DB2 for i – What’s New

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DB2 for i Center of Excellence
Who is the DB2 for i Center of Excellence?
An experienced IBM Team delivering:

- Product Offerings Developed through Engagements
- Briefings, consulting and guidance on demand
- IBM i for Business Intelligence Installation Services
- DB2 Web Query Getting Started Services
- Query/400 Modernization Services
- DB2 for i Modernization Workshop(s)
- DB2 for i SQL Performance Workshop
- DB2 for i SQL Performance Health Check
- DB2 for i Very Large Database (VLDB) Assessment
- DB2 for i remote database administration and engineer services

For more information, contact Mike Cain (cain@us.ibm.com)
Or Doug Mack (mackd@us.ibm.com)
Reminder - DB2 for i's strength!

One Database Management System with multiple interfaces

- Command Language (CL)
- Structured Query Language (SQL)
  - Embedded Static, Dynamic
  - ODBC
  - JDBC
  - CLI
  - PHP
- CREATE TABLE
- SELECT...
  FROM...
- UPDATE...

High Level Language
Record Level Access
DB2 for i
- Standard compliant
- Secure
- Scalable
- Functionally Advanced
- Excellent Performance
- Easier to use
- Easier to maintain

**Value Proposition**

**DB2 Features**

**V5R4**
- WebQuery
- XML Support
- Encryption enhancements (FIELDPROCs)
- Result set support in embedded SQL
- CURRENTLY COMMITTED
- MQ Functions
- SQE Logical file support
- EVI enhancements
- Inline functions
- CREATE OR REPLACE

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

**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

**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

**Continual Investment and Innovation**

7.2
- Row and Column Access Control
- XMLTable
- CONNECT BY
- TRANSFER OWNERSHIP
- Named arguments and defaults for parameters
- Obfuscation of SQL routines & triggers
- 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
- SQE I/O Costing model improvement
- TRUNCATE

**7.1**
- XML Support
- Encryption enhancements (FIELDPROCs)
- Result set support in embedded SQL
- CURRENTLY COMMITTED
- MERGE
- MQ Functions
- SQE Logical file support
- EVI enhancements
- Inline functions
- CREATE OR REPLACE

**6.1**
- Omnipfind
- MySQL storage engine
- DECIMAL
- Grouping sets /super groups
- 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 MQT and Logicals
- Environmental limits

**DB2 Value Proposition**

- Standard compliant
- Secure
- Scalable
- Functionally Advanced
- Excellent Performance
- Easier to use
- Easier to maintain

**IBM Information Management software**

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DB2 for i – Enhancements delivered via DB2 PTF Groups

IBM i 7.1

TR3 2012
SF99701 Level 11

TR4
SF99701 Level 14

TR5 2013
SF99701 Level 18

TR6
SF99701 Level 23

TR7
SF99701 Level 26

TR4 timed Enhancements:
- Performance enhancements for large numbers of row locks
- Automatic management of SQL Plan Cache size
- Field Procedure Masking
- CPYTOIMPF order by
- Many Others...

TR5 timed Enhancements:
- InfoSphere Guardium V9.0 – DB2 for i
- SOE enhancement for Encoded Vector Indexes defined with INCLUDE
- SQL metrics in Collection Services
- 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
DB2 for i – Enhancements delivered via DB2 PTF Groups

IBM i 7.1 & 7.2

7.2 - GA
- First DB2 PTF Group for 7.2
- All IBM i 7.1 Enhancements thru TR8

7.1 - TR8 timed Enhancements:
- High priority enhancements based upon customer requests
- Enhanced ability to programmatically analyze performance
- New DB2 for i services
- And more…

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

IBM i 7.1 TR8 – Landing page for all 7.1 TR8 enhancements:

IBM i 7.2 – Landing page for all 7.2 enhancements:
www.ibm.com/developerworks/ibmi/techupdates/i72
What is a ‘Technology Refresh’?

Technology Refresh is overloaded term:

1. The **TR PTF** (MF9900x)
   - A hardware enablement ptf that resets the ptf chains
2. The **TR PTF Group** (SF99707)
   - Contains the TR PTF plus other critical changes
3. A **Set of Enhancements** timed to release with the TR PTF Group
   - New capabilities in the OS or associated products
   - Usually done as group ptfs e.g. DB2 group SF99701

What do the ‘TR’s have in Common’?

