Improve SQL Performance with BMC Software
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INTRODUCTION
Poorly performing applications degrade end-user response times and typically consume more computer resources than required, which could accelerate the need to acquire expensive hardware and software upgrades. The primary cause of inadequate DB2® application performance is poorly written SQL statements. It can be difficult to find which SQL statements are causing the problems, particularly when dynamic SQL and SQL provided by ERP applications are involved. DB2 application performance problems require expert knowledge, costly diagnosis processes, and a substantial investment of time to identify and properly resolve the performance problem.

As the business demands higher availability from mainframe DB2 applications (for example, for web front-ends to legacy DB2 databases), optimal performance is required. Because more DB2 data is being processed, there is more performance data to manage. As such, it is increasingly difficult to identify and isolate a performance problem.

A performance problem can be caused by an SQL statement that uses an inefficient access path and runs thousands of times a day, or it can be caused by an SQL statement that runs once but takes a long time or excessive CPU.

Tuning SQL improves performance and can reduce peak MIPS. A general rule of thumb is that 80 percent of the benefits of tuning efforts can be achieved by analyzing and tuning the SQL statements in an application, but it is not feasible to tune every SQL statement and it can be challenging to find which statements are causing problems.

DB2 experts and CPU resources are scarce. You cannot afford to waste CPU cycles on unnecessary maintenance or on poorly performing SQL. And you cannot afford to have DB2 experts chasing down problems. You need tools that improve performance, reduce costs, and provide a comprehensive picture of performance and availability so that you can meet increasingly aggressive SLAs.
BMC SQL PERFORMANCE FOR DB2

BMC SQL Performance for DB2 enables DBAs, application developers, and system programmers to identify and correct performance problems. It provides a unique set of tools that allow you to fine-tune applications from conception, through growth, to retirement. BMC SQL Performance for DB2 reduces the MIPS required for DB2 application programs in production.

BMC SQL Performance for DB2:

» Solves application performance problems by quickly identifying the most expensive SQL statements and making tuning recommendations.
» Avoids application performance problems by proactively correcting problems before an application reaches production.
» Increases programmer productivity and efficiency by providing both analysis of access paths and easy-to-use tuning tools.
» Quickly and easily pinpoints resource-consuming SQL statements without executing a DB2 SQL trace.
» Allows developers to compare workload (within the same system or across systems) and identify what impact access path changes will have before the changes are implemented in production.
» Provides in-depth index optimization recommendations, including identification of unused indexes and “What-If Index” analysis across a workload (not just one SQL statement).
» Identifies and recommends actions for exception conditions.

BMC SQL Performance for DB2 is composed of integrated products and exclusive technology components, including:

» BMC APPTUNE for DB2 (also available as a stand-alone product)
» BMC SQL Explorer for DB2 (also available as a stand-alone product)
» Performance Advisor technology (available only as part of BMC SQL Performance for DB2)
  – Performance Advisor Database (PADB)
  – Workload Compare Advisor
  – Index Advisor
  – Reorg Advisor
  – Exception Advisor

BMC APPTUNE FOR DB2

BMC APPTUNE for DB2 is an application performance and resource analysis product that gathers and displays data from a single SQL statement or a set of SQL statements. The gathered data provides valuable information about performance and resource usage of DB2 applications. Unlike other DB2 performance aids that rely on expensive DB2 SQL traces to gather data, BMC APPTUNE for DB2 collects all relevant performance measures in real time for every SQL statement (static or dynamic) executed in one or more DB2 subsystems. It summarizes the collected data and stores it for analysis. This method of collecting data provides detailed information on the performance and resource usage of DB2 applications while avoiding the costly overhead and large volumes of data associated with other DB2 performance aids.

BMC APPTUNE for DB2 combines the analysis of SQL statements with the analysis of the objects that are accessed by the statement. You can identify the most heavily accessed DB2 tables and indexes, and you can analyze table and index GETPAGE activity, buffer pool efficiency, and I/O response time by subsystem, buffer pool, database, and data set (table space and index space).

