
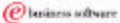


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# DB2 UDB for z/OS Vnext



Curt Cotner and Roger Miller  
A Preview Beyond Version 7

[ibm.com/software/db2zos/presentations.html](http://ibm.com/software/db2zos/presentations.html)


Vnext Themes in DB2® for z/OS

- ✓ Reengineering & Renaissance
- ✓ Breaking the Limits
- ✓ SQL Function & DB2 family
- ✓ Performance Enhancements
- ✓ Continuous Availability
- ✓ Indexing Improvements
- ✓ Very Large Database
- ✓ WebSphere & Java
- ✓ SAP, PeopleSoft & Siebel

**Building the e-infrastructure**

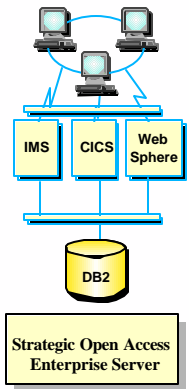
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▶ This talk will focus on future improvements in DB2 for z/OS. The delivery is not yet announced, so we will call it Vnext for now. The key focus points will be on performance, synergy with zSeries & the DB2 family, continuous availability, applications & productivity. This session will highlight only a few of the many key changes.

▶ We expect our next delivery to make a fundamental change in many areas, reengineering much of DB2 and helping customers break through the limits. Key improvements improve scalability, improve ability to port applications, and deliver continuous availability. The ability to manage very large databases is substantially improved. Support for key vendor applications is compelling. The enhancements for 64 bit virtual storage will make management simpler, improve scalability and availability.

## DB2 for z/OS Vnext



### Key Enhancements:

- Schema evolution
- 64 bit virtual storage
- Longer names and statements
- Improve optimization & parallelism
- Materialized Query Tables
- WebSphere integration
- Dynamic Cursor Scrolling
- Unicode
- Improved indexes & VLDB
- Enhanced utilities

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## Reengineering & Renaissance: History & Future



- Indexes
- Data Sharing
- Stored Procedures
- Object Relational
- Storage & Space
- SQL & Optimization
- Unicode
- DRDA & Common Client /  
Java Universal Client

### Building the e-infrastructure

- ✓ Continuous Availability
  - ✓ Systems Management, Security
  - ✓ Performance & Scalability
  - ✓ Connectivity
  - ✓ Productivity
  - ✓ Synergy: DB2 family & zSeries
- = Total Cost of Ownership

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- ▶ The most important change for many customers is the ability to use ALTER in many places instead of needing to drop and redefine. We call this schema evolution. Allowing more partitions is important for customers who need to have a partition for each day and keep the data for years.
- ▶ Standards & DB2 family consistency drive the application items. As in other DB2 family members, longer names for tables, columns & longer SQL statements will help application portability. We have more work on cursor scrolling & Unicode. Summary tables or materialized query tables are crucial to business intelligence performance.
- ▶ Multi-row fetch & insert reduce cpu time, especially when there are many rows & columns. We improve optimization and parallel processing in every release.
- ▶ We will continue to enhance online reorganization. We will be helping with the process for disaster recovery. Storage Area Network (SAN) and System Managed Storage (SMS) integration will be improved by allowing definition of the data class, management class and storage class in DDL.

- ▶ The renaissance of DB2 has continued as an ongoing process, refreshing some components, updating the work during each release. Some of the architecture has made more dramatic changes, such as changing to type 2 indexes, data sharing, stored procedures, object relational and moving to larger address spaces. These are examples of major changes. Unicode changes our definition and handling of characters, changing the foundation. A common client across the DB2 family provides better family consistency and a stronger DRDA.
- ▶ Building the e-infrastructure shows the value proposition of DB2 for z/OS. Rebuilding, rearchitecting and renewing continues. You will notice that many of the changes are related to other changes in the reengineering.

## Limits: DB2 for z/OS



### Breaking the limits

- Virtual Storage 2 GB  $2^{31}$  to  $2^{64}$
- Table name sizes 18 to 128
- VIEW & ALIAS names 18 to 128
- Column name sizes 18 to 30
- Partitions 254 to 4096
- SQL statement length 32K to 2 MB
- Index key size 255 to 2000
- Character Literals 255 to 32704
- Hex literal digits 255 to 32704
- Predicates 255 to 32704

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## Limits: DB2 for z/OS



### Breaking the limits ...

- Tables in a join 15 to 225
- Active logs 31 to 93
- Archive logs 1000 to 10,000
- Current optimization 8 to 128
- CURRENT PACKAGESET 18 to 128
- CURRENT PATH 254 to 2048
- CURRENT SQLID 8 to 128
- USER (SCHEMA) 8 to 128

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- ▶ One of the keys to reengineering is breaking through the limits of the current architecture. Increasing some of the limits improves the ability to scale DB2. Increasing other limits improves productivity, portability and family consistency.
- ▶ Increasing the amount of virtual storage we can address directly can help with the ability to scale and simplify management for main storage. It will require more storage, but permit increased scalability and availability.
- ▶ Increasing name sizes and SQL statements makes porting from other DBMS much easier and improves DB2 family compatibility.
- ▶ Increasing the maximum number of partitions helps DB2 scale farther and makes management much easier for cases that need to have one partition per day for a number of years.

- ▶ The larger number of tables in a join helps with porting applications and improves our ability to handle vendor applications.
- ▶ The additional active and archive logs provides larger volumes and better flexibility for the amount of log data. Customers could keep up to 372 GB of active log data and 40 terabytes of archive log data.
- ▶ Increasing the special register lengths allows more flexibility for applications.

## SQL and DB2 Family



- Multi-row INSERT & FETCH
- GET DIAGNOSTICS
- INSERT within SELECT
- IDENTITY Column enhancements
- SEQUENCES
- DYNAMIC SCROLLABLE CURSORS
- CURRENT PACKAGE PATH
- SCALAR FULLSELECT
- MATERIALIZED QUERY TABLES
- UNICODE SQL, MULTIPLE CCSIDs
- XML Publishing

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## Multi-row INSERT



- Inserts multiple rows on one API call
- Can be ATOMIC or NOT ATOMIC
- Can be static or dynamic SQL
- Significant performance boost

```
INSERT INTO T1 FOR :hv ROWS  
VALUES( :ARRAY1, :ARRAY2) ATOMIC;
```

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- ▶ This version is also a breakthrough in SQL, with too many new functions to list them all. We will discuss a few of them on the next pages. Add support for volatile tables, group by expression, multiple DISTINCT clauses, and qualified names for INSERT and UPDATE.
- ▶ Table function improvements, trigger performance, star join sparse index improvements, cost-based parallel sort, better ability to use indexes, longer statements, longer names, longer literals and predicates, session variables, new special registers and SQL procedures improvements, provide a giant leap for SQL.

- ▶ Being able to insert multiple rows helps in application portability and can improve performance, particularly across a network. This change supports host language arrays.

