QUEST SOFTWARE
Smart Systems Management

Achieving High Oracle Performance with Advanced Performance Management

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WHITE PAPER

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Overview

DBAs today need better tools than ever, because they are being asked to manage increasingly complex systems that are ever more critical to the organization. As those complex systems change—whether because of platform or application upgrades, changes in user workload or other factors—performance can suffer. Users, however, demand high performance around the clock. Therefore, DBAs cannot afford to be constantly in response mode, struggling with basic tools to diagnose complex database performance issues. Instead, they need advanced performance management tools that will enable them to catch emerging issues before they can affect end users—and the organization's bottom line.

This white paper explores how advanced database management can help DBAs not only respond to database performance problems more effectively, but also protect the system by preventing problems from developing at all, ensuring high service levels.

Introduction: Complex, Critical Systems Require Advanced Performance Management

Today's Database Systems: Complex and Critical

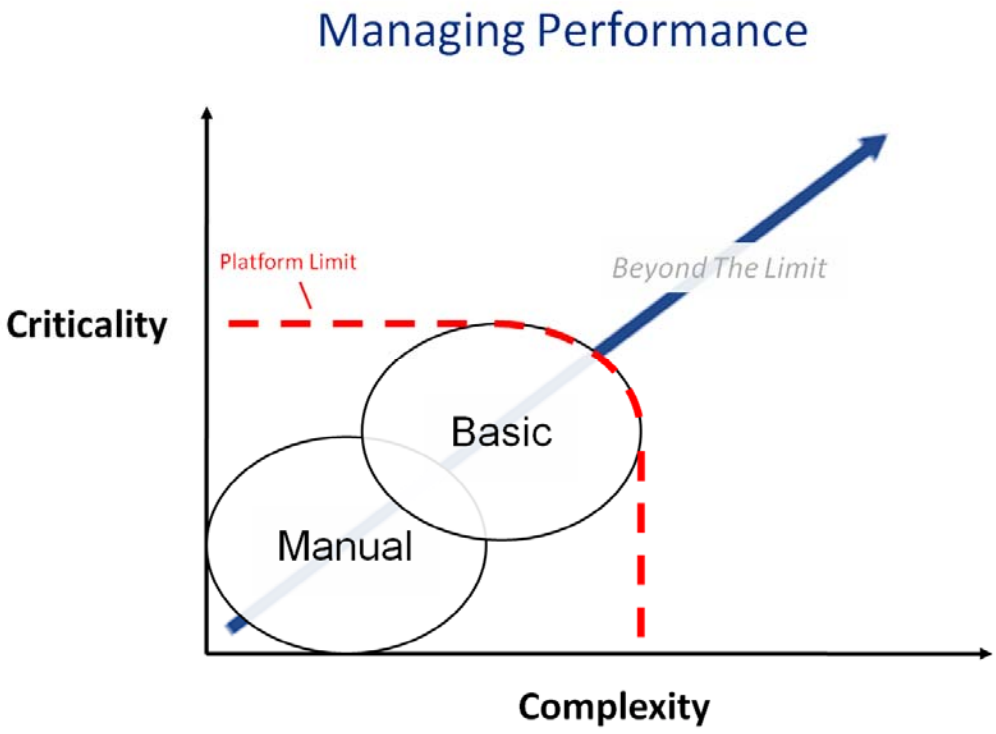
Database complexity is constantly growing in a variety of ways:

- The complexity of Oracle itself increases with each new version (and adding in new things like RAC, ASM and Dataguard make the system a whole lot more complex)
- Growing number of databases to manage
- Rapidly increasing size of storage needs
- Increasing transaction volume as organizations depend more on systems for critical applications

At the same time, the organization's databases are increasingly critical for the business, and users demand high service levels, all the time.