- They are announced together
- They are available at (roughly) the same time
- They are brought out approximately twice a year

The ‘TR’s being discussed for DB2 for i are the third type above
IBM i 7.2
DB2 for i - 7.2 Enhancements by role - Security

Security & DB2 for i

- Column Masks
  ➔ Deploy “need to know” logic

- Row Permissions
  ➔ Simpler & safer security

- Violation clause for CHECK constraints
  ➔ Protect data integrity

- Secure remote journal using SSL
  ➔ Achieve HA & DR objectives without exposure

- SQL alternative to CHGOBJOWN
  ➔ Embrace separation of duty, using SQL

- Use adopted authority identity within business logic
  ➔ “Who am I?” conditional code using SQL

Data-Centric Security

- Comprehensive
- Auditable
- Sustainable
- Scalable
- Manageable

Data is an asset… what’s your data worth?
DB2 for i - 7.2 Enhancements by role - Security

New SQL Statements for security
- CREATE PERMISSION
- ALTER PERMISSION
- CREATE MASK
- ALTER MASK
- ALTER TRIGGER
- TRANSFER OWNERSHIP

New Boss Option
IBM Advanced Data Security for i
(Boss option 47)
No Charge

New Built-in Function
- VERIFY_GROUP_FOR_USER()

New Function Usage ID
- QIBM_DB_SECADM

New Catalogs
- QSYS2/SYSCONTROLS
- QSYS2/SYSCONTROLSDEP

New tools in the toolbox…

New Journal Entry Types
For journal code D - Database file:
- M1, M2, M3 for create/drop/alter mask
- P1, P2, P3 for create/drop/alter permission

For journal code T – Audit trail:
- AX for Row and Column Access Control
- X2 for Query manager profile changes
DB2 for i - 7.2 Example - Row and Column Access Control

CREATE MASK SSN_MASK ON EMPLOYEE
   FOR COLUMN SSN RETURN
   CASE
       WHEN (VERIFY_GROUP_FOR_USER(SESSION_USER, 'PAYROLL') = 1)
           THEN SSN
       WHEN (VERIFY_GROUP_FOR_USER(SESSION_USER, 'MGR') = 1)
           THEN 'XXX-XX-' CONCAT SUBSTR(SSN, 8, 4)
       ELSE NULL
   END ENABLE;
ALTER TABLE EMPLOYEE ACTIVATE COLUMN ACCESS CONTROL;

CREATE PERMISSION PATIENT_TABLE_HMO_PERMISSION
ON HOSPITAL.PATIENT_TABLE
FOR ROWS
WHERE ((VERIFY_GROUP_FOR_USER(SESSION_USER, 'PCP') = 1 AND
    HOSPITAL.PATIENT_TABLE.PCP_ID = SESSION_USER) OR
    VERIFY_GROUP_FOR_USER(SESSION_USER, 'ACCTGROUP') = 1 OR
    VERIFY_GROUP_FOR_USER(SESSION_USER, 'RESGROUP') = 1)
ENFORCED FOR ALL ACCESS ENABLE;
ALTER TABLE HOSPITAL. PATIENT_TABLE ACTIVATE ROW ACCESS CONTROL;

IBM Advanced Data Security for i
(Boss option 47)
No Charge
Obfuscation provides the capability of optionally obscuring proprietary SQL statements and logic within SQL procedures, functions & triggers.

This support can be used to prevent others from seeing or changing SQL routines & triggers.