## Multi-row INSERT - continued



```
STMT = 'INSERT INTO T1
VALUES( ?, ?)
FOR MULTIPLE ROWS ATOMIC';

PREPARE S1 FROM STMT;

EXECUTE S1 FOR :hv ROWS
USING :ARRAY1, :ARRAY2;
```

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- Being able to insert multiple rows helps in application portability and can improve performance, particularly across a network. This change supports host language arrays.

## Multi-row FETCH



- ▀ Returns multiple rows on one API crossing
- ▀ "wide" cursor with locks on multiple rows
- ▀ Supports scrollable and non-scrollable, static and dynamic SQL
- ▀ Significant performance boost

```
DECLARE C1 CURSOR
WITH ROWSET POSITIONING
FOR SELECT COL1, COL2 FROM T1;
OPEN C1;
FETCH FROM C1
FOR :hv ROWS INTO :ARRAY1, :ARRAY2;
```

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- Multiple row FETCH also helps with application portability and performance. It provides a new concept called a "wide" cursor: multiple rows rather than just one.

## Positioned UPDATE/DELETE of Multi-row FETCH



- Allows positioned UPDATE or DELETE to be used on a "wide" cursor

```
UPDATE T1 SET COL1='ABC'  
FOR CURSOR C1  
FOR ROW :hv OF ROWSET
```

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## GET DIAGNOSTICS



- Returns SQL error information
  - ▶ for overall statement
  - ▶ for each condition (when multiple errors occur)
- Supports SQL error message tokens greater than 70 bytes (SQLDA limitation)

```
INSERT INTO T1 FOR 5 ROWS VALUES(:ARRAY);  
GET DIAGNOSTICS :ERR_COUNT = NUMBER;  
DO II = 1 TO ERR_COUNT;  
  GET DIAGNOSTICS FOR CONDITION :II  
    :RC = RETURNED_SQLSTATE;  
END;
```

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- ▶ Have you wanted to return some values from the row you just inserted, so that you have the value of the identity column, the defaults, expression results or the effect of a trigger. Now you can SELECT FROM the inserted row.

- ▶ The new GET DIAGNOSTICS statement is important to provide the information from all of the extended names and new function.

## INSERT within SELECT

- Elegant technique for retrieving values created/modified by DB2 during INSERT
  - ▶ identity columns, sequence values
  - ▶ user-defined defaults, expressions
  - ▶ columns modified by triggers
  - ▶ ROWIDs

### EXAMPLE:

```
SELECT C1, C2, C3, C4, C5 FROM
INSERT (C1, C5) INTO T1
VALUES('ABC', CURRENT DATE);
```

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## Identity Column Improvements

- ALTER support for Identity Columns
  - ▶ RESTART WITH value
  - ▶ INCREMENT BY
  - ▶ MINVALUE
  - ▶ MAXVALUE
  - ▶ CYCLE/NO CYCLE
  - ▶ CACHE/NO CACHE

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- ▶ Have you wanted to return some values from the row you just inserted, so that you have the value of the identity column, the defaults, expression results or the effect of a trigger. Now you can SELECT FROM the inserted row.

- ▶ When identity columns were provided with Version 6, customers identified some important enhancements that were needed. Many customers asked for the ability to ALTER many of the attributes. These changes will allow identity columns to be used in many more cases.

## Sequences

- Useful for porting Oracle applications
- New SQL support:
  - ▶ CREATE SEQUENCE
  - ▶ ALTER SEQUENCE
    - RESTART WITH value
    - INCREMENT BY
    - MINVALUE
    - MAXVALUE
    - CYCLE/NO CYCLE
    - CACHE/NO CACHE
  - ▶ GRANT/REVOKE privileges for the sequence object
  - ▶ NEXT VALUE FOR EXPRESSION
  - ▶ PREVIOUS VALUE FOR EXPRESSION

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## Dynamic Scrollable Cursors



- Scrollable cursor that provides access to base table rather than workfile -- allows viewing of updates by other users.
- Defaults to single row fetch, so DDF applications should use:
  - ▶ multi-row FETCH
  - ▶ positioned update/delete for multi-row FETCH

```
DECLARE C1 SENSITIVE DYNAMIC CURSOR
FOR SELECT C1, C2 FROM T1;
```

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▶ Sequences, like identity columns, provide an incremented counter within the DBMS. While the identity column is in a table, the sequence is separate.

▶ Static scrollable cursors came in V7, with the ability to use a work file for scrolling. Dynamic cursor scrolling is performed directly on the base tables.



## CURRENT PACKAGE PATH



- Important for SQLJ and DDF apps
  - Less need for SET CURRENT PACKAGESET
  - Less network traffic for multiple PKLIST values
  - Easier to switch to/from JDBC and SQLJ
  - Better handling of nested stored procedure pkgs
- Allows application to specify search list of package schemas (similar to PKLIST)

```
SET CURRENT PACKAGE PATH =  
  ALPHA,  
  BETA,  
  PROD
```

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## Scalar fullselect

- Allows scalar fullselect where expressions were previously supported

```
SELECT C1 FROM T1 WHERE  
  T2>(SELECT COL1 FROM T2 ...)  
  
SELECT C1,  
  (SELECT COL1 FROM T2...),  
  C3  
FROM T1
```

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- The scalar fullselect or a fullselect that results in a single scalar value to be used where an expression is allowed today. The scalar fullselect can be used in the SELECT clause, in the WHERE clause, or in a CASE expression, for instance. This improves DB2 function, the ability to port applications and DB2 family compatibility.
- A scalar fullselect, as supported in an expression, is a fullselect, enclosed in parentheses, that returns a single row consisting of a single column value. If the fullselect does not return a row, the result of the expression is the null value.

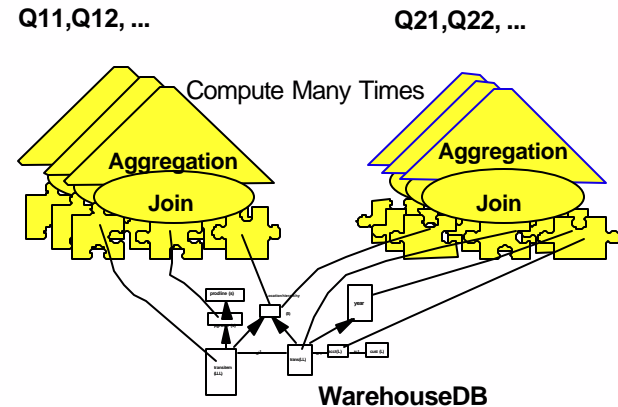
### Materialized Query Tables

- Previously known as "Summary Tables"
- Optimizer can now rewrite queries to access MQT instead of the base table/view
  - significant performance improvement
- Two types of MQTs
  - system-maintained (via SQL REFRESH statement)
  - user-maintained (via triggers, batch updates, etc.)

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### Without Materialized Query Tables: Each Query Re-Computes!



