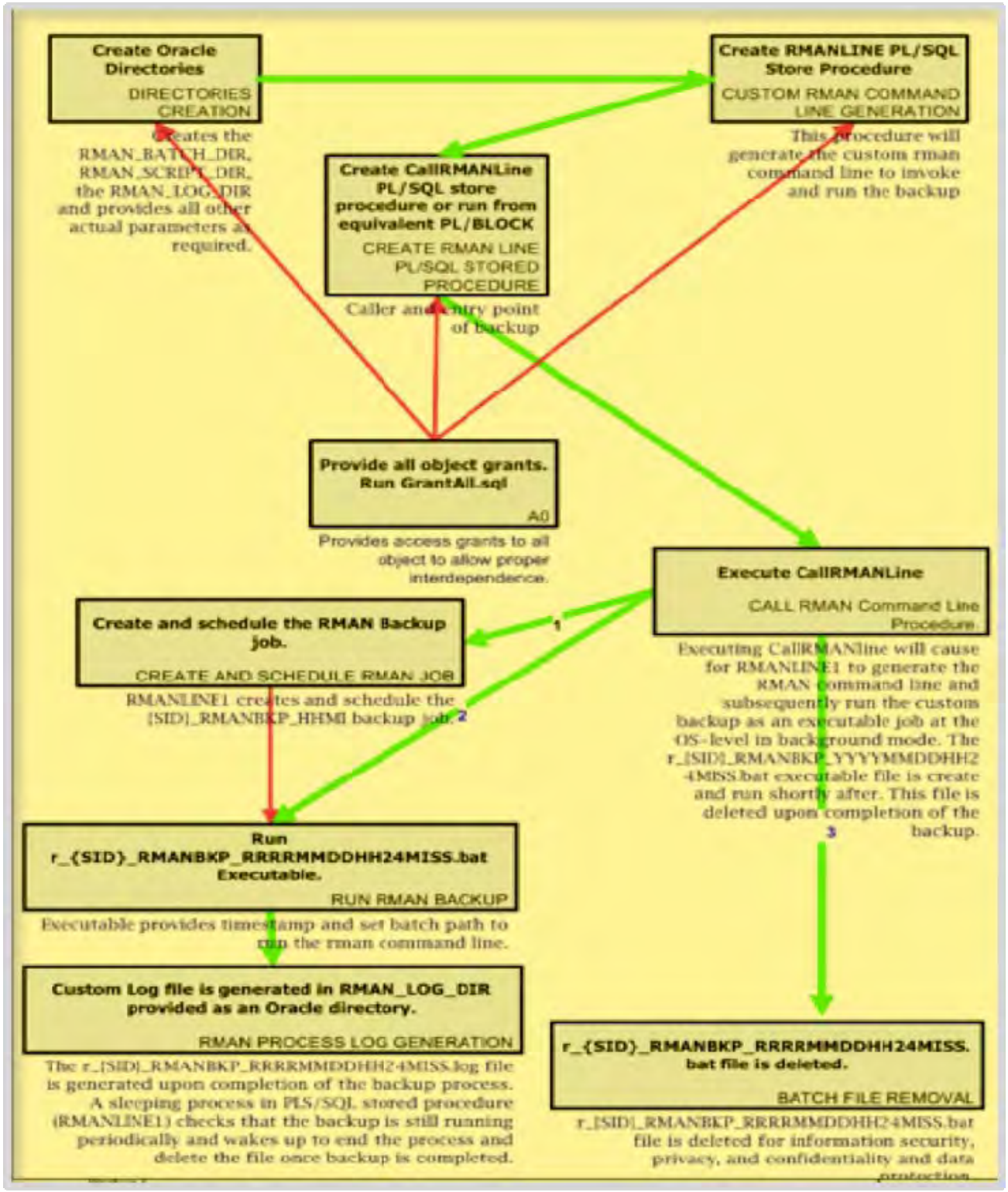

Exhibit 2. Backup Workflow

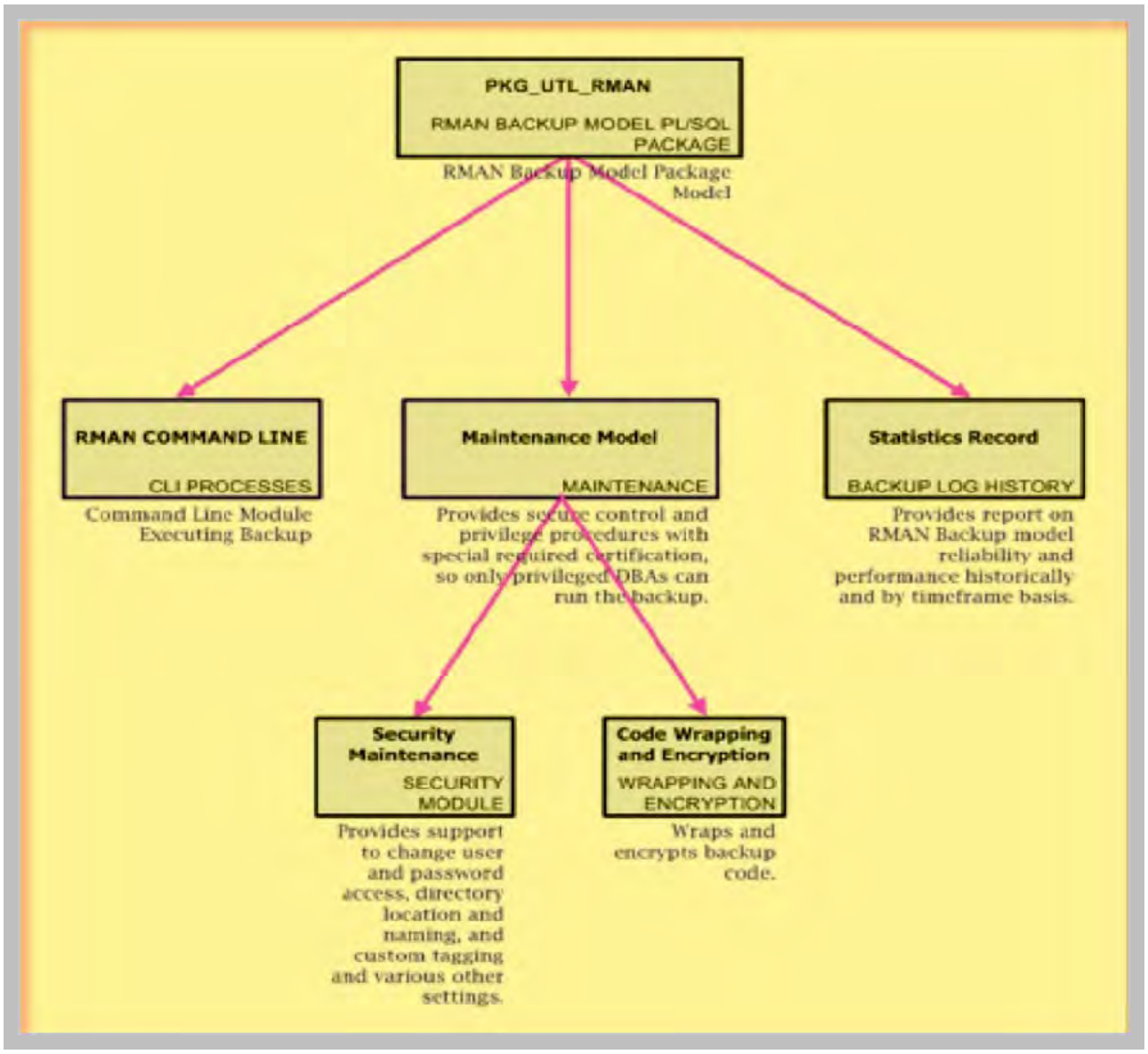

Exhibit 3. Backup Model Architecture

Tagging Strategies

The tagging strategies and techniques for RMAN can involve, namely:

- Using Oracle default tagging, which utilizes a smart timestamp.
- Utilizing custom tagging supporting corporate backup management and data warehousing integration when managing backup data across platforms.
- Applying tags specific to territories, timeframes, business units, goal seeking records and various others.

Also, tags can be customized dynamically using a programmatic interface passing actual parameters to RMAN substitution variables.
The following is an RMAN script using substitution variables, to be invoked by a shell with matching parameters:

```
set encryption &1;
run  {
         allocate  channel cH1 type disk;
         sql 'alter system archive log current';
         sql 'begin create_restore_point; end;';
         crosscheck archivelog all;
         release   channel cH1;
         allocate  channel cH1 type disk;
         allocate  channel cH2 type disk;
         allocate  channel cH3 type disk;
         allocate  channel cH4 type disk;
         set limit channel cH1 kbytes 16577216;
         set limit channel cH2 kbytes 16577216;
         set limit channel cH3 kbytes 16577216;
         set limit channel cH4 kbytes 16577216;
         BACKUP AS &2 BACKUPSET
            INCREMENTAL LEVEL &3 &4
            FORMAT '/home/oracle/app/oracle/flash_recovery_area/orcl/backupset/%T_%d_dbbkp_L0_%s%t%U'  tag = &7
         FILESPERSET &6
           (database);
         BACKUP AS &2 BACKUPSET
            INCREMENTAL LEVEL &3 &4
            FORMAT '/home/oracle/app/oracle/flash_recovery_area/orcl/backupset/%T_%d_ctlbkp_L0_%s%t%U' tag = &7
            (current controlfile);
            sql 'alter system archive log current';
          BACKUP AS &2 BACKUPSET
            INCREMENTAL LEVEL &3 &4
            FORMAT '/home/oracle/app/oracle/flash_recovery_area/orcl/backupset/%T_%d_arcbkp_L0_%s%t%U' tag = &7
             (archivelog all);
         backup spfile;
         sql 'alter database backup controlfile to trace';
         release channel cH1;
         release channel cH2;
         release channel cH3;
         release channel cH4;
       }
         resync catalog;
         list backupset of database;
         list backupset of controlfile;
         list backupset of archivelog all;
         list restore point all;
         report schema;
         validate check logical skip inaccessible database;
         restore validate database;
         restore validate archivelog all;
         report obsolete;
         delete noprompt obsolete;
         exit;
```

Exhibit 4. RMAN Versatile Script Using Substitution Variables

Equivalently, the RMAN command line matching this script could look as follows:

```
${ORACLE_HOME}/bin/rman target sys/${SYSPWD}@adnibsx catalog rman/${RMANPWD}@adnibmsx
@${RMAN_SCRIPT_DIR}/r_backup.rman  USING  'ON'  ' '   1  ' '  'adnibmsx' 1 'adnibmsx_INL1_201305011653'
LOG=${RMAN_LOG_DIR}/adnibmsx_r_backup.rman_L1_201305011653.log
```

Exhibit 5. RMAN Call Line in OS-shell

Encoding Strategies

Encoding strategies can be quite simple or extremely complex. This backup model customizing corporate encoding through the usage of a function returning a string to be used anywhere in the backup, such as for instance:

- Create a custom tag
- Create a portion of the backup piece name
- Create a naming convention for a backupset
- Create a naming convention for any other RMAN backup component

The following function is an example of simple encoding:

```
FUNCTION sf_simple_encoding (string1  IN VARCHAR2, string2 IN VARCHAR2, string3 IN VARCHAR2) RETURN VARCHAR2 IS
v_custom_tag VARCHAR2(4000);
BEGIN

        SELECT RTRIM(string1)||RTRIM(string2)||RTRIM(string3) AS custom_encode
            INTO v_custom_tag
            FROM dual;

       RETURN v_custom_tag;

EXCEPTION WHEN OTHERS
THEN
raise_application_error(-20119,'Invalid values used.');
DBMS_OUTPUT.put_line(SQLERRM);
RETURN NULL;
END sf_simple_encoding;
```

Exhibit 6. Simple Encoding Function

Then testing the function would produce the string to be used a tag name or other naming convention within the backup, passed as an actual parameter to the RMAN backup script.

```
SQL> get /tmp/tstfun.sql
1  begin
2     dbms_output.put_line(sf_simple_encoding('CERN','LAB1','TST321'));
3* end;
SQL> /
CERNLAB1TST321
```

Besides, complex functions can be implemented to customize an important aspect of the backup model, and this is not limited to a custom tagging strategy, but rather an extended corporate backup model can be easily implemented, which is more consistent with the convolution of big data and data warehousing environments, as well as smart storage hardware capabilities.

Other Major Considerations

RMAN Configuration Settings

The following is a recommended array of RMAN configuration settings useful to any environment, in general, but subject to any required adjustment due to regulatory compliance, business or resource constraints, capacity planning or performance tuning or any other *de facto* reasons.

```
RMAN> show all;

RMAN configuration parameters for database with db_unique_name ADNIBMSX are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1;
CONFIGURE BACKUP OPTIMIZATION ON;
CONFIGURE DEFAULT DEVICE TYPE TO DISK;
CONFIGURE CONTROLFILE AUTOBACKUP ON;
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '%F';
CONFIGURE DEVICE TYPE DISK PARALLELISM 4 BACKUP TYPE TO COMPRESSED BACKUPSET;
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1;
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1;
CONFIGURE CHANNEL 1 DEVICE TYPE DISK FORMAT   'C:\app\oracle\flash_recovery_area\ADNIBMSX\BACKUPSET\%Y_%M_%D\ADNIBMSX_%
CONFIGURE CHANNEL 2 DEVICE TYPE DISK FORMAT   'C:\app\oracle\flash_recovery_area\ADNIBMSX\BACKUPSET\%Y_%M_%D\ADNIBMSX_%
CONFIGURE CHANNEL 3 DEVICE TYPE DISK FORMAT   'C:\app\oracle\flash_recovery_area\ADNIBMSX\BACKUPSET\%Y_%M_%D\ADNIBMSX_%
CONFIGURE CHANNEL 4 DEVICE TYPE DISK FORMAT   'C:\app\oracle\flash_recovery_area\ADNIBMSX\BACKUPSET\%Y_%M_%D\ADNIBMSX_%
CONFIGURE MAXSETSIZE TO UNLIMITED;
CONFIGURE ENCRYPTION FOR DATABASE ON;
CONFIGURE ENCRYPTION ALGORITHM 'AES128';
CONFIGURE COMPRESSION ALGORITHM 'HIGH' AS OF RELEASE 'DEFAULT' OPTIMIZE FOR LOAD TRUE;
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE;
CONFIGURE SNAPSHOT CONTROLFILE NAME TO 'C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\SNCFADNIBMSX.ORA';
```

Exhibit 7. RMAN Configuration Settings

Encryption

For the past few months, the Oracle DBA team has successfully tested the implementation of the Oracle Transparent Data Encryption (TDE) in conjunction with an encrypted backup and secure backup policies, *using a file-based encryption wallet*. At the present time, the overall business process is reliable enough to be put into production. Cross-training among DBAs to attain full understanding and application of the backup process may be required for a thorough knowledge of the existing policy and the new changes to be applied.

Compression

The current backup policy already uses Oracle Basic compression. The new policy recommends using Oracle Advanced Compression with a *HIGH* compression setting rather than any other compression level.

Database Architecture

For many database environments, the current size of the database log files is only 50MB, which is already somewhat small for the size of essentially any database. The fact that the archived redo logs may reside in different NAS or SAN location represents an additional issue for backup performance optimization as the involved propagation delay represents a major concern.

The minimum recommended size for the a log file size in each environment, is as follows:

ENVIRONMENT	MINIMUM	AVERAGE	MAXIMUM
DEVELOPMENT	100MB	150MB	200MB
SIT	200MB	300MB	400MB
UAT	300MB	500MB	800MB
PRODUCTION	500MB	800MB	2GB[1]

Table 2. Sample Recommended Database Log Files Size

Other Concerns

For most corporations, the backup policy should work in accordance with the implementation of capacity planning operating procedures and the investment and allocation of the appropriate resources for coordinated deployment and maintenance plans.

APPENDIX

A. Sample Source Code

```
PROCEDURE  SP_RMANLINE(
                        ip_rmantuser            VARCHAR2,
                        ip_rmantuserpwd         VARCHAR2,
                        ip_rmancuser            VARCHAR2,
                        ip_rmancuserpwd         VARCHAR2,
                        ip_target               VARCHAR2,
                        ip_rcvcat               VARCHAR2,
                        ip_rman_script_dir      VARCHAR2    DEFAULT 'RMAN_SCRIPT_DIR',
                        ip_rman_batch_dir       VARCHAR2    DEFAULT 'RMAN_BATCH_DIR',
                        ip_Fname                VARCHAR2    DEFAULT 'r_backup.rman',
                        ip_log_dir              VARCHAR2    DEFAULT 'RMAN_LOG_DIR',
                        ip_lvl                  NUMBER      DEFAULT 0,
                        ip_Cum_Opt              VARCHAR2,
                        ip_Oracle_bin_dir       VARCHAR2    DEFAULT 'ORACLE_BIN_DIR',
                        ip_Comp_Flag            VARCHAR2    DEFAULT 'C',
                        ip_Encr_Flag            VARCHAR2    DEFAULT 'on',
                        ip_Filesps              NUMBER      DEFAULT 1
                      ) IS

crlf            CONSTANT VARCHAR2(10) := CHR(13)||CHR(10);
v_exit          VARCHAR2(30) := 'exit'||CHR(13)||CHR(10);
v_user          VARCHAR2(30);
v_rmanline      VARCHAR2(4000);
v_Fname         VARCHAR2(4000);
v_dFname        VARCHAR2(4000);
v_Path_Dir      VARCHAR2(4000);
v_Bin_Dir       VARCHAR2(4000);
v_logPath_Dir   VARCHAR2(4000);
v_ts            VARCHAR2(20);
v_ts2           VARCHAR2(20);

v_set_nls_date  VARCHAR2(128)  := 'set NLS_DATE_FORMAT=DD-MON-RRRR HH24:MI:SS'||CRLF;
```