Obfuscation of Procedures & Functions was PTF’d back to IBM i 7.1
DB2 for i - 7.2 Temporary storage – A mystery revealed

- Observe System-wide Temporary storage consumption via a new DB2 for i Service: QSYS2/SYSTMPSTG
- Read all about it in IBM Knowledge Center: www.ibm.com/support/knowledgecenter/ssw_ibm_i_72/rzajq/rzajqviewsystmpstg.htm

-- Which jobs are the top consumers of temporary storage?
SELECT bucket_current_size, bucket_peak_size, rtrim(job_number) concat '/' concat rtrim(job_user_name) concat '/' concat rtrim(job_name) as q_job_name
FROM QSYS2.SYSTMPSTG
WHERE job_status = '*ACTIVE'
ORDER BY bucket_current_size desc

<table>
<thead>
<tr>
<th>BUCKET_CURRENT_SIZE</th>
<th>BUCKET_PEAK_SIZE</th>
<th>Q_JOB_NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1236582400</td>
<td>1239851008</td>
<td>341402/QLMISVR/ADMIN2</td>
</tr>
<tr>
<td>706727936</td>
<td>789934080</td>
<td>342172/QDBTS/QJVAEXEC</td>
</tr>
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<td>463557452</td>
<td>482213888</td>
<td>367435/NTL/QADEV0000G</td>
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<tr>
<td>377365756</td>
<td>377368576</td>
<td>342174/QDBTS/QJVAEXEC</td>
</tr>
<tr>
<td>376946688</td>
<td>376946688</td>
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</tr>
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<td>335908664</td>
<td>342176/QDBTS/QJVAEXEC</td>
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<td>342177/QDBTS/QJVAEXEC</td>
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<tr>
<td>241729536</td>
<td>246112256</td>
<td>341120/QWEBADMIN/ADMIN1</td>
</tr>
<tr>
<td>226590720</td>
<td>229935212</td>
<td>367447/QUSER/QZDASOINIT</td>
</tr>
<tr>
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<td>194002944</td>
<td>341564/QLMISVR/SMART1113</td>
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<td>178647040</td>
<td>341121/QLMISVR/ADMIN1</td>
</tr>
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<td>341266/QLMISVR/ADMIN3</td>
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<td>162689024</td>
<td>367429/QLSTD/QTDFTB08D</td>
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<tr>
<td>156450816</td>
<td>156450816</td>
<td>341651/QLMISVR/SMART1115</td>
</tr>
<tr>
<td>151515136</td>
<td>151560192</td>
<td>340925/QSYS/QTCPWRK</td>
</tr>
<tr>
<td>108703744</td>
<td>122335232</td>
<td>000000/QSYS/SCPF</td>
</tr>
<tr>
<td>98451456</td>
<td>114917376</td>
<td>368352/QUSER/QZDASOINIT</td>
</tr>
</tbody>
</table>
DB2 for i - 7.2 Enhancements by role - Performance

Database Performance
- **SQE** enhancements:
  - Improved I/O Costing Model
  - Enhanced implementation for IN list processing
- **Navigator** enhancements:
  - New PDI perspectives
  - Enhanced SQL Plan Cache detail and tuning
- And other enhancements that were brought back to IBM i 7.1 alongside Technology Refreshes

Out of the Box... what’s **faster**?
- I/O intensive queries
- Queries with long IN lists

** Disclaimer: Realized performance gains depends upon many factors

New Service
- QSYS2/DUMP_SNAP_SHOT_PROPERTIES() procedure
SQE - I/O Cost Model Enhancement

**Motivation**
- Query optimizer needs to know how much time it’s going to take to access an object (scan a table, probe an index)
- Original I/O Cost model assumption: 25 msec access time per I/O for all H/W
- Hardware has changed a lot since V5R2 (e.g. faster and smaller HDDs, external storage, SSDs)
- I/O implementation and execution algorithms diverged from model over time
- Big Data paradigm means more dependency on I/O cost model correctness

**Costing Change @ 7.2**
- New method to sample actual access times rather than hard-code a fixed time; Every system will have unique I/O performance metrics tracked over time
- Sampling enables optimizer to distinguish unique performance characteristics of internal, external, and solid state storage devices

**Result**
- SQE has more accurate I/O detail when costing plans
DB2 for i & In-Memory controls

➢ **Set Object Access (SETOBJACC) command (tenured service)**
  - Target physical & logical files and programs
  - Separate memory pools can be used, effectively shielding the memory from competing applications
  - The file attributes do not change
  - Single thread (job) brings in object
  - No guarantee that objects will remain in memory