Advanced Performance Management

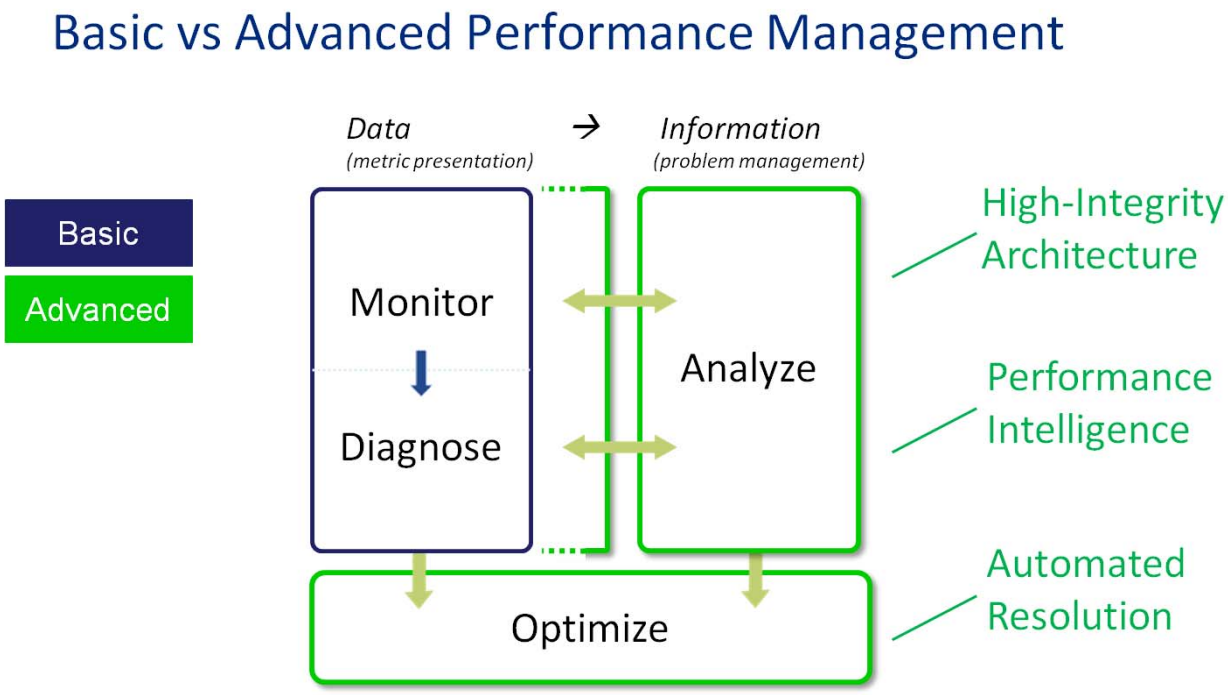
As your database systems grow in complexity and criticality, you need better tools, automation and analysis to help manage performance: manual processes and even the basic tools provided by Oracle no longer suffice. You need advanced performance management.



What is Advanced Performance Management?

Consider the basic tools provided with Oracle in Oracle Enterprise Manager's management packs. Those tools monitor the system, and when a problem arises, the DBA can drill down to access more detailed data for troubleshooting. But alerts are based on simple thresholds, so many problems never generate alerts, and by the time users complain, the problem may be difficult to diagnose and resolve. Moreover, DBAs cannot easily understand how the system is changing over time, and therefore cannot plan ahead and address emerging problems before they have a chance to affect end users.

Advanced performance management, of course, also provides system monitoring and helps the DBA diagnose and resolve issues that arise. But it does both in better ways, and provides important additional capabilities. Specifically, advanced performance management provides analysis that transforms data into information. Advanced tools collect a rich stream of high-quality data—data that can be kept for years, and mined to extract valuable trending information that can be used to create intelligent alerts. DBAs therefore see emerging problems early, and have the tools and information they need to resolve them not only faster, but with greater accuracy. Moreover, they can manage the database proactively, optimizing performance and even automating problem resolution.



