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Oracle Database 11g vs. IBM DB2 UDB V9.7 Manageability Overview

Executive Summary

The Oracle Database has long been known as the industry leader in the RDBMS space. Many successful businesses today use the Oracle Database to power their mission critical applications. As budget conscious businesses became gradually more wary of high management costs for their IT solutions, Oracle was one of the first database providers that recognized its importance and began focusing on ways to lower system administration costs by making the database increasingly self-managing. Starting with the revolutionary Oracle Database 10g and continuing the effort in 11g, Oracle delivered the industry's first truly self-managing database designed to self-monitor, diagnose and heal itself. Despite all the hype created by IBM about the simplified management breakthroughs of DB2 version 9.7, Oracle Database 11g remains the undisputed leader in manageability. Much of IBM's autonomic computing theory remains as concepts and research projects. The features they have introduced in DB2 V9.7 are lightweight versions of those already available with earlier releases of Oracle Database. DB2 still lacks essential self-tuning capabilities and is more expensive to own even with its highly advertised lower licensing costs.

While IBM is aggressively marketing the manageability of the latest release of DB2, version 9.7, a closer look its manageability enhancements reveals a different story. The features just now being introduced in DB2 have been around in Oracle for the past few releases, and are just a subset of a wide range of database self-management capabilities that Oracle customers have already become accustomed to. With all the claims made by IBM about "simplified management" and "self-healing" capabilities, DB2 has failed to deliver anything significant in V9.7 to ease the administrative burden of DB2 DBAs. The incremental manageability improvements in DB2 V9.7 do very little to narrow the gap Oracle still enjoys on ease of use.

This paper provides an overview of the significant areas in database manageability and highlights key manageability differentiators between the Oracle Database 11g and DB2 version 9.7.

Introduction

As IT vendors deliver increasingly sophisticated solutions to meet the high demands of grid computing, the task of systems management has never been more complex. Hiring highly skilled administrative staff to manage such complicated environments is an expensive proposition. This, coupled with frequent shortage of experienced administrative personnel, often results in spiraling management costs.

In order to meet these challenges, Oracle has made the manageability of its products one of its primary goals. Oracle Database 11g automates a number of key administrative tasks, reduces the complexity of administration and provides self-tuning capabilities that deliver optimal performance out-of-the box.

With respect to IBM, they have recognized the importance of manageability as well. With the enhancements in DB2 version 9.7, IBM tried to narrow the wide manageability gap the Oracle Database 11g had gained. However, many of the new 9.7 features represent minor steps towards capabilities that Oracles has had for a while and that have been widely adopted by Oracle customers.

Key Areas and Differentiators

Automatic Maintenance Tasks

Many DBA surveys have revealed over the years that administrators spend a lot of time on repetitious activities, mundane tasks that are critical and mandatory to run a business. These "Maintenance Tasks" are typically associated with activities that need to be performed periodically, that are time consuming and may require a lot of resources. These activities are perfect candidates for automation that translates into DBA timesavings and lower operational costs.

IBM's DB2 Automatic Maintenance concept is very similar to the Oracle Database 11g Scheduler Windows that are part of the Automatic Maintenance Tasks Infrastructure. This functionality, available now with both Oracle and DB2, allows administrators to run maintenance tasks, such as backups, space reorganization, etc., during a predefined window, typically during non-peak hours. DB2 allows you to run only a predefined set of tasks automatically, 4 of them to be exact:

- Gather optimizer statistics to update the system catalog with information on the data in tables and indexes
- Creates statistics profiles for optimal statistics collection based on query feedback and tables analysis
- Perform backups of the data in the database
- Reorganize fragmented tables

These activities can be performed during an administrator-defined maintenance window, offline or online, depending on the task. However, none of these tasks are enabled out-of-the-box with DB2.

