DB2 for IBM i – Briefing for Omni
“Latest & Greatest on IBM i 7.1”

Application Development Perspective

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DB2 for i

- Continual Investment
- Innovation
- Core values
- IBM i 7.1 ➔ big release
- Numerous enhancements delivered on the same cadence as Technology Refreshes (TRs)
DB2 for i
- Standard compliant
- Secure
- Scalable
- Functionally Advanced
- Excellent Performance
- Easier to use
- Easier to maintain

Value Proposition

Continual Investment and Innovation

V5R1
- SQL triggers
- Java Functions
- DRDA DUW TCP/IP
- 2 GB LOBs
- 1 Terabyte Table
- Journal Minimal Data
- Two-phase over TCP/IP
- DDL Journaling
- Database Navigator
- Generate SQL

V5R2
- SQE Stage 1
- IASPs
- Identity columns
- Savepoints
- UNION in views
- Scalar subselect
- UDTFs
- DECLARE GLOBAL TEMPORARY TABLE
- Catalog views
- JDBC V3.0
- DRDA Kerberos
- Journal Standby

V5R3
- Partitioned tables
- UFT-8 and UTF-16
- ICU sort sequence
- MQTs
- Sequences
- Implicit char/numeric
- BINARY/VARBINARY
- GET DIAGNOSTICS
- DRDA Alias
- DECIMAL(63)
- SQE Stage 3
- Ragged SWA
- QDBRPLAY
- Online Reorganize

V5R4
- WebQuery
- SSD Memory Preference
- On Demand Performance Center
- Health Center
- Completion of SQL Core
- Expressions in Indexes
- Row Change Timestamp
- Statistics catalog views
- CLIENT special registers
- SQE Stage 6
- DDM and DRDA IPv6
- Deferred Restore of MQTs and Logicals
- Implicit journaling enhancements

7.1
- XML Support
- Encryption enhancements (FIELDPROCs)
- Result set support in embedded SQL
- CURRENTLY COMMITTED
- MERGE
- MQ Functions
- Global variables
- Array support in procedures
- Partition table enhancements
- Three-part names and aliases
- SQE Logical file support
- SQE Adaptive Query Processing
- EVI enhancements
- Inline functions
- CREATE OR REPLACE

6.1
- Omnifind
- MySQL storage engine
- DECIMAL
- Grouping sets /supergroups
- INSERT in FROM
- VALUES in FROM
- Extended Indicator Variables
- Expression in Indexes
- ROW CHANGE TIMESTAMP
- Statistics catalog views
- CLIENT special registers
- SQE Stage 6
- DDM and DRDA IPv6
- Deferred Restore of MQTs and Logicals
- Implicit journaling enhancements

Next?
- Row and Column Access Control
- CONNECT BY
- XMLTABLE
- OLE DB Extensions
- Regression Functions/Covariance/Correlation
- TRANSFER
- OWNERSHIP
- Named arguments and defaults for parameters
- Obfuscation of SQL routines
- Array support in UDFs
- Timestamp precision
- Multiple-action Triggers
- Built-in Global Variables
- Record movement between partitions on UPDATE
- 1.7 Terabyte Indexes
- Health Center – Non-database limits
- Navigator Graphing and Charting

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DB2 for i – Enhancements delivered via DB2 PTF Groups

IBM i 7.1

TR3
TR4
TR5
TR6
TR7

TR4 timed Enhancements:
- XMLTable
- RUNSQL command
- Performance enhancements for large numbers of row locks
- Automatic management of SQL Plan Cache size
- Many Others…

TR5 timed Enhancements:
- Named and Default Parameters for Procedures
- Infosphere Guardium V9.0 – DB2 for i
- SQE enhancement for Encoded Vector Indexes defined with INCLUDE
- Many Others…

TR6 timed Enhancements:
- HTTP functions
- Database Reorganization (User specified starting point)
- Tracking System Limits (Phase 1)
- Many Others…

TR7 timed Enhancements:
- Dynamic Compound
- Additional RPG Free Format
- 1.7 TB Indexes
- Tracking System Limits (Phase 2)
- Many Others…