Benefits of Advanced Performance Management

Investing in advanced performance management offers a wealth of benefits, including the following:

- Save money – Advanced performance management enables organizations to squeeze more performance out of their existing servers without buying new hardware (every month that you defer hardware purchases not only saves you money, but enables you to get more for each dollar when you do finally make a purchase because IT technology advances quickly)
- Save time – With advanced tools, DBAs can resolve performance problems quickly and get back to work on improving your systems
- Increase productivity – Having tools that present information clearly and concisely enables DBAs to manage thousands of databases more effectively than ever
- Improve service levels – When problems are resolved faster, or prevented from occurring in the first place, users enjoy better performance more of the time (by proactively tuning your systems, you can even surprise users by making their systems run faster—for a change)
- Reduce risk – Advanced performance management tools help DBAs understand where the real problems are and fix them with greater accuracy, so the organization can consistently meet its service level agreements

Understanding the Factors that Affect Database Performance

The first step in advanced performance management is to understand the factors that can affect database performance and user service levels. For example, all of the following can have profound effects on database performance:

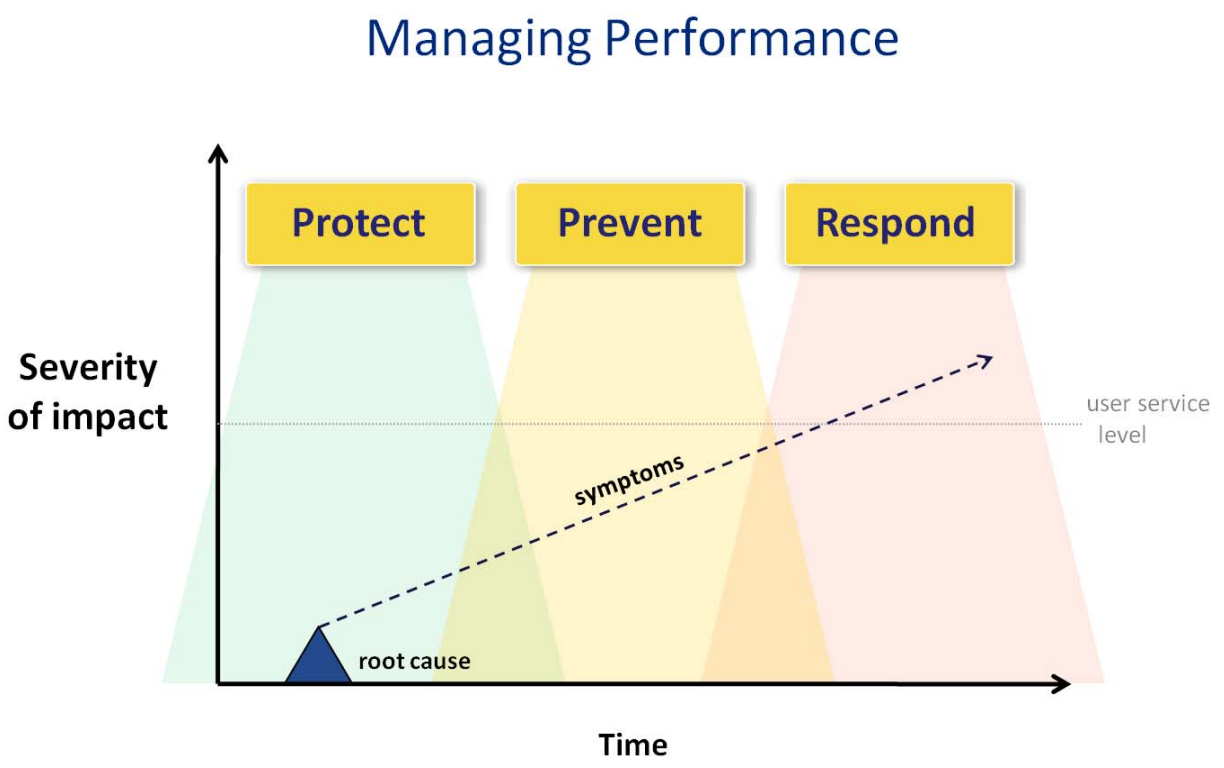
- SQL scripts and code
- Procedures and triggers
- Ad hoc queries and reports
- ETL and BI reports
- New columns and constraints
- Table and index rebuilds
- Optimizer statistics
- Object growth and fragmentation
- Configuration settings
- Upgrades to DBMS and OS
- Server and storage hardware
- Additional users
- Increased transaction volume