Oracle Database 11g provides a built-in infrastructure for defining maintenance activities. It uses the rich scheduling functionality introduced with the Oracle Database 11g Scheduler to run such tasks. By default, the maintenance window starts at 10 PM every night and lasts till 6 AM next morning and throughout the weekend. All attributes of the "Maintenance Window" are customizable, including start/end time, frequency, days of the week, etc., allowing it to adapt to specific scheduling needs. Unlike DB2, the tasks of automated optimizer statistics collections, Automatic-SQL Tuning, and re-organizing fragmented tables are set out-of-the-box to run periodically in the pre-defined maintenance window with Oracle Database 11g. More so, any other maintenance tasks can be assigned to run in that window. Also note that DB2 does not have anything similar to the Automatic SQL Tuning (described in detail later in this paper) that is available in Oracle Database 11g.

Resource Control

A powerful aspect of running a task in a maintenance window is the ability to control the system resources and limit maintenance tasks use of resources in favor of more business critical activities. Oracle's Maintenance Windows can control these resources using the Resource Manager plans. The Oracle Resource Manager optimizes resource utilization globally using bandwidth quotas and allows maintenance tasks to use available resources without impacting higher priority activities. DB2 leaves the resource control to individual utilities, by running them in throttling mode, if available. DB2 utilities throttling is based on a generic performance metric sensor that causes the utilities to pause and resume, a far less sophisticated technology than the fine-grained resource management, based on CPU %, Degree of Parallelism, Maximum Execution Time, etc., that the Oracle Resource Manager provides.

Space Reorganization

As tables inevitably become fragmented, reorganization tasks are often run to increase object access performance and optimize space utilization. These types of tasks are also ideal candidates for running in a maintenance window. DB2 Reorg task's inability to run in throttled mode, combined with possible impact on other automated tasks scheduled to run (such as unnecessary triggering of backups), force DB2 to run automated reorganizations in an "offline" maintenance window. Online reorganization has been recently introduced by IBM, however the preferred method in DB2 V9.7 is still offline reorganization. During an online table reorganization, the entire table is not reorganized at once. Instead, portions of the table are reorganized sequentially. This creates locking issues and slows the reorganization process dramatically. Therefore, this DB2 operation can properly be performed only in offline mode, with no write access to tables. Oracle, on the other hand, can not only schedule reorganization jobs online and offers flexible control over resources used by the job, but it also provides a richer set of options such as moving tables, changing structures, adding/dropping partitions, etc.

Health Monitoring and Diagnostics

Managing Locking Conflicts

One of the biggest strengths of Oracle from the performance management point of view comes from its fundamental architecture. Oracle implements a unique multi-version read consistency model and ensures that readers and writers never block each other by copying the original data values in database structures called 'undo segments'. This innovative technology allows the Oracle database to service queries without requiring any read locks as well as to wrap around the log files without waiting for transactions to commit. DB2 requires shared locks for readers, therefore any updates to those blocks may be blocked. From the start, Oracle DBAs do not even need to think about some of the most time consuming tasks that their DB2 counterparts have to perform on a daily basis: resolving deadlocks and monitoring uncommitted transactions.

Automatic Workload Repository (AWR)

The Automatic Workload Repository (AWR), introduced in Oracle Database 10g, is a self-managing repository of data that is used internally by Oracle to self-diagnose and tune. AWR provides the Oracle Database 11g an excellent "knowledge-base" of where time is being spent in the database. By analyzing the information stored in AWR, the database can itself identify the need to perform routine maintenance tasks or tune for better performance. Thanks to AWR, the self-management decisions made by Oracle Database 11g are always specific to the environment that the database is operating in. In the absence of such an infrastructure, DB2 needs to rely either on rules of thumb or instantaneous performance metrics, none of which can guarantee the same degree of effectiveness as the historical data stored in AWR.

Active Session History (ASH)

Active Session History (ASH) is another important type of statistical data collected by the Oracle kernel and saved as part of the AWR snapshot. ASH samples the current state of all active sessions, i.e., those sessions that are connected to the database and at that moment are using CPU, or waiting on a non-idle event. Active sessions are sampled every second and stored in a circular buffer in the system global area (SGA). ASH data is also written out to persistent store by the AWR snapshot processing.