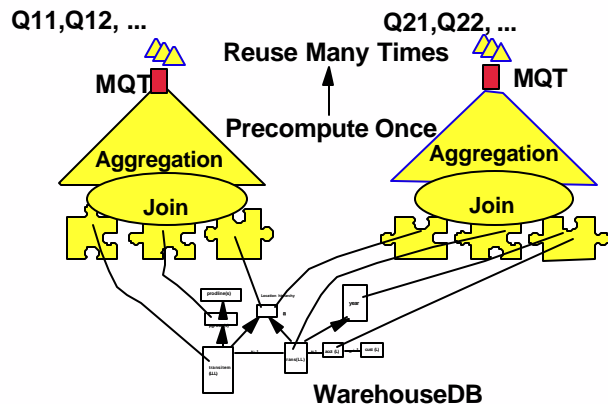
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- ▶ The nature of queries in a Data Warehouse is to touch a significant amount or rows of very large tables, sometimes billions of rows. The optimizer attempts to choose the best access path to process this data, however, due to the large amount of data to be processed, these queries can take many hours of elapsed time to process. In order to improve the performance and reduce the elapsed time we can either use parallelism or save (precompute and materialize) the results of prior queries and reuse these common query results for subsequent queries. This method we call Materialized Query Tables (MQTs).

- ▶ A materialized query table (MQT) can avoid redundant work of scanning, aggregation and joins. Multiple levels of summary tables have been used in warehouses and complex applications for years. One of the major issues is communicating the summaries to the users. In some cases, the users want to query the base data. With MQTs, the query users do not have to be aware of the MQT.

## With Materialized Query Tables: Avoid Redundant Computation



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## Enhanced Unicode Support



- DB2 Catalog is now stored in Unicode
  - allows SQL to contain Unicode literals and names
  - provides better integration with Java and Microsoft technologies
- Important to key ISVs (SAP, PeopleSoft, Siebel, etc.)

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- Even though the query is submitted for the base table, the optimizer can rewrite the query to use the MQT. Using the precalculated information can improve subsequent queries by as much as two or three orders of magnitude. Materialization or precalculation and parallelism resolve the long response times.
- A database administrator can use an MQT much as she or he would use an index for optimization. Controls for usage, initial loading and refresh are part of the definition.

### Multiple CCSIDs per statement



- A single SQL statement can now intermix EBCDIC, ASCII and Unicode tables and host variables
- Unlike host variables are translated to column CCSID
- Unlike column CCSIDs are "promoted" to Unicode
  - ▶ May require query to be materialized/sorted

```
SELECT T1.COL_EBCDIC ||  
       T2.COL_ASCII  ||  
       T3.COL_UNICODE FROM T1,T2,T3;
```

### VOLATILE Table Support

- Forces index access for tables that have unpredictable cardinality
- Significant performance improvement for some SAP applications

```
CREATE TABLE XYZ ..... VOLATILE
```

## Star Join Sparse Indexes



- Optimizer improvement that addresses the same requirement as Hash Join
  - ▶ ACCESS\_TYPE='T' in PLAN table
  - ▶ uses sparse index to process the contents of workfile
  - ▶ Improves upon APAR PQ61458 on V7

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## XML Publishing Functions

- New built-in functions for generating XML
  - ▶ XMLELEMENT
  - ▶ XMLATTRIBUTES
  - ▶ XMLFOREST
  - ▶ XMLCONCAT
  - ▶ XMLAGG
  - ▶ XML2CLOB

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- ▶ The DB2 XML Extender is supported on z/OS. In Vnext, we are pushing more XML support into the engine by providing support for some of the built-in XML publishing functions that are currently in the process of being standardized in the ANSI SQL committee, such as XMLELEMENT, XMLATTRIBUTES, XMLFOREST, XMLCONCAT, XMLAGG, and XML2CLOB.

## Query Example - Demo Query 1

### Query:

```

SELECT
XML2CLOB(
XMLELEMENT
('Dept',
XMLATTRIBUTES (D.DEPTNO AS 'deptno',
D.DEPYNAME AS 'name'),
(SELECT XMLAGG (
XMLELEMENT (
'Proj',
XMLATTRIBUTES (P.PROJNO AS 'projno',
P.PROJNAME AS 'name'),
(SELECT XMLAGG (
XMLELEMENT (
'Emp',
XMLATTRIBUTES
(E.EMPNO AS 'empno',
E.FIRSTNAME || ' ' || E.LASTNAME
)
)
)
FROM DSN8810.EMP PROJACT EP,
DSN8810.EMP E
WHERE EP.PROJNO = P.PROJNO AND
EP.EMPNO = E.EMPNO
)
)
FROM DSN8810.PROJ P
WHERE P.DEPTNO = D.DEPTNO
)
)
FROM DSN8810.DEPT D
WHERE D.DEPTNO = 'D01'

```

### Result: (formatted for easy viewing)

```

<Dept deptno="D01" name="DEVELOPMENT CENTER">
  <Proj projno="AD3100" name="ADMIN SERVICES">
    <Emp empno="000010">CHRISTINE HAAS</Emp>
  </Proj>
  <Proj projno="MA2100" name="WELD LINE AUTOMATION">
    <Emp empno="000010">CHRISTINE HAAS</Emp>
    <Emp empno="000110">VINCENZO LUCCHESI</Emp>
  </Proj>
</Dept>

```

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## Parallel Sort



- Optimizer is enhanced to use parallel sort for multiple tables when cost tradeoff is advantageous

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### Stage 1 Indexable Unlike-types



- DB2 is enhanced to allow index access when host variable and target column are not the same datatype
- Deals with programming languages that don't support the full range of SQL datatypes
  - ▶ C/C++ has no DECIMAL datatype
  - ▶ Java has no fixed length CHAR datatype
  - ▶ etc.
- Significant performance improvement for many applications
- Simplifies application programmer & DBA tasks

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### SQL statements up to 2M bytes



- SQL statements can now be up to 2M bytes in length
- Parse tree has been completely rearchitected to reduce SQLCODE -101 scenarios due to SQL statement length
- Important for SQL Procedure Language applications!!!

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## SQL Procedure Language

- RETURN statement
- SIGNAL/RESIGNAL support
- CREATE PROCEDURE up to 2M bytes
- Integrated debugger
- GET DIAGNOSTICS for all fields in SQLCA

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## Other SQL Improvements

- GROUP BY expression
  - SELECT A+B,C FROM T ORDER BY A+B GROUP BY A+B
- Qualified column names on SET clause
  - UPDATE T1 SET T1.COL1...
- Qualified column names on INSERT
  - INSERT T1.COL1 INTO T1 VALUES...
- Multiple DISTINCT clauses
  - SELECT COUNT(DISTINCT(A1)), AVG(DISTINCT(A2)) FROM T2