These changes can be grouped into four categories:

- **Application changes** – Moving code from development to production always introduces the risk of hurting performance. Even small changes to an application can cause serious performance problems if they are not properly coded and optimized; for example, something as "simple" as a missing index can dramatically affect performance. Therefore, organizations need adequate control over application changes and need to understand the complex interaction between developers and production DBAs.
- **Platform changes** – Planned changes to the database engine, such as an upgrade or patch, in one area of production can cause unplanned change and performance degradation in another area. To reduce risk, organizations need to test new configurations with a true production load.
- **Workload changes** – Unlike application and platform changes, workload changes are often unplanned. While retailers like Amazon.com certainly expect increased system activity during the holiday shopping season, and many businesses expect increased internal billing and reporting activity at month-end and quarter-end, user interaction with database systems can be very volatile, and unexpected increases in end-user activity can cause performance degradation. Therefore, organizations need to understand all they can about how users interact with their systems and how much workload can be sustained.
- **Storage changes** – Constant growth within heavily-accessed objects can degrade I/O performance by making storage access increasingly inefficient. However, since storage changes are managed internally by the Oracle system, those changes are beyond the scope of this paper.

Understanding Database Management Modes

As the database system changes, performance problems can arise. A DBA's actions look very different depending on how early a problem is detected and therefore how serious the impact to end users has become, as shown below:



The longer it takes for the DBA to become aware of a problem, the more severe its impact becomes, and the DBA's choice of action becomes more limited:

- **Respond** – When a problem has gone on long enough to affect end users, the DBA must respond, working to fix the immediate problem. The goal of a DBA in response mode is to diagnose and resolve problems as quickly as possible and restore performance levels.
- **Prevent** – With the right tools, DBAs can identify issues earlier, before they have had a chance to cause significant performance problems for end users. That is, DBAs can anticipate problems and prevent them from affecting performance. They can minimize the impact of degrading conditions and recurring problems through proactive maintenance and best practice health checks.
- **Protect** – The DBA's ultimate goal is to protect the system—to manage and control planned changes, and to minimize unplanned changes, to eliminate the conditions that create problems in the first place.

The goal of advanced performance management, then, is to enable the DBA in respond mode to resolve problems faster—and to decrease the need to be in respond mode. That is, advanced performance management enables DBAs to prevent problems and protect the system, so that fewer problems ever affect end users. The next sections explore how advanced performance management makes the DBA more effective in each of the three modes.

Improving Response Management

An advanced performance management solution helps the DBA who is in respond mode by providing the following key capabilities:

- Intelligent alerting
- Problem-centric workflow
- Common problem recognition
- Automated tuning and optimization

Intelligent Alerting

Basic management tools use simple thresholds or rules to alert the DBA to performance problems. However, this approach leads to many missed alerts and many false alerts. One reason is that each threshold is built for a specific processing window, and is useless outside that. For instance, what constitutes “high” CPU depends a lot on the time of day, the time of the week and the time of the year. And within the window, there may be “normal” spikes, such as when everyone gets to work and logs on.

Advanced management, on the other hand, continuously learns and profiles the behavior for each metric individually, and builds an adaptive baseline representing “normal” performance based on weeks or months of data. Therefore, you can be alerted to “unusual” behavior—even when the activity does not exceed the set threshold. For example, your CPU threshold might be 80 percent, but if nights are normally quiet and at 4 a.m. one day, CPU spikes to 40 percent, an alert will be issued.

Problem-centric Workflow

Basic performance management is data-centric: it provides the raw data, and DBAs need to make sense of it themselves, navigating through all the data to isolate the issues and inferring the cause from the symptoms. This is time-consuming, but more importantly, it leaves room for inaccurate interpretation and missing the real problem.

