Two for One: Optim Solutions Update and Optimizing DB2 for z/OS Query Performance

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IBM

Tuesday, August 3, 2010: 1:30 PM-2:30 PM
Hynes, Room 103
Abstract

• Optim Solutions Update: Are you wondering how Optim Solutions relates to your z/OS DB2 Tools investment? Do you want to see what the lab is doing to help the z/OS DBA? Join one of our chief architects to hear how Optim solutions can extend administrative function for DB2 for z/OS, both today and in the future. The speaker will cover data design, performance and query monitoring, performance and query optimization, and key roadmap items.

• Optimizing DB2 for z/OS Query Performance: There are lots of factors that affect query performance and no silver bullets. Investigating performance issues includes looking at indexes, statistics, query design, cache size, execution mode, and the list goes on. Join the speaker as he digs into some of these areas in detail and at how Optim Solutions can help get resolutions faster and with more flexibility.
Agenda

- Introduction to Integrated Data Management (IDM)
- What can Data Studio be used for in DB2 for z/OS environments?
- How Java and .NET applications can be managed like CICS/IMS applications
- What results can be realized by query tuning
- Data movement options
- What value is there to extending the DB2 backup and recovery utilities?
- Other DB2 for z/OS Tooling
- What's cooking back at the lab
  - Performance Management
  - Configuration Management
  - Maintenance Management
- Wrap-up
Survey: CIO’s want to strengthen competitive advantage by better managing enterprise data

75% of CIO’s believe they can strengthen their competitive advantage by better using and managing enterprise data.

78% of CIO’s want to improve the way they use and manage their data.

…but only 15% believe that their data is currently comprehensively well managed.

• **Data management must drive competitive advantage**
  - Facilitate business alignment
  - Accelerate delivery of enterprise-ready, data-driven applications
  - Free up staff to drive business growth and optimization

Source: Accenture CIO Data Management Survey 2007. n=167 CIOs
Introducing Integrated Data Management

An integrated, modular environment to manage enterprise application data, and optimize data-driven applications, from requirements to retirement

- **Grow the business, without growing costs**
  - Develop and deploy business critical applications faster
  - Mitigate compliance risks with model-driven data governance
  - Prevent runaway infrastructure spending
  - Improve performance – of work teams, databases, applications, and business units

Integrated Data Management = Data Studio+Optim+DB2 for z/OS Tools
Integrated Data Management

- Deliver increasing value across the lifecycle, from requirements to retirement
- Facilitate collaboration and efficiency across roles, via shared artifacts automation and consistent interfaces
- Increase ability to meet service level agreements, improving problem isolation, performance optimization, capacity planning, and workload and impact analysis
- Comply with data security, privacy, and retention policies leveraging shared policy, services, and reporting infrastructure
Supporting Heterogeneous Environments

Optim Data Growth Solutions
- Optim Query Workload Tuner
- DB2 Performance Management
- DB2 Performance Expert and Extended Insight
- DB2 Automation Tool
- DB2 Recovery Solution
- DB2 Utilities Suite
- DB2 Change Management Solution

InfoSphere Data Architect

Optim Development Studio
- Optim Query Tuner
- Optim Test Data Management
- Optim Data Privacy Solutions
- Optim pureQuery Runtime

DB2 Audit Management Expert
- Database Encryption

Optim Database Administrator

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Integrated Data Management User Interface Directions

Data Studio and Optim
- Eclipse UI
- Web UI
- 3270

Develop and Deploy
- Design and Development
- Configuration
- Object Management
- Change Management
- Automation Planning
- Data Governance

Operate
- Monitoring
- Automation Management
- Reporting
- Data Governance

z/OS Database Administration
- Rich z/OS function
- Application Management
- Database Administration
- Performance Management
- Data Governance
## DB2 for z/OS Tools Portfolio

### Application Management
- InfoSphere Data Architect
- Optim Development Studio
- DB2 Path Checker
- DB2 Bind Manager
- DB2 SQL Performance Analyzer
- DB2 Table Editor
- Optim pureQuery Runtime

### Database Administration
- DB2 Administration Tool
- DB2 Object Comparison Tool
- DB2 Administration Toolkit SAP Edition
- DB2 Storage Management Utility

### Performance Management
- OMEGAMON XE DB2 Performance Expert
- OMEGAMON XE DB2 Performance Monitor
- DB2 Buffer Pool Analyzer
- Optim Query [Workload] Tuner
- DB2 Query Monitor
- DB2 Performance Toolkit SAP Edition

### Utilities Management
- DB2 Utilities Suite
- DB2 Automation Tool
- DB2 Automation Toolkit SAP Edition
- DB2 Utilities Enhancement Tool
- DB2 High Performance Unload

### Information Integration
- WebSphere Classic Data Event Publisher
- WebSphere Classic Federation Server
- WebSphere Classic Replication Server
- WebSphere DataStage
- WebSphere Replication Server
- DataMirror

### Backup and Recovery
- Application Recovery Tool for IMS and DB2 Databases
- DB2 Archive Log Accelerator
- DB2 Change Accumulation Tool
- DB2 Cloning Tool
- DB2 Log Analysis Tool
- DB2 Object Restore Tool
- DB2 Recovery Expert

### Data Governance
- IBM Optim Data Growth
- IBM Optim Data Privacy
- IBM Optim Test Data Management
- DB2 Audit Management Expert
- IBM Database Encryption Expert
- Data Encryption for DB2 and IMS

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**DB2 Developer Workbench vs. Data Studio**