➢ **CL Command level memory control (added in 7.1)**
  - Target existing DDS and SQL tables and views
    - CHGPF/CHGLF ... KEEPINMEM(*YES*|*NO*)
      - Database will bring the object into memory when accessed using SQL
      - Parallel I/O will be considered to bring the object into memory
      - Separate memory pools can be used, effectively shielding the memory from competing applications
      - Stored in the file attribute survives IPLs, Save/Restore, etc.
      - No guarantee that objects will remain in memory, but the odds are good because it happens whenever rows are fetched

➢ **SQL KEEP IN MEMORY memory-attribute (new in 7.2)**
  - Target new or existing SQL tables & indexes
    - ALTER/CREATE TABLE ... KEEP IN MEMORY NO or YES
      - Database will bring the object into memory when accessed using SQL
  - Granular control for managing partition tables
  - Once set, behavior matches KEEPINMEM

Blog thread: In Memory...
http://db2fori.blogspot.com/2013/10/in-memory.html
Warning – DB2 i – 7.2 - What Has Changed for SQE?

SQE will now be used to access files via through certain non-SQL interfaces

When is SQE ‘Native’ Access used?
- When any physical file or SQL table has active Row or Column Access Control (RCAC)
- For OPNQRYF, QRY/400 or an open (OPNDBF) of an SQL view

How can I control SQE Native Access?
- The SQE_NATIVE_ACCESS QAQQINI option was added in IBM i 7.2:
  - *NO – native open and non-SQL behavior remains like i7.1, unless RCAC is used
  - *YES – SQE will attempt to implement native open of an SQL view or native query
  - *DEFAULT – Same as *YES
Application Development
DB2 for i - 7.2 Enhancements by role – App Dev

**Database Application Development**
- Increased timestamp precision
- Named and Default parameter support on UDF/UDTFs
- Use of ARRAYs within UDF/UDTFs
- Built-in Global Variables
- Expressions on PREPARE & EXECUTE IMMEDIATE
- Autonomous procedures
- CURRENT USER special register
- Constants in LANGUAGE SQL routines
- Unified debugger support for SQL functions
- Datetime scalar function improvements
- And other enhancements that were brought back to IBM i 7.1 alongside Technology Refreshes

**New SQL Statement**
- TRUNCATE

**New Built-in Functions**
- LPAD()
- RPAD()

New capabilities for solving business problems with SQL and DB2 for i
Prior to 7.2, function resolution looked for an exact match
- Match on function name
- Match on # of parameters
- Match on data type of parameters

With 7.2, if DB2 for i doesn’t find an exact match, it looks for the “best fit”
- Read the SQL Reference rules for details
- Basic rule, if CAST() is supported for the parameter data type mismatch, the function will be found
- Prior to this support, you would observe SQL0204 – Function not found

For example:
CREATE OR REPLACE FUNCTION MY_CONCAT (FIRST_PART CHAR(10), SECOND_PART CHAR(50)) RETURNS VARCHAR(60) LANGUAGE SQL BEGIN RETURN(FIRST_PART CONCAT SECOND_PART); END;
VALUES(MY_CONCAT(123, 456789))
Function resolution using casting rules

- Character literal values are considered VARCHAR
- Passing character literal values to functions prior to 7.1 was difficult/annoying

**For example:**
CREATE FUNCTION How_Long(NAME CHAR(30))
RETURNS INT
RETURN LENGTH(NAME);

Prior to 7.2

```sql
VALUES(How_Long('a b c'))
```

SQL State: 42704
Vendor Code: -204
Message: [SQL0204] HOW_LONG in *LIBL type *N not found

With 7.2

```sql
VALUES(How_Long('a b c'))
```

<table>
<thead>
<tr>
<th>00001</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
</tr>
</tbody>
</table>

DB2 for i - 7.2 - Timestamp Precision

Provides the ability to specify between 0 and 12 digits of precision

- Prior to IBM i 7.2, we only support 6 digits of timestamp precision
- For some applications this is no longer sufficient as systems get faster with many more processors.
- In other cases, this is more than needed
- Use ALTER TABLE to adjust existing tables
- Any precision between 0 and 12 is allowed

CREATE TABLE X

(C1 TIMESTAMP(12), → Additional precision when 6 is not enough
(moving from 6→12 consumes 3 additional bytes)