Advanced management, however, provides meaningful, problem-centric information. Issues are prioritized by the severity of their impact on DBA productivity during problem periods, and the DBA’s attention is directed to the core issues. Good advanced management tools will even provide actionable next steps in a workflow so users can solve the problem faster.

Common Problem Recognition

Basic performance management tools have limited historical data, so there is little opportunity to learn from past experience. Advanced performance management tools, though, leverage historical data by building a library of frequently occurring problems. When a problem occurs again, the tool can provide real-time advice based on previous experience to help the DBA resolve the issue more quickly.

Automated Tuning and Optimization

Basic performance management tools are manual and time-consuming to use. Advanced performance management solutions leverage automation to simplify complex tasks and reduce the time to optimal resolution.

Enabling Problem Prevention

Advanced performance management goes beyond helping DBAs respond more quickly and effectively to problems affecting end users. It enables DBAs to prevent problems from affecting end users by providing capabilities such as:

- Degrading workload analysis
- SQL performance auditing
- Fragmentation assessment
- Configuration validation
- Vulnerability assessment

Degrading Workload Analysis

Advanced performance management provides workload analysis, so you can understand how users interact with your systems, including long-cycle trends. Historical workload analysis enables the DBA to identify deviations of true significance, so you are alerted to important changes in user workload (e.g. significant contributors to workload performance) and can easily identify their root cause. Another example would be the ability to compare the workloads from different time periods such that you can see recent workload activity and past historical performance. This can identify highs and lows to normal baseline trends so you know from who and where the performance pressure occurred.

SQL Code Performance Auditing

Advanced performance management tools proactively scan SQL from the source code on file from a code library or within the database to identify and classify problematic application SQL, enabling you to find faster alternatives or rectify coding issues before they affect end users.

Fragmentation Assessment and Reporting

A frequently occurring problem is I/O performance degradation, which is an unavoidable symptom of database growth. This growth of data then requires archiving of the information, which consequently affects storage efficiency and I/O efficiency. This can appear in the form of object fragmentation and/or inaccurate object statistics, which reduce the ability to make accurate decisions. In addition, hot spots from applications concentrate pressure on specific database resources.

However, advanced performance management provides the ability to run reports to identify where database fragmentations exist (e.g. chained rows and index tables) so DBAs can avoid or address potential storage issues and I/O performance degradations.

Configuration Validation

Advanced performance management tools proactively assess your configuration settings (e.g. memory size) and overall database health. The tool then displays potential issues that impact the database due to configuration changes (e.g. datatypes and configuration settings) so you can address them quickly.