**before**

**IBM DB2 Developer Workbench V9.1**
- SQL Query Editor
- SQLJ Editor
- SQL Builder
- XQuery Builder
- SQL Routine Debugger
- Java Routine Debugger
- XML Editor
- XML Schema Editor
- Data Management
- Visual Explain
- Project Management

**Data Studio is a full replacement of DB2 Developer Workbench plus much more**

- DB2 for Linux, Unix, Windows v8.x, v9.x
- DB2 for z/OS v7, v8, v9
- DB2 for i5/OS v5r2, v5r3, v5r4
- Informix Dynamic Server (IDS) v9.x, v10.x, v11

**now**

**IBM Data Studio V2.2**
- Integrated Query Editor – SQL + XQuery
- SQLJ Editor
- SQL Builder
- XQuery Builder
- SQL Routine Debugger
- Java Routine Debugger
- XML Editor
- XML Schema Editor
- Data Management
- Visual Explain
- Project Management
- ER Diagramming
- Data Distribution Viewer
- Object Management
- Browse & Update Statistics
- Security Access Control
- Connection Management integration with Kerberos and LDAP
- Data Web Services
- IDS Server Support

No-charge

Data Studio is no longer used as a brand
Create, Alter, Drop, Browse and Filter database objects

- Express yourself with optimal queries
  - Content assistance for database objects
  - Rapid interactive end-user feedback
  - Extensible templates
  - Multiple SQL statement testing
  - SQL assistance and XQuery assistance

Integrated Query Editor

Object Properties

Object Editors

ER Diagramming
Unleash SQL in your Java IDE

- SQL content assist

```java
// Select GOSALESCT.CUST by parameters
@Select(sql = "SELECT CUST_CODE, CUST_FRST_NAME, CUST_LAST_NAME, CUST_ADDR1,
         + " CUST_ADDR2, CUST_CITY, CUST_POST_ZONE, CUST_CTRY_CODE, CUST_PHN_NBR,
         + " CUST_INFO, CUST_EMAIL, CUST_GNDR_CODE, CUST_PROV_STATE"
         + " FROM GOSALESCT.CUST"
         + " WHERE ")
Cust getCust(int cust_code)
```

Press CTRL-SPACE to invoke content assist or auto complete

- SQL validation

```java
// Select GOSALESCT.CUST by parameters
@Select(sql = "SELECT CUST_CODE, CUST_FRST_NAME, CUST_LAST_NAME, CUST_ADDR1,
         + " CUST_ADDR2, CUST_CITY, CUST_POST_ZONE, CUST_CTRY_CODE, CUST_PHN_NBR,
         + " CUST_INFO, CUST_EMAIL, CUST_GNDR_CODE, CUST_PROV_STATE"
         + " FROM GOSALESCT.CUST"
         + " WHERE CUST_CODE = ?")
Cust getCust(int cust_code)
```

Table 'CUST' does not contain column 'CUST_COD'.
Unleash SQL in your Java IDE

- Run SQL at design time without the need to compile the program
- Launch Visual Explain
Stored Procedure Support
SQL and Java Debugger

Integrated editor and debugger for SQL PL and Java (JDBC or SQLJ)
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Data Management

Data Distribution Editor

View data distribution skews with the Data Distribution Viewer

Edit Data

Roles, Users, Privileges

Manage Roles

Privileges By User

Privileges By Object
IBM Data Studio

IBM Data Studio (stand-alone)

Downloads

To properly configure your download, please review the information below. Select the appropriate offering. When you are done, press the "Continue" button at the bottom.

Offering | Platform |
--- | --- |
IBM Data Studio Version 2.2 | Red Hat Linux SUSE Linux Enterprise Desktop (SLED) SUSE Linux Enterprise Server (SLES) |
Languages: | English |

| Languages: | English |

Download it today!
IBM Optim Development Studio

An integrated database development environment that speeds application design, development, and deployment while increasing data access performance and manageability.

- Enhance developer productivity
  - Drag and drop creation of Web services
  - Provide a seamless SQL/Java experience
  - Generate a data access layer using Java objects, JSON, or XML
  - Enhance problem isolation and impact analysis, even when using frameworks that generate the SQL
- Provide expert-equivalent performance
  - Facilitate use of JDBC and SQL data access best practices
  - Improve DB2 performance, predictability, and manageability by enabling transparent activation of static SQL (i.e. no change to the application) for Java and .NET
  - Facilitate DBA collaboration and optimization
- Enhance security
  - Eliminate SQL injection risk

“Development Studio enables us to bridge the gap between object-oriented design and relational database technology. As a result, we can speed the development of high quality applications and improve developer productivity by between 25 and 50 percent”
How Java and .NET applications can be managed like CICS/IMS applications

What problems do these application platforms present to the DBA?
- ORM frameworks obscure the SQL generated
- Dynamic SQL

Capturing SQL for review/tune/revisement
Converting to static SQL and the benefits of doing so
Frequently Cited Concerns

I have more and more Java workload coming into my data server driving up costs, but the budget is not keeping pace.

I don’t even want to allow framework-generated SQL on my database. If I can’t see it, I don’t know how it will impact me.

Java and .NET performance problems are a real pain to resolve because I can’t even tell what application issued the SQL.
Contemporary Application Stack Challenges

• Simplify development, but …
  • Challenge problem resolution
  • Impact performance
  • Obscure impact analysis
  • Impede capacity planning
Introducing pureQuery

A high-performance, data access platform to simplify developing, managing, securing, and optimizing data access for new and existing applications.