[1] Production log file sizing is strictly measured by the actual database size and daily production workload.

```
v_PATH          VARCHAR2(4000);
v_rmanbkp_name  VARCHAR2(30);
v_clean_rmanbkp_name  VARCHAR2(30);
v_batch_file    VARCHAR2(128);
v_dbatch_file   VARCHAR2(128);
RMANfh          utl_file.file_type;
dRMANfh         utl_file.file_type;

PROCEDURE prcGetTimestamps(ip_Ts1 IN OUT VARCHAR2, ip_Ts2 IN OUT VARCHAR2) IS
BEGIN
 SELECT TO_CHAR(SYSDATE,'YYYYMMDDHH24MI')   AS cts,
        TO_CHAR(SYSDATE,'RRRRMMDDHH24MI')   AS cts2
   INTO ip_Ts1,
        ip_Ts2
   FROM dual;
EXCEPTION
WHEN OTHERS THEN
   null;
END prcGetTimestamps;

-- Returns the actual directory path...
FUNCTION getPathDir (ipDir IN VARCHAR2) RETURN VARCHAR2 IS
lvPathDir       VARCHAR2(4000);
BEGIN
  SELECT directory_path
    INTO lvPathDir
    FROM  sys.dba_directories
  WHERE directory_name = ipDir;
  RETURN lvPathDir;
EXCEPTION
WHEN NO_DATA_FOUND THEN
  DBMS_OUTPUT.put_line('Invalid File system path or directory name.');
  RETURN NULL;
WHEN OTHERS THEN
  RAISE;
  DBMS_OUTPUT.put_line(SQLERRM);
END getPathDir;

FUNCTION getOracleBinDir  RETURN VARCHAR2 IS
lvOraHomeDir    VARCHAR2(4000);
lvOraBinDir     VARCHAR2(4000);
 begin
  sys.dbms_system.get_env('ORACLE_HOME', lvOraHomeDir);
  lvOraBinDir := lvOraHomeDir||'\bin\';
  RETURN lvOraBinDir;
EXCEPTION
WHEN NO_DATA_FOUND THEN
  DBMS_OUTPUT.put_line('Invalid File system path or directory name.');
  RETURN NULL;
WHEN OTHERS THEN
  RAISE;
  DBMS_OUTPUT.put_line(SQLERRM);
END getOracleBinDir;

-- Returns the actual directory path...
FUNCTION setPathDir (ipBinDir IN VARCHAR2) RETURN VARCHAR2 IS
```

```
v_PathDir       VARCHAR2(4000);

BEGIN
v_PathDir   := 'set PATH='||ipBinDir||CRLF;
RETURN v_PathDir;
EXCEPTION
WHEN NO_DATA_FOUND THEN
  DBMS_OUTPUT.put_line('Invalid File system path or directory name.');
  RETURN NULL;
WHEN OTHERS THEN
  RAISE;
  DBMS_OUTPUT.put_line(SQLERRM);
END setPathDir;

-- Generates the RMAN Backup command line
FUNCTION genRmanLine RETURN VARCHAR2 IS
v_rmanline_fun    VARCHAR2(4000);
BEGIN
SELECT    v_Bin_Dir
        ||'rman target'
        ||' '
        ||ip_rmantuser
        ||'/'
        ||ip_rmantuserpwd
        ||DECODE(ip_target,NULL,NULL,'@'||ip_target)
        ||' '
        ||DECODE(ip_rcvcat,NULL,'NOCATALOG','CATALOG')
        ||' '
        ||DECODE(ip_rcvcat,NULL,NULL,ip_rmancuser)
        ||DECODE(ip_rcvcat,NULL,NULL,'/')
        ||DECODE(ip_rcvcat,NULL,NULL,ip_rmancuserpwd )
        ||DECODE(ip_rcvcat,NULL,NULL,'@'||ip_rcvcat)
        ||' '
        ||'@'
        ||v_Path_Dir
        ||NVL(ip_Fname,'r_backup.rman')
        ||' '
        ||' USING '
        ||' '
        ||CHR(39)
        ||ip_Encr_Flag
        ||CHR(39)
        ||' '
        ||DECODE( UPPER(ip_Comp_Flag) , 'C' , CHR(39)||'COMPRESSED'||CHR(39), CHR(39)||'
'||CHR(39) )
        ||'  '
        ||TO_CHAR(ip_lvl,'9')
        ||' '
        ||DECODE( ip_Cum_Opt,'C', CHR(39)||'CUMULATIVE'||CHR(39), CHR(39)||' '||CHR(39) )
        ||'  '
        ||CHR(39)
        ||instance_name
        ||CHR(39)
        ||' '
        ||LTRIM(TO_CHAR( DECODE ( ip_Filesps, null, 1, ip_Filesps ),'99999' ))
        ||' '
        ||CHR(39)
```

```
        ||instance_name
        ||DECODE( ip_lvl,1, DECODE( ip_Cum_Opt , 'C', '_CIL1_' , '_INL1_' ), 0, '_FLL0_',
'_FLL0_')
        ||v_ts
        ||CHR(39)
        ||' '
        ||' LOG='
        ||v_logPath_Dir
        ||instance_name
        ||'_'
        ||NVL(ip_Fname,'_r_backup')
        ||DECODE( ip_lvl, 0,'_L0_','_L1_')
        ||v_ts
        ||'.log'
 INTO   v_rmanline_fun
 FROM   sys.V$instance;
RETURN v_rmanline_fun;
EXCEPTION
WHEN OTHERS THEN
raise_application_error(-20102,'Invalid option.');
END genRmanLine;

PROCEDURE CloseFile(ipFHandle IN OUT utl_file.file_type) IS
vFHandle utl_file.file_type;

BEGIN
     -- closing files
vFHandle := ipFHandle;

if utl_file.is_open(vFHandle) then
   utl_file.fclose(vFHandle);
end if;

dbms_output.put_line('File closed');

EXCEPTION
WHEN OTHERS THEN
     DBMS_OUTPUT.PUT_LINE(SQLERRM);
END CloseFile;

-- Opens file for reading or writing...
PROCEDURE OpenFile(ipFileHandle IN OUT UTL_FILE.FILE_TYPE, ipMode IN VARCHAR2, ipDir IN
VARCHAR2, ipFname IN VARCHAR2, ipBfrSz IN INTEGER) IS
BEGIN
       ipFileHandle := utl_file.fopen(ipDir,ipFname, ipMode,ipBfrSz);
EXCEPTION
WHEN UTL_FILE.INVALID_MODE THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid Mode used.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INVALID_PATH THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid path being used.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.ACCESS_DENIED THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Access denied.');
```

```
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.CHARSETMISMATCH THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid character set error');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INTERNAL_ERROR THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Internal Write error occured.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INVALID_MAXLINESIZE  THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Buffer overflow');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.READ_ERROR THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('OS Read error occured.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.WRITE_ERROR THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('OS Write error occured.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INVALID_FILENAME THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid file name used.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INVALID_FILEHANDLE THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid handle found.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN UTL_FILE.INVALID_OPERATION THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE('Invalid operation attempted.');
     CloseFile(ipFHandle => ipFileHandle);
WHEN OTHERS THEN
     RAISE;
     DBMS_OUTPUT.PUT_LINE(SQLERRM);
     CloseFile(ipFHandle => ipFileHandle);
END OpenFile;

-- Procedure to open the output file
PROCEDURE OpenOutPutFile IS
BEGIN
     RMANfh := utl_file.fopen(ip_rman_script_dir,ip_Fname,'a',1024);
EXCEPTION
WHEN OTHERS THEN
    DBMS_OUTPUT.put_line(SQLERRM);
END OpenOutPutFile;

-- Procedure to close the file
PROCEDURE DeleteFile (ipDir IN VARCHAR2, ipFileName IN VARCHAR2) IS
BEGIN
    DBMS_OUTPUT.put_line('Batch Directory is... => '||getPathDir( NVL(
ipDir,ip_rman_batch_dir) ) );
    DBMS_OUTPUT.put_line('File Name is file... => '||ipFileName);
    DBMS_OUTPUT.put_line('Deleting file... => '||getPathDir( NVL(
ipDir,ip_rman_batch_dir) )||ipFileName);
    utl_file.fremove(location => getPathDir( NVL( ipDir,ip_rman_batch_dir) ) , filename
```

```
=> ipFileName );
EXCEPTION
WHEN UTL_FILE.INVALID_MODE THEN
     DBMS_OUTPUT.PUT_LINE('Invalid Mode used.');
WHEN UTL_FILE.INVALID_PATH THEN
     DBMS_OUTPUT.PUT_LINE('Invalid path being used.');
WHEN UTL_FILE.ACCESS_DENIED THEN
     DBMS_OUTPUT.PUT_LINE('Access denied.');
WHEN UTL_FILE.INVALID_OFFSET THEN
     DBMS_OUTPUT.PUT_LINE('Invalid offset occurred.');
WHEN UTL_FILE.CHARSETMISMATCH THEN
     DBMS_OUTPUT.PUT_LINE('Invalid character set error');
WHEN UTL_FILE.INTERNAL_ERROR THEN
     DBMS_OUTPUT.PUT_LINE('Internal Write error occured.');
WHEN UTL_FILE.INVALID_FILENAME THEN
     DBMS_OUTPUT.PUT_LINE('Invalid file name used.');
WHEN UTL_FILE.INVALID_OPERATION THEN
     DBMS_OUTPUT.PUT_LINE('Invalid operation attempted.');
WHEN OTHERS THEN
  raise;
  DBMS_OUTPUT.PUT_LINE(SQLERRM);
END DeleteFile;

-- Procedure to write to the output file
PROCEDURE WriteFile (ipFHandle IN utl_file.file_type, ipBfr IN VARCHAR2) IS
BEGIN
    utl_file.putf(ipFHandle,'%s',ipBfr);
    utl_file.fflush(ipFHandle);
EXCEPTION
WHEN UTL_FILE.INVALID_MODE THEN
     DBMS_OUTPUT.PUT_LINE('Invalid Mode used.');
WHEN UTL_FILE.INVALID_PATH THEN
     DBMS_OUTPUT.PUT_LINE('Invalid path being used.');
WHEN UTL_FILE.ACCESS_DENIED THEN
     DBMS_OUTPUT.PUT_LINE('Access denied.');
WHEN UTL_FILE.INVALID_OFFSET THEN
     DBMS_OUTPUT.PUT_LINE('Invalid offset occurred.');
WHEN UTL_FILE.CHARSETMISMATCH THEN
     DBMS_OUTPUT.PUT_LINE('Invalid character set error');
WHEN UTL_FILE.INTERNAL_ERROR THEN
     DBMS_OUTPUT.PUT_LINE('Internal Write error occured.');
WHEN UTL_FILE.INVALID_MAXLINESIZE  THEN
     DBMS_OUTPUT.PUT_LINE('Buffer overflow');
WHEN UTL_FILE.WRITE_ERROR THEN
     DBMS_OUTPUT.PUT_LINE('OS Write error occured.');
WHEN UTL_FILE.INVALID_FILENAME THEN
     DBMS_OUTPUT.PUT_LINE('Invalid file name used.');
WHEN UTL_FILE.INVALID_FILEHANDLE THEN
     DBMS_OUTPUT.PUT_LINE('Invalid handle found.');
WHEN UTL_FILE.INVALID_OPERATION THEN
     DBMS_OUTPUT.PUT_LINE('Invalid operation attempted.');
WHEN OTHERS THEN
  raise;
  DBMS_OUTPUT.PUT_LINE(SQLERRM);
END WriteFile;

-- generates and runs the rman backup job...
```

```
PROCEDURE sub_create_bkp (ip_jname IN VARCHAR2, ip_jtype IN VARCHAR2, ip_jaction IN
VARCHAR2) IS
lv_start_time TIMESTAMP;
lv_bkp_time   TIMESTAMP;

BEGIN
   SELECT  current_timestamp + INTERVAL '0 0:00:30.000' DAY TO SECOND(3) AS vs
     INTO  lv_start_time
     FROM  dual;

   SELECT  current_timestamp + TO_DSINTERVAL('0 0:01:00.000') AS tsbkp
     INTO  lv_bkp_time
     FROM  dual;

   sys.dbms_scheduler.create_job(
                                   job_name    =>  ip_jname,
                                   job_type    =>  ip_jtype,
                                   job_action  =>  ip_jaction,
                                   start_date  =>  lv_start_time,
                                   job_class   =>  'DEFAULT_JOB_CLASS',
                                   comments    =>  'Generates and executes an Oracle
backup job',
                                   auto_drop   =>  TRUE,
                                   enabled     =>  FALSE
                                 );

   sys.dbms_scheduler.set_attribute( name => ip_jname, attribute => 'job_priority', value
=> 1 );

   sys.dbms_scheduler.set_attribute( name => ip_jname, attribute => 'logging_level',
value => DBMS_SCHEDULER.LOGGING_FULL
                                                                    );
   sys.dbms_scheduler.enable( ip_jname );

   sys.dbms_lock.sleep(60);

EXCEPTION
WHEN OTHERS THEN
   DBMS_OUTPUT.put_line(SQLERRM);
END sub_create_bkp;

PROCEDURE sub_cleanup_job (ip_jname IN VARCHAR2, ip_jtype IN VARCHAR2, ip_jaction IN
VARCHAR2) IS
lv_start_time TIMESTAMP;
lv_bkp_time   TIMESTAMP;

BEGIN
   SELECT  current_timestamp + INTERVAL '0 0:00:20.000' DAY TO SECOND(3) AS vs
     INTO  lv_start_time
     FROM  dual;

   SELECT  current_timestamp + TO_DSINTERVAL('0 0:00:40.000') AS tsbkp
     INTO  lv_bkp_time
     FROM  dual;

   sys.dbms_scheduler.create_job(
                                   job_name      =>  ip_jname,
```

```
                                    job_type      =>  ip_jtype,
                                    job_action    =>  ip_jaction,
                                    start_date    =>  lv_start_time,
                                    job_class     =>  'DEFAULT_JOB_CLASS',
                                    comments      =>  'Cleans up/removes rman backup
executable file.',
                                    auto_drop     =>  TRUE,
                                    enabled       =>  FALSE
                                  );
                                   sys.dbms_scheduler.set_attribute( name => ip_jname,
attribute => 'job_priority', value => 3 );
   sys.dbms_scheduler.enable( ip_jname );
   sys.dbms_lock.sleep(2);
EXCEPTION
WHEN OTHERS THEN
   BEGIN
    DeleteFile ( ipDir => ip_rman_batch_dir, ipFileName => v_Fname );
   EXCEPTION
   WHEN OTHERS THEN
      DBMS_OUTPUT.put_line('Could not erase rman file in use. Verify that manual deletion
is performed.');

      RAISE_APPLICATION_ERROR(-20116,'RMAN batch file with security information was not
permanently deleted.');

      DBMS_OUTPUT.put_line(SQLERRM);
   END;
END sub_cleanup_job;

PROCEDURE sub_disable_bkpjob (ip_jname IN VARCHAR2) IS
BEGIN
   sys.dbms_scheduler.disable ( name => ip_jname);
EXCEPTION
WHEN OTHERS THEN
   DBMS_OUTPUT.put_line(SQLERRM);
END sub_disable_bkpjob;

PROCEDURE sub_drop_bkpjob (ip_jname IN VARCHAR2) IS
BEGIN
   sys.dbms_scheduler.drop_job ( job_name => ip_jname);
EXCEPTION
WHEN OTHERS THEN
   DBMS_OUTPUT.put_line(SQLERRM);
END sub_drop_bkpjob;

FUNCTION funGetJobStatus(ip_jname IN VARCHAR2 ) RETURN BOOLEAN IS
  lv_enabled SYS.dba_scheduler_jobs.enabled%TYPE;
BEGIN
   SELECT enabled
     INTO lv_enabled
     FROM SYS.dba_scheduler_jobs
   WHERE job_name = ip_jname;
   IF lv_enabled = 'TRUE' THEN
      RETURN TRUE;
   ELSE
      RETURN FALSE;
   END IF;
```

```
EXCEPTION
WHEN NO_DATA_FOUND THEN
   raise_application_error(-20101,'Job was not previously created.');
   RETURN NULL;
WHEN OTHERS THEN
   DBMS_OUTPUT.put_line(SQLERRM);
   RETURN FALSE;
END funGetJobStatus;

FUNCTION JobIsRunning (ip_owner IN VARCHAR2, ip_jname IN VARCHAR2 ) RETURN BOOLEAN IS
v_resp_jname VARCHAR2(128);
BEGIN
   SELECT job_name
     INTO v_resp_jname
     FROM sys.dba_scheduler_running_jobs
    WHERE job_name = ip_jname
      AND owner = NVL(ip_owner,'SYS');

  IF v_resp_jname IS NOT NULL THEN
     RETURN TRUE;
  ELSE
     RETURN FALSE;
  END IF;
EXCEPTION
WHEN NO_DATA_FOUND THEN
     RETURN FALSE;
WHEN TOO_MANY_ROWS THEN
     RETURN TRUE;
WHEN OTHERS THEN
  RAISE_APPLICATION_ERROR(-20117,'Job status is unknown.');
  DBMS_OUTPUT.put_line(SQLERRM);
  RETURN NULL;
END JobIsRunning;

PROCEDURE sub_sleep_until_done(ip_owner IN VARCHAR2,ip_jname IN VARCHAR2) IS
BEGIN
     sys.dbms_lock.sleep(60);
WHILE JobIsRunning ( ip_owner => NVL(ip_owner,'SYS') , ip_jname => ip_jname ) LOOP
    BEGIN
     sys.dbms_lock.sleep(3);
    EXCEPTION
    WHEN OTHERS THEN null;
    END;
END LOOP;
END sub_sleep_until_done;

PROCEDURE sub_run_bkp (ip_jname IN VARCHAR2 ) IS
BEGIN
   CASE
   WHEN ( NOT funGetJobStatus (ip_jname) ) THEN
        sys.dbms_scheduler.enable( ip_jname );
        sys.dbms_scheduler.run_job( ip_jname );
   WHEN funGetJobStatus (ip_jname) THEN
        sys.dbms_scheduler.run_job( ip_jname );
   ELSE
        DBMS_OUTPUT.put_line('Job probably does not exist.');
   END CASE;
```

```
END sub_run_bkp;

PROCEDURE sub_write_cmd_line IS
BEGIN
    -- writes rman command line
    OpenFile(ipFileHandle => RMANfh ,   ipMode => 'a',   ipDir =>
NVL(ip_rman_batch_dir,'RMAN_BATCH_DIR'),    ipFname => v_Fname,    ipBfrSz => 32767);

    WriteFile ( ipFHandle => RMANfh, ipBfr => v_set_nls_date );

    WriteFile ( ipFHandle => RMANfh, ipBfr => setPathDir ( ipBinDir  => v_Bin_Dir ) );

    v_Bin_Dir := 'set PATH=echo %PATH%'||CRLF;

    WriteFile ( ipFHandle => RMANfh, ipBfr => setPathDir ( ipBinDir  => v_Bin_Dir ) );

    WriteFile ( ipFHandle => RMANfh , ipBfr => v_rmanline );

    WriteFile ( ipFHandle => RMANfh , ipBfr => v_exit);

    CloseFile(ipFHandle => RMANfh);
EXCEPTION
WHEN OTHERS THEN
DBMS_OUTPUT.put_line(SQLERRM);
END sub_write_cmd_line;

PROCEDURE sub_remove_rbat_file (ipDir IN VARCHAR2, ipFname IN VARCHAR2) IS
    v_CmdLine1 VARCHAR2(4000);
    v_CmdLine2 VARCHAR2(4000);

BEGIN
  --  v_dFname  := 'del_'||SUBSTR(NVL(ip_Fname,'r_backup'),1,14)||v_ts||'.bat';

    v_CmdLine1 := 'set PATH=echo %PATH%'||crlf;

    v_CmdLine2 := 'del /q '||getPathDir( NVL( ipDir,ip_rman_batch_dir) )||v_dFname||crlf;

    DBMS_OUTPUT.put_line('Batch Directory is... => '||getPathDir( NVL(
ipDir,ip_rman_batch_dir) ) );

    DBMS_OUTPUT.put_line('File Name is file... => '||ipFname);

    DBMS_OUTPUT.put_line('Background job is deleting file... => '||getPathDir( NVL(
ipDir,ip_rman_batch_dir) )||ipFname);

    OpenFile(ipFileHandle => dRMANfh , ipMode => 'a',   ipDir =>
NVL(ip_rman_batch_dir,'RMAN_BATCH_DIR'), ipFname => v_dFname, ipBfrSz => 32767);

    WriteFile ( ipFHandle => dRMANfh,  ipBfr => v_CmdLine1 );

    WriteFile ( ipFHandle => dRMANfh,  ipBfr => v_CmdLine2 );

    WriteFile ( ipFHandle => dRMANfh , ipBfr => v_exit);

    CloseFile(ipFHandle => dRMANfh );
EXCEPTION
WHEN OTHERS
```

```
THEN
  null;
END sub_remove_rbat_file;

-- Main Program and entry point...
BEGIN
    SELECT user
      INTO v_user
      FROM sys.dual;

    v_Path_Dir := getPathDir (ipDir => ip_rman_script_dir);

    v_Bin_Dir  := NVL( getPathDir (ipDir => ip_Oracle_bin_dir), getOracleBinDir() );

    v_logPath_Dir := getPathDir (ipDir => ip_log_dir);

    prcGetTimestamps(ip_Ts1 => v_ts, ip_Ts2 => v_ts2);

    v_rmanline := genRmanLine()||crlf;

    DBMS_OUTPUT.put_line(v_rmanline);

    v_Fname  := SUBSTR(NVL(ip_Fname,'r_backup.rman'),1,14)||v_ts||'.bat';

    v_dFname  := SUBSTR(NVL('del_'||ip_Fname,'r_backup.rman'),1,14)||v_ts||'.bat';
    -- writes rman command line

    sub_write_cmd_line();

    dbms_output.put_line(v_rmanline);

    v_rmanbkp_name := NVL(ip_target,NVL(ip_rcvcat,'ORCL'))||'_RMANBKP_'||v_ts2;

    v_batch_file := getPathDir (ipDir => ip_rman_batch_dir)||v_Fname;

    sub_create_bkp (ip_jname => v_rmanbkp_name, ip_jtype => 'EXECUTABLE', ip_jaction =>
v_batch_file) ;

    sub_sleep_until_done(ip_owner => NVL(v_user,'SYS'),ip_jname => v_rmanbkp_name );

    sub_remove_rbat_file ( ipDir => ip_rman_batch_dir, ipFname => v_Fname );

    v_clean_rmanbkp_name := NVL(ip_target,NVL(ip_rcvcat,'ORCL'))||'_rmbat_'||v_ts2;

    v_dbatch_file := getPathDir (ipDir => ip_rman_batch_dir)||v_dFname;

    sub_cleanup_job (ip_jname => v_clean_rmanbkp_name , ip_jtype => 'EXECUTABLE',
ip_jaction => v_dbatch_file );

    sub_sleep_until_done(ip_owner => NVL(v_user,'SYS'),ip_jname => v_clean_rmanbkp_name
);
end SP_RMANLINE;

-- calling main procedure
PROCEDURE SP_CALLRMANLINE IS
begin
SP_RMANLINE(
```

```
              ip_rmantuser => 'SYS',
              ip_rmantuserpwd => '%WINPWD_T%',
              ip_rmancuser => 'RMAN',
              ip_rmancuserpwd => '%WINPWD_C%',
              ip_target => 'ADNIBMSX',
              ip_rcvcat => 'ADNIBMSX',
              ip_rman_script_dir => 'RMAN_SCRIPT_DIR',
              ip_rman_batch_dir => 'RMAN_BATCH_DIR',
              ip_Fname => 'r_backup.rman',
              ip_log_dir => 'RMAN_LOG_DIR',
              ip_lvl => 1,
              ip_Cum_Opt => 'C',
              ip_Oracle_bin_dir => 'ORACLE_BIN_DIR',
              ip_Comp_Flag  => 'C',
              ip_Encr_Flag  => 'ON',
              ip_Filesps => 1
            );
exception
when others then
dbms_output.put_line(sqlerrm);
end;
```