BMC APPTUNE for DB2 can collect data from all of the DB2 subsystems or data sharing members on each z/OS image across the sysplex. This allows you to analyze collected data by individual DB2 subsystem or member, or to analyze data aggregated from multiple DB2 subsystems, or whole data sharing groups—all from a single TSO session.
BMC APPTUNE for DB2 includes a user interface and analysis capabilities that have been engineered for completeness and ease of use. In most cases, you need only three keystrokes to find the most resource-intensive SQL in your workload, and start to tune that SQL statement. In other words, BMC APPTUNE helps you to find the needle in the haystack.

BMC APPTUNE for DB2 provides a variety of reports that allow you to "zoom" or "expand" to multiple levels of performance data to get the answers you need to solve a performance problem. You can display the reports in a traditional, numeric presentation or an easy-to-understand, graphical presentation. Most reports are available in online and batch formats.

To facilitate the tuning of SQL statements, BMC APPTUNE for DB2 includes an integrated, robust functionality that can explain dynamic or static SQL statements, then interpret and summarize the results in an easy-to-read and understandable format. Expert rules are applied to the result of such an Explain, and you receive suggestions on where to start your tuning activities.

The BMC APPTUNE Data Unload process workload is zIIP eligible. This can reduce the general purpose MIPS required to capture BMC APPTUNE data.

**BMC SQL EXPLORER FOR DB2**

BMC SQL Explorer for DB2 is an SQL plan analysis tool that enables you to solve performance problems resulting from inefficient SQL statements using bad access paths. Application performance and availability can be significantly affected by minor changes in either application or DB2 data structures. DB2 optimizer changes in access path selections can occur because of subtle statistical changes in the catalog statistics or schemas, resulting in degraded application and transaction performance. SQL statements, catalog statistics, and data structure definitions can all have a major impact on throughput and response time. Often, changes in the access path selection are not detected until the application has been moved into production and the application either performs poorly or is unavailable.

**PERFORMANCE ADVISOR TECHNOLOGY**

Because DB2 has many moving parts and can produce a mountain of performance data, it can be challenging to find the data you need. Performance data includes high-level statistics and accounting data that can be captured at a relatively low cost. BMC MainView for DB2 collects and summarizes DB2 accounting and statistics data produced by DB2 traces and stores this data in a set of DB2 tables. BMC APPTUNE for DB2 collector low-level data about SQL statements and object access.

Performance Advisor technology turns data into intelligence, and intelligence into actions. Performance Advisor technology drives down cost of ownership while delivering high performance and availability. Performance Advisor technology adds advisory and analysis features to performance data that has been collected with BMC products to automatically identify and resolve problems. Performance Advisor technology takes this detail data, correlates and consolidates it, and externalizes the data into a Performance Advisor Database (PADB) where it can be analyzed using BMC products or other tools. For example, capturing DB2 access path information at DB2 bind time provides a valuable baseline for later analysis.

While performance data is critical, Performance Advisors provide the intelligence and automation required to identify and resolve performance problems. You can maintain historical data and use it for batch reporting. Automation is a key feature of Performance Advisor technology, with the ability to resolve problems as they are occurring without direct intervention from a person.
PERFORMANCE ADVISOR DATABASE (PADB)
The PADB contains statement and object performance data collected by:

- BMC APPTUNE for DB2
- Errors, exceptions, SQL text, and index usage patterns as seen by BMC APPTUNE for DB2
- Daily snapshots of real-time statistics (RTS) collected by DB2 itself
- The results of analyses that provide recommendations to improve your system and application performance

You can use the BMC APPTUNE for DB2 and RTS data to identify performance trends, compare recent performance against a baseline, identify usage patterns, and to generate recommendations for improved performance.

You can maintain a localized PADB at each location (DB2 subsystem or data-sharing group) where data is collected, or a centralized PADB at one central location. You can query the PADB tables to discover which indexes are not being used, what objects are being touched by which users or statements, and more.

WORKLOAD COMPARE ADVISOR
The Workload Compare Advisor allows you to define a set of SQL statements to analyze for access path changes within or between DB2 systems. This capability can be particularly effective when migrating from one version of DB2 to the next. For example, migrating from DB2 version 9 to DB2 10 could have a significant impact on your systems because of unforeseen access path changes. The Workload Compare Advisor is also helpful when migrating from one system to another, for example when moving from test to production, and when applying system maintenance.