**pureQuery Components:**

- **Optim Development Studio**
  - Integrated development environment with Java and SQL support
  - Improve problem isolation and impact analysis

- Simple and intuitive API
  - Enables SQL access to databases or in-memory Java objects
  - Facilitates best practices

- **Optim pureQuery Runtime**
  - Flexible static SQL deployment for DB2
pureQuery Improves Performance, Security, and Manageability for DB2 and Oracle... *Without Changing a Line of Code*

**Three steps**

1. **Capture the SQL**
   - Use pureQuery API, generate from WebSphere JPA, or capture while executing
   - Use with custom-developed, framework-based, or packaged applications
   - Translation of literals to host variables (new in 2.2)

2. **Bind SQL to DB2 (Client Optimization)**
   - Use tooling in Data Studio Developer, WAS console or command line

3. **Choose execution mode**
   - Dynamic or static
   - Choose at deployment time instead of development time

**Static SQL value**

- Make response time predictable
  - Lock in the SQL access path pre-execution
- Limit user access and reduce SQL injection
  - Grant execute privileges on the query packages rather than access privileges on the table
- Accelerate problem resolution
  - Trace SQL execution to a specific package and the originating source
- Improve impact analysis and capacity planning
  - Visualize application SQL and correlation metadata
- Increase system capacity
  - Drive down DB cycles

"The ability to use static SQL with pureQuery is huge. Recently, I worked with a client who could reduce CPU usage by 7 percent thanks to this one feature."

— David Beulke, Pragmatic Solutions Inc.
Dynamic vs. Static Execution

**Dynamic SQL Full Prepare**
- Check auth for package / plan
- Parse SQL Statement
- Check Table / View Auth
- Calculate access path
- Store access path in a temporary package
- Execute SQL statement

**Dynamic SQL Short Prepare**
- Check auth for package / plan
- Copy skeleton from cache to local DB2 thread storage
- Execute SQL statements

**Static SQL**
- Check auth for package / plan
- Extract access path from SYSIBM.PACKAGES and STATEMENTS
- Execute SQL statements
## Static Execution Advantages

<table>
<thead>
<tr>
<th>Feature</th>
<th>Dynamic SQL (pureQuery, JDBC)</th>
<th>Static SQL (pureQuery, SQLJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>Can approach static SQL performance with help from dynamic SQL cache. Cache misses are costly</td>
<td>All SQL parsing, catalog access, done at BIND time. Fully optimized during execution.</td>
</tr>
<tr>
<td>Access path reliability</td>
<td>Unpredictable – Any prepare can get a new access path as statistics or host variables change</td>
<td>Guaranteed – locked in at BIND time. All SQL available ahead of time for analysis by EXPLAIN.</td>
</tr>
<tr>
<td>Authorization</td>
<td>Privileges handled at object level. All users or groups must have direct table privileges – Security exposure, and administrative burden</td>
<td>Privileges are package based. Only administrator needs table access. Users/Groups have execute authority. Prevent non-authorized SQL execution.</td>
</tr>
<tr>
<td>Monitoring, Problem determination</td>
<td>Database View is of the JDBC or CLI package – No easy distinction of where any SQL statement came from.</td>
<td>Package View of applications makes it simple to track back to the SQL statement location in the application</td>
</tr>
<tr>
<td>Capacity planning, Forecasting</td>
<td>Difficult to summarize performance data at program level.</td>
<td>Package Level Accounting gives program view of workload to aid accurate forecasting.</td>
</tr>
<tr>
<td>Tracking dependent objects</td>
<td>No record of which objects are referenced by a compiled SQL statement</td>
<td>Object dependencies registered in database catalog</td>
</tr>
</tbody>
</table>
In-house testing shows over 40% reduction in CPU costs over dynamic JDBC using pureQuery and DB2 for z/OS (type-2)

- Read IBM Optim pureQuery Runtime for z/OS Performance
- IRWW – an OLTP workload, cache hit ratio between 70 and 85%

Preset application path never varies at runtime

Reduced CPU per transaction means more growth on existing resources

SHAREx in Boston
Java Database Access and pureQuery

Many on-ramps for new and existing applications

Java Persistence API (JPA)  Hibernate  Web services  .NET

pureQuery

DB2 (z/OS, i & LUW), Informix, and Oracle now
More coming
Deploying with pureQuery Runtime

**Application tier:**
- z/OS, Linux, UNIX, Windows

**Database tier:**
- DB2 for z/OS
- DB2 for i
- DB2 for Linux, UNIX, and Windows
- Informix Dynamic Server
- Oracle

Diagram:
- Application
  - pureQuery Runtime
  - JDBC Driver
- Static or dynamic execution

- Database tier:
  - DB2 for z/OS
  - DB2 for i
  - DB2 for Linux, UNIX, and Windows
  - Informix Dynamic Server
  - Oracle
Unique Package Names Improves PD on DB2 for z/OS

- Most dynamic Java applications use packages SYSLNx00 making it hard to identify specific programs
- Unique package names link SQL to Java Beans, similar to CICS transaction names to programs.
Static SQL for security – Administering table privileges

- Dynamic SQL
  - Table privileges granted directly to users(groups)/secondary authids
    - Security exposure and administrative burden

  ```sql
  GRANT SELECT
  ON TABLE PAYROLL
  TO DEPT_D47
  ```

- Static SQL (pureQuery)
  - Users get no table privileges

  ```sql
  GRANT EXECUTE
  ON PACKAGE
  POSITION_REPORT
  TO DEPT_D47
  ```
Reduce Costs with zIIP and zAAP