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- We are making big strides in SQL improvements: new SQL syntax, SQL scalability improvements, and SQL performance enhancements, including:
  - GET DIAGNOSTICS, SEQUENCES
  - Dynamic scrollable cursors, Scalar fullselect
  - Multiple DISTINCT clauses, GROUP BY expression
  - Qualified column names on INSERT and UPDATE SET clause
  - Intermixing EBCDIC, ASCII, or Unicode columns in a single SQL statement
  - Unicode support in SQL
  - SELECT from an INSERT statement
- In addition, we are making major changes in our SQL system limits by:
  - Extending support for long names in SQL objects to 30 characters for column names and to 128 characters for most other SQL objects;
  - Expanding support for SQL statements up to 2 megabytes in length;
  - Increasing the length of literals and predicates to 32 kilobytes; and
  - Extending JOIN to allow up to 225 tables in a single statement.
- For more, see
  - <http://www7b.boulder.ibm.com/dmdd/library/techarticle/0209cotner/0209cotner.html>



## Table Function Improvements



- **CARDINALITY** clause
  - ▶ `SELECT * FROM TABLE(TABUDF(C2) CARDINALITY 30) AS ABC`
- Performance improvement to move data between table functions and DB2 using block data movement

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## Trigger Performance

- **AFTER TRIGGER** workfiles are eliminated when old/new transition variables are returned for 3 rows or less

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## Row-level MLS security

Table has column defined AS SECURITY LABEL

Each row value has a specific security label

Get security labels from RACF

Save in rows for INSERT, UPDATE, LOAD, ...

Check for each new seclabel value accessed

If access is allowed, then normal access

If access is not allowed, data not returned

Runtime user to data checking

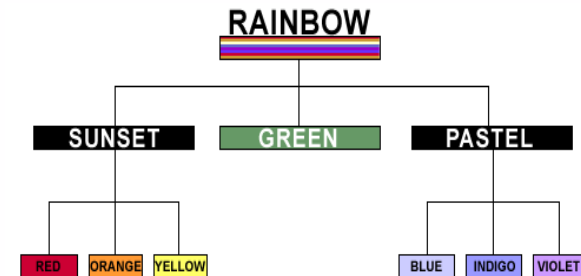
Seclabel values are cached to minimize cpu

Requires z/OS V1R5

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## Multilevel Security by Row ...



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- ▶ We have had a lot of requests for row-level security for applications that need more granular security schemes. For example, in organizational hierarchies, it is desirable to set up a hierarchy in which employees can see their own payroll data, a first line manager can see his or her payroll information and all of the employees reporting to that manager, and so on. In addition, government security schemes often include a security hierarchy such as TOP SECRET, SECRET, or UNCLASSIFIED. We are currently developing support for row-level security that includes support for these types of hierarchical security schemes. Basically, a table will be able to activate this support by adding a column that acts as the security label.

- ▶ With the hierarchy established in the security manager layer, the system would understand that users with authority to access RAINBOW can access anything. Someone with authority to access PASTEL information can access any row associated with BLUE, INDIGO, VIOLET, or PASTEL. Someone with SUNSET can access SUNSET, RED, ORANGE, YELLOW. This is a lot more powerful than just having an exact match on security label (i.e., user's label must exactly match the data's label), since it has the notion of "groups" that make security administration easier to manage.
- ▶ With this additional capability, we'll be able to implement that type of security scheme without requiring the application to access the data using special views or predicates.
- ▶ See <http://www7b.boulder.ibm.com/dmdd/library/techarticle/0209cotner/0209cotner.html>

### Multilevel Security by Row

DB2 SECURITY LABEL_EXT	COL1	COL2	COL2
RAINBOW	56	7	76
RAINBOW	24	56	65
RAINBOW	42	6	45
BLUE	3	456	7
INDIGO	113	456	56
VIOLET	3	456	4
BLUE	4	4566	7
RED	4	76	567
ORANGE	33	7	567
RED	5455	76	567
YELLOW	999	65	45

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### Session Variables

Variables set by connection or signon exit

Built in function to retrieve value for a variable

Use function in views, triggers, stored procedures & constraints to enforce security policy

Can have more general, flexible access checks

Multiple columns, AND/OR logic, ...

Complements other security mechanisms

```
CREATE VIEW V1 AS SELECT * FROM T1
WHERE COL5=DB2_SECURE_VAR('MY_VAR');
```

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- Row-level security helps applications that need more granular security schemes. For example, in organizational hierarchies, it is desirable to set up a hierarchy in which employees can see their own payroll data, a first line manager can see his or her payroll information and all of the employees reporting to that manager, and so on. In addition, government security schemes often include a security hierarchy such as TOP SECRET, SECRET, or UNCLASSIFIED. We are currently developing support for row-level security that includes support for these types of hierarchical security schemes. Basically, a table will be able to activate this support by adding a specially named column that acts as the security label. For example, an application might want to have a hierarchy representing the colors of the rainbow.
- At the top of the hierarchy, RAINBOW would be a security label that includes all the colors (RED, ORANGE, YELLOW, GREEN, BLUE, INDIGO, VIOLET). At the middle of the hierarchy, you could have other security labels: PASTEL (BLUE, INDIGO, VIOLET) and SUNSET (RED, ORANGE, YELLOW).

## New Special Registers

Client information for this connection

Provided by sqleseti, Java, RRS SIGNON

- CLIENT ACCTNG accounting string
- CLIENT APPLNAME value of application name
- CLIENT USERID client user ID
- CLIENT WRKSTNNAME workstation name

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## New Built-in Functions

- ENCRYPT
  - ▶ encrypt a column in a table with a user-provided encryption password
  - ▶ ENCRYPTION PASSWORD special register
- DECRYPT\_BIN
- DECRYPT\_CHAR
- GET\_HINT: obtain hint to help remember ENCRYPTION PASSWORD
- GENERATE\_UNIQUE
  - ▶ creates a CHAR(13) FOR BIT DATA value that is unique across the sysplex

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## Stored Procedures & RRS

- Stored Procedures improvements
  - WLM management of TCBs
    - TCBs are added/removed based on WLM recommendations
  - MAX FAILURES on CREATE PROCEDURE
  - Integrated debugger for SQL Procedure Language
  - COMPJAVA (HPJ) is replaced by interpretive Java
- RRS support for CAF migration
  - CAF-style "implicit" connection support

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## Distribution Statistics on non-Index Columns



- **RUNSTATS improvement that allows Optimizer to consider non-uniform distribution statistics on columns that aren't part of an index**
- **Current technique is separate DSTATS program**
- **Significant performance improvement**

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## ODBC Improvements for USS

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- CONNECT with USERID/PASSWORD
- Unicode

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## Intelligent Visual Explain

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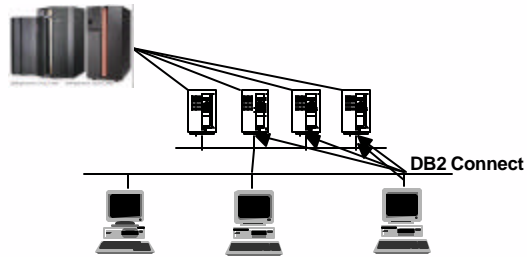
- Significant improvements to Visual Explain tool:
  - ▶ Much more detailed information about access path
  - ▶ More statistical details for each node in the graph
  - ▶ Ability to send XML output describing the query access path selected
  - ▶ Easier collection of information to send for help