The Workload Compare Advisor provides a set of ISPF panels that identify the plans, packages, DBRMs, and COLIDs that are to be compared. An extract process takes input from several sources (including the DB2 catalog, DBRMLIBs, and BMC APPTUNE for DB2 trace data sets), and the resulting files are processed with an Explain execution. The resultant access paths are compared and differences are highlighted. You can compare static and dynamic SQL.

The Workload Compare Advisor enables you to compare the performance metrics of the application from trace data from two or more points in time. Comparison can be made at the plan, package, or statement number level to detect performance changes over time.

INDEX ADVISOR
BMC SQL Performance for DB2 enables you to obtain accurate, real-time performance information about DB2 indexes. The Index Advisor automatically collects and displays actual access counts for each unique SQL statement (table and index, and predicate usage frequencies). A “what-if” index analysis lets you model changes to indexes. It presents data at the object level, so you can review the index access data to evaluate the performance of your SQL and identify candidates for index improvements.

The Index Advisor provides on-demand dynamic data collection of index dependencies and catalog statistics. Table and index reports provide quick access to listings of the most-used object based on GETPAGE volume or ratio.

The Index Advisor extends the capability of BMC APPTUNE for DB2 object analysis by collecting and reporting on column usage data for SQL statements. It extends the capability of the Explain function by comparing access paths after making “what if” changes to indexes in a cloned database.
The Index Advisor provides accurate, real-time performance information about DB2 indexes. Because the Index Advisor presents data at the object level, you can review the index access data to evaluate the performance of your indexes and identify candidates for index improvements.

The “what if” index analysis feature simulates the effects of adding, dropping, or updating statistics for an index with the use of cloned structures. You can save the DDL for “what if” index changes to a data set, and then import another statement to see the effects of the changes on that statement. The “what if” index process is cumulative, so incremental changes followed by Explains enable you to see the effects of each change.

The Index Advisor can analyze an entire workload or a single SQL statement.

**REORG ADVISOR**

If a database is performing poorly, you may decide to reorganize it because reorganization generally improves performance. However, not all poor performance is caused by disorganized databases. BMC SQL Performance for DB2 provides the Reorg Advisor to determine whether a reorganization could improve performance. It eliminates unnecessary reorganizations.

The Reorg Advisor identifies potential candidate objects for reorganization, based on two criteria:

- The level of disorganization of the object
- The level of performance degradation for the object since the last reorganization occurred

To arrive at these recommendations, the Reorg Advisor uses data from the daily real-time statistics tables (BMCTABLESPACESTATS and BMCIINDEXSPACESTATS), and the daily object statistics table (DAILY_OBJ_STATISTICS). The candidate objects are listed in the output of the Reorg Advisor and are also maintained in the REORG_CANDIDATE_TABLE. In this table, the DISORGANIZED column indicates whether an object is considered to be disorganized, and the REORG_CANDIDATE column indicates whether a disorganized object also meets the performance degradation criteria to be considered a candidate for reorganization.

**EXCEPTION ADVISOR**

The PADB collects performance data over time so that you can see trends. The Exception Advisor flags performance exceptions and abnormalities. It identifies the root cause of exception conditions and makes tuning recommendations.

The Exception Advisor examines the data accompanying exceptions and compares that data to past execution statistics for the same statement in the baseline or aggregated tables. The Exception Advisor bases its recommendations on observed conditions, so as your workloads and environment changes, the Exception Advisor adjusts accordingly.

**USE CASES**

You can use BMC SQL Performance for DB2 to improve performance in a wide range of areas.

**UNNECESSARY REORGANIZATIONS**

You may reorganize application objects based on a schedule, or you may analyze statistics and reorganize when certain thresholds are reached. However, for some types of workload, even a “disorganized” object doesn’t degrade application performance because of the nature of the workload. The Reorg Advisor will identify objects that are both disorganized and experiencing performance degradation. These objects are loaded into a REORG_CANDIDATE_TABLE. You can trigger a reorganization process only for those objects that will benefit from reorganization. More importantly you can avoid scheduling reorganizations for objects that would not benefit, saving a lot of wasted CPU time in the process.
UNNECESSARY INDEXES
Over years of service and versions of DB2, many applications have acquired multiple indexes. It is not uncommon for some tables to have 3-6 indexes. Due to changes in the optimizer logic over time, some of these indexes may have become obsolete. With the SQL Performance PADB, you can easily identify those indexes that have not been used in some period of time.