- Using COBOL or SQL/PL stored procedures instead of executing SQL directly
  - Separation of application development from data access
  - DBAs retain better control over SQL including static execution
  - If not written in DB2 9 for z/OS's Native SQL/PL, the stored procedure must use general purpose processors

- pureQuery introduces alternatives
  - Create Java stored procedures to run on zAAP using the pureQuery runtime
    - DBAs retain control, Data Studio helps with development, pureQuery executes statically

- Execute SQL directly from Java application or method to run on zIIP
  - Developers use Data Studio Developer to generate access layer with pureQuery, content assist helps with best practices and SQL validation, packages SQL for easy collaboration with DBA, pureQuery executes statically
More Visibility and Control of Application SQL

- Capture SQL
- Share, review, and optimize SQL
- Revise and validate equivalency
- Bind for static execution or run dynamically
- Restrict SQL to eliminate SQL injection

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IT PRO
FIT FOR BUSINESS

IT PRO has been watching and charting the progress of what is one of the biggest and most high profile web security threats of this year - the SQL injection.
By Asavin Wattanajantra, 4 Aug 2008 at 11:55

Capture ➔ Review ➔ Optimize ➔ Revise ➔ Restrict
Three methods

1. Use pureQuery API
2. Use JPA and generate the pureQuery file
3. Set captureMode=ON and execute the program

IBM Optim Development Studio
Visualize Application and SQL Metadata

- Review the captured SQL
- View metrics about execution frequency and duration
- Share captured SQL with DBA
SQL Outline

Speed up problem isolation for developers – even when using frameworks

- Capture application-SQL-data object correlation (with or without the source code)
- Trace SQL statements to using code for faster problem isolation
- Enhance impact analysis identifying application code impacted due to database changes
- Answer “Where used” questions like “Where is this table used within the application?”
- Use with modern Java frameworks e.g. Hibernate, Spring, iBatis, OpenJPA

IBM Optim Development Studio
Optimize SQL

- Launch Visual Explain
- Copy SQL to Optim Query Workload Tuner
Query Tuning
Introduction to query tuning
Query performance causes application outage

- Customer example
  - Application service drops from 3 seconds to 5 minutes
  - Limited performance management expertise
  - Took 3 days to identify the problem query
  - 5 day application outage
  - Loss of confidence in IT team
  - Time and money in analysts

- Expert analysis revealed
  - Relevant statistics were not being collected
  - Wasted CPU resources due to default statistics collection
  - Index design was very poor
  - Rapid development practices drove untuned queries into production
Introduction to query tuning
Why is query tuning such a pain?

• Development
  • Lack of query tuning skills
  • Use of frameworks that generate SQL
  • Inadequate testing environments to drive the workload and data scale
  • Disconnect between application and data groups

• Production
  • Performance problems appear without warning
  • Aggregate information from multiple places
  • Complexity of analysis requires specialized skills
  • Need to consider entire workloads, not just single queries
Introduction to query tuning

- Why do we have to perform query and system tuning? Isn’t this why I have DB2?
  - DB2 is powerful, but it’s not all-knowing
    - DB2 doesn’t know what queries are going to be submitted
    - DB2 doesn’t know object sizes or cardinality unless statistics are gathered
    - DB2 doesn’t know about cross-table correlation
    - DB2 doesn’t know how many rows will be fetched, unless told
  - The biggest reason for a non-optimal access path is because the desired statistics are not collected

- Defining the task "query tuning" -- Developer versus DBA tasks
  - Developer tasks
    - Follow shop standards
    - Avoid Stage 2 (and Stage 3) predicates
  - DBA tasks
    - Design indexing scheme
    - Collect and maintain needed statistics
    - Analyze access paths and influence them when needed
Introduction to query tuning

• Techniques used
  • Rules-based analysis of SQL statement text
  • Invoking EXPLAIN to understand the access path and cost of the query blocks
  • Invoking EXPLAIN to understand what statistics are interesting to DB2
  • Simulation of index schemes

• Other issues
  • Sometimes the SQL is generated and cannot be reviewed
IBM Tooling that is available to assist with this

- IBM Tooling that is available to assist with this
  - DB2 SQL Performance Analyzer (SQL PA)
  - Optim Query Workload Tuner
SQL Performance Analyzer

- ISPF and batch
- Enhanced Explain
  - Compare access paths
  - What if
  - Retro explain
  - Migrate DB2 Statistics
- Provides advice on each SQL statement (helps users write better SQL)
  - Warnings, alerts, guidelines and recommendations
  - Performance notes
- Forecasts SQL performance (response/wait times, CPU, I/O counts)
- Forecasts the cost of the query, in terms of
  - Charge back (monetary, in national currency)
  - QUNITS (query service units)
- Acts as a governor for Static or Dynamic SQL
  - in QMF, as a preemptive exit
  - in DRDA and IMS or CICS, via a Stored Procedure call

Suitable for SQL Develop, Tuning and Control
Query Workload Tuner

- Eclipse-based interface
- Gathers SQL from various sources (catalog, statement cache, captured file)
- Visualize queries and costs (query annotation and visual explain)
- View DB2 Optimizer’s query transformations
- Analyze one query or a whole workload
  - Access path
  - Statistics
  - Index
- Validate changes

Suitable for SQL Tuning, Statistics Collection and Index Design by DBAs
Streamlined Analysis