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## DB2 Connect Version 8

- ✓ Performance & Scalability
- ✓ Improved Application Availability
- ✓ Innovative manageability
- ✓ Programmer productivity

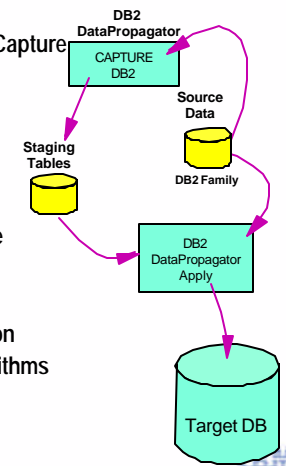


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## DB2 Replication Version 8

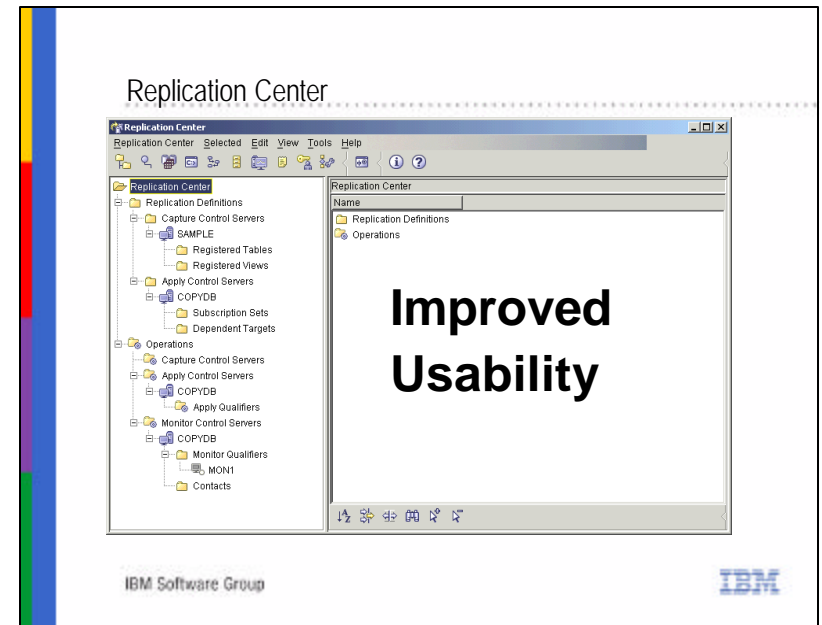
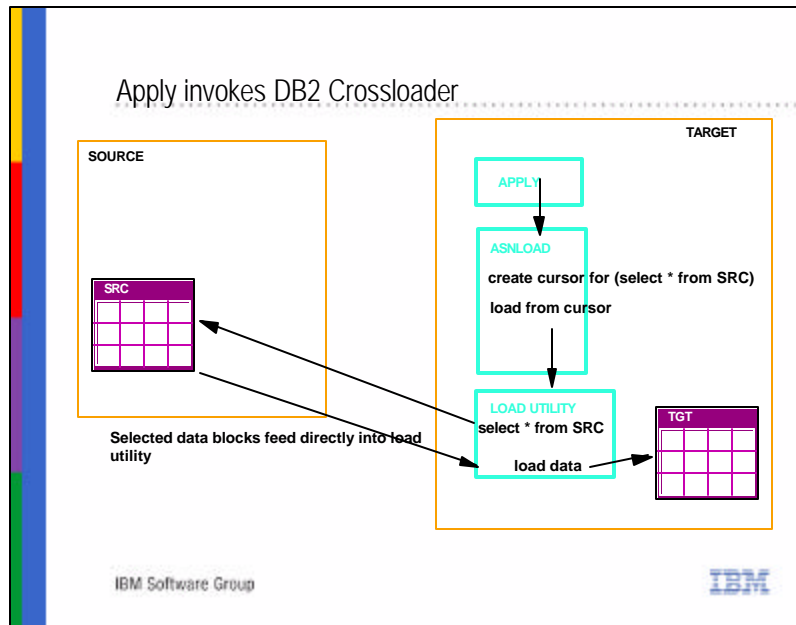
- Performance
  - ▶ Multithreaded transaction based Capture
  - ▶ Multiple Capture Schemas
  - ▶ Reduced need for joins
- Usability
  - ▶ New Replication Admin features
  - ▶ Monitoring
  - ▶ Less rules, product more adaptive
  - ▶ Long name support
- Reliability
  - ▶ Emphasis on continuous operation
  - ▶ Improved restart and failure algorithms
- Availability December 6, 2002



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- ▶ DB2 Connect improvements are noted in the recent announcements and in the What's New in DB2 UDB Version 8.1? book.
  - ▶ [ibm.com/software/data/db2/udb/pdfs/db2q0.pdf](http://ibm.com/software/data/db2/udb/pdfs/db2q0.pdf)
- ▶ Also see the web:
  - ▶ [ibm.com/software/data/db2/db2connect/](http://ibm.com/software/data/db2/db2connect/)



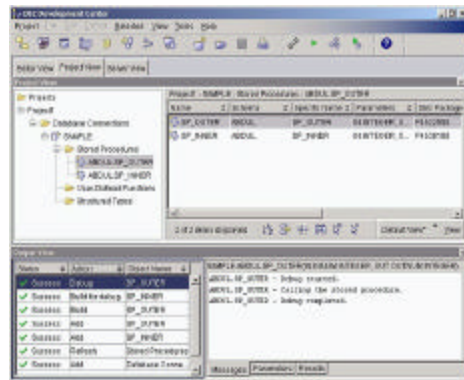
- ▶ Please note that this is for full refresh only. Changes are still fetched from the staging tables and applied using insert/update/delete statements
- ▶ On z/OS platforms, a 3 part name is used in the select statement
- ▶ On UNIX/Windows platforms, the select statement can specify only a 2 part name, and is therefore either a local source table, or it is a nickname (uses federated support).
- ▶ On z/OS platforms, the load utility is invoked through a stored procedure. WLM is required.
- ▶ The ptf numbers are UQ63468 UQ63470.
- ▶ The apar number is PQ54884.