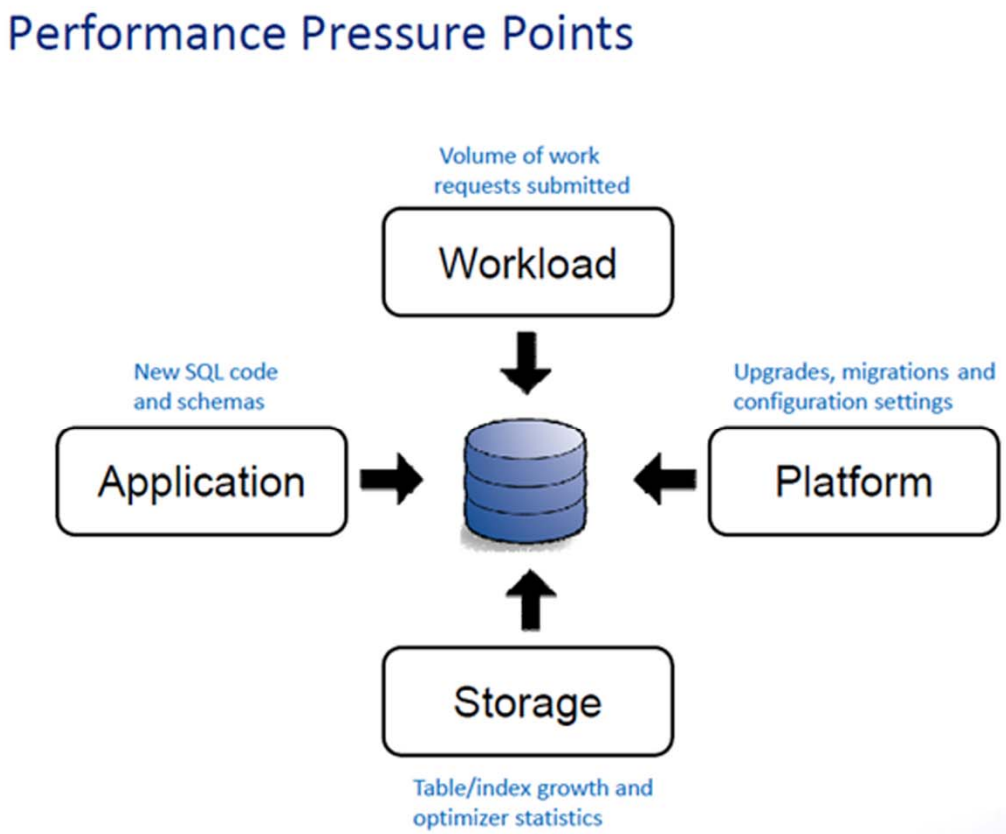
Vulnerability Assessment

Advanced performance management tools also proactively assess overall database security vulnerability so you can prevent security weaknesses from leading to security breaches. For example, security vulnerabilities are often due to inappropriate account rights, whereby a new user is set up and given access to the system. There is a risk of human error during this process. An advanced management tool automates this task to safeguard against such potential problems.

Enabling Performance Protection

In addition to improving the DBA's ability to respond to and prevent problems, advanced performance management also enables performance protection. As we saw earlier, four distinct types of changes can affect database performance:

- Application changes
- Platform changes
- Workload changes
- Storage changes



Performance protection involves managing the first three of these types of changes. (Because storage changes are handled by the Oracle system itself, they are not relevant here.) In particular, the goals of performance protection are to:

- Identify high-risk change activity
- Control planned change processes
- Eliminate the potential impact of unplanned changes

Let's see how these goals can be achieved for each type of change.

Protecting Against Application Changes

Often database performance issues are SQL related. Therefore, organizations must protect against application changes that can affect performance and service levels by carefully controlling the release of new application code into production.

An advanced performance management solution can help protect against application changes affecting performance by:

- Detecting inefficient SQL during code development
- Optimizing SQL for performance using an automated process. This process involves:
    a. Automatically identifying tuning candidates—the SQL statements that are most likely to benefit from tuning. Direct IDE integration, as offered by Toad, makes identifying tuning candidates easy and convenient, so developers are more likely to tune their code consistently.
    b. Automatically re-writing single or multiple SQL statements—having a tool that can offer alternative SQL saves developers time and helps ensure the integrity of the overall code base.
- Validating SQL and PL/SQL performance prior to deployment. The DBA is responsible for ensuring that code performs correctly before it is released into production, and automated performance auditing makes this job easier. Automated scalability testing ensures that code will meet performance SLAs.

Protecting Against Platform Changes

Different types of platform changes pose different challenges. DBAs need to determine whether an upgrade to the database, operating system or hardware will actually make their particular system faster for their production users. For example, the underlying optimizer changed from Oracle 8i to 9i, so some queries will actually run slower after upgrade because they are compiled in a different way.

DBAs also need to understand the advantages and limitations of the upgrade to new technology, such as RAC. How much faster is the new platform? How many nodes are optimal for your particular application? And finally, DBAs also need to understand the scalability limits of their production infrastructure, so they can plan properly. Advanced performance management can help with all of these challenges.

Eliminating Deployment Risk

To reduce deployment risk, you need to stress test new configurations with a true production workload in your test environment. Advanced performance management tools can help you capture and replay that workload, so you can be confident when you deploy a new platform.