Define or select workload

Execute advisors

Drill into advice

Validate improvement
Gather High Cost Queries and Workloads

DB2
- Plan table
- Statement table
- Catalog plan or package
- Statement cache

Optim Development Studio

QMF and QMF HPO

DB2 Query Monitor

OMEGAMON XE for DB2

File, text, or exported workload

User defined category

Define or select workload
### Visualize Queries and Costs to Speed Analysis

- **Accelerate analysis, reduce downtime**
  - Spot human errors
  - Identify where filtering should occur

---

**Table:**

<table>
<thead>
<tr>
<th>Formatted Query</th>
<th>Annotation</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CARDF=(missing) QUALIFIED_ROWS=42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CARDF=42 MAX_FREQ=35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CARDF=14 QUALIFIED_ROWS=42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CARDF=9 MAX_FREQ=45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COLCARDF=8/14 MAX_FREQ=8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COLCARDF=14/(missing) MAX_FREQ=14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSN8910.DEPT.MGRNO contain(6) skewed data</td>
<td></td>
</tr>
</tbody>
</table>

---

**Easily see tables, sections, join predicates, etc.**

**Examine table statistics and additional information**
View Optimizer Transformations

- Accelerate analysis, reduce downtime
  - Spot transformations which will occur

```
SELECT A.EMPNO, A.FIRSTNAME, A.LASTNAME, A.JOB, A.SALARY, A.BONUS, A.COMM, B.LOCATION, C.PROJNAME
FROM DSN8910.DEPT AS B, DSN8910.EMP AS A, DSN8910.EPROJ AS C
WHERE ( A.EMPNO IN ( SELECT DSN8910.DEPT,MGRNO
                   FROM DSN8910.DEPT
                   WHERE DSN8910.DEPT,MGRNO IS NOT NULL )
                AND A.WORKDEPT = B.DEPTNO
          AND B.DEPTNO = C.DEPTNO )
AND A.WORKDEPT = B.DEPTNO
ORDER BY A.EMPNO ASC, A.FIRSTNAME ASC, A.LASTNAME ASC
```
### Execute Advisors

Immediately capture statements or multiple sources to this workload, launch workload advisors, use tools capture, consolidation, and analysis.

<table>
<thead>
<tr>
<th>Execution Count</th>
<th>Average Elapsed Time (sec)</th>
<th>Accum</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>21.151768</td>
<td>0.0696</td>
</tr>
<tr>
<td>5</td>
<td>23.351143</td>
<td>2.2789</td>
</tr>
<tr>
<td>5</td>
<td>18.033714</td>
<td>10.322</td>
</tr>
<tr>
<td>5</td>
<td>5.907151</td>
<td>0.0459</td>
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<td>5</td>
<td>20.778751</td>
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<td>99.665344</td>
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<td>5</td>
<td>13.440651</td>
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<td>18.914537</td>
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<tr>
<td>11</td>
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<td>6.4435</td>
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<td>0.0872</td>
</tr>
<tr>
<td>16</td>
<td>0.970876</td>
<td>0.3689</td>
</tr>
</tbody>
</table>

- **Statistics**
  - Get recommendations on the best statistics to capture to influence access path selection

- **Query**
  - Get recommendations regarding how to rewrite the query for better efficiency

- **Index**
  - Get recommendations on additional indexes that can reduce database scans
Analyze Access Plans

- Visualize access path
  - See flow of query processing
  - See indexes and operations
  - See optimizer rationale

- Assess access path stability to reduce risk of performance regression
  - Is the optimizer able to apply the filtering early?
  - Are there indexes that support an efficient path?
  - Do statistics allow distinction between the choices?
Improve Statistics Quality and Collection

- Provides advice on
  - Missing statistics
  - Conflicting statistics
  - Out-of-date statistics

- Results
  - Accurate estimated costs
  - Better query performance
  - Less CPU consumption
  - Improved maintenance window throughput

“Half of access path PMRs could be resolved by statistics advisor before calling IBM support.”
– IBM Support
Improve Query Design

Guard against errors and oversights:
Further constrain query, increase index utilization, and reduce data reads

View analysis summary

Filter recommendations by severity

Query Advisor checks for
- Missing join predicate for referential constraint
- Predicates that can be rewritten as indexable
- Stage 2 predicates that can be rewritten as stage 1 predicates

Highlights relevant components of the query

Recommendation and rationale
Indexing Advice to Improve Query Efficiency

- Improve query efficiency
  - Indexing foreign keys in queries that do not have indexes defined
  - Identifying index filtering and screening
  - Support for index only access
  - Indexing to avoid sorts

- Simplify use
  - Consolidate indexes and provide a single recommendation
  - Enables what-if analysis
  - Provides DDL to create indexes
  - Run immediately or save

- Test before deployment
  - Utilize virtual index capabilities built into the DB2 engine
Visual Plan Hints for Experienced DBAs

- Why hints?
  - Version to version migration
  - Assumptions made by optimizer when SQL contains parameter markers or host variables

- Reduce errors
  - Hint editor
  - Hint validation
  - Hint deployment
Query tuning tools for z/OS – Unique benefits

Optim Query Workload Tuner
• Better support for modern dev environment and dynamic SQL
• Eclipse-based, GUI and stored procedure-driven
• Integrates with OM/PE and QM GUI interfaces, Data Studio, Optim
• Provides virtual index capability for single queries and across workloads
• Recommends rewriting queries only when improvements result
• Has limited support to create statistics in Query Environment Capture and Workload Environment Capture service support
• Strategic investment spans databases