- ▶ Same look and feel as the DB2 Control Center
- ▶ Many more options than the current replication support provided by the control center - customization, operations support, static monitoring
- ▶ Includes many of the options that were available through DJRA - mass registration, mass subscription, promote capability



## Development Center

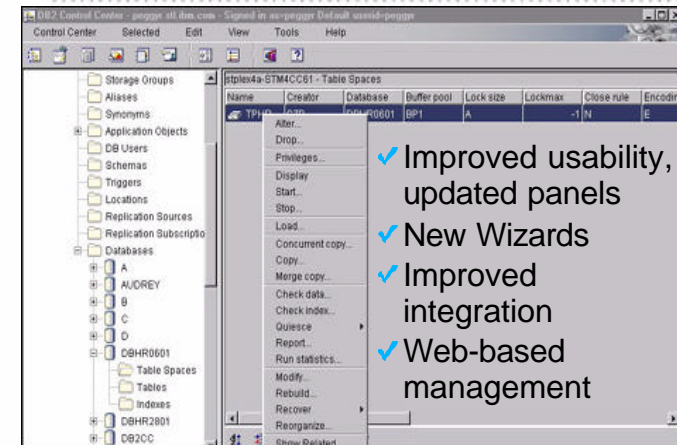
- ✓ Build, test & deploy Java & SQL Stored Procedures
- ✓ Build SQL Table functions
- ✓ Extract data from XML documents



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## DB2 Control Center



- ✓ Improved usability, updated panels
- ✓ New Wizards
- ✓ Improved integration
- ✓ Web-based management

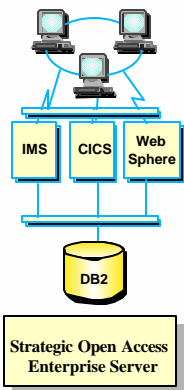
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- ▶ See Development Center articles on DB2 Developer Domain.
  - ▶ <http://www7b.boulder.ibm.com/dmdd/>
- ▶ DB2 Development Center -- The Next-Generation AD Tooling for DB2
  - ▶ <http://www7b.boulder.ibm.com/dmdd/library/techarticle/0207alazzawe/0207alazzawe.html>
- ▶ DB2 Development Add-Ins for Visual Studio 6.0 - The Next-Generation AD Tooling
  - ▶ <http://www7b.boulder.ibm.com/dmdd/library/techarticle/0208alazzawe/0208alazzawe.html>
- ▶ Developing Enterprise Java Applications Using DB2 Version 8
  - ▶ <http://www7b.boulder.ibm.com/dmdd/library/techarticle/0209hutchison/0209hutchison.html>

- ▶ Control Center improvements are spelled out in the What's New? book.
  - ▶ [ibm.com/software/data/db2/udb/v8/](http://ibm.com/software/data/db2/udb/v8/)
  - ▶ [ibm.com/software/data/db2/udb/pdfs/db2q0.pdf](http://ibm.com/software/data/db2/udb/pdfs/db2q0.pdf)
  - ▶ [ibm.com/software/dmdd/library/techarticle/0207gartner/0207gartner.html](http://ibm.com/software/dmdd/library/techarticle/0207gartner/0207gartner.html)
- ▶ Control Center 390 now supports:
  - ▶ Copying an entire DB2 subsystem. The new Subsystem cloning wizard that generates the Job Control Language (JCL) required to homogeneously copy (clone) an entire subsystem to a target subsystem.
  - ▶ Support for the DB2 unload utility has also been added to the Control Center for OS/390, which lets you unload data from one source object (i.e., a table space) to a sequential data set in external formats.
  - ▶ You can select multiple table objects within the same table space.
  - ▶ Utility execution is now optimized by supporting parallel execution.
  - ▶ DB2 for OS/390 batch processing functions have been integrated into the Control Center: Build JCL, Create JCL and Custom JCL.

## Network Computing Improvements



- Encrypt data flowing on the wire
- CDB improvements for data sharing member routing
- LOCATION aliases at requester and server (e.g. CONNECT)
- Extended DESCRIBE for CLI & Java
- LOB streaming
- SQL Cancel
- Auto-close for WITH HOLD cursors
- Reduced block FETCH CPU cost
- Reduced TCP/IP CPU cost

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## Aggregated Accounting Data

- RRS Attach and DDF accounting records can now be aggregated based on:
  - end user's ID (QWHCEUID)
  - end user txn name (QWHCEUTX)
  - end user workstation name (QWHCEUWN)
- ▶ JDBC, SQLJ, RRS Attach, and DDF are all enhanced to accept the above values any time during unit of work
- ZPARM for controlling aggregation (DSN6SYSP ACCUMACC)
  - ▶ Aggregation can be turned on/off dynamically

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- ▶ We are also working on many improvements for network computing: security, availability, usability and performance. Performance improvements will reduce cpu costs substantially.

## Enhanced IFC records

- New Statistics values
  - ▶ Q3STHWIB - IDBACK high water mark
  - ▶ Q3STHWIF - IDFORE high water mark
  - ▶ Q3STHWCT - CTHREAD high water mark
  - ▶ QLSTHWMD - MAXDBAT high water mark
  - ▶ QLSTHWMC - CONDBAT high water mark
- SQL counts added to package level accounting
- Package information added to deadlock and timeout records (0172, 0196)

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## Key Java Improvements


- Type 2 and type 4 driver
  - ▶ Updated to support JDBC/SQLJ 3.0 standard
    - savepoint support
    - connection pooling improvements
      - reusing PreparedStatements
      - standard connection pool properties
      - reset of server connection at getConnection
    - new metadata for PreparedStatements
    - return autogenerated keys
    - multiple open ResultSets for a single stored procedure
    - WITH HOLD cursors
    - improved BLOB/CLOB support

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- ▶ We will be supporting both Type 2 and Type 4 Java drivers which will be updated to support the JDBC/SQLJ 3.0 standard, including improvements like savepoints, connection pooling improvements, the ability to reuse PreparedStatements, multiple open ResultSets for a single stored procedure, WITH HOLD cursors, and improved BLOB and CLOB support.

DB2 Family SQL Reference





IBM DB2 Universal Database  
**SQL Reference**  
**for Cross Platform Development**  
 z/OS OS/390 OS/400 AIX HP-UX Solaris Linux Windows

A new SQL Reference book for the DB2 UDB family, not just one platform.  
<http://www7b.software.ibm.com/dmdd/library/techarticle/0206sqlref/0206sqlref.html>

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Z41





Vnext Technical Overview: Availability & Engine  
 Beyond Version 7

 | 

- ▶ Do you want to design or write applications for the entire DB2 family, rather than for just one of the platforms? If so, you need the IBM DB2 Universal Database SQL Reference for Cross-Platform Development. This book covers these product versions:
  - ▶ DB2 UDB for UNIX, Windows, OS/2 Version 7 Release 2
  - ▶ DB2 UDB for z/OS and OS/390 Version 7
  - ▶ DB2 UDB for iSeries Version 5 Release 1
- ▶ I think that you will find that SQL consistency across the DB2 family has improved substantially in the past few versions, while significant new function has been added. This book defines IBM DB2 Universal Database Structured Query Language (DB2 UDB SQL) for programmers who want to write portable applications. SQL that is common to the DB2 UDB relational database products and the SQL 1999 Core standard is a much larger set. The book describes the rules and limits for preparing portable programs for these versions, and later releases make improvements. Get it from <http://www7b.software.ibm.com/dmdd/library/techarticle/0206sqlref/0206sqlref.html>

- ▶ This talk will focus on recent and future improvements in DB2 for z/OS. The key focus points will be on performance, synergy with zSeries & the DB2 family, continuous availability, applications & productivity. This session will highlight some of the key changes.
- ▶ We expect our next delivery to make a fundamental change in many areas, reengineering much of DB2 and helping deliver more growth. There are key improvements that help improve scalability, improved ability to port applications, much better ability to deliver continuous availability. The ability to handle very large databases is changing in fundamental ways. Support for key vendor applications is compelling. The enhancements for 64 bit virtual storage will make management simpler, improve scalability and availability.