Enhancements delivered by PTF are documented here:
www.ibm.com/developerworks/ibmi/techupDATES/db2
& in this article “A Hit Parade of DB2 for i Enhancements”
http://iprodeveloper.com/database/hit-parade-db2-i-enhancements

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DB2 for i – Enhancements delivered by DB2 PTF Groups

- The developerWorks IBM i Technology Updates wiki includes the schedule, status and enhancement breakdown.

  www.ibm.com/developerworks/ibmi/techupdates/db2/groupptf

### DB2 for i 7.1

<table>
<thead>
<tr>
<th>PTF Group</th>
<th>Enhancements in this DB PTF Group</th>
<th>Level</th>
<th>External Availability</th>
<th>Status</th>
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<tr>
<td>SF99701</td>
<td>Group 21 enhancements</td>
<td>21</td>
<td>1/16/2013</td>
<td>Released</td>
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<tr>
<td>SF99701</td>
<td>Group 22 enhancements</td>
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<td>3/8/2013</td>
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<td>Group 24 enhancements</td>
<td>24</td>
<td>6/19/2013</td>
<td>Group 24 re-released to include PTFs MF57366 &amp; MF57329 Released</td>
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<td>SF99701</td>
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<td>25</td>
<td>8/20/2013</td>
<td></td>
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<tr>
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<td>26</td>
<td>11/15/2013</td>
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### DB2 for i 6.1 and 6.1.1

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<tr>
<th>PTF Group</th>
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<th>External Availability</th>
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<td>30</td>
<td>7/17/2013</td>
<td>Released</td>
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<td>SF99601</td>
<td>31</td>
<td>12/6/2013</td>
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</table>
developerWorks – Communities and more…


Forums and communities

- **IBM i OpenSSH and OpenSSL community**
  OpenSSH/OpenSSL information related to the IBM Portable Utilities for i (5733-SC1) product.

- **DB2 for i**
  Connect with your DB2 for i peers. Ask questions and share solutions with your fellow developers and DBAs on the DB2 for i forum.

- **IBM i**
  This new forum is a technical discussion for the interchange of information related to all IBM i topics.

- **RPG Cafe**
  This forum is for discussions on the RPG language.

- **Rational Developer for Power Systems**
  This forum is for discussions on Rational Developer for Power Systems.

- **midrange.com technical discussion mailing lists**
  Email based technical discussion forums for IBM i professionals

- **IBM i Backup/Recovery**
  This forum provides a place for IBM i questions related to backup and recovery.

- **IBM i Firmware**
  This forum provides a place for IBM i questions related to server firmware.

- **iPro Developer Forums**

- **WebSphere Development Studio for iSeries**
  This forum provides a place for IBM i questions related to WDS.

- **IBM i. Logical Partitioning (LPAR)**
  This forum provides a place for IBM i questions related to Logical Partitioning.
DB2 for i – Explaining the technology

- Enhancements delivered by PTF are documented here: www.ibm.com/developerworks/ibmi/techupdates/db2

- The 7.1 SQL Reference is updated on the same TR cadence: http://pic.dhe.ibm.com/infocenter/iseries/v7r1m0/topic/db2/rbafz.pdf

- The “IBM i 7.1 Technical Overview” Redbook gets updated periodically: http://www.redbooks.ibm.com/abstracts/sg247858.html

- We publish deep dive White Papers on some topics:

- We explore some Technology topics with articles: www.ibm.com/developerworks/ibmi/library

- DB2 for i – Power page: http://ibm.com/systems/i/db2
IBM Power Systems

DB2 Family Products

Infosphere Data Architect
- Enterprise data modeling and management

DB2 Connect
- .NET Plug ins - Entity Framework

Optim Data Studio
- Graphical development, deployment, and debug of SQL procedures and functions

OmniFind
- Text indexes and text search

Infosphere Guardium
- Real-time Database Protection and Compliance

Change Data Capture
- Enterprise replication

Infosphere Optim Test Data Management
- Streamlined test data management
Data Studio 4.1 & DB2 for i

Use with Data Studio & DB2 for i to:
- Develop SQL Procedures and Functions against DB2 for i
- Create and Execute SQL scripts
- Leverage context sensitive SQL aids
- Graphically debug, using the JCC driver
- Prepare for Toolbox JDBC deployment by setting JDBC connection properties
- Develop with DB2 Express-C (no charge), then obtain a DB2 Connect trial license to test out deployment to IBM i or DB2 for z/OS prior to purchase.