DB2 SQL Performance Analyzer
• Better support for classic z/OS env, DBRMs, batch analysis, and z/OS libraries
• ISPF-based, Command and JCL- driven
• Integrates with OM/PE VTAM and QM 3270 interfaces
• Creates real indexes for “WHAT-IF” scenarios for single queries
• Offers a best practices Query Advisor with approx. 150 rules
• Has full support for cloning statistics
• Continued z/OS-specific investment
Optimization Service Center (the fate of)

- Current OSC remains supported through DB2 9
- OSC functionality will be split among the following offerings:
  - Data Studio (no charge)
  - Query Tuner (single query tuning capabilities already overlap with Q[W]T today)
  - Base function in DB2 for z/OS customers
    - SQL environment capture
    - Profile monitoring
## Contents of Eclipse-based Query Tuning offerings

<table>
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<tr>
<th>Feature</th>
<th>Data Studio</th>
<th>Optim Query Tuner for z/OS</th>
<th>Optim Query Workload Tuner for z/OS</th>
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<tr>
<td>Queries from all sources</td>
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<td>Query Statistics Advisor</td>
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<td>Query Index Advisor</td>
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<td>Access Path Advisor</td>
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<td>Workload Statistics Advisor</td>
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<td>Workload Index Advisor</td>
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<td>Workload Query Advisor</td>
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</table>
End of query tuning
Revise SQL Without Modifying the Application

Capture → Review → Optimize → Revise → Restrict

Edit or delete SQL

Tooling validates equivalent SQL
Shows replaced
Eliminate SQL Injection

1. Restrict SQL execution to only those statements captured
2. Set `capturedOnly=true` in `pdq.properties`
3. `pureQuery` Runtime looks for it in the classpath
Optimize for WebSphere and DB2 with pureQuery

**Enhance development productivity**
- Code generation, content assist
- Database aware, Java SQL Editor

**Simplify impact analysis**
- Categorize by Java, SQL, Database, Packages, track back to line of code

**Prevent SQL Injection**
- Lock down SQL for dynamic or static execution

**Focus tuning efforts**
- Find and sort by query elapsed time from Java

**Enhance performance**
- Leverage best practices, automatically for JPA
- Use static execution, automatically for JPA
- Lock in access plans for consistent performance

**Reduce HW and SW costs**
- Up to 42% lower CPU/Trans
- Move workload to zIIP and zAAP

**Replace SQL without changing the source**
- Editor validates equivalency

**Speed up problem resolution**
- Trace SQL back to line of code in the application

**Capture metadata from existing applications**
- Capture from JPA without executing
- Derive performance, costs, security and manageability value

**Jump start application design**
- Generate SQL and Code from Database Objects
- Setup basic DAO Pattern

**Reduce security exposure**
- Grant access to queries, not tables

**Optimize for WebSphere and DB2 with pureQuery**

- Develop
- Design
- Deploy
- Operate
- Govern

**Policies Models Metadata**
Optim Development Studio and pureQuery Runtime

Trial: IBM Optim Development Studio and Optim pureQuery Runtime

Download Optim Development Studio, which provides an integrated database development environment for Oracle, DB2, and Informix. Optim Development Studio improves development productivity up to 50% for developing and testing SQL and XQuery queries, stored procedures, Web services, and Java data access layers.

Trial download

The evaluation period for this trial is 30 days. All of the product’s features are enabled.

A trial version of Optim pureQuery Runtime V2.2 is available within the Optim Development Studio V2.2 trial package for use on the same Windows or Linux machine. To try the pureQuery Runtime on another platform, contact your IBM sales representative or IBM Business Partner.

System requirements

The estimated download time using Download Director over a 1.5Mbps connection is 1 hour and 24 minutes; 43 minutes using Installation Manager.

Choose one of these options to download the trial. A Web install downloads and installs the product from a Web based repository. A local Install downloads and installs the product to your local hard drive.

<table>
<thead>
<tr>
<th>Operating system</th>
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<th>Download method</th>
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<td>Web install using IBM Installation Manager (recommended)</td>
<td>V2.2</td>
<td>480MB</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Windows, Linux</td>
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<tr>
<td>Web install if you already have IBM Installation Manager installed</td>
<td>V2.2</td>
<td>372MB</td>
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<tr>
<td></td>
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<td></td>
<td>Windows</td>
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</tbody>
</table>
Data movement options

UNLOAD Utility
- Designed for loading back into DB2 for z/OS
- Ultra fast loading of data when the source is in a relational table – even remote
- Perfect for remote loading/unloading
- Ideal data moving to another platform
- SQL interface enables developer usage
- Low CPU consumption

Crossloader (LOAD from INCURSOR DD)
- Ultra fast loading of data when the source is in a relational table – even remote
- Local or remote

LOAD/UNLOAD via pipes
- Perfect for remote loading/unloading
- High Performance Unload (z/OS and LUW)
- Ideal data moving to another platform
- SQL interface enables developer usage
- Low CPU consumption

SQL:
```
SELECT c2, char c3
WHERE...
```

Pipe: `LOAD utility` to `tablespace`
Backup: `UNLOAD utility` to `tablespace`
HPU: `select c2, char c3 where...`
Recovery Tooling

• What value is there to extending the DB2 backup and recovery utilities?
  • Safety net for a complex task
  • Ability to view and make surgical changes using the DB2 recovery log
  • Allows you to use DB2 9 function on a DB2 Version 8 system
Recovery management

- DB2 Change Accumulation Tool
- DB2 Log Analysis Tool
- DB2 Object Restore Tool
- DB2 Recovery Expert