For instance, the query:

```sql
SELECT DBNAME, OBNAME, PARTITN
FROM BMCSFTWR.INDEX_USAGE
WHERE READTM IS NULL
OR READTM < CURRENT_TIMESTAMP - 90 DAYS;
```

would result in a list of indexes that have not been read with SELECT in the last 90 days. You may be able to DROP these indexes if they are not used to enforce UNIQUE, CLUSTER, or primary/foreign key relationships. Dropping these indexes will result in an immediate CPU performance benefit to every INSERT and DELETE on the table, and also to UPDATE to the columns that were in the dropped index.

INEFFICIENT ACCESS PATHS
SQL and the DB2 optimizer have evolved into complicated technologies. It is easy for even an experienced SQL user to code a statement that results in inefficient performance. The result set is correct, but the amount of work being done to derive it can consume (waste) a lot of processing time. Using "what if" index analysis, you can see the benefit (in CPU savings) of changing or adding a new index to an application and see a relative cost number for comparison on the CPU savings.

MIGRATION AND ACCESS PATH CONVERSION
Many users have been surprised by changes in access paths due to migrating to new versions of DB2. The Workload Compare Advisor allows you to Explain the statements before doing the REBINDs, so you can discover (and mitigate) poor performing access paths before migration. This can result in significant reduction of wasted CPU cycles in the new version.

DEGRADING I/O PERFORMANCE
Monitors see what is happening in real time. However, they don’t do a good job of letting you know that performance is degrading over time. Using the data in the PADB, you can identify objects that are degrading, but may not yet have reached a point where the have become a problem. Identifying such degrading objects early allows you to manage and tune the object, resulting in improved performance and reducing wasted resources.

For instance, this query:

```sql
SELECT INTVTIME, DBNAME, OBNAME, PARTITN,
CASE WHEN SYNCIO=0 THEN GETPAGES
ELSE GETPAGES/SYNCIO
END AS "GETPAGES PER SYNCIO"
FROM BMCSFTWR.DAILY_OBJ_STATISTICS
ORDER BY DBNAME, OBNAME, PARTITN, INTVTIME;
```

would list GETPAGEs and I/Os for a set of objects over time, allowing you to identify those objects with degrading performance.
BASELINE COMPARE
If you are notified that users are experiencing bad performance, you can use BMC APPTUNE for DB2 to identify a particular static SQL statement. To see how different the execution performance is to the last time it ran, you can use the Interval Analysis Compare feature online (or in batch). To see the access path difference, you can identify the package as the input to Workload Access Path Compare and then compare it to the baseline version.

EXCEPTION IDENTIFICATION AND RECOMMENDATIONS
SQL tuners that run on IBM® DB2 subsystems have access to large quantities of performance data. As a result, tuning efforts can be quite time-consuming. By narrowing the focus of the tuning effort to those statements that exceed target thresholds, Exception Advisor can often identify the root cause of an exception immediately. The Exception Advisor is not looking at predicted performance, such as Explain data, but at actual performance history. Because Exception Advisor uses existing data, you incur no further cost for data collection.

ADDITIONAL FEATURES
BMC SQL Performance for DB2 provides additional solution-level features to improve SQL performance.