64 bit evolution

- zSeries, z/OS, z/Architecture & large real storage
- Real storage for performance
  - V6 data space advantages
    - zSeries & 64 bit addressing
- 64 bit virtual (used in Vnext)
  - z/OS 64-bit Virtual Storage Roadmap
  - Improve scalability, availability, ease
  - Move above the bar
  - Hiperpool/dataspace no longer needed

16 EB

DBM1

Buffer pool  
EDM pool  
RID pool  
Sort pool  
Comp dict

2 GB

The bar

0

16M-Line

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How do we create room?

Move over the bar

Below 16 MB line	$2^{24}$
Below 2 GB bar	$2^{31}$
Above 2 GB bar	$2^{64}$

No hiperpools or data spaces - not needed

Most large storage areas moved above the bar

Management of virtual storage is much simpler

Allows increase in number of threads

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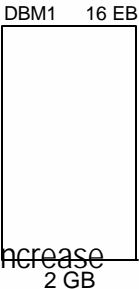
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- The biggest impact of the zSeries architecture on DB2 is the ability to have large real memory support. Prior to the zSeries, customers were limited to 2 GB real storage due to the 31-bit addressing of the S/390 architecture. The real storage limit of 2 GB is a leading performance inhibitor for many high end customers. Another performance inhibitor is the 2 GB virtual storage limit for the main DB2 (DBM1) address space. Moving virtual pool buffers to hiperpools offers some relief, but many customers need more. If you have zSeries & OS/390 V2R10 64-bit mode or z/OS, use V6 buffer pools in data spaces, but not otherwise. See V7 Performance Topics red book and the web.
- There will be many more steps as real and virtual memory sizes increase, moving more above the line and above the bar. See the Roadmap, GM13-0076-01 updated June 2002 [ibm.com/servers/eserver/zseries/library/whitepapers/gm130076.html](http://ibm.com/servers/eserver/zseries/library/whitepapers/gm130076.html)

- We are still working to move a few z/OS and DFSMS control blocks above the 16 MB line, but this is a relatively minor concern in z/OS R3.
- The area below the 2 GB bar is  $2^7$  or roughly 128 times larger, at 2 GB. Large customers have filled this space, so it's time to move the large data areas above the bar.
- The area over the bar is  $2^{33}$  or roughly 8 billion times larger. It is not infinite, but the virtual address space will not be the limiting factor for some time. Our concerns will shift to real storage. We can restructure to remove the complexity and overhead of hiperspaces and data spaces. Moving most large data areas above the bar is how we spell relief for virtual storage constraints.

64 bit virtual storage

- Line  $2^{24}$  Bar  $2^{31}$   $2^{64}$
- Above the bar
  - ▶ Buffer pools, EDM pool, Sort Pool
  - ▶ Rid Pool, Compression dictionaries
  - ▶ IRLM locks
- Real storage requirements probably increase
- Improve scalability and availability
- Much reduced management for virtual storage





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## Performance: DB2 for z/OS

### Performance Enhancements

- Ability to use indexes more often
- More matching in predicates
- Index backward scan
- Index varying length
- Distribution statistics on non-index columns
- Materialized Query Tables
- Star Join sparse index
- Multi-row fetch & insert
- Data Sharing improvements
- Cost-based Parallel Sorting



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- ▶ A statement of direction was included in the September 11, 2001 announcement, IBM z/OS Version 1 Release 2: Enabling and Protecting Your e-business and Preview: z/OS Version 1 Release 3
- ▶ IBM plans to deliver 64-bit virtual storage addressing for the DB2® for z/OS product in a future release. The future release of DB2 for z/OS, with 64-bit virtual address support, can only execute on IBM (elogo)server zSeries 900 (z900), or equivalent, running z/OS V1R3, or later.
- ▶ Instead of hiperspaces or data spaces, the single large address space can allow easier management of storage. We expect real storage needs to increase as scalability & availability are addressed.

- ▶ Many of the performance enhancements come from the enhanced index capabilities. Comparing a decimal column to a floating point number could not be done in the past. Being able to compare these values can mean choosing a better index or even an index access instead of a table space scan. An index can be used for a backward scan, so some indexes may not be required, reducing the overhead for inserts & deletes. Support for varying length indexes can save space and can use index-only access with a varchar. Having distribution statistics for columns which are not part of the index can give the optimizer better information so it can perform better optimization. Gathering these statistics was a separate DSTATS program, rather than part of RUNSTATS.
- ▶ Materialized query tables can provide a one or two order of magnitude performance improvement by rewriting queries to use the precalculated information.

## Availability: DB2 for z/OS

### Continuous Availability



- **Schema Evolution:**  
**ALTER instead of DROP / CREATE**
- **Data Partitioned Secondary Indexes (DPSI)**
- **System-Level Point in Time Recovery**
- **Improved LPL Recovery**
- **Additional online zparms**

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### New ALTERs

- Add a partition to the end of a table
- Rotate partitions
- Extend CHAR(n) column lengths
- Change type within character data types (CHAR, VARCHAR)
- Change type within numeric data types (small integer, integer, float, real, float8, double, decimal).
- Change type graphic data types (GRAPHIC, VARGRAPHIC)
- Includes column data type changes for columns that are referenced within a view
- Includes column changes for indexed columns

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- The most important change for many customers is the ability to use ALTER in many places instead of needing to drop and redefine. We call this schema evolution, and it can reduce outages by hours or days for a major structure change on an application.
- The ability to have secondary indexes that are partitioned with the data can improve recovery times by an order of magnitude. It can also eliminate the outage for online reorganizing a single partition or BUILD2 phase.
- We have some additional cases where subsystem parameters can be changed while the subsystem is running.

- This is a list of the changes in the ability to ALTER instead of needing to DROP and recreate. On the next foils, we'll discuss the most important changes.