- DB2 Cloning Tool
DB2 Recovery Expert for z/OS

- Wizard driven
  - Object selection (Database, Table space, Table, … Multiple objects supported)
- Point in time selection (Time, Quiesce point, Backup point, Log point)
- Recovery Paths / alternate recovery resources
  - Analyzes all possible recovery paths for a version and attaches a relative cost to each
  - Recommends the least cost recovery path while allowing other paths to be chosen
- Recovery paths include
  - Traditional restore and log apply (forward recovery)
  - Generating undo operations (backward recovery)
- Recommend set of objects to recover
  - Prompts the user to show related objects (next slide)
  - Assists in including these objects in the recovery process
- Manage recovery via policies: Recovery Policy – Insure that I can recover an application (set of DBMS objects) within twenty minutes to any point in time in the last week. {Supersedes the need for a backup policy}
Data Governance

- IBM Optim Data Growth
- IBM Optim Data Privacy
- IBM Optim Test Data Management
- DB2 Audit Management Expert
- IBM Database Encryption Expert
- Data Encryption for DB2 and IMS
Create Production-like, Privatized Databases

Optim Test Data Manager and Data Privacy Solutions

- Increase software quality
  - Use test data that accurately reflects production systems

- Accelerate release schedules
  - Comparison to expected results and fast refresh

- Comply with privacy regulations
  - De-identify personal information with realistic substitutions

- Protect confidential information
  - Mask sensitive data

- Facilitate consistent use
Optim Test Data Management and Data Privacy Solutions

Increase software quality and comply with regulatory requirements based on test data that accurately reflects production systems while protecting client privacy and sensitive information.

- Create targeted, right-sized test databases
  - Refresh, reset, and maintain test environments – quickly and easily
  - Extract complete, referentially intact business objects
  - Compare data to pinpoint and resolve application defects faster
- De-identify sensitive information
  - Substitute confidential information with fictionalized data
  - Protect private data in non-production environments
  - Provide contextual, application-aware, persistent data masking
- Facilitate consistent use
  - Define practices in InfoSphere Data Architect
  - Use repeatedly across environments

Production or Clone

Extract

Extracted Files

Load
Insert / Update
Compare

Development

Test

Anonymous
Analysis

SHARE in Boston
Optimize Systems for Growth

Optim Data Growth Solution

- Improve application performance
- Accelerate application upgrades
- Reduce the risk of application consolidation and retirement
- Comply with retention requirements
- Find information for legal discovery
Optim Data Growth Solution

Facilitates application growth, application upgrades, application retirement, and retention management.

- Complete business object provides historical reference snapshot of business activity
- Storage device independence enables storage cost optimization
- Immutable file format enables data retention compliance

Universal Access to Application Data

Application

Archives
- Reference Data
- Historical Data
- Reporting Data

Application XML ODBC / JDBC

SHARE in Boston
What's cooking back at the lab?

- Performance Management
The (not so new) differences between modern distributed apps and legacy Cobol and PL/I apps

<table>
<thead>
<tr>
<th>Legacy apps</th>
<th>Distributed Java apps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostly static SQL. Each program module was mapped to one DBRM under usually one DB2 PLAN.</td>
<td>Primarily dynamic SQL. No DBRMs or DB2 PLANs.</td>
</tr>
<tr>
<td>-&gt; Each app module automatically identified by auth ID, DBRM, and DB2 PLAN, and optionally CICS or IMS region</td>
<td>-&gt; Program had to identify itself via DB2 client info fields. Otherwise it would use default ids such as java.exe.</td>
</tr>
<tr>
<td>Program was running on mainframe only, no distributed access. Very small number of apps accessing database.</td>
<td>Distributed apps can access database from anywhere. A 'new app' is developed in short period of time.</td>
</tr>
<tr>
<td>-&gt; DBA knew each app personally 😊</td>
<td>-&gt; Increasing number of different apps accessing database. Not easy to keep an overview which app is running where.</td>
</tr>
<tr>
<td>DB2 pre-processor was well integrated into development languages</td>
<td>No pre-processor used. Program simply calls JDBC methods, or CLI functions to execute SQL statements</td>
</tr>
<tr>
<td>-&gt; each SQL statement was identified by source line number</td>
<td>-&gt; No information about location of SQL statement</td>
</tr>
<tr>
<td>Developer was coding SQL directly</td>
<td>Program is generating the statement text on-the-fly by concatenating strings, or frameworks and persistence layers like iBatis, Spring, EJB, JPA are generating the SQL statements out of programming language constructs</td>
</tr>
<tr>
<td>-&gt; easy to find and change SQL statement if necessary</td>
<td>-&gt; can be extremely difficult to identify origin of SQL statement. Changing SQL statement text can be impossible if you can't control the generation.</td>
</tr>
</tbody>
</table>
So, what is it what we are looking for?

Something ...