The Active Session History allows us to go 'back in time' and perform analysis in great detail and often removes the need to replay the workload to gather additional performance tracing information as part of performance diagnosis. Among other things, the ASH report allows us to diagnose transient performance problems, locking issues, long running transaction issues, expensive SQL statements, top database CPU consumers, generalized performance issues (multi-dimensional aggregation of DB Time for skew analysis).

This kind of analysis is not available to DB2 DBAs. Issues that could have been caught by ASH have the potential of surfacing later in a much more aggravating form and could be the reason behind some serious firefighting efforts.

Automatic Database Diagnostics Monitor (ADDM)

The unique Automatic Database Diagnostics Monitor (ADDM) technology by itself places Oracle far ahead of any competitors, in manageability. ADDM is a self-diagnostic engine built right into the Oracle Database 11g kernel. It enables the Oracle Database 11g to automatically diagnose performance problems, find the root cause and recommend solutions based on self-collected data in AWR. DB2 V9.7 lacks an equivalent self-diagnostic component to assess its own performance. All that DB2 offers for performance monitoring is the Health Monitor, exposed via alerts and reports, which notify the DBA any time a problem symptom is detected. These alerts are accompanied by a recommendation about how to fix a particular problem. However, there is no infrastructure which investigates all those symptoms and identifies the root cause of problem – increasing the TCO associated with the long terms management costs

associated with the information infrastructure since time-consuming manual DBA analysis is required to diagnose performance problems. In the absence of a root cause, DBAs are forced to try a multitude of symptom fixes, none of which can guarantee success. Even if a set of DB2 alerts identified the actual problems, what problem is causing the most impact on the system, how to best address and solve this problem, and its expected performance impact are still unknown. With DB2 the majority of this work has to be done manually by a performance expert.

ADDM can compare problems across different components (e.g. space, memory, application design) and identify which ones are impacting the system the most. As an example, a DB2 health indicator can alert on low memory conditions and recommend increasing the memory. The recommended increase of memory can be performed several times, yet the problem can still persist. This happens because applications commonly can generate SQL statements which cause repeated parsing. So no matter how much the memory increases, the problems will not be resolved unless the application is corrected. ADDM can elegantly detect this situation and recommend actions, such as cursor sharing. DB2 alerts and health indicators, on the other hand, are unable to recognize this common case.

Also, since ADDM findings are stored in the AWR by default, it helps DBAs answer questions about historical performance problem with a few mouse clicks. Detailed comparative analysis is available with AWR Compare Period Report functionality that compares two AWR snapshots side by side.

Alerts

Oracle Database 11g's built-in Server Generated alerts and Enterprise Manager's propagation framework, along with its browser-based interface, provide the foundation to manage systems performance problems and database maintenance tasks. The various self-managing initiatives provided by Oracle Database 11g assist in enabling automation of Oracle systems -- reducing manual intervention, lowering costs and providing better quality of service.

IBM's Health Monitor is somewhat similar to Oracle Database 11g's Server Generated Alerts and the Enterprise Manager alerting framework. But Oracle Database 11g solution remains more powerful and comprehensive. Health monitoring for DB2 happens outside of the database engine by periodically polling for data and comparing values with thresholds. With Oracle Database 11g, health monitoring and alerting is done by the database itself, therefore in a much more efficient manner and only as needed. For example, Oracle performs space health checks incrementally as space is allocated and freed up in the database server. This guarantees immediate availability of space usage information. Computed on-the-fly, if space usage exceeds predefined thresholds, alerts are proactively sent through the appropriate channels.

Monitoring out-of-space situations

Operations such as data loads or batch updates can encounter errors when they run out of space. Sometimes these errors occur just when the operation is about to finish. Oracle's Resumable Space Allocation feature enables the server to handle such errors in a very graceful manner. Whenever an operation encounters an out-of-space situation, it is held in a "suspended" state while the administrator is notified of the problem and given a chance to fix it. The "suspended" operation automatically resumes as soon as the error condition is corrected. In case of a transient problem, such as a query running out of temporary space, no administrator intervention may be required since Oracle will resume the operation automatically as soon as the transient problem disappears. Virtually any kind of operation, be it a PL/SQL or Java stored procedure, a DML or DDL statement or, an export/import or loader session, can run in the "Resumable" mode.