Platform Pre-deployment Checklist

Specifically, as you create your test environment and test workload, it's a good rule of thumb to have the following:

- Hardware systems that reflect the new production (post-deployment) environment
- OS and database kernels installed with the target version
- Trace files from the production database (you need to identify a reliable source of production transactions to get a real production workload; a simulated load simply isn't as good)
- A mechanism to replay collected transactions

- The ability to measure the workload and optimize the target environment (for example, by using a bigger sort area size)
- A “what-if” capability to increase the replayed workload and test for new limits, such as by doubling or tripling the workload (this is sometimes called breaking point analysis, and it is especially important for public systems that have higher workload volatility)

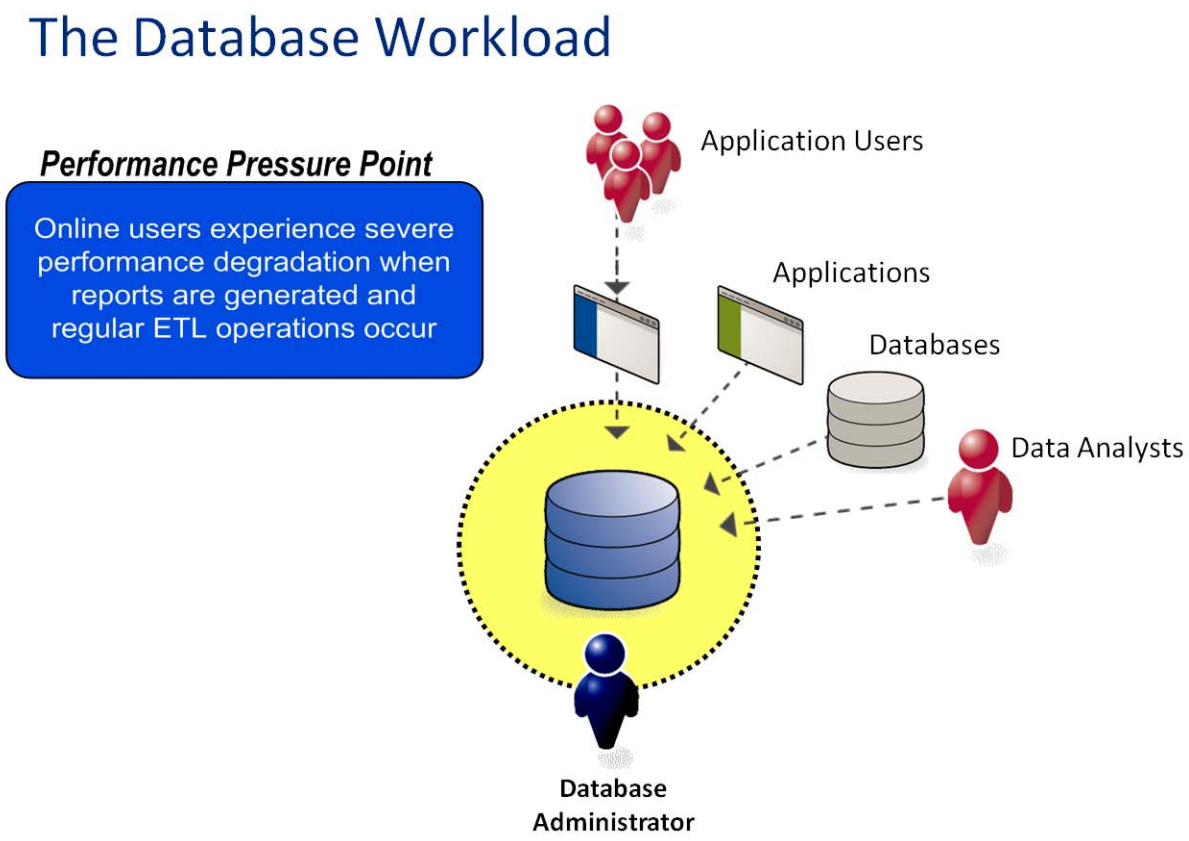
Protecting Against User Workload Volatility

Application changes and platform changes are planned changes. Workload changes, on the other hand, are often unexpected. To protect against user workload volatility, you need to:

- Identify and quantify each distinct source of database workload, since problems are usually caused by people you’re not aware of who are accessing the database
- Offload non-primary, read-only workload (generally 70 to 80 percent of workload) to secondary systems

Understanding Your Workload

The first step to understanding your workload is to understand the different types of database users.