B. Sample Log Files (Excerpts)

B.1 Full or Incremental Level 0

```
Recovery Manager: Release 11.2.0.3.0 - Production on Wed May 1 16:25:57 2013

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connected to target database: ADNIBMSX (DBID=2634802274)
connected to recovery catalog database

RMAN> # Will allow for encrpted rman backups without introducing any keys, once the wallet is
opned...
2> # should pass tag as a partial parameter for the tag name.
3>
4> set encryption on;
5>
6> run  {
7>          allocate  channel cH1 type disk;
8>          sql 'alter system archive log current';
9>          crosscheck archivelog all;
10>          release   channel cH1;
11>          allocate  channel cH1 type disk;
12>          allocate  channel cH2 type disk;
13>          allocate  channel cH3 type disk;
14>          allocate  channel cH4 type disk;
15>          set limit channel cH1 kbytes 16577216;
16>          set limit channel cH2 kbytes 16577216;
17>          set limit channel cH3 kbytes 16577216;
18>          set limit channel cH4 kbytes 16577216;
19>          BACKUP AS COMPRESSED BACKUPSET
20>             INCREMENTAL LEVEL 0
21>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L0_bkp_Db_%s%t%U'  tag =
adnibmsx_FLL0_201305011625
22>          FILESPERSET 1
23>            (database);
24>          BACKUP AS COMPRESSED BACKUPSET
```

```
25>             INCREMENTAL LEVEL 0
26>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L0_bkp_Ctl_%s%t%U' tag =
adnibmsx_FLL0_201305011625
27>             (current controlfile);
28>             sql 'alter system archive log current';
29>           BACKUP AS COMPRESSED BACKUPSET
30>             INCREMENTAL LEVEL 0
31>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L0_bkp_Arc_%s%t%U' tag =
adnibmsx_FLL0_201305011625
32>              (archivelog all);
33>          backup spfile;
34>          sql 'alter database backup controlfile to trace';
35>          release channel cH1;
36>          release channel cH2;
37>          release channel cH3;
38>          release channel cH4;
39>        }
40>          resync catalog;
41>          list backupset of database;
42>          list backupset of controlfile;
43>          list backupset of archivelog all;
44>          list restore point all;
45>          report schema;
46>          validate check logical skip inaccessible database;
47>          restore validate database;
48>          restore validate archivelog all;
49>          report obsolete;
50>          delete noprompt obsolete;
51>          exit;
executing command: SET encryption

allocated channel: cH1
channel cH1: SID=536 device type=DISK

sql statement: alter system archive log current

validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_466_8QZYK67Y_.ARC
RECID=462 STAMP=814108007
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_467_8QZYKBGQ_.ARC
RECID=463 STAMP=814108010
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_468_8R05TK4H_.ARC
RECID=464 STAMP=814115495
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_469_8R067B98_.ARC
RECID=465 STAMP=814115897
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_470_8R06D8FP_.ARC
RECID=466 STAMP=814116077
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_471_8R2CDMXZ_.ARC
RECID=467 STAMP=814273130
validation succeeded for archived log
```

```
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_472_8R2CY3XS_.ARC
RECID=468 STAMP=814273668
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_473_8R2CY5JN_.ARC
RECID=469 STAMP=814273669
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_474_8R2YLR7Q_.ARC
RECID=470 STAMP=814292762
Crosschecked 9 objects

released channel: cH1

allocated channel: cH1
channel cH1: SID=536 device type=DISK

allocated channel: cH2
channel cH2: SID=37 device type=DISK

allocated channel: cH3
channel cH3: SID=537 device type=DISK

allocated channel: cH4
channel cH4: SID=28 device type=DISK

Starting backup at 01-MAY-2013 16:26:06
channel cH1: starting compressed incremental level 0 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00009 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT.DBF
channel cH1: starting piece 1 at 01-MAY-2013 16:26:07
channel cH2: starting compressed incremental level 0 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00001 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSTEM01.DBF
channel cH2: starting piece 1 at 01-MAY-2013 16:26:08
channel cH3: starting compressed incremental level 0 datafile backup set
channel cH3: specifying datafile(s) in backup set
input datafile file number=00003 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\UNDOTBS01.DBF
channel cH3: starting piece 1 at 01-MAY-2013 16:26:08
channel cH4: starting compressed incremental level 0 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00005 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\EXAMPLE01.DBF
channel cH4: starting piece 1 at 01-MAY-2013 16:26:09
channel cH1: finished piece 1 at 01-MAY-2013 16:30:04
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1359_ADNIBMSX_L0_BKP_DB_135981
4292767AFO8I7OV_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH1: backup set complete, elapsed time: 00:03:57
channel cH1: starting compressed incremental level 0 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00002 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSAUX01.DBF
channel cH1: starting piece 1 at 01-MAY-2013 16:30:06
channel cH4: finished piece 1 at 01-MAY-2013 16:30:07
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1362_ADNIBMSX_L0_BKP_DB_136281
4292768AIO8I7P0_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH4: backup set complete, elapsed time: 00:03:58
channel cH4: starting compressed incremental level 0 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00010 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_AD4J.DBF
channel cH4: starting piece 1 at 01-MAY-2013 16:30:09
channel cH4: finished piece 1 at 01-MAY-2013 16:31:14
```

```
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1364_ADNIBMSX_L0_BKP_DB_136481
4293007AKO8I80F_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH4: backup set complete, elapsed time: 00:01:05
channel cH4: starting compressed incremental level 0 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00007 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\HZNENCR01.DBF
channel cH4: starting piece 1 at 01-MAY-2013 16:31:17
channel cH4: finished piece 1 at 01-MAY-2013 16:31:52
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1365_ADNIBMSX_L0_BKP_DB_136581
4293075ALO8I82J_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:35
channel cH4: starting compressed incremental level 0 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00006 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\RMANTS01.DBF
channel cH4: starting piece 1 at 01-MAY-2013 16:31:55
channel cH2: finished piece 1 at 01-MAY-2013 16:33:12
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1360_ADNIBMSX_L0_BKP_DB_136081
4292767AGO8I7OV_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH2: backup set complete, elapsed time: 00:07:04
channel cH2: starting compressed incremental level 0 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00011 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_ECM_DEPOT1.DBF
channel cH2: starting piece 1 at 01-MAY-2013 16:33:14
channel cH4: finished piece 1 at 01-MAY-2013 16:33:17
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1366_ADNIBMSX_L0_BKP_DB_136681
4293113AMO8I83P_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH4: backup set complete, elapsed time: 00:01:22
channel cH4: starting compressed incremental level 0 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00004 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\USERS01.DBF
channel cH4: starting piece 1 at 01-MAY-2013 16:33:21
channel cH2: finished piece 1 at 01-MAY-2013 16:33:46
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1367_ADNIBMSX_L0_BKP_DB_136781
4293193ANO8I869_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:32
channel cH2: starting compressed incremental level 0 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00008 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\DATA01.DBF
channel cH2: starting piece 1 at 01-MAY-2013 16:33:49
channel cH4: finished piece 1 at 01-MAY-2013 16:33:49
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1368_ADNIBMSX_L0_BKP_DB_136881
4293198AOO8I86E_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:28
channel cH1: finished piece 1 at 01-MAY-2013 16:33:56
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1363_ADNIBMSX_L0_BKP_DB_136381
4293005AJO8I80D_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH1: backup set complete, elapsed time: 00:03:50
channel cH2: finished piece 1 at 01-MAY-2013 16:33:56
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1369_ADNIBMSX_L0_BKP_DB_136981
4293228APO8I87C_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:07
channel cH3: finished piece 1 at 01-MAY-2013 16:34:44
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1361_ADNIBMSX_L0_BKP_DB_136181
4292768AHO8I7P0_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
```

```
channel cH3: backup set complete, elapsed time: 00:08:36
Finished backup at 01-MAY-2013 16:34:44

Starting backup at 01-MAY-2013 16:34:47
channel cH1: starting compressed incremental level 0 datafile backup set
channel cH1: specifying datafile(s) in backup set
including current control file in backup set
channel cH1: starting piece 1 at 01-MAY-2013 16:34:52
channel cH1: finished piece 1 at 01-MAY-2013 16:34:53
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1370_ADNIBMSX_L0_BKP_CTL_13708
14293288AQO8I898_1_1 tag=ADNIBMSX_FLL0_201305011625 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:01
Finished backup at 01-MAY-2013 16:34:53
```

...

```
channel ORA_DISK_4: validation complete, elapsed time: 00:00:14
channel ORA_DISK_1: piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1323_ADNIBMSX_L0_BKP_ARC_13238
141080149BO8CJBE_1_1 tag=ADNIBMSX_FLL0_201304301254
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: validation complete, elapsed time: 00:00:15
channel ORA_DISK_2: piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1324_ADNIBMSX_L0_BKP_ARC_13248
141080159CO8CJBF_1_1 tag=ADNIBMSX_FLL0_201304301254
channel ORA_DISK_2: restored backup piece 1
channel ORA_DISK_2: validation complete, elapsed time: 00:00:15
Finished restore at 01-MAY-2013 16:46:50

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
Report of obsolete backups and copies
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           11543  30-APR-2013 12:58:42
  Backup Piece       11556  30-APR-2013 12:58:42
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1312_ADNIBMSX_L0_BKP_DB_1312814107358
90O8CIMU_1_1
Backup Set           11544  30-APR-2013 13:00:26
  Backup Piece       11557  30-APR-2013 13:00:26
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1310_ADNIBMSX_L0_BKP_DB_1310814107357
8UO8CIMT_1_1
Backup Set           11545  30-APR-2013 13:01:58
  Backup Piece       11558  30-APR-2013 13:01:58
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1315_ADNIBMSX_L0_BKP_DB_1315814107643
93O8CIVR_1_1
Backup Set           11546  30-APR-2013 13:02:50
  Backup Piece       11559  30-APR-2013 13:02:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1316_ADNIBMSX_L0_BKP_DB_1316814107725
94O8CJ2D_1_1
Backup Set           11547  30-APR-2013 13:03:49
  Backup Piece       11560  30-APR-2013 13:03:49
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1311_ADNIBMSX_L0_BKP_DB_1311814107357
8VO8CIMT_1_1
Backup Set           11548  30-APR-2013 13:04:14
  Backup Piece       11561  30-APR-2013 13:04:14
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1317_ADNIBMSX_L0_BKP_DB_1317814107782
95O8CJ46_1_1
Backup Set           11549  30-APR-2013 13:04:14
  Backup Piece       11562  30-APR-2013 13:04:14
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1318_ADNIBMSX_L0_BKP_DB_1318814107839
96O8CJ5V_1_1
```

```
Backup Set           11550  30-APR-2013 13:04:33
  Backup Piece       11563  30-APR-2013 13:04:33
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1319_ADNIBMSX_L0_BKP_DB_1319814107865
97O8CJ6P_1_1
Backup Set           11551  30-APR-2013 13:04:36
  Backup Piece       11564  30-APR-2013 13:04:36
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1320_ADNIBMSX_L0_BKP_DB_1320814107866
98O8CJ6Q_1_1
Backup Set           11552  30-APR-2013 13:05:25
  Backup Piece       11565  30-APR-2013 13:05:25
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1313_ADNIBMSX_L0_BKP_DB_1313814107358
91O8CIMU_1_1
Archive Log          11621  30-APR-2013 13:06:47
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_466_8QZYK67Y_.ARC
Backup Set           11553  30-APR-2013 13:05:39
  Backup Piece       11566  30-APR-2013 13:05:39
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1314_ADNIBMSX_L0_BKP_DB_1314814107559
92O8CIT7_1_1
Archive Log          11629  30-APR-2013 13:06:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_467_8QZYKBGQ_.ARC
Archive Log          11758  30-APR-2013 15:11:35
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_468_8R05TK4H_.ARC
Archive Log          11759  30-APR-2013 15:18:17
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_469_8R067B98_.ARC
Archive Log          11760  30-APR-2013 15:21:17
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_470_8R06D8FP_.ARC
Archive Log          11764  01-MAY-2013 10:58:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_471_8R2CDMXZ_.ARC
Backup Set           11824  01-MAY-2013 11:07:45
  Backup Piece       11826  01-MAY-2013 11:07:45 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-00
Backup Set           11884  01-MAY-2013 11:09:06
  Backup Piece       11887  01-MAY-2013 11:09:06
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T110905_8R2D
0LGM_.BKP
Backup Set           11897  01-MAY-2013 11:09:13
  Backup Piece       11899  01-MAY-2013 11:09:13 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-01
Backup Set           12059  01-MAY-2013 16:34:52
  Backup Piece       12061  01-MAY-2013 16:34:52
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1370_ADNIBMSX_L0_BKP_CTL_137081429328
8AQO8I898_1_1

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
using channel ORA_DISK_1
using channel ORA_DISK_2
using channel ORA_DISK_3
using channel ORA_DISK_4
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           11543  30-APR-2013 12:58:42
  Backup Piece       11556  30-APR-2013 12:58:42
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1312_ADNIBMSX_L0_BKP_DB_1312814107358
90O8CIMU_1_1
Backup Set           11544  30-APR-2013 13:00:26
  Backup Piece       11557  30-APR-2013 13:00:26
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1310_ADNIBMSX_L0_BKP_DB_1310814107357
8UO8CIMT_1_1
Backup Set           11545  30-APR-2013 13:01:58
  Backup Piece       11558  30-APR-2013 13:01:58
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1315_ADNIBMSX_L0_BKP_DB_1315814107643
```

```
93O8CIVR_1_1
Backup Set           11546  30-APR-2013 13:02:50
  Backup Piece       11559  30-APR-2013 13:02:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1316_ADNIBMSX_L0_BKP_DB_1316814107725
94O8CJ2D_1_1
Backup Set           11547  30-APR-2013 13:03:49
  Backup Piece       11560  30-APR-2013 13:03:49
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1311_ADNIBMSX_L0_BKP_DB_1311814107357
8VO8CIMT_1_1
Backup Set           11548  30-APR-2013 13:04:14
  Backup Piece       11561  30-APR-2013 13:04:14
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1317_ADNIBMSX_L0_BKP_DB_1317814107782
95O8CJ46_1_1
Backup Set           11549  30-APR-2013 13:04:14
  Backup Piece       11562  30-APR-2013 13:04:14
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1318_ADNIBMSX_L0_BKP_DB_1318814107839
96O8CJ5V_1_1
Backup Set           11550  30-APR-2013 13:04:33
  Backup Piece       11563  30-APR-2013 13:04:33
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1319_ADNIBMSX_L0_BKP_DB_1319814107865
97O8CJ6P_1_1
Backup Set           11551  30-APR-2013 13:04:36
  Backup Piece       11564  30-APR-2013 13:04:36
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1320_ADNIBMSX_L0_BKP_DB_1320814107866
98O8CJ6Q_1_1
Backup Set           11552  30-APR-2013 13:05:25
  Backup Piece       11565  30-APR-2013 13:05:25
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1313_ADNIBMSX_L0_BKP_DB_1313814107358
91O8CIMU_1_1
Archive Log          11621  30-APR-2013 13:06:47
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_466_8QZYK67Y_.ARC
Backup Set           11553  30-APR-2013 13:05:39
  Backup Piece       11566  30-APR-2013 13:05:39
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1314_ADNIBMSX_L0_BKP_DB_1314814107559
92O8CIT7_1_1
Archive Log          11629  30-APR-2013 13:06:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_467_8QZYKBGQ_.ARC
Archive Log          11758  30-APR-2013 15:11:35
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_468_8R05TK4H_.ARC
Archive Log          11759  30-APR-2013 15:18:17
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_469_8R067B98_.ARC
Archive Log          11760  30-APR-2013 15:21:17
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_470_8R06D8FP_.ARC
Archive Log          11764  01-MAY-2013 10:58:50
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_471_8R2CDMXZ_.ARC
Backup Set           11824  01-MAY-2013 11:07:45
  Backup Piece       11826  01-MAY-2013 11:07:45 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-00
Backup Set           11884  01-MAY-2013 11:09:06
  Backup Piece       11887  01-MAY-2013 11:09:06
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T110905_8R2D
0LGM_.BKP
Backup Set           11897  01-MAY-2013 11:09:13
  Backup Piece       11899  01-MAY-2013 11:09:13 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-01
Backup Set           12059  01-MAY-2013 16:34:52
  Backup Piece       12061  01-MAY-2013 16:34:52
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1370_ADNIBMSX_L0_BKP_CTL_137081429328
8AQO8I898_1_1
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1312_ADNIBMSX_L0_BKP_DB_131281
41073589O8CIMU_1_1 RECID=944 STAMP=814107362
```

```
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1310_ADNIBMSX_L0_BKP_DB_131081
41073578UO8CIMT_1_1 RECID=945 STAMP=814107362
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1315_ADNIBMSX_L0_BKP_DB_131581
41076439 3O8CIVR_1_1 RECID=946 STAMP=814107658
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1316_ADNIBMSX_L0_BKP_DB_131681
41077259 4O8CJ2D_1_1 RECID=947 STAMP=814107736
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1311_ADNIBMSX_L0_BKP_DB_131181
41073578VO8CIMT_1_1 RECID=948 STAMP=814107362
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1317_ADNIBMSX_L0_BKP_DB_131781
41077829 5O8CJ46_1_1 RECID=949 STAMP=814107837
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1318_ADNIBMSX_L0_BKP_DB_131881
41078399 6O8CJ5V_1_1 RECID=950 STAMP=814107841
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1319_ADNIBMSX_L0_BKP_DB_131981
41078659 7O8CJ6P_1_1 RECID=951 STAMP=814107869
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1320_ADNIBMSX_L0_BKP_DB_132081
41078669 8O8CJ6Q_1_1 RECID=952 STAMP=814107873
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1313_ADNIBMSX_L0_BKP_DB_131381
41073589 1O8CIMU_1_1 RECID=953 STAMP=814107363
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_466_8QZYK67Y_.ARC
RECID=462 STAMP=814108007
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130430_1314_ADNIBMSX_L0_BKP_DB_131481
41075599 2O8CIT7_1_1 RECID=954 STAMP=814107645
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_467_8QZYKBGQ_.ARC
RECID=463 STAMP=814108010
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_468_8R05TK4H_.ARC
RECID=464 STAMP=814115495
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_469_8R067B98_.ARC
RECID=465 STAMP=814115897
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_04_30\O1_MF_1_470_8R06D8FP_.ARC
RECID=466 STAMP=814116077
deleted archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_471_8R2CDMXZ_.ARC
```

```
RECID=467 STAMP=814273130
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130501-00
RECID=975 STAMP=814273664
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T1109
05_8R2D0LGM_.BKP RECID=979 STAMP=814273746
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130501-01
RECID=980 STAMP=814273749
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1370_ADNIBMSX_L0_BKP_CTL_13708
14293288AQO8I898_1_1 RECID=992 STAMP=814293292
Deleted 21 objects

Recovery Manager complete.
```