This capability is still unique to Oracle, with no equivalent in DB2. It saves Oracle DBAs enormous time that the DB2 DBAs spend in monitoring and re-executing failed long running operations. With DB2, if an operation runs into an out-of-space situation, the entire operation may have to be repeated after the space issue has been addressed. This not only results time lost, but it can also hamper normal database performance if the out-of-space situation forces the DBA to re-run the batch job during normal workload hours. Oracle's Resumable Space Allocation feature avoids all the pitfalls that a DB2 user would encounter by offering the user a graceful way to address out-of-space situations.

SQL Tuning

Automatic Optimizer Statistics Collection

Timely and accurate statistics collections are critical to performance optimization. For some time, IBM has been promoting their Learning Optimizer (LEO), which made its debut in version 8.2. In version 9.7 automatic statistics collection can occur at statement compilation time using the real-time statistics (RTS) feature or can be collected by the RUNSTATS utility that runs every 2 hours in the background. This obviously results in some overhead (~4%, according to an IBM public presentation) to identify the kind of optimizer statistics needed to gather during the next refresh cycle. Starting with DB2 V9, automatic statistics collection tests whether a UDI ratio (UDI (update delete insert) counter / Table Cardinality) is more than 50% before considering the historical information for any table. RUNSTATS will be triggered within 2 hours after the UDI ratio exceeds this threshold. Even though this is an improvement over version 8.2, UDI counters still need to be maintained by the system. As far as the RTS collection is concerned, IBM highly recommends trying it in a test environment before enabling it in production to ensure that there is no negative performance impact. This might be the case in some online transaction processing (OLTP) scenarios, especially if there is an upper boundary for how long a query can run. New in DB2 version 9.7 is the introduction of statistical cache that makes synchronously collected

statistics available to all queries. Although an optimization, this feature posses additional memory requirements on the catalog cache (where statistical data is stored) that may easily run out of space especially when RTS is enabled.

IBM's automatic statistics collection offers functionality that is already provided by Oracle Database 11g's Automatic Statistics Collection. Oracle's Automatic Optimizer Statistics Collection mechanism uses sophisticated DML monitoring that identifies which objects need statistics refresh by tracking the staleness of the optimizer statistics on each object. In addition, Oracle determines automatically what the most efficient way to collect statistics is, for example what degree of parallelism to use, what the column level sample size should be using adaptive sampling techniques, etc. This innovative solution is completely automated. It takes full advantage of Oracle's default Maintenance Window capabilities and, unlike IBM DB2's RTS functionality, is enabled by default.

Automation of SQL Tuning

SQL tuning is recognized as one of the most challenging database administration tasks, requiring both expertise and time. Determining what indexes to create is very helpful, but the more challenging aspects of SQL tuning is to make sure that SQL statements are optimally structured/designed and that the query optimizer is choosing the best possible execution plan. This is especially true for complex SQL statements. This area is not addressed at all in this latest release of DB2 V9.7.

Oracle Database 11g offers the SQL Tuning Advisor, which can analyze a problematic SQL statement and make specific recommendations to comprehensively tune it on the spot. Users can then implement the recommendation at a click of a button, tuning the statement. Along with the recommendations, the SQL Tuning Advisor also provides the rationale for each recommendation and the actual performance benefit by test-executing the SQL statement with and without the changes.