- #1 which tells me which application it is, and ultimatively which business function is performing
- #2 where I can measure what my application/user is really experiencing (from application to database and back) and which tells me which components are involved and where my application is spending its time.
- #3 which tells me where the SQL statement is coded and let’s me change it if necessary.
Performance Expert Extended Insight Feature

- IBM offers a feature for its database monitor DB2 Performance Expert for LUW called 'Extended Insight' to collect exactly this information automatically ...
  - Supports standard applications (WebSphere, InfoSphere Warehouse, SAP, DataStage, Cognos, eXtremeScale) and homegrown Java applications setting the DB2 client information fields
  - Support for static and dynamic SQL
  - Works with DB2 for LUW V9.1 or higher. DB2 for LUW V9.7 will give you additional insight into database side – where your application is spending its time
  - Easy deployment: only a few files have to be copied into location of DB2 driver on application side; no configuration on client side necessary.
  - Collects statement and transaction level information with low overhead on client side (<= 5% overhead)
  - Allows to check for Service Level Agreement (SLA) violations
Database Workload Overview - Extended Insight Feature

End-to-end database monitoring

- ... the most advanced way to monitor your applications and solution accessing data in a database.
- introduced in DB2 Performance Expert V3.2 in 12/2008 as priced feature with focus on WebSphere applications
- now enhanced to support out-of-the-box: WebSphere, Cognos, DataStage, SQL Warehouse, SAP
- will also be used to monitor other applications using JCC or CLI database drivers (.NET support will follow)
- intuitive to use because looking at the applications/solutions behind it and not into DB2 resources or DB connections
- will auto-detect the application behind the DB connection
Database Workload Details - Extended Insight Feature

- showing you the real response time of your application and where it is spending its time
- including database side – new with DB2 V9.7 FP1

seamlessly integrated with Optim Query Tuner; identify problematic SQL and tune it
SQL statement are not coded directly and generated on-the-fly during execution

- The developer can code additional queries – in SQL but also in its own EJB Query Language, which is once again ‘translated’ into SQL statements on the fly

```
@Entity
@Table(name="ORDER_TABLE")
public class Order {
    private int id;
    private String address;
    private Customer customer;

    @Id
    @Column(name="ORDER_ID")
    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    @Column(name="SHIPPING_ADDRESS")
    public String getAddress() {
        return address;
    }

    public void setAddress(String address) {
        this.address = address;
    }

    @ManyToOne()
    @JoinColumn(name="CUSTOMER_ID")
    public Customer getCustomer() {
        return customer;
    }

    public void setCustomer(Customer customer) {
        this.customer = customer;
    }
}
```

How can you fix a problematic SQL statement if you can’t even find it?
Tell me where my SQL is and let me control it

How pureQuery runtime can help

- **pureQuery runtime** allows to capture SQL statements and convert them into static SQL
- Includes information about origin of statement (class, method, java package, EJB query, etc.) and stack trace
- Information can be uploaded into performance monitor when application SQL is converted
- Works with all Java applications; transparent to app
Database Performance Monitoring + Tivoli Enterprise portal

• Can run stand alone, or inside Tivoli Enterprise Portal
• Integrated into ITCAM for Transactions; high application response times can be directly analyzed with database performance monitor
How to prepare yourself for the future …

- New functionality will not replace existing Optimization Expert, Query Monitor, or OMEGAMON XE products, but be an add-on to them …
- It will most likely have a pre-requisite for OMEGAMON XE Performance Expert for DB2 on z/OS (OMPE)
- Long-term: It might consolidate OMPEs graphical user interfaces into one
What's cooking back at the lab?

• Configuration Management
  • Speeding up problem determination by analyzing what has changed
  • Simplifying implementation of and checking adherence to best practices
  • Centralizing control of client configuration

• Maintenance Management
  • Managing large, complex enterprise environments by exception
  • Shifting from time-based maintenance via utilities to policy-based maintenance
  • Visualization of space management
The problem ...
Our solution!
Manage by Exception to Lower TCO

Disk Efficiency Alert

In excess of 40% of allocated space for database objects can be reclaimed. Recommended courses of action:

- Turn off alert - "I don't care or I will handle this all on my own"
- Change alert threshold - "Customize to my environment or workload"
- Reclaim space now - "I need to fix it now, but need some options to tailor."
- Reclaim space later - "Schedule during maintenance window, possibly repeatedly."
- Automate space reclamation - "Just do it for me, I have more important things to do."

TCO:

- Fully manual
- High TCO
- Fully automatic
- Low TCO
Enable Fully-manual to Fully-automated Management

Best Practice Violation Alert: Log and Data Files Collocated on Single Disk
Log files are on same disk as table space container files which negatively impacts performance and may potentially prevent full recovery upon disk failure.

Recommended courses of action:
- Turn off alert - "I will figure out how to handle this all on my own"
- Manually reconfigure now - "I need to fix it myself now, but a little guidance would be nice."
- Reconfigure later - "Script the reconfiguration and schedule during maintenance window."
- Automate this best practice - "Just do it for me, I have more important things to do."
Manage by Exception to Lower TCO

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<th>Name</th>
<th>Monitoring Status</th>
<th>Data Server Status</th>
<th>Critical</th>
<th>Warning</th>
<th>CPU Usage</th>
<th>Disk Space</th>
<th>Memory Usage</th>
<th>System</th>
<th>Configuration</th>
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<th>Connections</th>
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</table>

**Configuration Change Alerts:**

- Table space container 'tblsp25003' is no longer on disk
- Index 'idx00453' has been dropped from table 'mkt.tblA'
- Column 'A' of table 'mkt.tblA' changed data type from INT to FLOAT
- Configuration parameter 'Automaintenance' changed from ON to OFF
Data Management Communities for DB2

• IDUG – the worldwide community of DB2 users
  • Membership is FREE – join today! www.idug.org

• Data Management Community – share and interact with peers around the world
  • www.ibm.com/software/data/management/community.html

• Information Champions – recognizes individuals who have made the most outstanding contributions to the Information Management community
  • www.ibm.com/software/data/champion
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