Access the Data Studio product here...

Works with IBM i 6.1 and 7.1

IBM Data Studio

Simplify database administration, accelerate application development and increase collaboration

Download at no charge

IBM Data Studio provides an integrated, modular environment for database development and administration of DB2 for Linux, UNIX and Windows. It also offers collaborative database development tools for IBM DB2 for z/OS, DB2 for i and IBM Informix®. This software is available at no charge.

IBM Data Studio enables developers and administrators to create and manage heterogeneous database environments for increased productivity.

- Streamline database development with advanced query validation, object management and system deployment features.
- Improve collaboration through an integrated environment and shared platforms.
- Help save time and reduce errors using advanced data management, configuration and administration tools and features.
IBM Data Studio debugger and IBM DB2 for i

Kent Milligan’s feature article explains how to…

Graphically debug SQL Procedures and UDFs

IBM® Data Studio provides a graphical debugger that can be used with IBM DB2® for i SQL and Java™ stored procedures as well as SQL user-defined functions.

This powerful debugger can help you quickly identify and resolve issues with your SQL code.

This article shows how to configure and use the Data Studio debugger with DB2 for i procedural objects.

Find the article here…

App Dev Enhancements – Base IBM i 7.1

- XML data type and more
- Three-part names and aliases
- **Global variables**
- Result set support in embedded SQL
- MERGE
- Database Monitor – Filter by Client Special Registers
- **CREATE OR REPLACE** for many DDL statements
- **CURRENTLY COMMITTED**
- Array support in procedures
- 128-byte schema names
- Allow transactions to span *SYSBAS and IASPs
- And others…
App Dev Enhancements – 2011 With TR2 & TR3

- CONNECT BY
- OmniFind searching of non-DB2 tables
- ADD LIBRARY LIST support to JDBC 4.0 getSchemas() method
- Retrieve Short Name support for long schema name (QDBRTVSN)
- Add FTRSQLCODE parameter to STRDBMON
- And others...
App Dev Enhancements – 2012 With TR4 & TR5

- XMLTABLE
- Named Arguments and Defaults for Parameters – Procedures
- Run SQL (RUNSQL) - new command
- INSERT with remote SUBSELECT
- CREATE TABLE with remote SUBSELECT
- SQL Procedure and Function obfuscation
- JTOpen Lite and JTLite – enabling mobile devices which use java
- System naming convention expanded to permit (slash) and (dot) qualifiers
- Java stored procedures and functions - System naming option
- OmniFind for IBM i – searching Multiple Member source physical files
- And others…
App Dev Enhancements – 1Q/2013 With TR6

- Multiple events supported in a single SQL trigger
- Direct control of system names for tables, views and indexes
- **New HTTP functions added to SYSTOOLS** ← Demo
- DB2 Connect - system naming attribute
- **CHECK_SYSROUTINE()** procedure added to SYSTOOLS
- And others…
App Dev Enhancements – 4Q/2013 With TR7

- Dynamic Compound SQL statement
- Remote 3-part name – controlled using RDB aliases
- DB2 Connect – date, time and timestamp data type support
- A new breed of DB2 for i catalogs
- Additional Full free-format RPG for Embedded SQL
- IBM i Debugger - Step through SQL Procedure, Function or Trigger source
- And others…
Field Procedures and Data Encryption

Create a CUSTOMER table where the CCNBR column has a FIELDPROC.