The core new technology that makes the SQL Tuning Advisor solution possible is the Automatic Tuning Optimizer (ATO). ATO is a significantly enhanced version of Oracle's query optimizer that performs the actual analyses on behalf of the SQL Tuning Advisor. This sophisticated technology is unprecedented. It uses dynamic sampling and partial execution techniques to verify its own estimates of cost, selectivity, and cardinality. It also uses past execution history of the SQL statement to determine optimal settings for the optimizer. The recommendations generated by the ATO include creation of new indexes, updating of optimizer statistics, optimizing of the SQL statement design, and creation of a SQL Profile. A SQL Profile is a database object in Oracle Database 11g that offers a revolutionary way of tuning SQL statements. It collects information on predicate selectivity, data correlations and skews for the specific SQL statement, which is then used by the query optimizer to produce the best possible execution plan. Correctly handling data correlations and skews is one of the hardest problems in SQL optimization and Oracle uses the groundbreaking technology of SQL Profiles to address it.

One of the unique aspects of SQL Profiles is that they enable Oracle to optimize SQL statements without changing the SQL code, thus making them ideal for tuning packaged applications. DB2 has no solution in this arena and, as such, has no way of handling complex SQL tuning problems. DB2 turns the problem over to performance experts relying on their ability to solve this most intractable of SQL tuning problems. Oracle's SQL tuning solution is a radical departure from traditional tuning techniques. It eliminates the need for manual SQL tuning and provides novice databases users the ability to tune their SQL statements like performance experts, at a small fraction of the time and cost of manual tuning.

In Oracle Database 11g, the automation of the SQL tuning process has been taken to an even higher level from the previous release. The SQL Tuning Advisor now runs automatically during the system maintenance window, automatically identifies high-load SQL queries in the system, and generates recommendations on how to tune them. This Automatic SQL Tuning Advisor can also be configured to auto-implement its tuning recommendations (SQL Profiles only), thereby completely automating the tuning process. Other types of recommendations such as to create new indexes or refresh optimizer statistics or to restructure SQL can only be implemented manually.

On the design side of tuning, the DB2 Design Advisor is similar to Oracle Database 11g's Access Advisor in a way that both recommend schema changes (for example, indexes and materialized views) required to optimize database performance. Both advisors are workload driven, and provide benefit-ranked recommendations. However, Oracle's technology relies directly on the Oracle optimizer itself to do the analysis and takes into account a much larger set of options. For example, Oracle's solution recommends other types of indexes (i.e., bitmap, functional) that DB2 does not support. The Oracle SQL Access Advisor is also much more flexible in its filtering and prioritization capabilities when defining the workload, as well as in its recommendations presentation and sorting, contributing to a clearly better all-around tuning solution. There also is well-known issue with the DB2 Design Advisor of the temporary tables cleanup. IBM even recommends creating a separate table space for the simulated catalog table to address the issue. Oracle's SQL Access Advisor not only deals gracefully with incomplete runs it also allows the immediate use of the already completed portion of analysis via its publish points, making it a more robust and flexible solution.

Resource Management

CPU

The ability to easily and accurately perform system and resource management is critical to maintaining application and database performance, scalability and availability. The Oracle Database Resource Manager enables administrators to align the distribution of system resources with enterprise goals by allowing allocation of CPU resources among database users and applications according to business priorities. Its ability to automatically limit the resources

consumed by batch jobs helps in ensuring that such operation do not adversely impact online users in a mixed workload environment. The Database Resource Manager, therefore, makes it extremely easy to deliver predictable service level with minimal human intervention and facilitates almost unlimited system scalability without compromising performance.

DB2 also provides a tool called "Governor" which can be used to monitor and change behavior of applications that run against a database. DB2 Governor, introduced in a an earlier version of DB2, claims to have many of the same capabilities as the Database Resource Manager including enforcement of resource limits, assignment of relative priorities and, application of different behavioral rules (or resource management policies) during different time windows. However, there are some significant fundamental differences in how the two tools work and what they actually do. Unlike the Database Resource Manager, which is completely integrated with the Oracle database kernel, DB2 Governor runs as an external daemon that wakes up periodically and needs to be separately managed, which implies more work for the database administrator. While the Database Resource Manager allows administrators to implement deterministic resource management policies by allocating CPU in terms of percentages or ratios among different applications, DB2 governor can only prioritize processing of one application over another. The resource allocation mechanism provided by the Database Resource Manager, also enhanced in version 11g, is significantly superior to the conventional priority based scheme that DB2 Governor offers. Using percentages or ratios to allocate CPU ensures that all resource consumer groups receive a certain minimum resource and hence cannot be starved by a high demand from other groups. Finally, since the Database Resource Manager runs continuously within the database, it is in a better position to respond to workload fluctuations, while DB2 Governor daemon can only respond when it wakes up. The Governor incurs significant overhead on the system. Thus one of DB2's best practices is to increase the Governor wakeup interval as much as possible to reduce its CPU overload. Overall, Oracle 11g provides a much more comprehensive and effective resource management solution than DB2 V9.7.