C2 TIMESTAMP(0)) → Less precision (and storage) when 6 isn’t needed
(moving from 6→0 eliminates 3 bytes)
DB2 for i - 7.2 - TRUNCATE

- Similar to “fast delete”
- Additional functions to
  - IGNORE or RESTRICT when delete triggers are present
  - CONTINUE or RESTART identity values
  - DROP or REUSE storage
  - IMMEDIATE performs the operation without commit even if running under commit

TRUNCATE Order_Table IGNORE DELETE TRIGGERS
TRUNCATE Order_Table RESTRICT WHEN DELETE TRIGGERS IMMEDIATE
TRUNCATE Order_Table CONTINUE IDENTITY
TRUNCATE Order_Table RESTART IDENTITY IMMEDIATE
DB2 for i - 7.2 - Built-in Global Variables

- Can be referenced anywhere a column name can be used
- DB2 for i maintains the value
- Can’t be the targets of a data change operation (not settable)
- Will be set to NULL when not applicable

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Schema</th>
<th>Data Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT_IPADDR</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>128</td>
</tr>
<tr>
<td>CLIENT_HOST</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>255</td>
</tr>
<tr>
<td>CLIENT_PORT</td>
<td>SYSIBM</td>
<td>INTEGER</td>
<td>-</td>
</tr>
<tr>
<td>PACKAGE_NAME</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>128</td>
</tr>
<tr>
<td>PACKAGE_SCHEMA</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>128</td>
</tr>
<tr>
<td>PACKAGE_VERSION</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>64</td>
</tr>
<tr>
<td>ROUTINE_SCHEMA</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>128</td>
</tr>
<tr>
<td>ROUTINE_SPECIFIC_NAME</td>
<td>SYSIBM</td>
<td>VARCHAR</td>
<td>128</td>
</tr>
<tr>
<td>ROUTINE_TYPE</td>
<td>SYSIBM</td>
<td>CHAR</td>
<td>1</td>
</tr>
</tbody>
</table>
Ex: Built-in Global Variables – Client information

SELECT SYSIBM.client_host AS CLIENT_HOST, SYSIBM.client_ipaddr AS CLIENT_IP, SYSIBM.client_port AS CLIENT_PORT FROM LP92UT27.SYSIBM.SYSDUMMY1

• Two ways to extract the detail
• Global variables fit nicely into View definitions & RCAC masks/permissions

SELECT * FROM LP92UT27.QSYS2.TCPIP_INFO
DB2 for i - 7.2 – User special registers – similar names, different needs

**USER this, USER that… which one should I use?**

<table>
<thead>
<tr>
<th>Special Register</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER or SESSION_USER</td>
<td>The effective user of the thread is returned.</td>
</tr>
<tr>
<td>SYSTEM_USER</td>
<td>The authorization ID that initiated the connection is returned.</td>
</tr>
<tr>
<td>CURRENT USER or CURRENT_USER</td>
<td>The most recently adopted authorization ID within the thread will be returned. When no adopted authority has occurred, the effective user of the thread is returned.</td>
</tr>
</tbody>
</table>
An autonomous procedure is one that is executed in a unit of work that is independent from the calling application.

Similar to running COMMIT(*NONE) except that you can do commit or rollback inside the autonomous procedure and the commit and rollback is independent of the calling application.

CREATE PROCEDURE writelog (loginfo VARCHAR(1000)
AUTONOMOUS
BEGIN
...
INSERT INTO SCOTT.TRACKING_TABLE VALUES(LOGINFO);
...
END

Autonomous procedures use the named activation group ‘QSQAUTOAG’.
DB2 for i 7.2 – Numerous other enhancements

And a host of other (smaller) items
• Queued exclusive locks control
• SQL Server Mode detail in collection services
• SQL Details for Jobs enhancement
• Improved VARCHAR & LOB space management
• Automatic record movement between partitions
• Performance Data Investigator (PDI)
  - Investigate Data – DB2 category
  - SQL Plan Cache perspectives
  - Physical vs Logical I/O breakdowns
  - ...
• And many others…
IBM i 7.1 Review