B.2 Incremental Level 1

```
Recovery Manager: Release 11.2.0.3.0 - Production on Thu May 2 11:03:13 2013

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connected to target database: ADNIBMSX (DBID=2634802274)
connected to recovery catalog database

RMAN> # Will allow for encrpted rman backups without introducing any keys, once the wallet is
opned...
2> # should pass tag as a partial parameter for the tag name.
3>
4> set encryption on;
5>
6> run  {
7>          allocate  channel cH1 type disk;
8>          sql 'alter system archive log current';
9>          crosscheck archivelog all;
10>          release   channel cH1;
11>          allocate  channel cH1 type disk;
12>          allocate  channel cH2 type disk;
13>          allocate  channel cH3 type disk;
14>          allocate  channel cH4 type disk;
15>          set limit channel cH1 kbytes 16577216;
16>          set limit channel cH2 kbytes 16577216;
17>          set limit channel cH3 kbytes 16577216;
18>          set limit channel cH4 kbytes 16577216;
19>          BACKUP AS COMPRESSED BACKUPSET
20>             INCREMENTAL LEVEL 1
21>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Db_%s%t%U'  tag =
adnibmsx_INL1_201305021102
22>          FILESPERSET 1
23>            (database);
24>          BACKUP AS COMPRESSED BACKUPSET
25>             INCREMENTAL LEVEL 1
26>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Ctl_%s%t%U' tag =
adnibmsx_INL1_201305021102
27>             (current controlfile);
28>             sql 'alter system archive log current';
29>           BACKUP AS COMPRESSED BACKUPSET
30>             INCREMENTAL LEVEL 1
```

```
31>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Arc_%s%t%U' tag =
adnibmsx_INL1_201305021102
32>              (archivelog all);
33>          backup spfile;
34>          sql 'alter database backup controlfile to trace';
35>          release channel cH1;
36>          release channel cH2;
37>          release channel cH3;
38>          release channel cH4;
39>        }
40>          resync catalog;
41>          list backupset of database;
42>          list backupset of controlfile;
43>          list backupset of archivelog all;
44>          list restore point all;
45>          report schema;
46>          validate check logical skip inaccessible database;
47>          restore validate database;
48>          restore validate archivelog all;
49>          report obsolete;
50>          delete noprompt obsolete;
51>          exit;
executing command: SET encryption
starting full resync of recovery catalog
full resync complete

allocated channel: cH1
channel cH1: SID=537 device type=DISK

sql statement: alter system archive log current

validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_472_8R2CY3XS_.ARC
RECID=468 STAMP=814273668
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_473_8R2CY5JN_.ARC
RECID=469 STAMP=814273669
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_474_8R2YLR7Q_.ARC
RECID=470 STAMP=814292762
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_475_8R2Z3MF4_.ARC
RECID=471 STAMP=814293299
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_476_8R2Z3O05_.ARC
RECID=472 STAMP=814293301
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_477_8R307R17_.ARC
RECID=473 STAMP=814294456
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_478_8R309GBF_.ARC
RECID=474 STAMP=814294511
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_479_8R309KDR_.ARC
```

```
RECID=475 STAMP=814294513
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_02\O1_MF_1_480_8R501S3W_.ARC
RECID=476 STAMP=814359807
Crosschecked 9 objects

released channel: cH1

allocated channel: cH1
channel cH1: SID=537 device type=DISK

allocated channel: cH2
channel cH2: SID=26 device type=DISK

allocated channel: cH3
channel cH3: SID=529 device type=DISK

allocated channel: cH4
channel cH4: SID=19 device type=DISK

Starting backup at 02-MAY-2013 11:03:32
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00009 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT.DBF
channel cH1: starting piece 1 at 02-MAY-2013 11:03:33
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00001 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSTEM01.DBF
channel cH2: starting piece 1 at 02-MAY-2013 11:03:34
channel cH3: starting compressed incremental level 1 datafile backup set
channel cH3: specifying datafile(s) in backup set
input datafile file number=00003 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\UNDOTBS01.DBF
channel cH3: starting piece 1 at 02-MAY-2013 11:03:34
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00005 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\EXAMPLE01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 11:03:35
channel cH1: finished piece 1 at 02-MAY-2013 11:03:36
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1407_ADNIBMSX_L1_BKP_DB_140781
4359813BVO8K985_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:03
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00002 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSAUX01.DBF
channel cH1: starting piece 1 at 02-MAY-2013 11:03:39
channel cH2: finished piece 1 at 02-MAY-2013 11:03:42
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1408_ADNIBMSX_L1_BKP_DB_140881
4359813C0O8K985_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:08
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00010 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_AD4J.DBF
channel cH2: starting piece 1 at 02-MAY-2013 11:03:47
channel cH4: finished piece 1 at 02-MAY-2013 11:03:47
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1410_ADNIBMSX_L1_BKP_DB_141081
4359814C2O8K986_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:12
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
```

```
input datafile file number=00007 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\HZNENCR01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 11:03:48
channel cH3: finished piece 1 at 02-MAY-2013 11:03:48
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1409_ADNIBMSX_L1_BKP_DB_140981
4359814C1O8K986_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:14
channel cH3: starting compressed incremental level 1 datafile backup set
channel cH3: specifying datafile(s) in backup set
input datafile file number=00006 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\RMANTS01.DBF
channel cH3: starting piece 1 at 02-MAY-2013 11:03:49
channel cH1: finished piece 1 at 02-MAY-2013 11:03:49
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1411_ADNIBMSX_L1_BKP_DB_141181
4359817C3O8K989_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:10
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00011 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_ECM_DEPOT1.DBF
channel cH1: starting piece 1 at 02-MAY-2013 11:03:50
channel cH2: finished piece 1 at 02-MAY-2013 11:03:51
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1412_ADNIBMSX_L1_BKP_DB_141281
4359823C4O8K98F_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:04
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00004 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\USERS01.DBF
channel cH2: starting piece 1 at 02-MAY-2013 11:03:52
channel cH4: finished piece 1 at 02-MAY-2013 11:03:52
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1413_ADNIBMSX_L1_BKP_DB_141381
4359827C5O8K98J_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:04
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00008 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\DATA01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 11:03:53
channel cH3: finished piece 1 at 02-MAY-2013 11:03:54
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1414_ADNIBMSX_L1_BKP_DB_141481
4359828C6O8K98K_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:05
channel cH1: finished piece 1 at 02-MAY-2013 11:03:55
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1415_ADNIBMSX_L1_BKP_DB_141581
4359829C7O8K98L_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:05
channel cH2: finished piece 1 at 02-MAY-2013 11:03:55
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1416_ADNIBMSX_L1_BKP_DB_141681
4359831C8O8K98N_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:03
channel cH4: finished piece 1 at 02-MAY-2013 11:03:55
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1417_ADNIBMSX_L1_BKP_DB_141781
4359833C9O8K98P_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:02
Finished backup at 02-MAY-2013 11:03:55

Starting backup at 02-MAY-2013 11:03:58
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
```

```
including current control file in backup set
channel cH1: starting piece 1 at 02-MAY-2013 11:04:02
channel cH1: finished piece 1 at 02-MAY-2013 11:04:05
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1418_ADNIBMSX_L1_BKP_CTL_14188
14359839CAO8K98V_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:03
Finished backup at 02-MAY-2013 11:04:05

Starting Control File and SPFILE Autobackup at 02-MAY-2013 11:04:05
piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-00 comment=NONE
Finished Control File and SPFILE Autobackup at 02-MAY-2013 11:04:09

sql statement: alter system archive log current

Starting backup at 02-MAY-2013 11:04:14
current log archived
skipping archived logs of thread 1 from sequence 472 to 479; already backed up
channel cH1: starting compressed archived log backup set
channel cH1: specifying archived log(s) in backup set
input archived log thread=1 sequence=480 RECID=476 STAMP=814359807
channel cH1: starting piece 1 at 02-MAY-2013 11:04:16
channel cH2: starting compressed archived log backup set
channel cH2: specifying archived log(s) in backup set
input archived log thread=1 sequence=481 RECID=477 STAMP=814359852
channel cH2: starting piece 1 at 02-MAY-2013 11:04:17
channel cH3: starting compressed archived log backup set
channel cH3: specifying archived log(s) in backup set
input archived log thread=1 sequence=482 RECID=478 STAMP=814359854
channel cH3: starting piece 1 at 02-MAY-2013 11:04:17
channel cH2: finished piece 1 at 02-MAY-2013 11:04:19
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1421_ADNIBMSX_L1_BKP_ARC_14218
14359856CDO8K99G_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:02
channel cH3: finished piece 1 at 02-MAY-2013 11:04:19
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1422_ADNIBMSX_L1_BKP_ARC_14228
14359857CEO8K99H_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:02
channel cH1: finished piece 1 at 02-MAY-2013 11:04:33
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1420_ADNIBMSX_L1_BKP_ARC_14208
14359856CCO8K99G_1_1 tag=ADNIBMSX_INL1_201305021102 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:17
Finished backup at 02-MAY-2013 11:04:33

Starting backup at 02-MAY-2013 11:04:36
channel cH1: starting full datafile backup set
channel cH1: specifying datafile(s) in backup set
including current SPFILE in backup set
channel cH1: starting piece 1 at 02-MAY-2013 11:04:37
channel cH1: finished piece 1 at 02-MAY-2013 11:04:38
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_02\O1_MF_NNSNF_TAG20130502T1104
36_8R50457B_.BKP tag=TAG20130502T110436 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:01
Finished backup at 02-MAY-2013 11:04:38

Starting Control File and SPFILE Autobackup at 02-MAY-2013 11:04:38
piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-01 comment=NONE
Finished Control File and SPFILE Autobackup at 02-MAY-2013 11:04:42
```

```
sql statement: alter database backup controlfile to trace

released channel: cH1

released channel: cH2

released channel: cH3

released channel: cH4

starting full resync of recovery catalog
full resync complete

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

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11771   Incr 0  22.66M     DISK        00:04:16     01-MAY-2013 11:03:14
        BP Key: 11784   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1338_ADNIBMSX_L0_BKP_DB_1338814273138
9QO8HKJI_1_1
  List of Datafiles in backup set 11771
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
  5    0  Incr 28687384761 01-MAY-2013 10:59:08 C:\APP\ORACLE\ORADATA\ADNIBMSX\EXAMPLE01.DBF

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11772   Incr 0  36.52M     DISK        00:04:18     01-MAY-2013 11:03:15
        BP Key: 11785   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1335_ADNIBMSX_L0_BKP_DB_1335814273137
9NO8HKJH_1_1
  List of Datafiles in backup set 11772
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
  9    0  Incr 28687384749 01-MAY-2013 10:58:58 C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT.DBF

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11773   Incr 0  1.07M      DISK        00:01:33     01-MAY-2013 11:04:52
        BP Key: 11786   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1340_ADNIBMSX_L0_BKP_DB_1340814273399
9SO8HKRN_1_1
  List of Datafiles in backup set 11773
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
0  Incr 28687384925 01-MAY-2013 11:03:25 C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_AD4J.DBF
```

...

```
channel ORA_DISK_3: restored backup piece 1
channel ORA_DISK_3: validation complete, elapsed time: 00:00:29
channel ORA_DISK_4: piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1348_ADNIBMSX_L0_BKP_ARC_13488
14273671A4O8HL47_1_1 tag=ADNIBMSX_FLL0_201305011057
channel ORA_DISK_4: restored backup piece 1
channel ORA_DISK_4: validation complete, elapsed time: 00:00:34
Finished restore at 02-MAY-2013 11:16:37
```

```
RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
Report of obsolete backups and copies
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           12326  01-MAY-2013 16:55:03
  Backup Piece       12328  01-MAY-2013 16:55:03 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-04
Backup Set           12383  01-MAY-2013 16:55:25
  Backup Piece       12385  01-MAY-2013 16:55:25
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T165523_8R30
9X17_.BKP
Backup Set           12395  01-MAY-2013 16:55:31
  Backup Piece       12397  01-MAY-2013 16:55:31 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-05
Backup Set           12527  02-MAY-2013 11:04:03
  Backup Piece       12529  02-MAY-2013 11:04:03
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1418_ADNIBMSX_L1_BKP_CTL_141881435983
9CAO8K98V_1_1

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
using channel ORA_DISK_1
using channel ORA_DISK_2
using channel ORA_DISK_3
using channel ORA_DISK_4
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           12326  01-MAY-2013 16:55:03
  Backup Piece       12328  01-MAY-2013 16:55:03 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-04
Backup Set           12383  01-MAY-2013 16:55:25
  Backup Piece       12385  01-MAY-2013 16:55:25
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T165523_8R30
9X17_.BKP
Backup Set           12395  01-MAY-2013 16:55:31
  Backup Piece       12397  01-MAY-2013 16:55:31 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130501-05
Backup Set           12527  02-MAY-2013 11:04:03
  Backup Piece       12529  02-MAY-2013 11:04:03
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1418_ADNIBMSX_L1_BKP_CTL_141881435983
9CAO8K98V_1_1
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130501-04
RECID=1011 STAMP=814294502
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_01\O1_MF_NNSNF_TAG20130501T1655
23_8R309X17_.BKP RECID=1015 STAMP=814294525
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130501-05
RECID=1016 STAMP=814294529
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1418_ADNIBMSX_L1_BKP_CTL_14188
14359839CAO8K98V_1_1 RECID=1028 STAMP=814359842
Deleted 4 objects

Recovery Manager complete.
```