Memory Tuning

Memory management is a good candidate for a truly self-managing sub-component of any solid RDBMS technology. The database engine itself should be able to track memory allocations and intelligently monitor the need of various types of memory, depending on the workload. Management of various shared memory heaps can now be automated with DB2 version 9.7, by setting a single memory parameter as the memory target size. It is enabled by default with DB2 V9.7.

.Memory management in Oracle Database is also automated. The equivalent Oracle Shared Global Area (SGA) is self-managing in version 10g and in 11g. Both SGA and Program Global Area (PGA) are managed with only one combined parameter (MEMORY_TARGET). With no manual configuration, the Oracle out-of-the-box server automatically distributes the available memory as needed between the PGA and SGA. At a lower level various SGA pools are also

automatically adjusted, adapting to changing workloads and ensuring maximum performance benefits. Oracle uses a sophisticated internal algorithm to continuously monitor the distribution of memory and changes it periodically as needed, according to the demands of the workload. Also, the Memory Advisor works in conjunction with ADDM to detect any performance bottlenecks due to under-sized configurations and provide guidance on exact memory settings to overcome problems. Thus Oracle 11g's Automatic Memory Management is tightly coupled with the performance monitoring and diagnostics components of the system, which is not the case for DB2.

Schema Objects and Compression

The application lifecycle requires schema objects to be managed from development to test to production. DBAs are often required to move schema objects or make more efficient use of space resources through compression as a part of maintaining the schema. DB2 9.7 introduces several capabilities to simplify management of these schema objects such as online table move, transportable schema, and space saving capabilities such as index and temporary table compression.

Oracle has supported the movement of tables across tablespaces as well as transportable tablespaces for many releases. IBM DB2 is making this available in 9.7 whereas Oracle customers have enjoyed similar capabilities since Release 8i. Oracle Database 11g Release 2 offers the most diverse compression schemes for various types of data, including OLTP and warehouse data, providing all the space-saving benefits of compression with no performance overhead. Oracle also has comprehensive compression support for all storage elements of the Oracle database including,

- Access structures, such as indexes and partitions
- Binary objects maintained in SecureFiles
- Backup data
- Data Pump data
- Network data, used for applying redo logs on a standby database

Automatic Storage

Managing and optimizing storage for databases used to be a major manageability task for database administrators. To ease this burden, IBM DB2 provides DB2 Automatic Storage to manage data files automatically and provides alerts when the drive or the path is about to become full.

Oracle introduced Automatic Storage Management (ASM) in 2003 with Oracle Database Release 10g and has enhanced it further in Oracle Database 11g Release 2. There are some key differences between Oracle's and DB2's storage management capabilities. Oracle's ASM

technology allows DBAs to automatically manage storage for multiple databases in a single ASM instance while DB2 requires automatic storage to be configured for each database individually. ASM automatically distributes database files across all available storage devices thereby preventing a single point of failure from a single storage subsystem without any additional management overhead. Enterprises thus can get the performance benefits of a raw device with the fault tolerance of intelligent disk mirroring. The ASM cluster file system, introduced in Oracle Database 11g Release 2, is a general purpose scalable storage management technology that can now support any general purpose file, including non-Oracle database files, for the Linux and Windows platforms. Examples of these files include Oracle binary, application executables, trace files, alert logs, BFILEs or audio-video files.