Just the highlights
DB2 for i – Enhancements delivered via DB2 PTF Groups

IBM i 7.1

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
DB2 i7.1 Base – XML Support

- **Rich XML Support now available with DB2 for i**
  - XML data type stores documents supporting database operations
  - Decompose (shred) documents into relational columns
  - Generate XML documents from existing relational data with publishing functions

- **OmniFind Text Search Server provides support for searching XML documents**
  - Search elements of an XML document (e.g., customer name = Smith)
  - SQL statements use OmniFind to search the XML documents
  - Available with IBM i for no additional charge

- **Strategic replacement for XML Extenders Program Product**

<table>
<thead>
<tr>
<th>PO #</th>
<th>Customer #</th>
<th>Date</th>
<th>Purchase Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>2468</td>
<td>5/27/11</td>
<td>~ XML</td>
</tr>
<tr>
<td>456</td>
<td>1357</td>
<td>6/10/11</td>
<td>~ XML</td>
</tr>
</tbody>
</table>
DB2 i7.1 Base – Field Procedures

- **Field Procedures**
  - Register a program that is called whenever a table column is read or written
  - Allows control of both ‘at rest’ and viewed data

- **Column Level Encryption**
  - Extension of field procedures
  - Allows for transparent (no application changes) encryption of a specific column in a database table accessed through SQL or native
  - Solutions from tool providers including Patrick Townsend, Linoma Software & nuBridges supply encryption algorithms
**DB2 i7.1 TR5 –**

**Named Arguments and Defaults for Parameters - Procedures**

- Named and default parameters support for SQL procedures
- Extend procedures without breaking existing callers
- Simplify calling requirements by adding default values
- Procedure call invocation has the same usability as CL commands

```
default-clause:
  DEFAULT
  NULL
  constant
  special-register
  global-variable
  (expression)
```

**Examples:**

**Ex1:**
CREATE PROCEDURE p1 (i1 INT, i2 INT DEFAULT 0, i3 INT DEFAULT -1)...
CALL p1(55)
CALL p1(55, i3=>33)

**Ex2:**
CREATE OR REPLACE PROCEDURE Add_New_Employee
(EmpFirstName VARCHAR(20), EmpLastName VARCHAR(20), EmpAddress VARCHAR(200),
EmpTwitterHandle VARCHAR(40) DEFAULT NULL,
EmpUniqueID BIGINT DEFAULT (SELECT NEXT VALUE from EmployeeIDs))
Three part alias

- Ability to specify a remote database file by name
- Specify database name (from WRKRDBDIRE) along with schema and table
- Saves CONNECTing to database first
- Can wrap in an ALIAS to hide changes from application
- Can mix local and remote systems on
  1. INSERT with subselect
  2. GLOBAL TEMPORARY TABLEs

CONNECT TO mydb;
SELECT * FROM myschema.mytable;
SELECT * FROM mydb.myschema.mytable;

INSERT INTO MyLocalFile
SELECT * FROM RemoteDB.RemoteLib.RemoteFile;

DECLARE GLOBAL TEMPORARY TABLE localtable AS
( SELECT * FROM remotedb.remotelib.remotetable ) WITH DATA WITH REPLACE;
DB2 i7.1 TR6 –
Multiple events supported in a single SQL trigger

- A single SQL trigger programs can now handle multiple events
- Reduces the number of SQL triggers to install, manage and maintain

The following trigger:

a) increments the number of employees each time a new person is hired
b) decrements the number of employees each time an employee leaves the company
c) raises an error when a salary increase is greater than ten percent

```sql
CREATE TRIGGER HIRED
AFTER INSERT OR DELETE OR UPDATE OF SALARY ON EMPLOYEE
REFERENCING NEW AS N OLD AS O FOR EACH ROW
BEGIN
  IF INSERTING
    THEN UPDATE COMPANY_STATS SET NBREMP = NBREMP + 1;
  END IF;
  IF DELETING
    THEN UPDATE COMPANY_STATS SET NBREMP = NBREMP - 1;
  END IF;
  IF UPDATING AND (N.SALARY > 1.1 * O.SALARY)
    THEN SIGNAL SQLSTATE '75000'
      SET MESSAGE_TEXT = 'Salary increase > 10%';
  END IF;
END
```

Data Centric Computing
Expressions in procedure calls
- Use derivations as parameter values into stored procedure calls

CREATE OR REPLACE
- On a create, if the DB2 object exists, replace it (preserving characteristics)

New functions
- Websphere MQ series functions
  - Better integration with MQ messages
- BITxxx
  - BITAND, BITOR...