CREATE TABLE CUSTOMER ( 
    NAME VARCHAR(50),
    ADDRESS VARCHAR(100),
    CCNBR CHAR(16) FIELDPROC ENCRYPTLIB.ENCRYPTPGM1 )

Alter an existing CUSTOMER table to add a FIELDPROC to the CCNBR column.

ALTER TABLE CUSTOMER
    ALTER COLUMN CCNBR SET FIELDPROC ENCRYPTLIB.ENCRYPTPGM1

White Paper: Protecting IBM i data with encryption

Articles:
Enable Transparent Encryption with DB2 Field Procedures

DB2 Field Procedures Finally Support Conditional Masking
www.mcpressonline.com/rpg/db2-field-procedures-finally-support-conditional-masking.html
RDB alias support for 3-part SQL statements

- Instead of using CREATE ALIAS (SQL) to deploy database transparency, the Relational Database Directory Entry Alias name can be used.

```
ADDRDBDIRE RDB(X1423P2 MYALIAS) RMTLOCNAME(X1423P2 *IP)
INSERT INTO WORKTABLE SELECT * FROM MYALIAS.SALESLIB.DAILY_SALES

CHGRDBDIRE RDB(LP13UT16 MYALIAS) RMTLOCNAME(LP13UT16 *IP)
INSERT INTO WORKTABLE SELECT * FROM MYALIAS.SALESLIB.DAILY_SALES
```

Note:
The SQL statement text does not change

Article: Improve Your Data Center with Three-part Name Aliases
OmniFind for IBM i – enhancements abound

- The OmniFind™ Text Search Server for DB2 for i product (5733-OMF) for IBM i 7.1 has been enhanced to include additional SQL programmable interfaces that extend its support beyond traditional DB2 tables.
- **Multiple Member source physical files** are added one at a time to the OmniFind collection. The members from source physical file are retrieved and treated as separate objects.
- **Spool files** and **IFS Stream Files** can be added to OmniFind collections
- Integration into Navigator for I
- And more…

Articles:

**Searching source physical file members using IBM OmniFind Text Search server for DB2 for i 7.1**

**Introduction to IBM i OmniFind Health Checker**

**Searching Spool Files and IFS Stream Files**
## Navigator – what database users need to know

<table>
<thead>
<tr>
<th>What are the choices?</th>
<th>IBM i Navigator (aka System i Navigator)</th>
<th>IBM Navigator for i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where does it run?</td>
<td>Windows PC Install</td>
<td>Browser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Served from IBM i 6.1 or 7.1</td>
</tr>
<tr>
<td>Recent service level?</td>
<td>IBM i Access Windows Service Pack 7.1 – SI50567 ➔ TR7</td>
<td>IBM HTTP SERVER FOR i PTF Group: 7.1 - SF99368 Level 24 ➔ TR7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.1 - SF99115 Level 35</td>
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<tr>
<td>Database commonality</td>
<td>Most features are identical, including TRx enhancements</td>
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</tr>
<tr>
<td>Database differences</td>
<td>Run SQL Scripts</td>
<td>Time-based performance metrics for SQL OmniFind administration</td>
</tr>
<tr>
<td></td>
<td>Visual explain</td>
<td></td>
</tr>
<tr>
<td>Next (planned) Update</td>
<td>May 30, 2014 ➔ IBM i 7.1 TR8</td>
<td>May 30, 2014 ➔ IBM i 7.1 TR8</td>
</tr>
</tbody>
</table>
Windows Installed Client - Best Practices

1. Use the latest version of Navigator release/service pack regardless of your IBM i OS release
2. Use the **Columns**… control to customize & order detail
3. Create Navigator shortcuts on the desktop
Windows Installed Client - Best Practices

4. Direct Launch of Run SQL Scripts from a Shortcut

"C:\Program Files (x86)\IBM\Client Access\Shared\cwbundbs.exe" /s=<machine> <optional-RSS-filename>

Example:
"C:\Program Files (x86)\IBM\Client Access\Shared\cwbundbs.exe" /s=rchaptf3.rch.stglabs.ibm.com "C:\Users\IBM_ADMIN\Documents\ODBC tests\dump plan cache today.sql"
Feature Enhancements in the field