Change Assurance

IT managers face change every day coming from different directions. Corporate compliance teams require that the IT infrastructure, such as databases and operating systems, need to be kept up-to-date with the latest patch levels. Applications need to be upgraded through patches or major upgrades. These may be in response to business process changes or application bugs. Whether the enterprise is making infrastructure improvements or implementing database changes for compliance or business process reasons, Oracle Database provides a comprehensive framework for managing change in the form of its Real Application Testing solution.

Database Load Testing

Database Replay, one component of the Real Application Testing solution, enables realistic testing of system changes by essentially recreating production load environment on a test system. It does this by capturing a workload on the production system with negligible performance overhead and replaying it on a test system with the exact timing, concurrency, and transaction characteristics of the original workload. This allows complete assessment of the impact of the change including undesired results, new contention points or performance regressions. Extensive analysis and reporting is provided to help identify any potential problems, such as new system errors or performance degradations. The ability to accurately capture the production workload results in significant cost and timesaving since it completely eliminates the need to develop simulation workloads or scripts. As a result, realistic testing of even complex applications using load simulation tools/scripts that previously took several months now can be accomplished in a few days with minimal effort with the help of Database Replay. Thus using Database Replay, businesses can lower their testing costs and still have a high degree of confidence in the overall success of the system change.

SQL Unit Testing

SQL Performance Analyzer (SPA), the second component of Oracle Real Application Testing, provides functionality similar to Database Replay, but is focused on predicting problems resulting

from any change that affects the SQL execution performance. SPA provides fine-grained assessment of a change on SQL execution plan and statistics by executing the SQL statements serially before and after a change and then automatically comparing their performance to determine performance changes.

This enables users to assess the overall effect of change and makes it possible to remediate any negative outcome before end-users can be impacted. Being able to accurately forecast the potential impact of system changes on SQL performance enables you to tune the system beforehand in cases where some SQL statements regress, or to validate and measure the performance gain in cases where the performance of the SQL statements improves.

DB2 version 9.7 does not have a competitive offering to Oracle's Real Application Testing Option. Thus the task of validating changes before introducing them into production is left to the DB2 DBA. The DBA has to either rely on 3rd party tools, such as Quest's Benchmark Factory, engineer some manual custom testing procedures or blindly implement changes in production and hope for the best, which, for obvious reasons, will most likely result in system outages and severe loss of service.

Backup and Recovery

While the basic IBM DB2 V9.7 backup capabilities are essentially the same as the backup capabilities provided by Oracle 11g, a few significant differences still exist. Here are the important ones:

- Oracle Database 11g enables users to offload all backup activities from the primary database to a physical standby database. Since DB2 users cannot access the standby database for backup they are unable to extract value out of their investment -- wasting money on system resources that are essentially sitting idle.
- DB2 users cannot check their backup to look for physical corruption of backups and to ensure recoverability. Oracle's RMAN checks data files for physical and logical corruption and to confirm that all database files exist and are in the correct locations.
- The Oracle RESTORE command supports a PREVIEW option, which identifies the backups required to carry out a given restore operation based on the information in the RMAN repository. Using RESTORE PREVIEW ensures that all required backups are available – DB2 has no similar restore preview.
- Unique to Oracle Database 11g is the concept of a central location for all recovery files, called the Flashback Recovery Area. With this location defined, Oracle automatically writes and maintains all files needed for recovery, such as Oracle backup files, archive logs, etc. Oracle also automatically monitors the space usage within this defined area, proactively issuing alerts if the pre-defined thresholds are exceeded. IBM's DB2 V9.7

has no concept of a unified on-disk location for all recovery files and so it cannot automatically manage the space used by archive logs as well as on-disk backups, etc.

Database Cloning

Creating a standard definition for enterprise wide databases is a fairly common practice. Having all databases conform to a standard greatly simplifies their management by allowing the use of uniform administrative and monitoring procedures. DBAs also often want to duplicate databases for the purpose of setting up development and test environments. Oracle database templates available using the Database Configuration Assistant (DBCA) allow for storing database definition in XML format and make these tasks extremely simple. The template definition includes all characteristics of the database, such as initialization parameters, redo log settings, etc., and can be used to create identical databases on local or remote machines. The two kinds of templates, those that contain only the structure of a database, and those that contain both the structure and the data, allow administrators to either create a new structurally identical database or clone a database along with its data. A template can be created by reverse engineering an existing database. This ability is extremely useful since it saves administrators a significant amount of time and effort in creating and testing scripts for duplicating a database.