CALL PROC1(a+1)
CALL PROC2(UPPER(p1))

Allows an easy way to send, read, and receive Websphere MQ messages in an SQL statement.
DB2 i7.1 Base - DB2 Concurrent Access Resolution

- Concurrent Access Resolution behavior controllable at different levels
  - System-wide: SQL_CONCURRENT_ACCESS_RESOLUTION QAQQINI option
  - Program-level: CONACC pre-compiler option
  - Connection-level property/attribute
    • IBM i Access middleware: ADO.NET, JDBC, ODBC, OLE DB
    • SQL CLI & Native JDBC Driver
  - Statement-level
    • USE CURRENTLY COMMITTED
    • WAIT FOR OUTCOME
    • SKIP LOCKED DATA (added in 6.1)

**JOB#1:**
UPDATE parts
SET part_qty = 25
WHERE part_id = 'W12'

**JOB#2:**
SELECT part_id
FROM parts
WHERE part_type
  IN ('KSR', 'MNG')
USE CURRENTLY COMMITTED
DB2 i7.1 Base - Performance - SQE indexing advancements

- **Query Optimizer awareness of SQL Select/Omit Indexes**
  - Use ‘sparse’ and ‘derived’ indexes for query plans
  - Improve performance and save storage

- **Encoded Vector Index (EVI) aggregate support**
  - Leverage advanced EVI indexes for aggregate processing
  - Maintained summaries!

```
CREATE INDEX cust_ix1 ON customers(cust_id)
WHERE activeCust='Y'
```

```
CREATE ENCODED VECTOR INDEX idx2
ON sales(territory)
INCLUDE
(SUM(saleamt + promoamt), COUNT(*))
.
.
.
SELECT territory,
SUM(saleamt+promoamt) FROM sales
GROUP by territory
```
DB2 i7.1 TR4 –
System naming convention expanded to permit (/) and (.) qualifiers

- Historically, system naming required a slash (/) between library and file

- Now, when using system naming, both the slash (/) and dot (.) can be used for object qualification
  - system naming flexible, SQL statement text doesn’t need to be updated from SQL

- Object references can vary and SQL UDF’s can be library qualified with a “.”

The following example works when using NAMING(*SYS), but fails when using NAMING(*SQL)

Example:
SELECT a.ibmreqd, b.ibmreqd
FROM sysibm.sysdummy1 a, sysibm/sysdummy1 b

Mixed naming syntax supported
Control (internal) system names for tables, views and indexes

- The **FOR SYSTEM NAME** clause has been added to these SQL statements:
  - `CREATE TABLE`
  - `CREATE VIEW`
  - `CREATE INDEX`
  - `DECLARE GLOBAL TEMPORARY TABLE`

- **Achieve direct control over ‘short name’ of tables, views and indexes**

- The Generate SQL / QSQGNDL() interface will leverage this enhancement to produce SQL DDL scripts that produce identical object names.

Example:

```
CREATE OR REPLACE VIEW
PRODLIB/COMPARE_YEARS_2012_AND_2011
    FOR SYSTEM NAME COMP_12_11
AS SELECT ...
```

`COMP_12_11` *FILE object created instead of COMPA00001, COMPA00002, etc...
DB2 v7.1 TR6 –
New HTTP functions added to SYSTOOLS

• HTTP is the preferred way for communicating on the Web

• RESTful services provide access to information addressable via a URL and accessed using HTTP

• DB2 for i has shipped HTTP in the SYSTOOLS schema
  • SYSTOOLS contain ‘as is’ tools and examples from DB2

• Fast-Start to building your own applications

• Requires Java 1.6 (5761-JV1)