Features available with an IBM i OS target of 6.1 or 7.1

- Health Center – System Limits
- Audit journal viewer
- Generate SQL additional indexes option
- Table reorganization – Starting from record (FROMRCD) option
- Tables list new member details columns
- Monitor compare multiple plan/plan change option
- Run SQL Scripts – hide result sets when running multiple statements
- Additional filtering on include dialog for tables and indexes
- Media Preference
Feature Enhancements in the field

Features available with an IBM i OS target of 7.1

1. Generate SQL –
   - Obfuscation
   - OR REPLACE
   - SQL Privilege statements
   - Schema qualified names

2. Procedures & Functions ➔ New Based On

3. Multi-event triggers

4. Show statements –
   - Exact match from index advice
   - Key match from condensed index advice
   - OR'd filtering
   - Show Job History

5. Index advice – Dependent on Other Advised Indexes column

6. Additional columns in index build

7. System SQL Plan Cache properties – n number of plans

8. SQLCODE filter on new monitor wizard
New Generate SQL options

- **SQL Privileges** (GRANT statements to match authorizations on the object)
- Schema qualify names for objects (easily cleansed)
- Column CCSID values (easily cleansed)
- OR REPLACE clause
- Obfuscate (treat SQL logic as a corporate asset)
- Generate index options (modernize DDS→SQL)

Output Options

- Standards
  - ANSI/ISO
  - DB2 family
  - Extensions

- Output
  - SQL privilege statements
  - System names for objects
  - Schema qualify names for objects
  - Column CCSID values
  - Drop statements
  - Labels and comments
  - Associated constraints and triggers (for table objects)
  - Informational messages
  - OR REPLACE clause
  - Obfuscate (for SQL function, procedure, and trigger objects)
  - Generate additional indexes (for keyed physical and logical files)
  - Generate index instead of View (for keyed logical files)

Generate
DB2 for i – Function Usage IDs

Database Function Usage Identifiers:

- **QIBM_DB_DDMDRDA** (ability to lock down DRDA and DDM application server access)
- **QIBM_DB_SQLADM** (enable use of OnDemand Performance Center tools and more)
- **QIBM_DB_SYSMON** (SQL Details for jobs)
- **QIBM_DB_ZDA** (restrict ODBC and JDBC Toolbox from the server side, including Run SQL Scripts, System i Navigator and others)

Articles:

**Improved Security Controls Open Door to DB2 for i Tool Usage**
http://iprodeveloper.com/database/improved-security-controls-open-door-db2-i-tool-usage

**Granular security control with function usage**
ADD ORDERBY parameter to CPYTOIMPF command

The new (optional) ORDERBY parameter can be used to control how rows are identified for the copy operation.

ORDERBY parameter values:

1) *NONE - No specific order requested. This is the default value for the command.

2) *ARRIVAL - The records will be inserted in Relative Record Number order.

3) character-value - Specifies an SQL ORDER BY clause that will be used for ordering the records in the to file.

Example:

CPYTOIMPF FROMFILE(CORPDB1/DEPARTMENT) TOSTMF('/dept.file') RCDDLM(*LF) ORDERBY(*ARRIVAL')

CPYTOIMPF FROMFILE(CORPDB1/DEPARTMENT) TOSTMF('/dept.file') RCDDLM(*LF) ORDERBY(' DEPTNO ASC FETCH FIRST 5 ROWS ONLY ')

After the ORDER BY detail, the user can tack on the following:

- FETCH FIRST n ROWS
- OPTIMIZE FOR n ROWS
- FOR UPDATE
- FOR READ ONLY
- WITH <isolation-level>
- SKIP LOCKED DATA
- USE CURRENTLY COMMITTED
- WAIT FOR OUTCOME
**CPYTOIMPF and CPYFRMIMPF commands – Include column headings**

**Copy To Import File (CPYTOIMPF)** – a new (optional) parameter indicates whether the column names should be included as the first row in the target file.