B.3 Cumulative Incremental Level 1

```
Recovery Manager: Release 11.2.0.3.0 - Production on Thu May 2 13:22:39 2013

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connected to target database: ADNIBMSX (DBID=2634802274)
connected to recovery catalog database

RMAN> # Will allow for encrpted rman backups without introducing any keys, once the wallet is
opned...
2> # should pass tag as a partial parameter for the tag name.
3>
4> set encryption on;
5>
6> run  {
7>          allocate  channel cH1 type disk;
8>          sql 'alter system archive log current';
9>          crosscheck archivelog all;
10>          release   channel cH1;
11>          allocate  channel cH1 type disk;
12>          allocate  channel cH2 type disk;
13>          allocate  channel cH3 type disk;
14>          allocate  channel cH4 type disk;
15>          set limit channel cH1 kbytes 16577216;
16>          set limit channel cH2 kbytes 16577216;
17>          set limit channel cH3 kbytes 16577216;
18>          set limit channel cH4 kbytes 16577216;
19>          BACKUP AS COMPRESSED BACKUPSET
20>             INCREMENTAL LEVEL 1 CUMULATIVE
21>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Db_%s%t%U'  tag =
adnibmsx_CIL1_201305021322
22>          FILESPERSET 1
23>            (database);
24>          BACKUP AS COMPRESSED BACKUPSET
25>             INCREMENTAL LEVEL 1 CUMULATIVE
26>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Ctl_%s%t%U' tag =
adnibmsx_CIL1_201305021322
27>             (current controlfile);
28>             sql 'alter system archive log current';
29>           BACKUP AS COMPRESSED BACKUPSET
30>             INCREMENTAL LEVEL 1 CUMULATIVE
31>             FORMAT
'C:\app\oracle\flash_recovery_area\adnibmsx\BACKUPSET\%T_%s_%d_L1_bkp_Arc_%s%t%U' tag =
adnibmsx_CIL1_201305021322
32>              (archivelog all);
33>          backup spfile;
34>          sql 'alter database backup controlfile to trace';
35>          release channel cH1;
36>          release channel cH2;
37>          release channel cH3;
38>          release channel cH4;
39>        }
40>          resync catalog;
41>          list backupset of database;
42>          list backupset of controlfile;
43>          list backupset of archivelog all;
44>          list restore point all;
45>          report schema;
46>          validate check logical skip inaccessible database;
47>          restore validate database;
```

```
48>          restore validate archivelog all;
49>          report obsolete;
50>          delete noprompt obsolete;
51>          exit;
executing command: SET encryption

allocated channel: cH1
channel cH1: SID=29 device type=DISK

sql statement: alter system archive log current

starting full resync of recovery catalog
full resync complete
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_472_8R2CY3XS_.ARC
RECID=468 STAMP=814273668
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_473_8R2CY5JN_.ARC
RECID=469 STAMP=814273669
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_474_8R2YLR7Q_.ARC
RECID=470 STAMP=814292762
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_475_8R2Z3MF4_.ARC
RECID=471 STAMP=814293299
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_476_8R2Z3O05_.ARC
RECID=472 STAMP=814293301
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_477_8R307R17_.ARC
RECID=473 STAMP=814294456
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_478_8R309GBF_.ARC
RECID=474 STAMP=814294511
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_01\O1_MF_1_479_8R309KDR_.ARC
RECID=475 STAMP=814294513
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_02\O1_MF_1_480_8R501S3W_.ARC
RECID=476 STAMP=814359807
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_02\O1_MF_1_481_8R503DLN_.ARC
RECID=477 STAMP=814359852
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_02\O1_MF_1_482_8R503GFW_.ARC
RECID=478 STAMP=814359854
validation succeeded for archived log
archived log file
name=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\ARCHIVELOG\2013_05_02\O1_MF_1_483_8R587316_.ARC
RECID=479 STAMP=814368164
Crosschecked 12 objects
```

```
released channel: cH1

allocated channel: cH1
channel cH1: SID=29 device type=DISK

allocated channel: cH2
channel cH2: SID=528 device type=DISK

allocated channel: cH3
channel cH3: SID=19 device type=DISK

allocated channel: cH4
channel cH4: SID=530 device type=DISK

Starting backup at 02-MAY-2013 13:22:55
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00009 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT.DBF
channel cH1: starting piece 1 at 02-MAY-2013 13:22:57
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00001 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSTEM01.DBF
channel cH2: starting piece 1 at 02-MAY-2013 13:22:57
channel cH3: starting compressed incremental level 1 datafile backup set
channel cH3: specifying datafile(s) in backup set
input datafile file number=00003 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\UNDOTBS01.DBF
channel cH3: starting piece 1 at 02-MAY-2013 13:22:57
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00005 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\EXAMPLE01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 13:22:58
channel cH1: finished piece 1 at 02-MAY-2013 13:23:02
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1431_ADNIBMSX_L1_BKP_DB_143181
4368176CNO8KHDG_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:05
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00002 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\SYSAUX01.DBF
channel cH1: starting piece 1 at 02-MAY-2013 13:23:03
channel cH2: finished piece 1 at 02-MAY-2013 13:23:05
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1432_ADNIBMSX_L1_BKP_DB_143281
4368177COO8KHDH_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:08
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00010 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_AD4J.DBF
channel cH2: starting piece 1 at 02-MAY-2013 13:23:07
channel cH4: finished piece 1 at 02-MAY-2013 13:23:08
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1434_ADNIBMSX_L1_BKP_DB_143481
4368178CQO8KHDI_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:10
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00007 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\HZNENCR01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 13:23:11
channel cH3: finished piece 1 at 02-MAY-2013 13:23:12
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1433_ADNIBMSX_L1_BKP_DB_143381
4368177CPO8KHDH_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:15
```

```
channel cH3: starting compressed incremental level 1 datafile backup set
channel cH3: specifying datafile(s) in backup set
input datafile file number=00006 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\RMANTS01.DBF
channel cH3: starting piece 1 at 02-MAY-2013 13:23:13
channel cH1: finished piece 1 at 02-MAY-2013 13:23:13
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1435_ADNIBMSX_L1_BKP_DB_143581
4368183CRO8KHDN_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:10
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
input datafile file number=00011 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_ECM_DEPOT1.DBF
channel cH1: starting piece 1 at 02-MAY-2013 13:23:14
channel cH2: finished piece 1 at 02-MAY-2013 13:23:15
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1436_ADNIBMSX_L1_BKP_DB_143681
4368185CSO8KHDP_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:08
channel cH2: starting compressed incremental level 1 datafile backup set
channel cH2: specifying datafile(s) in backup set
input datafile file number=00004 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\USERS01.DBF
channel cH2: starting piece 1 at 02-MAY-2013 13:23:16
channel cH4: finished piece 1 at 02-MAY-2013 13:23:17
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1437_ADNIBMSX_L1_BKP_DB_143781
4368188CTO8KHDS_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:06
channel cH4: starting compressed incremental level 1 datafile backup set
channel cH4: specifying datafile(s) in backup set
input datafile file number=00008 name=C:\APP\ORACLE\ORADATA\ADNIBMSX\DATA01.DBF
channel cH4: starting piece 1 at 02-MAY-2013 13:23:18
channel cH1: finished piece 1 at 02-MAY-2013 13:23:21
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1439_ADNIBMSX_L1_BKP_DB_143981
4368194CVO8KHE2_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:07
channel cH2: finished piece 1 at 02-MAY-2013 13:23:21
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1440_ADNIBMSX_L1_BKP_DB_144081
4368196D0O8KHE4_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:05
channel cH3: finished piece 1 at 02-MAY-2013 13:23:21
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1438_ADNIBMSX_L1_BKP_DB_143881
4368193CUO8KHE1_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:08
channel cH4: finished piece 1 at 02-MAY-2013 13:23:21
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1441_ADNIBMSX_L1_BKP_DB_144181
4368198D1O8KHE6_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH4: backup set complete, elapsed time: 00:00:03
Finished backup at 02-MAY-2013 13:23:21

Starting backup at 02-MAY-2013 13:23:25
channel cH1: starting compressed incremental level 1 datafile backup set
channel cH1: specifying datafile(s) in backup set
including current control file in backup set
channel cH1: starting piece 1 at 02-MAY-2013 13:23:29
channel cH1: finished piece 1 at 02-MAY-2013 13:23:32
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1442_ADNIBMSX_L1_BKP_CTL_14428
14368206D2O8KHEE_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:03
```

```
Finished backup at 02-MAY-2013 13:23:32

Starting Control File and SPFILE Autobackup at 02-MAY-2013 13:23:32
piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-02 comment=NONE
Finished Control File and SPFILE Autobackup at 02-MAY-2013 13:23:36

sql statement: alter system archive log current

Starting backup at 02-MAY-2013 13:23:41
current log archived
skipping archived logs of thread 1 from sequence 472 to 482; already backed up
channel cH1: starting compressed archived log backup set
channel cH1: specifying archived log(s) in backup set
input archived log thread=1 sequence=483 RECID=479 STAMP=814368164
channel cH1: starting piece 1 at 02-MAY-2013 13:23:44
channel cH2: starting compressed archived log backup set
channel cH2: specifying archived log(s) in backup set
input archived log thread=1 sequence=484 RECID=480 STAMP=814368219
channel cH2: starting piece 1 at 02-MAY-2013 13:23:44
channel cH3: starting compressed archived log backup set
channel cH3: specifying archived log(s) in backup set
input archived log thread=1 sequence=485 RECID=481 STAMP=814368221
channel cH3: starting piece 1 at 02-MAY-2013 13:23:45
channel cH1: finished piece 1 at 02-MAY-2013 13:23:46
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1444_ADNIBMSX_L1_BKP_ARC_14448
14368224D4O8KHF0_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:02
channel cH2: finished piece 1 at 02-MAY-2013 13:23:46
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1445_ADNIBMSX_L1_BKP_ARC_14458
14368224D5O8KHF0_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH2: backup set complete, elapsed time: 00:00:02
channel cH3: finished piece 1 at 02-MAY-2013 13:23:46
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1446_ADNIBMSX_L1_BKP_ARC_14468
14368224D6O8KHF0_1_1 tag=ADNIBMSX_CIL1_201305021322 comment=NONE
channel cH3: backup set complete, elapsed time: 00:00:01
Finished backup at 02-MAY-2013 13:23:46

Starting backup at 02-MAY-2013 13:23:49
channel cH1: starting compressed full datafile backup set
channel cH1: specifying datafile(s) in backup set
including current SPFILE in backup set
channel cH1: starting piece 1 at 02-MAY-2013 13:23:51
channel cH1: finished piece 1 at 02-MAY-2013 13:23:52
piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_02\O1_MF_NNSNF_TAG20130502T1323
50_8R589730_.BKP tag=TAG20130502T132350 comment=NONE
channel cH1: backup set complete, elapsed time: 00:00:01
Finished backup at 02-MAY-2013 13:23:52

Starting Control File and SPFILE Autobackup at 02-MAY-2013 13:23:52
piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-03 comment=NONE
Finished Control File and SPFILE Autobackup at 02-MAY-2013 13:24:00

sql statement: alter database backup controlfile to trace

released channel: cH1

released channel: cH2

released channel: cH3
```

```
released channel: cH4

starting full resync of recovery catalog
full resync complete

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

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11771   Incr 0  22.66M     DISK        00:04:16     01-MAY-2013 11:03:14
        BP Key: 11784   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1338_ADNIBMSX_L0_BKP_DB_1338814273138
9QO8HKJI_1_1
  List of Datafiles in backup set 11771
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
  5    0  Incr 28687384761 01-MAY-2013 10:59:08 C:\APP\ORACLE\ORADATA\ADNIBMSX\EXAMPLE01.DBF

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11772   Incr 0  36.52M     DISK        00:04:18     01-MAY-2013 11:03:15
        BP Key: 11785   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1335_ADNIBMSX_L0_BKP_DB_1335814273137
9NO8HKJH_1_1
  List of Datafiles in backup set 11772
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
  9    0  Incr 28687384749 01-MAY-2013 10:58:58 C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT.DBF

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11773   Incr 0  1.07M      DISK        00:01:33     01-MAY-2013 11:04:52
        BP Key: 11786   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1340_ADNIBMSX_L0_BKP_DB_1340814273399
9SO8HKRN_1_1
  List of Datafiles in backup set 11773
  File LV Type Ckp SCN    Ckp Time             Name
  ---- -- ---- ---------- -------------------- ----
  10   0  Incr 28687384925 01-MAY-2013 11:03:25 C:\APP\ORACLE\ORADATA\ADNIBMSX\MGMT_AD4J.DBF

BS Key  Type LV Size       Device Type Elapsed Time Completion Time
------- ---- -- ---------- ----------- ------------ --------------------
11774   Incr 0  183.73M    DISK        00:06:44     01-MAY-2013 11:05:41
        BP Key: 11787   Status: AVAILABLE  Compressed: YES  Tag: ADNIBMSX_FLL0_201305011057
        Piece Name:
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1336_ADNIBMSX_L0_BKP_DB_1336814273137
9OO8HKJH_1_1
  List of Datafiles in backup set 11774

■■■

channel ORA_DISK_2: piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130501_1348_ADNIBMSX_L0_BKP_ARC_13488
14273671A4O8HL47_1_1 tag=ADNIBMSX_FLL0_201305011057
channel ORA_DISK_2: restored backup piece 1
channel ORA_DISK_2: validation complete, elapsed time: 00:00:37
Finished restore at 02-MAY-2013 13:36:05
```

```
RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
Report of obsolete backups and copies
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           12536  02-MAY-2013 11:04:09
  Backup Piece       12538  02-MAY-2013 11:04:09 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130502-00
Backup Set           12593  02-MAY-2013 11:04:37
  Backup Piece       12595  02-MAY-2013 11:04:37
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_02\O1_MF_NNSNF_TAG20130502T110436_8R50
457B_.BKP
Backup Set           12605  02-MAY-2013 11:04:41
  Backup Piece       12607  02-MAY-2013 11:04:41 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130502-01
Backup Set           12740  02-MAY-2013 13:23:30
  Backup Piece       12742  02-MAY-2013 13:23:30
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1442_ADNIBMSX_L1_BKP_CTL_144281436820
6D2O8KHEE_1_1

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 2
using channel ORA_DISK_1
using channel ORA_DISK_2
using channel ORA_DISK_3
using channel ORA_DISK_4
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ --------------------
Backup Set           12536  02-MAY-2013 11:04:09
  Backup Piece       12538  02-MAY-2013 11:04:09 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130502-00
Backup Set           12593  02-MAY-2013 11:04:37
  Backup Piece       12595  02-MAY-2013 11:04:37
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_02\O1_MF_NNSNF_TAG20130502T110436_8R50
457B_.BKP
Backup Set           12605  02-MAY-2013 11:04:41
  Backup Piece       12607  02-MAY-2013 11:04:41 C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-
2634802274-20130502-01
Backup Set           12740  02-MAY-2013 13:23:30
  Backup Piece       12742  02-MAY-2013 13:23:30
C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1442_ADNIBMSX_L1_BKP_CTL_144281436820
6D2O8KHEE_1_1
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-00
RECID=1029 STAMP=814359848
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\2013_05_02\O1_MF_NNSNF_TAG20130502T1104
36_8R50457B_.BKP RECID=1033 STAMP=814359877
deleted backup piece
backup piece handle=C:\APP\ORACLE\PRODUCT\11.2.0\DBHOME_4\DATABASE\C-2634802274-20130502-01
RECID=1034 STAMP=814359881
deleted backup piece
backup piece
handle=C:\APP\ORACLE\FLASH_RECOVERY_AREA\ADNIBMSX\BACKUPSET\20130502_1442_ADNIBMSX_L1_BKP_CTL_14428
14368206D2O8KHEE_1_1 RECID=1046 STAMP=814368209
Deleted 4 objects

Recovery Manager complete.
```

Creating Custom PDF Reports with Oracle Application Express and the APEX Listener

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Introduction

Oracle Application Express 4.2.2 has introduced report printing enhancements and a new option for PDF printing. You can now use APEX Listener release 2.0.2 or above to enable PDF printing for your classic reports, interactive reports, and report queries. The FOP libraries for PDF printing are built into the APEX Listener. Therefore, with this new PDF printing option, you do not need to configure an external printing engine such as BI Publisher or Apache FOP anymore. This white paper provides an overview of different options for PDF printing in Oracle Application Express. The focus of this document is how to configure and use APEX Listener as a print server with Oracle Application Express. This white paper outlines the steps to create custom report layouts using third party tools such as Altova StyleVision or Stylus Studio, and then how to use these custom report layouts for PDF printing.

Prerequisites

Before performing the examples and steps discussed in this white paper, you should:

- Install Oracle Database 11g
- Install Oracle Application Express 4.2.2 or above
- Install and configure Oracle APEX Listener 2.0.2 or above as a web listener for Oracle Application Express
- Download and install any of the following third party tools:
  - Altova StyleVision: http://www.altova.com/stylevision.html
  - Stylus Studio: http://www.stylusstudio.com

Note: APEX Listener 2.0.2 supports only the Base-14 fonts. To configure additional fonts, see this document: http://xmlgraphics.apache.org/fop/0.95/fonts.html

The examples provided in this document use Oracle Application Express 4.2.2. The screenshots might be different for later versions of Oracle Application Express 4.2.2.

Oracle Application Express PDF Printing Architecture

Oracle Application Express allows you to configure a classic report region to print by exporting it to an Adobe portable document format (PDF), Microsoft Word rich text format (RTF), Microsoft Excel format (XLS), or Extensible Markup Language (XML). By taking advantage of region report printing, your application users can view and print reports that have a predefined orientation, page size, column headings, and page header and footer.

In the releases prior to Oracle Application Express 4.2.2, the report printing functionality requires an externally defined print server such as Oracle BI Publisher, OC4J with Apache FOP, or any other standard XSL-FO processing engine. PDF printing using APEX Listener as a print server has been added as a third option in APEX 4.2.2.

All of the PDF printing options in APEX share the same underlying architecture. When an application user clicks a print link on a report, the request is sent to the Oracle Application Express engine. The APEX engine then generates the corresponding report data in XML and transfers this XML to a print rendering engine along with an XSL-FO or an RTF stylesheet. Based on the stylesheet, your data gets formatted, rendered in PDF and then downloaded to your browser.

Configuring PDF Printing in Oracle Application Express

With the latest addition of APEX Listener based printing, now you can use any of the following three different options for PDF printing in Oracle Application Express:

- Oracle APEX with Apache FOP
- Oracle APEX with BI Publisher
- Oracle APEX with APEX Listener

Oracle APEX with Apache FOP

To use this option, you must configure your Oracle Application Express instance to use the FOP print server. Oracle Application Express includes a supported configuration of Apache FOP in conjunction with Oracle Containers for J2EE. The Apache FOP installation is included in the Oracle Application Express distribution under /home/oracle/utilities/fop/fop.war. After installing this war file, you need to configure Oracle Database to enable network services for APEX to call out to the FOP rendering engine through utl_http. Oracle Application Express Instance administrator has to enter the server URL and script information under the Manage Instance > Instance Settings > Report Printing in the APEX instance administration. Once this is setup, developers can enable PDF printing on their classic, interactive reports, and report queries. With the Apache FOP option, you can use either the generic built-in XSL-FO layout or a custom report layout.

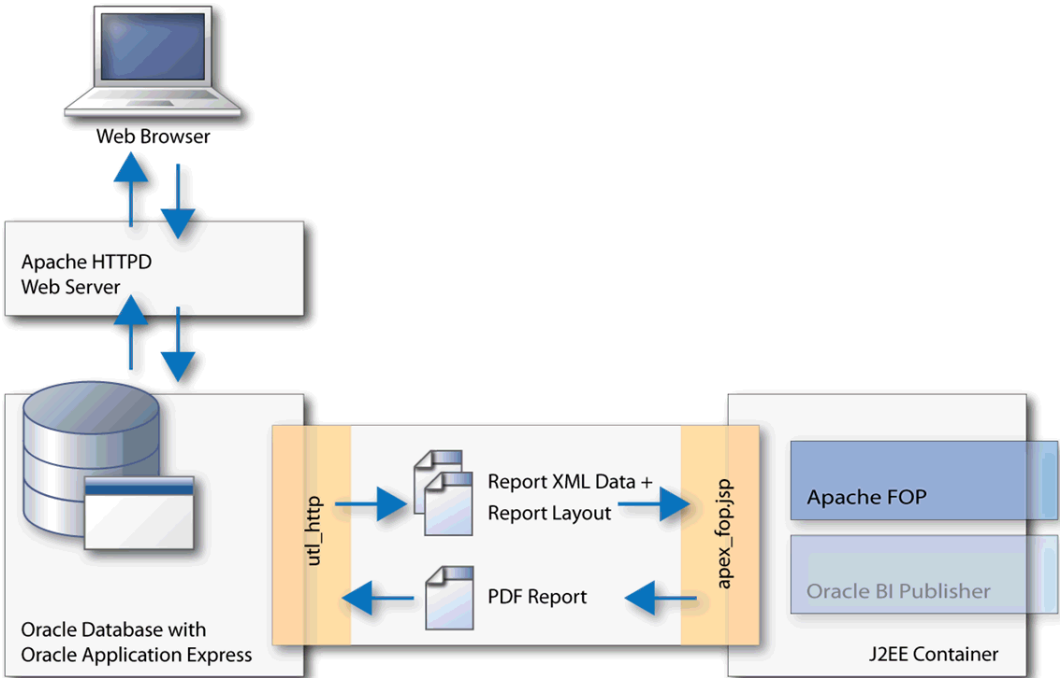

Figure 1: Oracle APEX with Apache FOP

Oracle APEX with BI Publisher

This option requires a valid license for Oracle BI Publisher. With this configuration, you have all the capabilities available with Apache FOP configuration plus the ability to define RTF-based report layouts developed using the BI Publisher Word Template Plug-In. This provides easy graphical control over every aspect of your report. You can add logos to your pages, add complex control breaks, and have full pagination control. You can even embed charts and create reports that look exactly like standard government forms.

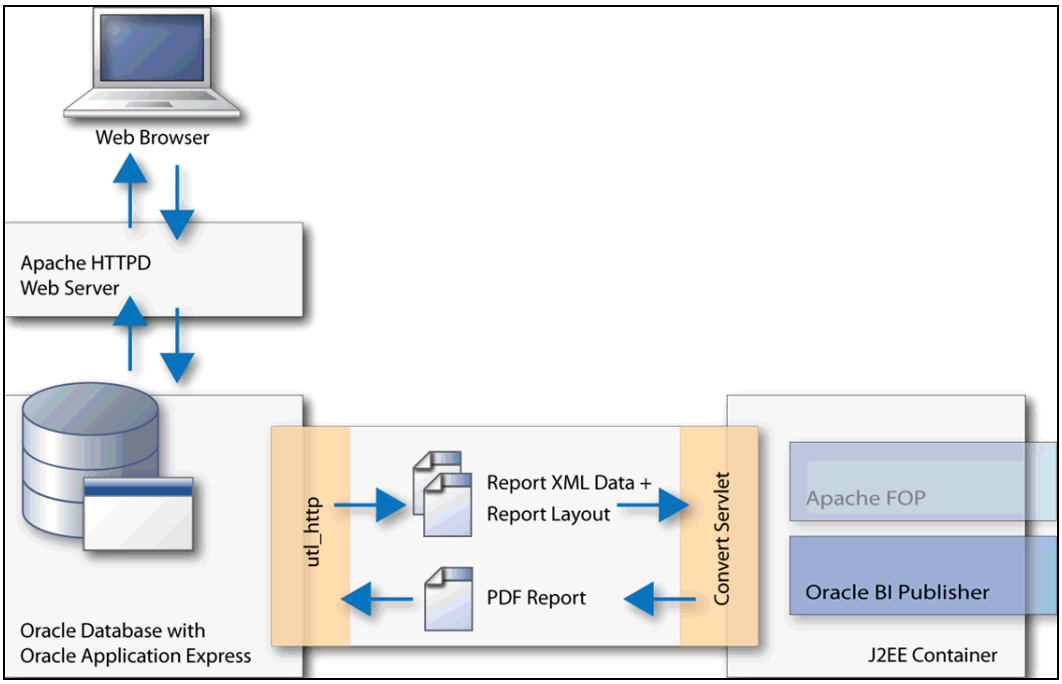

Figure 2: Oracle APEX with BI Publisher

Oracle APEX with APEX Listener

APEX Listener 2.0 and above includes FOP support. Oracle Application Express generates report XML data with XSL-FO stylesheet in single document. APEX Listener intercepts this file and renders PDF document that is downloaded straight into your browser. With the APEX Listener option you can either use the built-in generic report layout that allows for limited customization or your own custom report layout.

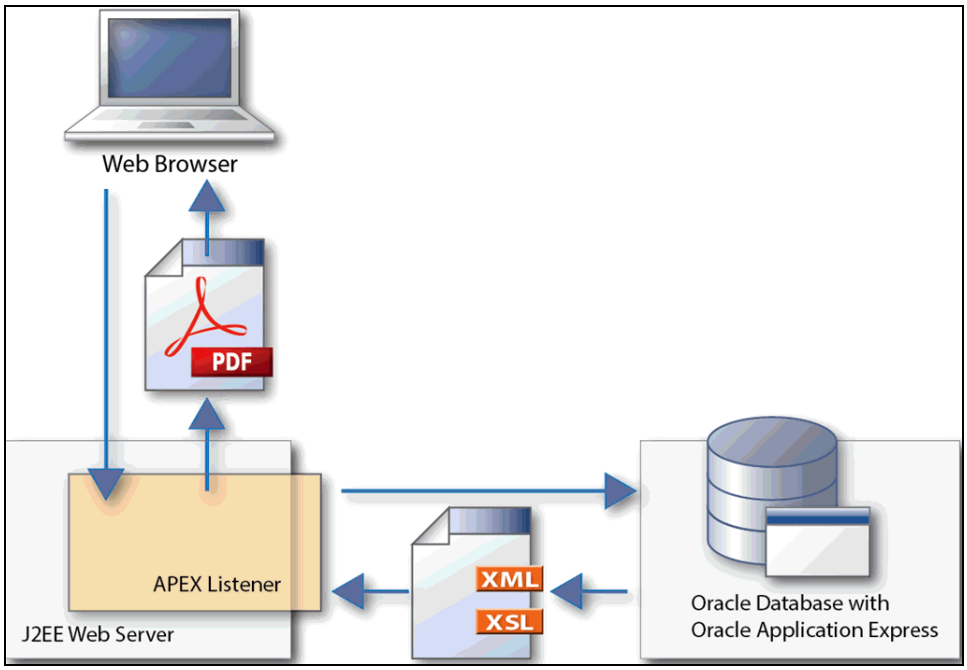

Figure 3: Oracle APEX with APEX Listener

Configuring APEX Listener as a Print Server

The APEX Listener based printing option loads your reports straight to the APEX Listener. Then the APEX Listener renders these reports in PDF format and downloads them to your browser. Therefore, unless you are calling APEX Print APIs directly in your custom PL/SQL code, you do not need to enable networking services in Oracle Database 11g anymore. You need to perform the following simple steps to enable APEX Listener as the print server in Oracle Application Express:

1. Log in to Oracle Application Express instance administration
2. Click Manage Instance > Instance Settings
3. Select Report Printing
4. Select Oracle APEX Listener for Print Server and then click Apply Changes.