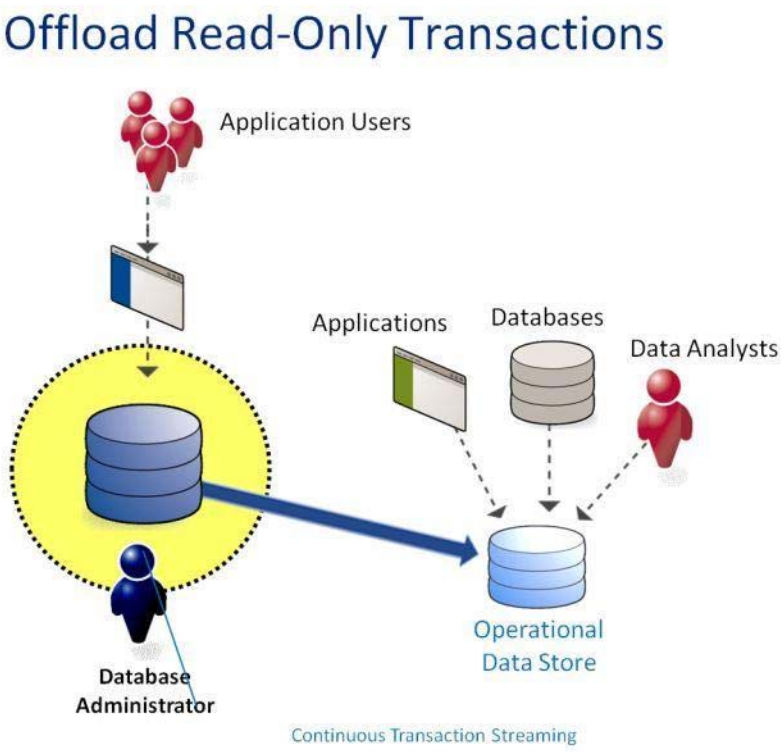
Applications and application users, especially ETL, usually account for a signification portion of the workload. However, it is important to also consider the load caused by cross-database lookups (such as a billing system that has to get customer information), but this activity can be hard to identify. Data analysts can also have a big impact by hitting the database directly to generate operational reports.

To understand your particular workload, it's best to capture and analyze it to see what types of users are generating the most load, and to find unusual or unknown users, such as remote users. Quest Software's Foglight Performance Analysis, for example, enables you to capture and analyze workload very effectively.

Offloading Read-only Transactions to an ODS

Once you understand your workload, you can offload read-only transactions to an operational data store (ODS), using a tool like Quest SharePlex for Oracle. This architecture offers significant benefits:

- Offloading ad hoc reporting and ETL makes your primary database less volatile: response time on the production system will be not only better, but more consistent
- You can horizontally scale performance using a number of smaller, less expensive servers that are easy to deploy, such as Oracle Standard Edition on Linux, and thereby accommodate large numbers of requests
- You can optimize the systems separately, such as optimizing the ODS for reporting and the production system for OLTP



Quest Tools

Quest's development and administration tools are designed to improve DBA and developer productivity, as well as boost database performance. We offer database management products for Oracle, SQL Server, DB2, MySQL and Sybase. With our database management products, you can:

- Plan, develop and validate database code to assure optimal performance
- Detect, diagnose and resolve performance issues
- Ensure high availability and secure back-up processes
- Access and understand data from any source with one tool

Conclusion

DBAs today need better, more advanced solutions to manage increasingly complex systems that are ever more critical to the organization. Advanced performance management tools can help DBAs not only respond to database performance problems more effectively, but also prevent problems from degrading service levels and protect the system by stopping issues from developing at all.

About the Author

Dave Pearson is a senior product manager at Quest Software, where he focuses on Oracle performance management products. He has been with Quest since 1999, and has 20 years of experience working with relational database systems and the applications that use them.

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