- **Complete SQL Capture** - Enables you to capture data for each SQL statement (OPEN, FETCH, CLOSE, and so on) executed during a collection period. BMC SQL Performance for DB2 provides the information needed to tune application performance, while Explain-based products provide only part of the information needed.
- **SQL-level statistics** - You can obtain statistics and data at the SQL statement level about accounting, buffer, I/O, and lock activities. This feature provides you with the information needed to identify a costly SQL statement quickly and to undertake effective tuning.
- **Application groups and application profiles** - You can define the plans, programs, and users that make up an application group (using your own criteria) and the application groups that make up an application profile. You can define application groups and application profiles by each user or at the system level. Public access to an application group can be limited to NONE, READ, or UPDATE. This allows you to create collections of plans, programs, users, correlation IDs, or a combination of these elements in groups that you want to analyze for application performance.
- **IN-SQL measurement** - To find the most accurate data for measuring the cost of an SQL statement, you can measure only the resources consumed during the execution of an SQL statement. IN-SQL measurements exclude the time spent on associated DB2 housekeeping tasks. Measurements based on IN-DB2 time are less accurate and might not reflect the actual cost of an SQL statement.
- **Explain function** - You can Explain dynamic and static SQL statements, providing both statistical and textual information about the access path, with suggestions on how to improve SQL statement performance.
- **SQL error reporting** - You can identify SQL errors and view the corresponding SQLCA data and SQL text. Using BMC SQL Performance for DB2, you can capture SQL error data automatically without having to change existing programs, and to determine which errors occurred when and to whom.
- **DB2 current status** - You can display current information about a DB2 subsystem and active threads quickly and easily. From an active thread, you can also zoom down to the text of the SQL statement currently executing and Explain it, if needed. This feature is helpful for diagnosing a system-level problem, such as a long-running transaction or batch job.
- **Object reports** - You can collect and analyze information about access, usage, and response times for DB2 buffer pools, databases, page sets, tables, and indexes.
- **Analysis of dynamic SQL from trace data sets** - This feature is useful when you plan to migrate to a different version of DB2 and want to find out how your existing data will perform, or when you want to Explain and compare the access paths for dynamic SQL from subsystems running on different versions of DB2.
Support for static and dynamic SQL - BMC SQL Performance for DB2 captures performance data for both static and dynamic SQL statements and enables you to view both as a single workload. You can capture data for all SQL statements—including dynamic SQL statements that usually cannot be captured—to determine the tuning needs of applications and users.

Dynamic statement cache - Provides a general picture of dynamic statement cache performance at a low cost. You can explain dynamic SQL with BMC SQL Performance for DB2.

Analysis criteria - You can specify the time period, DB2 subsystems, and data source (archived data or online data) used to generate online or batch reports. This feature allows you to exclude unnecessary information from generated reports, include real-time data as needed, analyze historical data, and choose a report format that best suits your needs.

Graphical data reporting option - You can choose whether reports are displayed in a traditional, numeric format or a graphical format.

Variable and fixed length collection intervals - You can establish a set interval for data collection and vary this interval as needed (for problem diagnosis, for example).

Trace data set archiving - You can perform a comprehensive historical analysis for a specified period of time.

Archive directory - BMC SQL Performance for DB2 can provide a list of all archived data sets and the IFCIDs they contain. Using this feature, you can find the DB2 and the time period that you want to examine. Then you can see which archived data sets have records for that DB2 subsystem and time period and use them as the source for your batch report request.

SQL export function - You can export SQL statement data for additional processing with a third-party analysis tool. It provides additional compatibility between BMC SQL Performance for DB2 and analysis tools from other vendors, extending your existing investment in software and training.

Support for multiple DB2 subsystems - You can analyze all of the DB2 subsystems across the sysplex where BMC SQL Performance for DB2 is installed, or you can support BMC SQL Performance for DB2 from a single data collector. You can have concurrent access to multiple DB2 subsystems and work with multiple BMC Software products using only one started task.

Fully functional administrative facility - You can define data collector parameters and user privileges completely. If multiple instances of BMC SQL Performance for DB2 and/or BMC System Performance for DB2 are installed, you can control all products from one console.

**SUMMARY**

BMC SQL Performance for DB2 reduces the CPU required to execute application code. It enables you to pinpoint poorly performing SQL quickly and easily, so that you can reduce costs and improve response times. It provides tools to manage SQL performance across the application lifecycle:

- In development, it validates SQL to ensure optimal performance characteristics like valid access paths and best-practice SQL coding techniques.
- In production, it captures metrics to identify and resolve performance problems.

BMC SQL Performance for DB2 recommends optimal index usage, enables workload comparisons, and uses historical data to identify performance trends.
Business runs on IT. IT runs on BMC Software.
Business thrives when IT runs smarter, faster and stronger. That’s why the most demanding IT organizations in the world rely on BMC Software across distributed, mainframe, virtual and cloud environments. Recognized as the leader in Business Service Management, BMC offers a comprehensive approach and unified platform that helps IT organizations cut cost, reduce risk and drive business profit. For the four fiscal quarters ended December 31, 2010, BMC revenue was approximately $2 billion Visit www.bmc.com for more information.