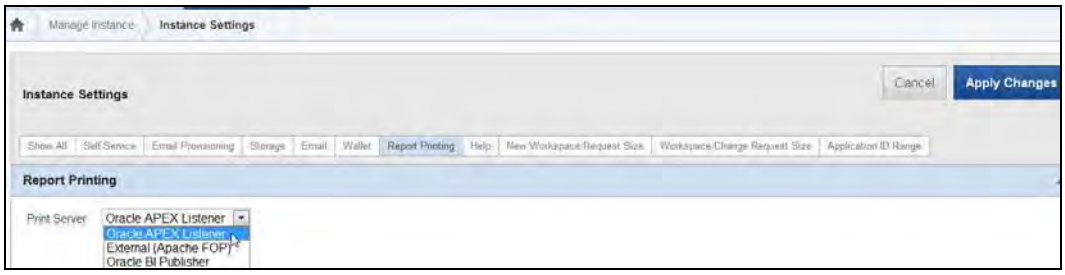

Figure 4: Configure the APEX Listener as the Print Server

When using the PL/SQL Print APIs (apex_util.get_print_document and apex_util.download_print_document), it is still necessary to enable networking services in Oracle Database 11g. If you are using the PL/SQL Print APIs, perform the following two additional steps:

1. Enable networking services in Oracle Database 11g. For instructions on how to enable networking services in Oracle Database 11g, see Oracle Application Express 4.2 Release Notes: http://docs.oracle.com/cd/E37097_01/doc/doc.42/e35121/toc.htm#HTMRN119

2. Configure the APEX Listener to enable FOP based PDF rendering via http requests from the database. To enable FOP, navigate to the /apex directory of the APEX Listener configuration folder, edit the default.xml file and add the following code:

```
<entry key="misc.enableOldFOP">true</entry>
```

Printing a Simple Classic Report as PDF

This example shows how to quickly create a classic report and print the report data as PDF.

1. First, create a database application with a classic report implementation on the EMP table. In the Create Application wizard, specify the following:
   - Name: Employees
   - Select Page Type: Report
   - Page Source: Table
   - Table Name: EMP
   - Implementation: Classic
2. Edit the Print Attributes of this classic report. Click Printing and select Yes for Enable Report Printing. Then, click Apply Changes.

3. Now, run the page and click the Print link. You should see the PDF format of the report.

Creating and Using a Fully Custom Report Layout

Oracle Application Express 4.2.2 includes improved support for custom XSL-FO layouts. You can now easily customize your PDF reports to your requirements using third-party tools such as Altova Stylevision or Stylus Studio that allow for drag and drop layout of XSLT stylesheets. If you have a Report Query or a Classic Report Region, you can simply download your report data in XML format and use this XML data as the data source for any of these tools. Once loaded into the tool, all components of your report data, including information about your application, page, report region, user name as well as session state can be easily included in the layout via drag and drop.

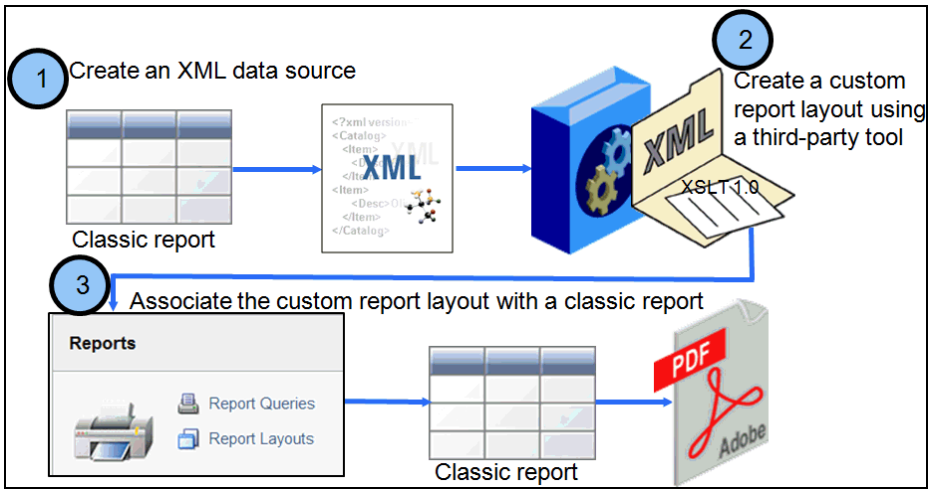

Figure 5: Creating a Custom Report Layout

The screenshot above shows the three steps that you need to perform to create and use a fully custom report layout:

1. Create an XML Data Source: First, download your report data in XML format
2. Create a custom report layout using a third-party tool: In this step, you load the XML data source into a third-party tool, drag and drop components of your report data into the empty layout and finally save the report layout as an XSLT 1.0 file
3. Associate the custom report layout to your report: Finally, you upload the XSLT 1.0 file as a report layout into APEX under Shared Components > Reports > Report Layouts. Then, update your report query or classic report region to use this custom layout when exporting your report in PDF format

Creating an XML Data Source

You need to first create an XML data source for your report layout. In this example, you use the database application that you created in the previous section. Perform the following steps:

1. Edit the employees classic report page
2. Under Print Attributes, set the output format to XML and click Apply Changes
3. Run the page. Click the Print link at the bottom of the page and then save the XML document on your desktop folder.

Creating a Custom Report Layout Using a Third-party Tool

Once you have the XML data source, you need to load this XML into a third party tool such as Altova StyleVision or Stylus Studio. After loading the XML, you add elements to the empty layout by using the drag and drop functionality and then make some formatting changes to the layout. Finally, you save this report layout as an XSLT-FO file.
This document shows examples of creating a custom report layout using both Altova StyleVision and Stylus Studio. You can choose to use either of this third party tools.

Using Altova StyleVision

To create a custom report layout using Altova StyleVision, perform the following steps:

1. Open Altova StyleVision and click File > New > New from XML Schema/DTD/XML…
2. Select the EMP.xml file that you created in the previous section and click Open
3. Select Generate new XML Schema and click OK. Save the XML Schema file on your desktop folder
4. Select Create a free-flow document and click OK. Now you see a tree view of the XML document (Schema Tree) at the left side bar.
5. FOP currently supports only XSLT 1.0 version. Click the XSLT 1.0 icon to set the XSLT version for your layout. Note: If you do not see this icon on the tool bar, click Customize > Add or Remove Buttons > Standard and then select Generate XSLT Version 1.0.

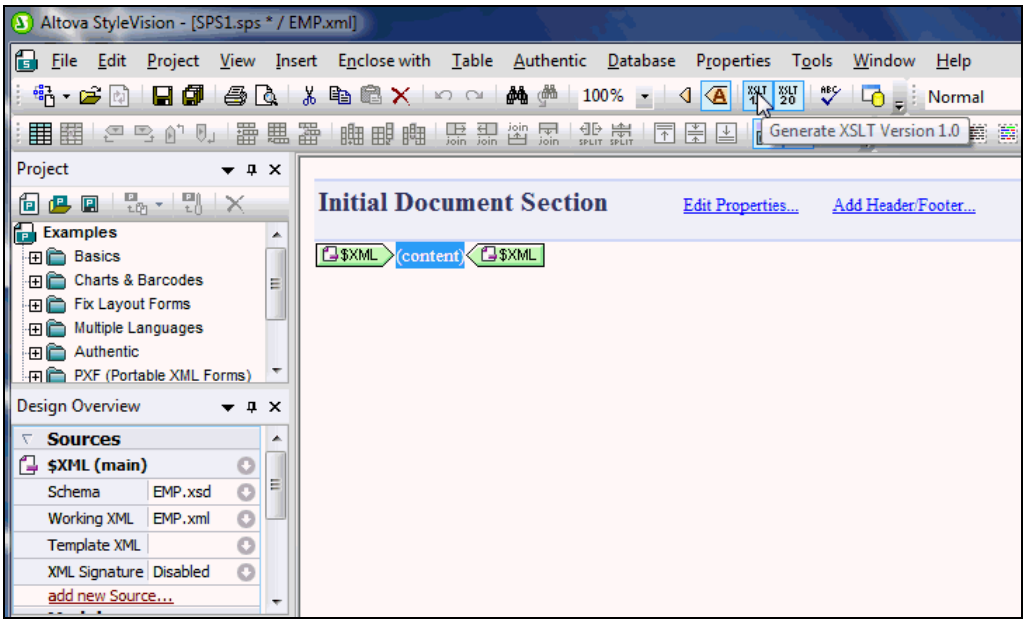

Figure 6: Report Layout with Stylevision

6. You can drag and drop XML elements from this Schema Tree to the empty layout. Drag and drop the USER_NAME element from the Schema Tree to the layout and then select Create Contents.
7. In this example, you create a table based on your report data. Navigate to the Schema Tree and then drag and drop the ROW element to the layout. Select Create Table and then in the Create Dynamic Table window click OK.
8. Now apply some formatting options to the layout. For example, increase the font size, and then change the background color and foreground color of the column header.
9. Click Add Header/Footer to add a header and footer for all pages.
10. You can add an image to your layout. Click the Insert Image icon and point to the location on the layout where you

want the image to be displayed. Click Browse and then click Switch to URL. For File URL, enter a fully qualified URL of an image. This URL needs to be accessible from the instance where the APEX Listener is running.

11. Click the HTML tab to preview your report layout. You need to save this generated file. Click File > Save Generated Files > Save Generated XSLT-FO File. Enter a file name and click Save. In this example, enter employees1 for file name.

Associating the Custom Report Layout with a Classic Report

Once you have the custom report layout ready as an XSLT-FO file, you need to load this file to Oracle Application Express and then associate the layout with your report query or region.

1. Navigate to your application Home page > Shared Components > Reports > Report Layouts
2. Click Create. Select Named Columns (XSL-FO) for Report Layout Type.
3. Enter a name for Layout Name and click Browse to select the XSLT-FO file that you have saved in the previous section. If you select the XSL file generated by Altova StyleVision, enter employees1 for Layout Name and enter employees2 if you select the XSL file generated by Stylus Studio. Click Create Layout.
4. Now edit your employees report page. Right click the report region and select Print Attributes.
5. Under Printing, select PDF for Output Format
6. Select your report layout name for Report Layout and click Apply Changes.
7. Now run your report. Click the Print link and open the PDF document.

Summary

Oracle Application Express 4.2.2 has introduced a new PDF printing option by using APEX Listener. You can now build a custom report layout using third-party tools and associate the layout with your report.

The key benefits of using APEX Listener as a printing option are:

- No separate external printing engine is required
- Using a supported Oracle product, APEX Listener
- Single step configuration as a print server for Oracle Application Express

About the Author

Marc Sewtz is a Senior Software Development Manager at Oracle Corporation in New York. With over sixteen years of industry experience, Marc held roles in Consulting, Sales and Product Development and now manages a global team of Software Developers and Product Managers in the Oracle Application Express (APEX) development team, part of the Oracle Database Tools group. Marc and his team are responsible for features such as the development of Mobile Web Applications with APEX, Reporting and Charting, Tabular Forms, Oracle Forms to APEX conversion and integration with Oracle Business Intelligence Publisher. Marc has a Master's degree in computer science from the University of Applied Sciences in Wedel, Germany.

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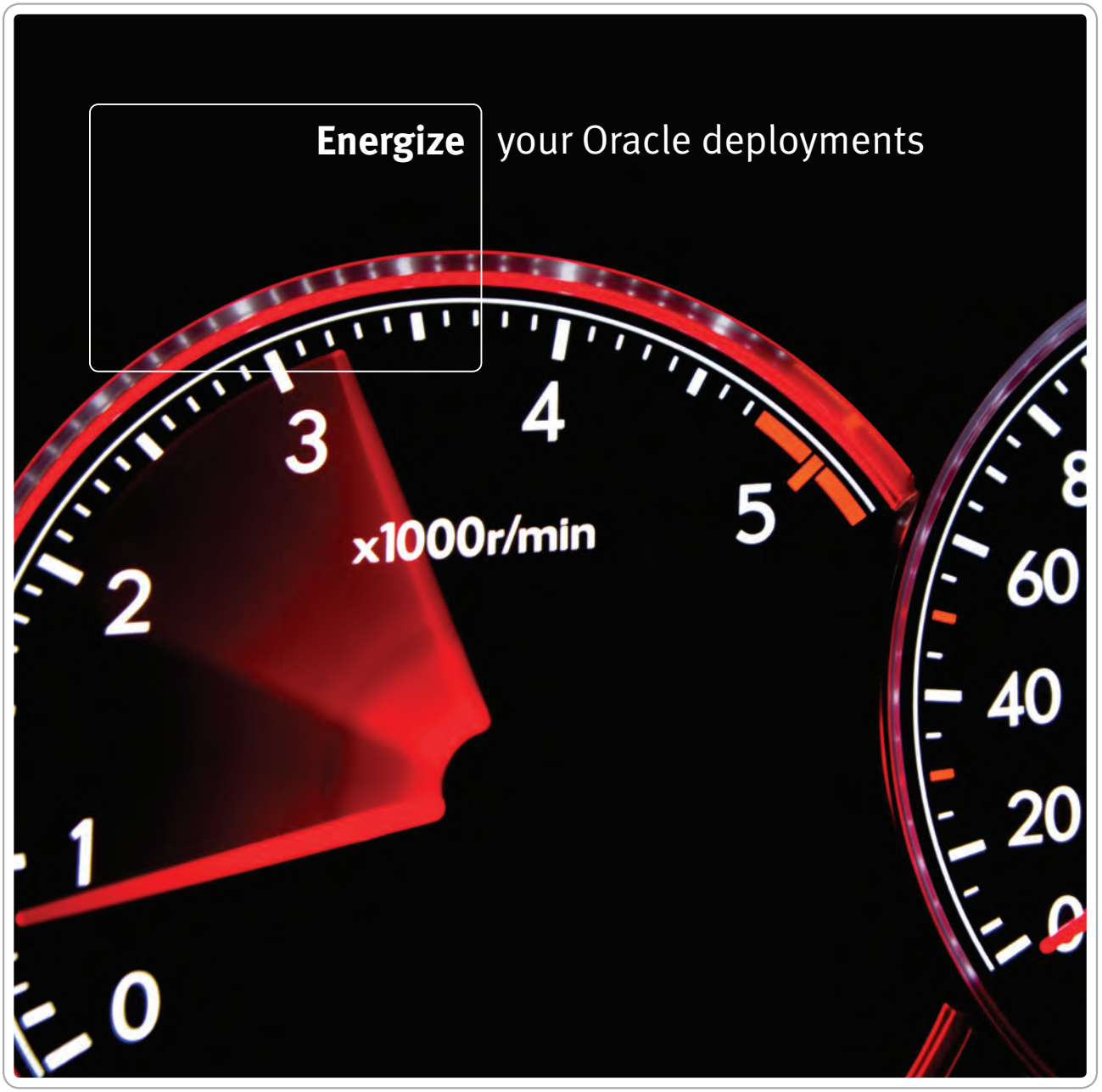

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Oracle Moves to the NYSE

Carl Esposito
President Emeritus and Director of Strategic Planning
NYOUG

Oracle's recent move to the New York Stock Exchange (NYSE) from NASDAQ is a more noteworthy development for those two stock exchanges and Tesla Motors, than it is for Oracle. And it might be an even bigger deal for IBM, Microsoft and HP. Although traditionally the home of blue chip, higher yielding companies, the NYSE has been nibbling away at NASDAQ's dominance in technology firms for the past several years. Tesla, the electric vehicle manufacturer, replaces Oracle in the Nasdaq 100. It's the fourth major defection from NASDAQ this year, replacing the $140 billion (market cap) computer vendor with a fledgling $12+ billion newbie.

"Greed, for lack of a better word, is good"

Mark Hurd, Oracle's chief, said on Bloomberg TV, that they (Oracle) are a "core IT company" and the biggest enterprise software company in the world – something that IBM, and to a lesser extent, Microsoft and HP will surely take note of. How do Oracle shareholders see this? Do they see Oracle as an up and coming IBM? Do they see Oracle as a full service, enterprise IT provider? Hopefully, much of the NYOUG membership base fits into this category (since Tony Ziemba's crusade to members to purchase Oracle stock when it was below $5, 20+ years ago – yes, remember us "old" guys might still be relevant). Oracle's market cap increased by 10,000 % since 1990 - so Tony, indeed, has proven to be the "oracle of 40 Wall St"!

Irina Cotler, NYOUG Board Member and an Information Architect by trade, remarked, "*The question in the minds of many, after the announcement that Oracle is switching to NYSE, was: What is the reason? The official statement said that it would be 'in the best interests of its stockholders, customers and partners, which is a rough equivalent of proclaiming that salt is salty. All the published information is not particularly reasoning-worthy, yet, if I were to unleash a guess - how about Oracle starring in a new, not yet announced NYSE-based index, while 'keeping (your) friends close and (your)*

enemies closer'? Of course, it could be as simple as the quality and cost of service offered by the exchanges, though this does not sound 'Larry-grade'".
If we look at global IT companies (including electronics firms), Oracle isn't even in the top 10. The list is lead by Apple and includes HP, IBM, Microsoft, Dell, Fujitsu, Intel and Google. So Oracle may have a long way to go before it is considered a "core" IT company, offering a full array of hardware, software and services to a tech hungry world. Obviously Oracle's acquisition of Sun and its Engineered Systems offerings are a start in that direction. OES unifies and brands its integrated products including Exadata/Exalogic, Supercluster, Appliance, Exalytics and Network Applications Platform offerings. OES product offerings are "pre-integrated to reduce the cost and complexity of IT infrastructures while increasing productivity and performance. Only Oracle can innovate and optimize at every layer of the stack to simplify data center operations, drive down costs, and accelerate business innovation" according to the sales material.

"The main thing about money, Bud, is that it makes you do things you don't want to do"

I can still remember when I was the development manager for a small Long Island based company, as we were trying to get Oracle to sell us version 5, circa 1986. Danny Turano, I think, ignored several phone requests, so I mailed him a $1 bill and told him that our money was just as good as that of the big boys. (In those days, a $1 could still buy you a newspaper, subway ride or a rather large cup of coffee – I don't think I ever got reimbursed for that!).
Turano was instrumental in growing Oracle from a small software company into a much more serious contender. One of the many great quotes in the book *The Difference Between G*d and Larry Ellison: G*d Doesn't Think He's Larry Ellison*, by Mike Wilson, is Turano saying "Aren't we mortgaging our future?" to Larry's mandate that sales be doubled each year. It is amusing to note that the year he said it, Turano was challenged with reaching the unfathomable amount of $110 million in sales! "People were buying our product just because they didn't want to be the only one without it. They had no idea what to do with it. They had nowhere to run it". Ziemba (and a reference to NYOUG) is also mentioned in this book (page 186).

Where's Larry (Shouldn't he be shaking hands with NYOUG in this picture)?

Although the official transition to the NYSE took place earlier in July, the formal commemoration of the event consisting of Oracle executives (excluding Larry Ellison – he dodged us once again, dagnabbit!), the media and select invitees including key customers and noted user group members, took place on July 30, 2013. Mark Hurd rang the closing bell at

3:59:59 pm as the world looked on. A reception on the trading floor followed in the early evening, but despite the good will, top shelf liquor and imported prosciutto, Larry was nowhere to be found. Maybe he was looking into the abyss?

Laurence Jennings, a 20+ year veteran Oracle DBA/developer and NYOUG member, said that Oracle is making a statement here and is positioning themselves to get into the Dow 30 (possibly displacing one of the other 3 aforementioned technology giants) – this could be a strategic play to up their market cap and institutional trading volume, which could increase their stock price further.