HTTP functions:

httpGetBlob     httpDeleteBlob     URLencode
httpGetClob     httpDeleteClob    URLdecode
httpPutBlob     httpBlob          Base64encode
httpPutClob     httpClob          Base64decode
httpPostBlob    httpHead          "Query the web"
Ex: httpGetBlob

Get information about an order with httpGetBlob

- Scalar Function
  - No response header information returned
  - Use the httpGetBlobVerbose table function to retrieve the response headers
- Inputs
  - URL (Resource to GET)
  - Request headers (information about the request (XML AS CLOB or XML))
- Result
  - Response message (as a BLOB)

In this example XMLPARSE and XMLTABLE are used to convert the response message into a result set.
HTTP functions - Query the web example

-- Blog Posts for the last 6 months, order by reader responses
SELECT published, updated, author, title, responses, url, author_bio, html_content, url_atom
FROM
XMLTABLE( XMLNAMESPACES(DEFAULT 'http://www.w3.org/2005/Atom', 'http://purl.org/syndication/thread/1.0' AS "thr"),
'feed.entry' PASSING XMLPARSE(DOCUMENT SYSTOOLS.HTTPGETBLOB( -- URL -- 'http://db2fori.blogspot.com/feeds/posts/default?published-min=' || SYSTOOLS.URLENCODE(QGPL.RFC339_DATE_FORMAT(CURRENT_TIMESTAMP - 6 MONTHS), 'UTF-8') || '&published-max=' || SYSTOOLS.URLENCODE(QGPL.RFC339_DATE_FORMAT(CURRENT_TIMESTAMP + 1 DAYS), 'UTF-8'), -- header -- '<httpHeader> <header name="Accept" value="application/atom+xml"/> </httpHeader>' ) )
COLUMNS ...

see developerWorks for details
DB2 v7.1 TR5 – JTOpen Lite - enabling mobile devices which use java

- JTOpen Lite… a java solution for mobile application development against DB2 for i (delivered with TR5)

- Download for free and go mobile with DB2 for i

- Robust subset of java programming features

<table>
<thead>
<tr>
<th>Database (SQL and DDM)</th>
<th>Job Information</th>
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</thead>
<tbody>
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<td>Messages</td>
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<td>Program calls</td>
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<td>Object Information</td>
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<td></td>
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</tr>
</tbody>
</table>
UI enhancements
DB2 i7.1 GUI - System i Navigator Enhancement

- **On Demand Performance Center**
  - Database monitor
    - Client register filters
    - Initial allocation
  - Authority changes
  - Show Statements
    - Save statements
    - Work Statement With Variables
  - Run SQL Scripts – Visual Explain Options
  - SQL Details for a Job
    - Result set information
    - Start database monitor
  - Index Advisor enhancements
    - MTI information
    - First Advised

- **Health Center**
  - SQL0901 Logger
  - Random and Sequential I/O Counts

- **Database Management**
  - Support for new Database Features
    - XML, Schema Repository (XSR)
    - Global Variables
    - Array Types
    - Field Procedures
    - 3-part alias
    - Enable constraints without checking
  - Support for Omnifind
  - Generate SQL - GRANTs
  - Progress Status Monitors
    - Reorganize status enhancements
    - Index build status
    - Text Search Index build status
    - ALTER TABLE status
  - New *SSD and In Memory info
  - Object list enhancements
  - Save folder contents
  - Large list performance
  - Long schema name
  - Last build info in SYSPARTITIONINDEXSTAT
New folder in 7.1
Table Reorganizations consolidated
Index Builds and Table Alters allow you to watch the operation’s progress and better anticipate how much is left
Performance Data Investigator – New Database Perspective

- Robust graphical interface enabled by Collection Services support.
- New breakdown makes it easier to notice “what changed”?
On the Web

developerWorksDB2 URL:
- www.ibm.com/developerworks/ibmi/techupdates/db2
DB2 for i Home Page
System i Advantages
System i Access
- http://www.ibm.com/systems/i/access/
DB2 for i Java
Education and Publications
- http://www.ibm.com/systems/i/ - Click on Education
- http://publib.boulder.ibm.com/iseries/
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- comp.databases.ibm-db2
- comp.sys.ibm.as400.misc groups
Questions can be sent to:
- rchudb@us.ibm.com
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