**ADDCOLNAM** (*NONE or *SQL or *SYS)

* NONE – (default) don’t include the columns names
  * SQL – The column SQL names will be used to populate the first row
  * SYS – The column System names will be used to populate the first row

**Copy From Import File (CPYFRMIMPF)** – a new (optional) parameter indicates whether the first row should be skipped when processing the import file.

**RMVCOLNAM** (*NO or *YES)

* NO – (default) don’t skip the first row
  * YES – remove the columns names from the file being imported by skipping the first row of data
Database commands - instrumented for Client Special Registers

- **RUNSQLSTM, RUNSQL, STRSQL, WRKQRY, RUNITQRY, STRQRY & STRQMQR** commands are instrumented to utilize default values for the Client Special Registers.
- Use these registers to identify workloads, track usage, and more.
- Surfaces in SQL Details for Jobs, STRDBMON, Visual Explain, Health Center, etc.

- **STRQMQR** Client Special Register values:
  - CURRENT CLIENT_APPLNAME – “START QUERY MANAGEMENT QUERY”
  - CURRENT CLIENT_PROGRAMID – “STRQMQR”
  - CURRENT CLIENT_USERID – <Caller of the command>
  - CURRENT CLIENT_WRKSTNNAM – <database name>
  - CURRENT CLIENT_ACCTNG – <Accounting code (ACGCDE) of caller>

- Database Monitor pre-filtering:
  STRDBMON OUTFILE(DBMONLIB/QMQRMON1) JOB(*ALL/*ALL/*ALL) FTRCLTPGM(STRQMQR)

Article: **SOX Auditing of STRSQL and RUNSQLSTM Commands**
App Dev & DB2 for i – did you know these 5 things?

1. When moving to IBM i 7.1 → **Rebuild SQL Procedures, Functions and Triggers.** Why? We have better code generation logic on 7.1.

2. IBM i Navigator’s Run SQL Scripts – **Check SQL Portability** shows your readiness for deployment on other DB vendors
App Dev & DB2 for i – did you know these 5 things?

3. Earliest Possible Release – statement or program level

Determine IBM i OS deployment readiness based upon SQL use

- **Embedded SQL** – Use the QSYS2/SYSPROGRAMSTAT catalog

<table>
<thead>
<tr>
<th>EARLIEST_POSSIBLE_RELEASE</th>
<th>MINRLS</th>
<th>VARCHAR(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nullable</td>
</tr>
</tbody>
</table>

Indicates the earliest IBM i release that supports all the SQL statements in the program, service program, or module (VxRxMx).

- **Dynamic SQL** – Use Database Monitor

The QQC82 column contains the earliest IBM i OS release level where this SQL statement is supported.

**Possible values for QQC82:**

' ' - The statement release level has not been determined

'ANY' - The statement is valid on any supported IBM i OS release

'V6R1M0' - The statement is valid on IBM i 6.1 or later

'V7R1M0' - The statement is valid on IBM i 7.1 or later
App Dev & DB2 for i – did you know these 5 things?

4. Client Special registers are truly “special”

Client Special registers were added to IBM i 6.1. DB2 for i tooling includes these registers both as output (identification of workload) and filter (find something specific)

Identify applications and workloads using:

- Set Client Information (SQLESETI) API
- SQL Call Level Interface (SQL CLI) – SQLSetConnectAttr()
- ODBC – SQLSetConnectAttr()
- JDBC - setClientInfo() connection method
- SYSPROC.WLM_SET_CLIENT_INFO procedure

Find out more here:

App Dev & DB2 for i – did you know these 5 things?

5. Database monitor can be used to isolate application problems.

Use IBM i Navigator’s SQL Performance Monitor pre-filter support to identify specific or general SQLCODE criteria.

Or

Use the Start Database Monitor (STRDBMON) command Filter by SQLCODE

```
STRDBMON
OUTFILE(DBMONLIB/LOCKMON)
JOB(*ALL/*ALL/QZDASOINIT)
TYPE(*DETAIL)
FTRSQLCODE(-913)
```