"If you're not inside, you're outside"

Oracle executives wasted no time cashing in on Oracle's new position amid the blue chips as its price hovered around $33. By mid August, company insiders sold shares to the tune of $114.8 million (source Insiderslab.com) and trading volume calmed down after a turbulent July where ORCL averaged 20 million shares a day.

Stock market aficionados considered this defection a "home run" for Euronext (NYSE) and it is expected that further defections, as well as increased competition for attractive companies, will cause Nasdaq to fight back. Nasdaq previously lured Texas Instruments, Facebook and Kraft foods away from NYSE.

But Oracle may have it sights set on none of the enterprise technology companies previously mentioned – rather they may shooting for Google or Apple. Larry, on "CBS This Morning" told Charlie Rose that Apple, without Steve Jobs, will see dark days ahead. And Wall Street may agree. In any event, we wish Oracle well in its new home – it's in everyone's best interest.

Remember what Gordon Gekko said while sitting in the NYOUG presentation auditorium at Swiss Bank: "It's not a question of enough, pal. It's a zero sum game, somebody wins, somebody loses. Money itself isn't lost or made. It's simply transferred - from one perception to another. Like magic."

Carl Esposito, President Emeritus and Director of Strategic Planning for NYOUG, is an ITIL-certified 33 year veteran of the IT industry. He works as IT Director for a City of New York pension fund, and prior to that he worked at Merrill Lynch, H.J. Heinz and Lockheed Martin. Esposito holds an MBA degree and is active in several industry groups, in addition to the NYOUG.

Using SQL Developer 3.2 Debugging Queries with XML Documents with Oracle 11gR2

Coleman Leviter, Arrow Electronics

As an Oracle PL/SQL developer, I often find myself trying out different development and debugging tools. I usually find that one tool might have more features than another tool and vice versa. One of the PL/SQL activities that I perform is XML DB development. In that arena, I find it most important to debug and view XML documents, preferably using one tool. One previous weakness of SQL Developer was its inability to display XML documents in pretty-print. This shortcoming prevented me from using one tool to develop, debug, and finally view XML documents.
Earlier this year, Oracle released SQL Developer version 3.2. Among its impressive list of new features is the ability to view XML documents in pretty-print. This article includes the following information:

1. An XML DB debugging exercise using Oracle 11.2.0.1 and SQL Developer 3.2
2. Description of features of SQL Developer useful in development and debugging:
   a. Connect to a schema
   b. Completion insight – start typing
   c. Run statement
   d. View variable data in debugging
3. Demonstrate salient points of SQL Developer 3.2 when debugging XML documents

The debugging example follows these steps:

1. Using SQLX, query a relational table.
2. Store the results from Step 1 in an XMLTYPE column.
3. View the XML document using SQL Developer.

To begin a session, connect to a default schema, “scott” by left-clicking scott. Your session is now ready.
Note that SQL Developer stores the connection details in the file named “connections.xml” in the following directory: (your directory path might be slightly different)

C:\Users\cleviter\AppData\Roaming\SQL Developer\system3.1.06.82\o.jdeveloper.db.connection.11.1.1.4.37.59.48

The relational table, my_relat_table, used in this example contains data shown in Figure 1.

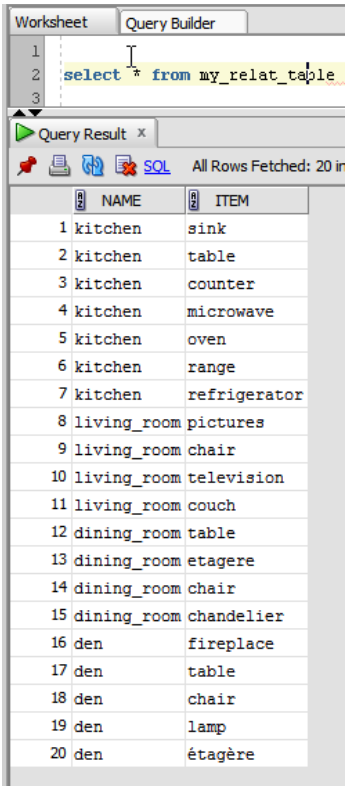

Figure 1: my_relat_table Data

The following is the data structure for my_relat_table:

```
CREATE TABLE "SCOTT"."MY_RELAT_TABLE"
  (
    "NAME" VARCHAR2(20 CHAR),
    "ITEM" VARCHAR2(20 CHAR)
  )
```

I obtained the table contents of "my_relat_table" by running a query in an anonymous block. Completion Insight (Tools->Preferences->Code Editor->Completion Insight)) provided choices to complete the query as shown in Figure 2.

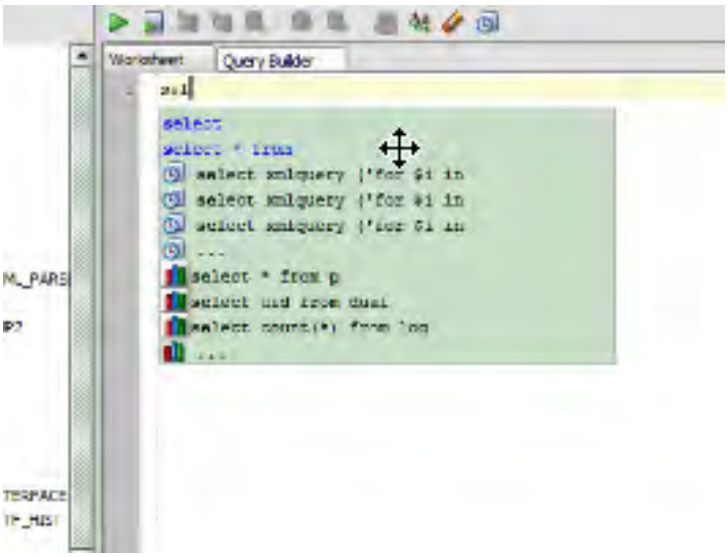

Figure 2: Completion Insight Query Completion Options

I created a sample procedure, my_xml_proc to produce an XML document (and its corresponding CLOB document) from the contents of my_relat_table and stored both in the table my_table_house using the following code:

```
CREATE TABLE "SCOTT"."MY_TABLE_HOUSE"
  (
    "HOUSE_CLOB" CLOB,
    "HOUSE_XMLTYPE" "XMLTYPE"
  )
```

Using SQL Developer, you'll be able to place breakpoints in the procedure and view the contents of the local CLOB variable: lcl_clob_house.
After the program completes, observe the XML document stored in my_table_house.house_xmltype using the SQL Developer editor. You'll be able to view the nodal relationship in the XML document, which is one of the newest features in SQL Developer 3.2. What follows is the example procedure my_xml_proc:

```
CREATE OR REPLACE
PROCEDURE my_xml_proc AS
       lcl_clob_house  CLOB;

BEGIN
      SELECT  XMLTYPE.GETCLOBVAL(
              XMLELEMENT("house",
              XMLAGG(  xmlelement("room",
              XMLELEMENT("name", name),
              XMLELEMENT("item",item)) )  ) )
              INTO lcl_clob_house
      FROM my_relat_table;

      INSERT INTO my_table_house
      (house_clob, house_xmltype)
      VALUES (lcl_clob_house, XMLTYPE(lcl_clob_house)) ;

COMMIT;
END;
```

The steps for creating and debugging a stored procedure in SQL Developer are as follows:

1. GRANT debug any procedure, debug connect session TO scott (grants must be issued)
2. Run my_xml_proc in an anonymous block: (ALT-F10)
3. Refresh the Object Navigator and right-click the procedure my_xml_proc
4. Right-click the procedure name found and left-click Edit
5. Select breakpoint
6. Click "gears: compile to debug"
7. Click Lady Bug
8. Click OK "Hit Run" ==>-
9. Right-click data window to inspect data.
10. Click "X" to close.
11. Step through program (F8 Over code block) (F7 into code block)

Figures 3-6 help to illustrate the steps above.

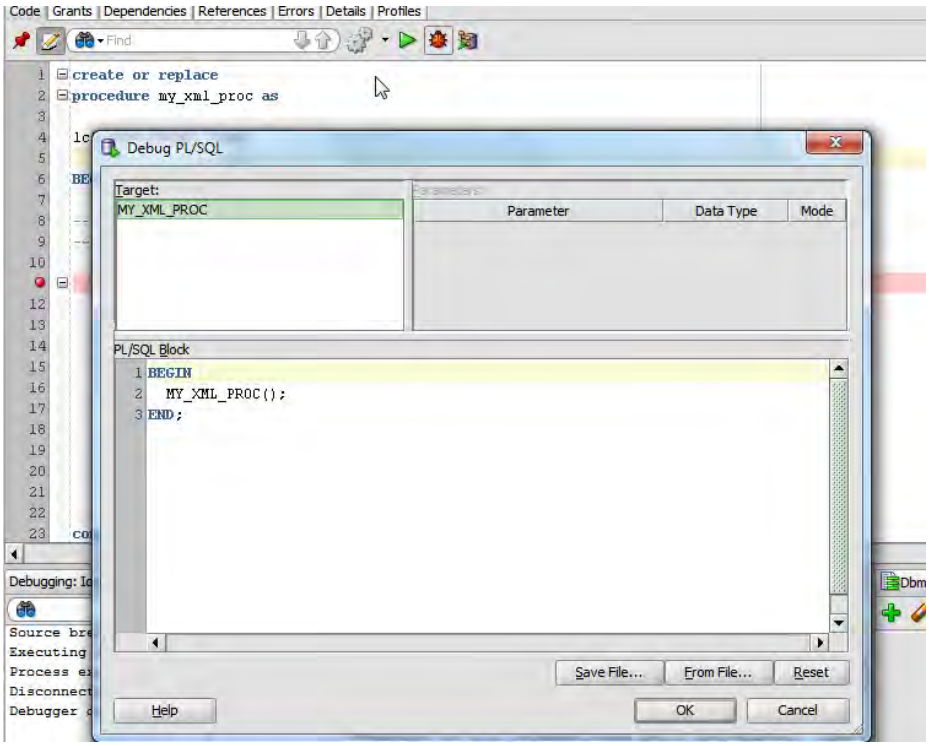

Figure 3: Click the Lady Bug Icon to Debug the Program

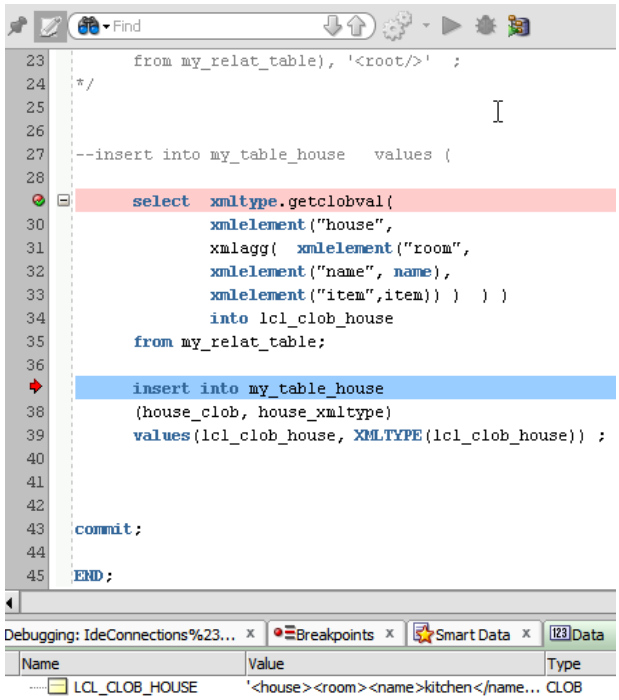

Figure 4: Breakpoint at Line 37. Observe lcl_clob_house Data

Complete the debugging session and review the XML Document in the table, my_table_house.

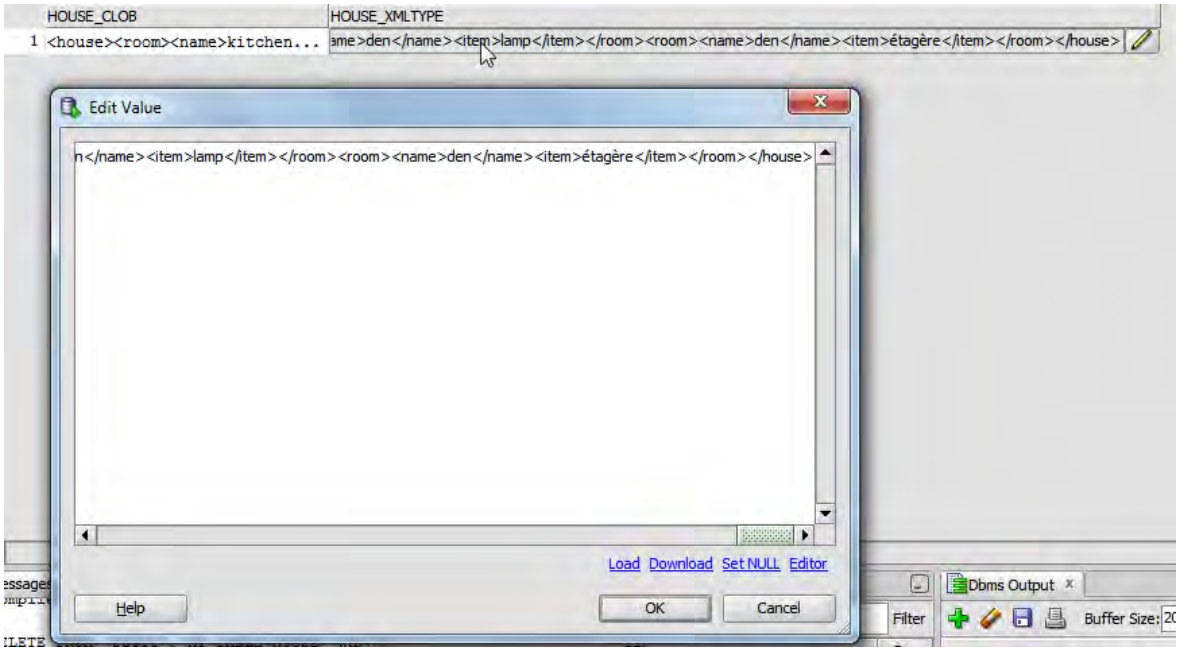

Figure 5: Left-click the Pencil Icon to Access the Edit Value Window

Then, click Editor at the bottom right side of the Edit Value window and press "ctrl alt-l" and review the XML document displayed in a parent-child relationship or "pretty print":

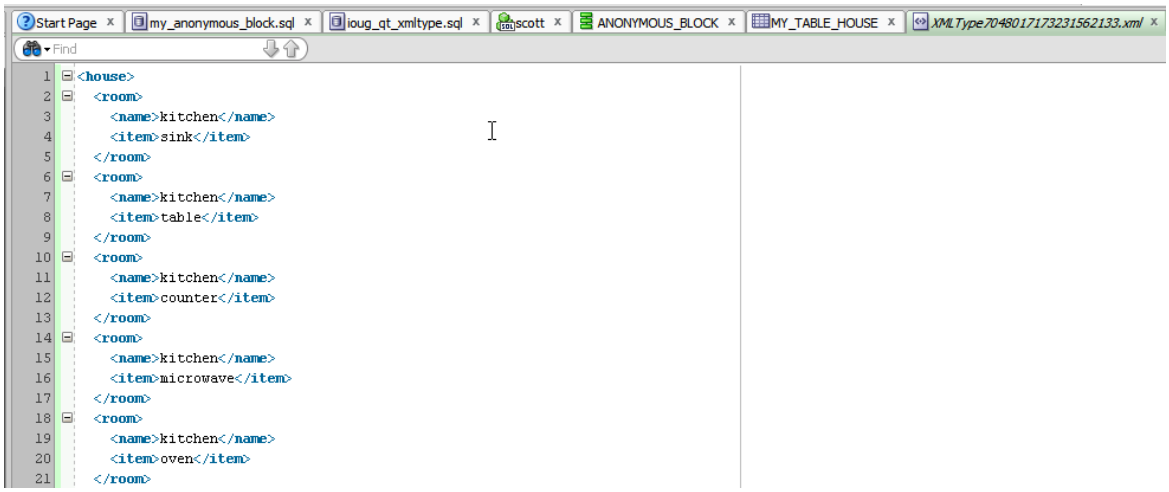

Figure 6: XML Document in Pretty Print

Conclusions

Although I've touched on a brief debugging session using SQL Developer, my intent was to demonstrate one of the latest features, namely the ability to view XML documents in "pretty print." Previously, I'd find myself using alternate tools (i.e. XMLSPY) to view XML documents. With the latest SQL Developer 3.2 release, all facets of a debugging session are self contained. This article includes all of the data structures and procedures for you to try the above example on your own Oracle 11.2.0.1 environment. SQL Developer 3.2, of course is free and can be downloaded at: http://www.oracle.com/technetwork/developer-tools/sql-developer/downloads/index.html.
Enjoy working with this new version of SQL Developer 3.2.

About the Author

Coleman Leviter, OCP is employed as an IT Software Systems Engineer at Arrow Electronics. He has presented at IOUG's Collaborate and at Oracle Open World. His articles have appeared in Select Magazine, ODTUG Journal, IOUG's Best Practices and the New York Oracle User's Group (NYOUG) Journal. He is the WEB SIG chair and sits on the

steering committee at the NY Oracle Users Group (www.nyoug.org). Additionally, he is a member of the IOUG Board of Directors (ioug.org). He has worked in the financial services industry and the aerospace industry where he developed Navigation, Flight Control and Reconnaissance software for the F-14D Tomcat. Coleman has a BSEE from Rochester Institute of Technology, an MBA from C.W. Post and an MSCS from New York Institute of Technology. He may be contacted at cleviter@ieee.org .

SIGS, SIGS and more SIGS!

The following Special Interest Groups (SIG) hold meetings throughout the year for the benefit of NYOUG members:

DBA SIG – Database Administration
Data Warehouse SIG – Business Intelligence
Web SIG – Web / XML / Java / Weblogic / APEX / Fusion
Long Island SIG – Nassau/Suffolk area - All topics

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Oracle PL/SQL Function Statistics

Michael Rosenblum, Dulcian, Inc.

There are few Oracle professionals who are not aware of the importance of keeping database statistics up to date. However, contrary to the common knowledge, these statistics are not limited to tables, columns and indexes. A number of years ago it was a big surprise for me to discover the following facts from an article by my fellow Oracle ACE, Adrian Billington:

1. PL/SQL functions have a number of associated statistics, but Oracle default values are somewhat strange:
   a. CPU cost – 3000 [CPU instructions]
   b. I/0 cost – 0 [data blocks to be read/written]
   c. Network cost – 0 [data blocks to be transmitted]
   d. Selectivity – 1% [i.e. if you compare the results of your function to a constant, they will match only 1 in every 100 comparisons]
   e. Cardinality (for functions returning collections) – 8168 [objects]
2. Cost-Based Optimizer uses these default values to build execution plans.
3. Default values could be changed using the ASSOCIATE STATISTICS command in two ways: either with hard-coded values or dynamic calculation using the Oracle Extensible Optimizer.

Obviously, it is very easy to imagine lots of scenarios where insufficiently set defaults slow down the whole database. For the purposes of this article, the scope will be limited to the cost of PL/SQL functions, because usually that is the area where performance problems most often occur.

Why Do We Care about PL/SQL Statistics?