DB2 has no comparable functionality. The only way to create a new DB2 database that is identical to an existing one is restore a backup of the source database to the new location. The obvious drawback of this method is that the database structure alone cannot be duplicated; instead, both the data and the database have to be copied. The second drawback is that it requires direct DBA input and hence cannot be done unsupervised, in "silent mode", a method Oracle supports. With DB2, to duplicate just the structure of the database, which is the more common case, the database and all its objects have to be re-created manually using scripts or the GUI tool. This is a particularly cumbersome and error-prone method and, it is certainly not as easy as the functionality provided by Oracle.

Management Tools

Graphic management tools are a standard part of any enterprise software today. In the new version, IBM has introduced the Information Management Console, web based operational console model for remote system management. However, they have yet to reach the richness of the Oracle management framework, including all the management functions built right into the database and their seamless integration into Enterprise Manager (EM). This applies especially to remote management where Oracle's default management graphical interface does not require any client side installations, only a browser. Even though some form of web administration has been introduced, DB2 still mainly relies on a set of client-server graphical administrative and monitoring tools such as the "Control Center" or the "Health Center" to manage a single or small number of databases. Oracle Enterprise Manager on the other hand, is Oracle's integrated solution for administering anywhere from single databases to monitoring global e-Business

enterprises. Oracle Enterprise Manager Database Control comes pre-configured out-of-the-box to monitor a single database. As your enterprise grows, Oracle offers the option to migrate to Oracle Enterprise Manager Grid Control and take full advantage of capabilities to manage multiple databases, including various older versions, as well as other non-database targets (including DB2). Oracle Enterprise Manager Grid Control is much more than just another GUI database administrative tool. It is a complete enterprise IT infrastructure management framework. Unlike DB2's Information Management Console or even its Control Center, the EM product suite enables the centralized management of all components of an e-Business infrastructure, from application through the middle-tier and database, down to the operating system and network layers. Enterprise Manager Grid Control simply allows administrators manage the end-user experience, not just the individual system components.

This is a significant differentiator for Oracle, since DB2 customers have the option to either adopt at additional cost IBMs enterprise management solution, or, alternatively purchase different third party tools and integrate them in-house to create a complete solution. Oracle Enterprise Manager significantly improves the day-to-day database administration experience by combining simplicity in use with a rich feature set, to offer a complete solution for managing the complete Oracle platform. Oracle's Enterprise Manager Grid Control is a unifying solution for enterprise management of multiple, various platform and versions databases as well as other non-database components. Best of all, Grid Control supports management of non-Oracle targets through the extensibility framework – a feature unique to Oracle.

Conclusion: Oracle Database 11g Easier to Manage than DB2 V9.7

The Automatic Database Diagnostic Monitor (ADDM), SQL Advisors and Real Application Testing are just some of the unique Oracle Database 11g features that are yet unmatched by DB2 version 9.7. Oracle Database 11g is the only database product available today that automatically collects and manages historical performance data for self-management purposes, periodically and automatically analyses this data and makes tuning recommendations. Oracle Database 11g is also the only RDBMS with rich software quality management features for real workload testing. These distinct technologies are at the core of the next generation of Oracle databases that represent simplicity, ease of management and software quality management while still providing the most robust, reliable and secure of relational databases.

It will take DB2 at least several more releases before it can approach the current self-management capabilities of Oracle Database 11g. With its self-managing capabilities, Oracle Database 11g eliminates time-consuming, error-prone administrative tasks, so database administrators can focus on strategic business objectives instead of performance and availability fire drills. Oracle continues to improve its self-management capabilities, which contribute to

lowering Oracle's TCO, while IBM struggles to close the functionality gap that exists between the two products.

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