To illustrate the need for properly maintained PL/SQL statistics, examine the following case. Assume that there are two different function calls in the WHERE clause. The first function is calculation-heavy, while the second one is calculation-light. Keep in mind that any time Oracle processes a group of Boolean statements, the short-circuit evaluation is applied to eliminate unnecessary calls: if there is a statement “ConditionA OR ConditionB” and ConditionA is TRUE, the whole calculation of ConditionB can be ignored. To utilize such optimization techniques in the described case of two functions, it always makes sense to first check the light function and continue only when it does not return a needed value.
The real issue is how to tell the CBO which function is light and which function is heavy. If those functions are standalone and you know for sure that they are so different, the solution is very simple. You can just set really high hard-coded values:

```
CREATE FUNCTION f_light_tx (i_empno number) RETURN VARCHAR2 IS
BEGIN RETURN 'Light:'||i_empno; END;

ASSOCIATE STATISTICS WITH FUNCTIONS f_light_tx
DEFAULT COST (0,0,0); -- order of parameters: CPU, I/O, Network

CREATE FUNCTION f_heavy_tx (i_deptno number) RETURN VARCHAR2 IS
BEGIN RETURN 'Heavy:'||i_deptno; END;

ASSOCIATE STATISTICS WITH FUNCTIONS f_heavy_tx
DEFAULT COST (99999,99999,99999);
```

The impact of the statistics can be seen immediately. The CBO will change the order of predicates on the fly as shown here:

```
SQL> set autotrace on explain
SQL> select count(*)
  2  from emp
  3  where f_heavy_tx(deptno) = 'A'
  4  or f_light_tx(empno) = 'B';

  COUNT(*)
----------
         0

Execution Plan
----------------------------------------------------------
Plan hash value: 2083865914

---------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
---------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |     1 |     7 |  1385K  (0)| 04:37:12 |
|   1 |  SORT AGGREGATE    |      |     1 |     7 |            |          |
|*  2 |   TABLE ACCESS FULL| EMP  |     1 |     7 |  1385K  (0)| 04:37:12 |
---------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------
   2 - filter("F_LIGHT_TX"("EMPNO")='B' OR "F_HEAVY_TX"("DEPTNO")='A')
```

Keep in mind that there are techniques to get more realistic values instead of 99999s without using the Extensible Optimizer. Getting I/O and network costs is reasonably straightforward with regular session statistics: “db block gets”/“consistent gets” and "bytes sent via SQL*Net to dblink"/"bytes received via SQL*Net from dblink". As for CPU cost, as long as you know how much CPU time is consumed (on average) by the function, you can always find a number of CPU instructions for that time. The code snippet below shows how to do it for 0.01 sec interval:

```
SQL> DECLARE
  2       v_units_nr NUMBER;
  3       v_time_nr number:=0.01; -- in seconds
  4  BEGIN
  5       v_units_nr := DBMS_ODCI.ESTIMATE_CPU_UNITS(v_time_nr) * 1000;
  6       DBMS_OUTPUT.PUT_LINE('Instructions:'||round(v_units_nr));
  7  END;
  8  /
Instructions:9476396
SQL>
```

Solving the Problem of Packaged Functions

The manipulation of the statistics demonstrated above seemed to be very promising until I realized the following restriction: if multiple functions are inside of the same package, there is no way to associate hard-coded statistics with them separately:

- ASSOCIATE STATISTICS WITH FUNCTIONS <PackageName>.<FunctionName> is invalid syntax
- ASSOCIATE STATISTICS WITH PACKAGES <PackageName> applies hard-coded values to all functions in the package.

The last hope was the Extensible Optimizer with all of its obscure syntactical constructions, very limited documentation, and high learning curve. After a number of unsuccessful attempts, it became obvious that the problem was solvable. It is indeed possible to associate different statistics with packaged functions as long as you understand how the Extensible Optimizer treats them.
To illustrate this finding in the following example, assume that you have a package with three functions:

```
CREATE OR REPLACE PACKAGE perf_pkg
IS
    FUNCTION f_heavy_tx (i_deptno NUMBER) RETURN VARCHAR2;
    FUNCTION f_light_tx (i_empno NUMBER) return VARCHAR2;
    FUNCTION f_medium_tx (i_name VARCHAR2) return VARCHAR2;
END;

CREATE OR REPLACE PACKAGE BODY perf_pkg
IS
    FUNCTION f_heavy_tx (i_deptno number) RETURN VARCHAR2 IS
    BEGIN RETURN 'Heavy:'||i_deptno; END;

    FUNCTION f_light_tx (i_empno number) RETURN VARCHAR2 IS
    BEGIN RETURN 'Light:'||i_empno; END;

    FUNCTION f_medium_tx (i_name VARCHAR2) RETURN VARCHAR2 IS
    BEGIN RETURN initcap(i_name); END;
END;
```

The challenge is how to tell the CBO about the different costs of these functions. As always with the Extensible Optimizer, you need to start with a special object type that matches the required template.

```
CREATE OR REPLACE TYPE function_cost_oty AS OBJECT (
  dummy_attribute NUMBER,

  STATIC FUNCTION ODCIGetInterfaces (p_interfaces OUT SYS.ODCIObjectList)
  RETURN NUMBER,

  STATIC FUNCTION ODCIStatsFunctionCost (
                    p_func_info      IN  SYS.ODCIFuncInfo,
                    p_cost           OUT SYS.ODCICost,
                    p_args           IN  SYS.ODCIArgDescList,
                    i_single_nr      IN  NUMBER,
                    p_env            IN  SYS.ODCIEnv
  ) RETURN NUMBER,

  STATIC FUNCTION ODCIStatsFunctionCost (
                    p_func_info      IN  SYS.ODCIFuncInfo,
                    p_cost           OUT SYS.ODCICost,
                    p_args           IN  SYS.ODCIArgDescList,
                    i_single_tx      IN  VARCHAR2,
                    p_env            IN  SYS.ODCIEnv
                    ) RETURN NUMBER
  )
```

Since the reason to create this type is to adjust function cost, the only method needed is ODCIStatsFunctionCost (in addition to the mandatory ODCIGetInterfaces). The structure of the parameters in this method is a bit strange. It includes a number of standard ones (p_func_info, p_cost, p_args), a list of user-defined parameters of functions that we are planning to correct, and another standard parameter (p_env).

The following is the trick to make it work. You need to create as many overloads of the ODCIGetInterfaces method as the number of distinct combinations of function input parameters. In the package PERF_PKG, there are two functions with one NUMBER IN-parameter and one function with a VARCHAR2 IN-parameter. This means that you need to have two overloads: one for single numeric input and one for single textual input. The parameter names are irrelevant, but in the case of multiple function parameters, their order would matter.
The body of FUNCTION_COST_OTY is as obscure as the specification, but don't forget that the format must match the Oracle templates in order to work:

```
CREATE OR REPLACE TYPE BODY function_cost_oty
AS
  STATIC FUNCTION ODCIGetInterfaces (p_interfaces OUT SYS.ODCIObjectList)
  RETURN NUMBER IS
  BEGIN
    p_interfaces := SYS.ODCIObjectList(SYS.ODCIObject ('SYS', 'ODCISTATS2'));
    RETURN ODCIConst.success;
  END ODCIGetInterfaces;

  STATIC FUNCTION ODCIStatsFunctionCost (p_func_info      IN  SYS.ODCIFuncInfo,
                                         p_cost           OUT SYS.ODCICost,
                                         p_args           IN  SYS.ODCIArgDescList,
                                         i_single_nr      IN  NUMBER,
                                         p_env            IN  SYS.ODCIEnv
  ) RETURN NUMBER IS
  BEGIN
    IF p_func_info.MethodName like '%HEAVY%' THEN
      p_cost := SYS.ODCICost
        (CPUcost=>NULL, IOcost=>1000, NetworkCost=>NULL, IndexCostInfo=>NULL);
    END if;
    RETURN ODCIConst.success;
  END;

  STATIC FUNCTION ODCIStatsFunctionCost (p_func_info      IN  SYS.ODCIFuncInfo,
                                         p_cost           OUT SYS.ODCICost,
                                         p_args           IN  SYS.ODCIArgDescList,
                                         i_single_tx      IN  VARCHAR2,
                                         p_env            IN  SYS.ODCIEnv
  ) RETURN NUMBER IS
  BEGIN
    IF p_func_info.MethodName like '%MEDIUM%' THEN
      p_cost := SYS.ODCICost(NULL, 10, NULL, INULL);
    END IF;
    RETURN ODCIConst.success;
  END;
END;
```

The logic of the code is as follows: it evaluates a name of the function passed using the P_FUNC_INFO input parameter and sets higher I/O costs if needed. That parameter is of type SYS.ODCIFuncInfo and has the following attributes: ObjectSchema, ObjectName, MethodName, Flags. If the function is standalone, its name will be represented in ObjectName, but if the function is part of the package, the package name will be in ObjectName and the function name will be in MethodName. In terms of assigning costs, NULL would mean to use the default. Anything other than NULL indicates override.
Now that all of the parts of the equation are set, it is time to associate statistics with the package and test its impact:

```
SQL> associate statistics with packages perf_pkg using function_cost_oty;
SQL> set autotrace on explain
```

```
SQL> select count(*)
  2  from emp
  3  where perf_pkg.f_heavy_tx(empno)='A'
  4  or perf_pkg.f_light_tx(deptno)='B'
  5  or perf_pkg.f_medium_tx(job)='C';

  COUNT(*)
----------
         0

Execution Plan
----------------------------------------------------------
Plan hash value: 2083865914

---------------------------------------------------------------------------
| Id  | Operation          | Name | Rows  | Bytes | Cost (%CPU)| Time     |
---------------------------------------------------------------------------
|   0 | SELECT STATEMENT   |      |     1 |    15 | 13863   (0)| 00:02:47 |
|   1 |  SORT AGGREGATE    |      |     1 |    15 |            |          |
|*  2 |   TABLE ACCESS FULL| EMP  |     1 |    15 | 13863   (0)| 00:02:47 |
---------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------
   2 - filter("PERF_PKG"."F_LIGHT_TX"("DEPTNO")='B' OR
              "PERF_PKG"."F_MEDIUM_TX"("JOB")='C' OR
              "PERF_PKG"."F_HEAVY_TX"("EMPNO")='A')
```

As you can see, the CBO changed the sequence of the functions to evaluate them in the order of the associated costs, namely light, medium, and heavy, which was exactly as required.

Summary

It will be a big surprise for a lot of Database Administrators to know that they need to worry about PL/SQL statistics. These statistics directly impact the way in which Oracle calculates the costs of the different execution plans of corresponding SQL statements. Providing valid data to the CBO is crucial in ensuring that it makes the most informed decision, because currently there is no other way for the CBO to look inside of the PL/SQL units. On the other hand, special object types provided by the Extensible Optimizer can do the job regardless of whether you are using standalone or packaged functions. It just takes a bit of time to learn and experiment. For more information about this topic see my upcoming book *PL/SQL Performance Tuning: Tips and Techniques* (McGraw-Hill Education, ETA - late spring 2014).

About the Author

Michael Rosenblum is a Software Architect/Senior DBA at Dulcian, Inc. where he is responsible for system tuning and application architecture. Michael supports Dulcian developers by writing complex PL/SQL routines and researching new features. He is the co-author of *PL/SQL for Dummies* (Wiley Press, 2006), contributing author of *Expert PL/SQL Practices* (APress, 2011), and author of a number of database-related articles (IOUG Select Journal, ODTUG Tech Journal) and conference papers. Michael is an Oracle ACE, a frequent presenter at various Oracle user group conferences (Oracle OpenWorld, ODTUG, IOUG Collaborate, RMOUG, NYOUG, etc), and winner of the ODTUG Kaleidoscope 2009 Best Speaker Award.

Row Limiting, PL/SQL WITH SQL, and Temporal Validity: Three in 12c

Melanie Caffrey, Oracle America, Inc.

The latest, greatest incarnation of the Oracle database, 12c, is chockfull of interesting and exciting new features. This article introduces the reader to just three of them available within SQL alone. Top-N queries can now employ simpler syntax with the use of the new *row_limiting* clause, which allows you to limit the rows returned by a query. You can now define a PL/SQL function in the WITH clause of a query, and reference it within the query, as well as any of the query's subqueries. And last, but not least, *temporal validity* enables you to have data visible depending on its time-based validity, as determined by the periods of time for which it is considered valid. Any application can now support a situation where it is important to have visible only the data within a table considered valid as of a specified time period, instead of all the data within a table (the current default).

To demonstrate the power of the *row limiting clause*, I'll start by querying a table called EMPLOYEE. First the table is queried with no row limiting clauses and then the table is queried with the new row limiting FETCH FIRST and ROWS ONLY clauses, for comparison purposes.

```
ashton%ORA12CR1> select employee_id, first_name, last_name, salary
  2                from employee
  3              order by salary desc;

EMPLOYEE_ID FIRST_NAME                     LAST_NAME                          SALARY
----------- ------------------------------ ------------------------------ ----------
       6573 Lori                           Dovichi
       6571 Thomas                         Jeffrey                            300000
         28 Emily                          Eckhardt                           100000
       6569 michael                        peterson                            90000
       1234 Donald                         Newton                              80000
         37 Frances                        Newton                              75000
       7895 Matthew                        Michaels                            70000
       6572 Theresa                        Wong                                70000
       6570 mark                           leblanc                             65000
       6567 Roger                          Friedli                             60000
       6568 Betsy                          James                               60000

11 rows selected.

ashton%ORA12CR1> set feedback on
ashton%ORA12CR1> set lines 32000
ashton%ORA12CR1> select employee_id, first_name, last_name, salary
  2                 from employee
  3               order by salary desc nulls last
  4               FETCH FIRST 5 ROWS ONLY;

EMPLOYEE_ID FIRST_NAME                     LAST_NAME                          SALARY
----------- ------------------------------ ------------------------------ ----------
       6571 Thomas                         Jeffrey                            300000
         28 Emily                          Eckhardt                           100000
       6569 michael                        peterson                            90000
       1234 Donald                         Newton                              80000
         37 Frances                        Newton                              75000
```

```
5 rows selected.
```

Notice how with just a few extra keywords, FETCH FIRST 5 ROWS ONLY, the query is limited to the Top-N records we are interested in. This is a syntactical simplification over, for example, the RANK and DENSE_RANK analytic functions also used within Oracle SQL. This is not to say that RANK and DENSE_RANK should not be used. (I am a huge fan of analytic functions.) This is simply a statement that many Top-N queries that are interested in, say, fetching the first five rows, and maybe the next five rows, for example, could make good use of the new row limiting clause syntax available in 12c.
The FETCH clause specifies the number of rows or percentage of rows to return. Comparing the second query with the first query, you can see that the omission of this clause results in all rows returned. The second query fetches only the top five salary earners from the employee table (additionally, the second query omits any records with null salary values, so that only real salary values are returned). To then fetch the next top 5 salary earners, consider the following query:

```
ashton%ORA12CR1> select employee_id, first_name, last_name, salary
  2                from employee
  3              order by salary desc nulls last
  4              OFFSET 5 ROWS FETCH NEXT 5 ROWS ONLY;

EMPLOYEE_ID FIRST_NAME                     LAST_NAME                           SALARY
----------- ------------------------------ ------------------------------ ----------
       7895 Matthew                        Michaels                            70000
       6572 Theresa                        Wong                                70000
       6570 mark                           leblanc                             65000
       6567 Roger                          Friedli                             60000
       6568 Betsy                          James                               60000

5 rows selected.
```

The differences between the third query and the second query are the OFFSET and FETCH NEXT clauses. The OFFSET clause specifies the number of rows to skip before the row limiting begins. The way to look at this is to read it as “skip the first five salary earners, and return the next five salary earners only”.
Effectively calling PL/SQL within SQL has been a challenge for many application developers since PL/SQL was first written. One of the challenges has consistently been how to effectively write SQL that calls schema-level stored functions and procedures and ensure that, overall, the code performs well and is maintainable. As far as name resolution goes, a PL/SQL function declared within a SQL query has precedence over schema-level stored functions and procedures. The following query demonstrates how you can declare a function within the WITH clause of an SQL query:

```
ashton%ORA12CR1> WITH
  2              FUNCTION get_prod_name (sku VARCHAR2) RETURN VARCHAR2 IS
  3                 start  BINARY_INTEGER;
  4                 length BINARY_INTEGER;
  5              BEGIN
  6                 start  := INSTR(sku, ‘***.’);
  7                 length := INSTR(SUBSTR(sku, start + 4), ‘.’) – 1;
  8                 RETURN SUBSTR(sku, start + 4, length);
  9              END;
 10              SELECT get_prod_name(product_sku)
 11                FROM product_catalog;
 12              /
```

This type of query is particularly useful in a read-only database where the values are not likely to change often while the query is running. Keep in mind that if the query in which you specify this clause is not a top-level SELECT statement, but a sub-query, then if the top-level statement is a SELECT statement, it must have either a PL/SQL function or procedure

declared within a WITH clause or it must specify the WITH_PLSQL hint. If the top-level statement is an INSERT, UPDATE, DELETE or MERGE statement, then it must have the WITH_PLSQL hint. This hint is not an optimizer hint. It is used specifically for declaring PL/SQL within SQL.
Temporal Validity is sure to be a key audit feature as it allows you to specify valid time periods or intervals within a table's data. A heap table can become a table that supports temporal validity with the addition of the PERIOD FOR clause, which allows you to specify a valid start and end period for which rows are valid and should, therefore, be visible by an application, for example. Consider the following CREATE TABLE statement for a table named EMPLOYEE_VALID, (a table that is similar to the EMPLOYEE table used in this article's first three queries.

```
ashton%ORA12CR1> create table employee_valid (employee_id   NUMBER,
  2  first_name    VARCHAR2(30),
  3  last_name     VARCHAR2(30),
  4  hire_date     DATE,
  5  departed_date DATE,
  6  salary        NUMBER(9,2),
  7  manager       NUMBER,
  8  department_id NUMBER,
  9  PERIOD FOR emp_valid_time (hire_date, departed_date));

Table created.
```

The EMPLOYEE_VALID table has a valid period of time for which data is now considered when it falls between the time period specified by the emp_valid_time period created with the PERIOD clause of the above CREATE TABLE statement. A subset of the records from this table reveals the following employee start and end periods:

```
ashton%ORA12CR1> select last_name, first_name, hire_date, departed_date
  2                from employee_valid;

LAST_NAME                      FIRST_NAME                     HIRE_DATE DEPARTED_
------------------------------ ------------------------------ --------- ---------
Eckhardt                       Emily                          07-JUL-04 01-JUL-05
Newton                         Frances                        14-SEP-05 07-DEC-06
Newton                         Donald                         24-SEP-06 03-OCT-10

3 rows selected.
```

This table can now be queried using Oracle Flashback Technology to perform AS OF and VERSIONS BETWEEN queries similar to the following:

```
ashton%ORA12CR1> select last_name, first_name, hire_date, departed_date
  2                from employee_valid
  3             AS OF PERIOD FOR emp_valid_time TO_DATE('07-JUL-2004', 'DD-MON-YYYY');

LAST_NAME                      FIRST_NAME                     HIRE_DATE DEPARTED_
------------------------------ ------------------------------ --------- ---------
Eckhardt                       Emily                          07-JUL-04 01-JUL-05

1 row selected.

ashton%ORA12CR1> select last_name, first_name, hire_date, departed_date
  2                from employee_valid
  3            VERSIONS PERIOD FOR emp_valid_time BETWEEN
  4            TO_DATE('15-SEP-2005', 'DD-MON-YYYY') AND
  5            TO_DATE('15-JAN-2006', 'DD-MON-YYYY');
```

```
LAST_NAME                      FIRST_NAME                     HIRE_DATE DEPARTED_
------------------------------ ------------------------------ --------- ---------
Newton                         Frances                        14-SEP-05 07-DEC-06

1 row selected.

ashton%ORA12CR1> select last_name, first_name, hire_date, departed_date
  2                from employee_valid
  3            AS OF PERIOD FOR emp_valid_time TO_DATE ('01-OCT-2006', 'DD-MON-YYYY');

LAST_NAME                      FIRST_NAME                     HIRE_DATE DEPARTED_
------------------------------ ------------------------------ --------- ---------
Newton                         Frances                        14-SEP-05 07-DEC-06
Newton                         Donald                         24-SEP-06 03-OCT-10

2 rows selected.
```

Summary

So, in summary, each of these three new 12c SQL features has their place in terms of providing a simpler way to code an often asked-for type of query. The new row limiting clause greatly simplifies the syntax required for creating, for example, a ranked Top-N query. You can now declare and use a PL/SQL function or procedure within a SQL query which cuts down on necessary namespace resolution. And, last but not least, you can give your table data temporal validity and be sure that certain table rows are only visible when they are valid (and not visible when they are not).

About the Author

Melanie Caffrey is a senior development manager for Oracle Corporation and she is the editor for the technical journal you happen to be reading at the moment. Additionally, she is co-author of several technical publications including Expert PL/SQL Practices for Oracle Developers and DBAs and Expert Oracle Practices: Oracle Database Administration from the Oak Table (Apress), and the SQL 101 series of articles for Oracle Magazine.

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