### New ALTERs ...

- Add a column to an index
- Drop the partitioning index (or create a table without one)
- Change the clustering index
- Create or alter an index to have true varying length character columns within a key
- Alter identity column attributes
- Alter sequence attributes

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### Online Schema Evolution

- ▶ Changing Partition Definitions
  - Add Partition
  - Rotate Partition
    - Move first part to last
    - E.g. keep rolling 36 months
- ▶ ALTER INDEX : ADD COLUMN, PADDED or NOT, CLUSTER or NOT



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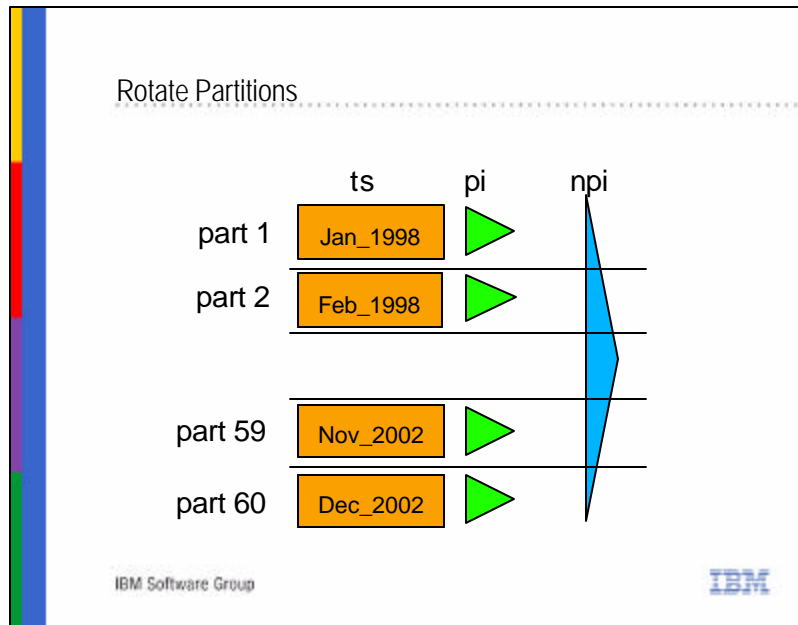


▶ This is a list of the changes in the ability to ALTER instead of needing to DROP and recreate. On the next foils, we'll discuss the most important changes.

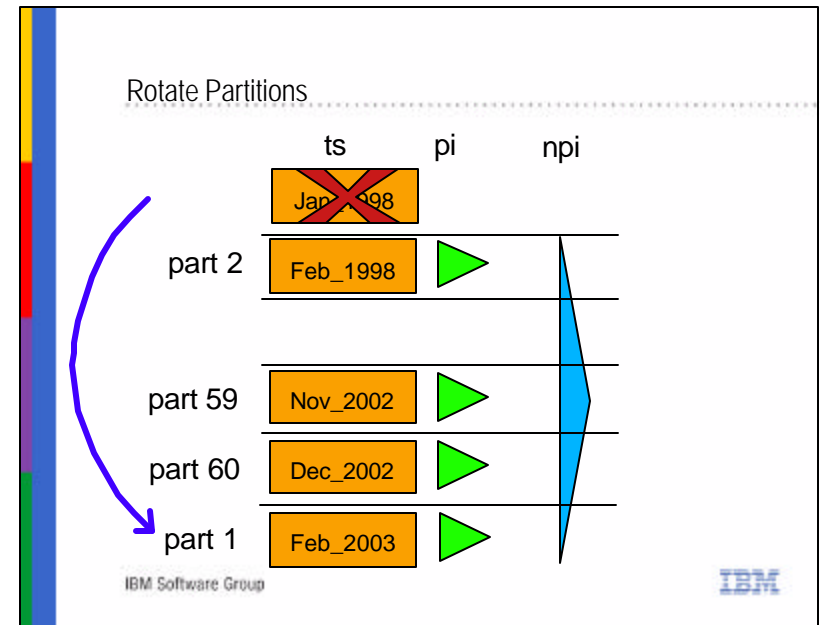
▶ Three types of changes are very high on our priority list: changing partitions, changing table attributes and unbundling partitioning and clustering. This is the first category, partition changes.

- ▶ Adding a new partition to an existing partitioned tables space is very important. Rotating the partitions, such as keeping a rolling 36 months of data is also key.





- ▶ This is a picture for rotating a partition, to keep the most current 60 partitions or five years by month. As we reach the end of December 2002, we need to get a new partition for 2003.



- ▶ Rather than just create a new partition, we empty the first logical partition and rotate it to be the last one. In many cases, one additional partition is needed.

## Online Schema Evolution

### ■ Table or column Changes

- ▶ Increase column within numeric data types
  - smallint, integer, decimal, float
  - No loss of precision allowed
- ▶ Change to expand character data type
- ▶ Change varchar to / from char



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## Online Schema Evolution

### ■ Unbundling Partitioned Table Attributes

- ▶ Partition without an index
  - May be able to have one less index
- ▶ Data Partitioned Secondary Index
- ▶ Cluster on any index
  - May be able to have more efficient clustering
  - E.g. partition by date, cluster by account
- ▶ ALTER CLUSTER attribute



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- ▶ We need to be able to change the data type for columns. In V5 we could increase the size of varchar columns, but the change allows us to extend numeric and character columns and to change between char and varchar.

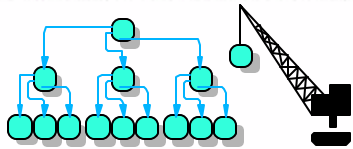
- ▶ Partitioning and clustering are bundled in current DB2. Some of the time we are required to make a difficult choice. We also want to partition without an index and be able to cluster on any index. These changes will allow us to have one less index and less random IO in some cases.

## Index: DB2 for z/OS

### Index Improvements

- Variable length index keys
- Index-only access for varchar data
- Maximum index key 2000 bytes
- Predicates indexable for unlike types
- Backward Index Scan
- Partitioning separate from clustering
- Data-partitioned secondary indexes (DPSI)

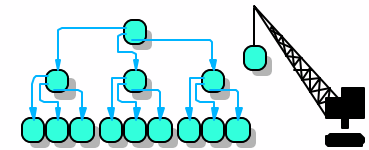
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## Indexable Predicates: DB2 for z/OS

- Predicates indexable for unlike types
  - Column is decimal; Host variable is float
  - Column is char(3); Literal or host variable is char(4)
  - Can be used with transitive closure
  - Some restrictions still exist for stage 1, indexable

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- ▶ DB2 provides many new opportunities for improving index processing, rebuilding the architecture for indexes.
- ▶ We are able to use indexes more effectively, reducing the space in variable-length indexes, being able to have index-only access with variable-length data and being able to use the index when the predicates do not match.
- ▶ In some cases, such as backward index scans or partitioning, we will be able to work as efficiently with one less index. Being able to eliminate an index will improve the insert, delete, LOAD, REORG and update processing.
- ▶ We have more flexibility in indexes, with longer index keys, the ability to partition secondary indexes and the ability to have more effective clustering.

- ▶ The most common mismatches for data types come with languages like Java, C++ and C and decimal data. Often the comparison is from a floating point host variable to a decimal column.
- ▶ A second type of mismatch that is very common is to have a literal or host variable with a character column length greater than that of the column.
- ▶ For both of these cases, the result was often poor performance because of the inability to use an index. While there are still some restrictions, performance is expected to improve substantially for many customers.

## Data Partitioned Secondary Index

- Physical partitions like table
- Benefits
  - ▶ Eliminate REORG BUILD2 phase
  - ▶ Improve index recovery
  - ▶ Facilitate parallel partition processing
  - ▶ Eliminate LOAD PART contention
  - ▶ Reduce Data Sharing overhead
- Some tradeoffs for index use
  - ▶ Need to check multiple partitions
  - ▶ Not for unique indexes



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## Data Partitioned Secondary Indexes (DPSIs)

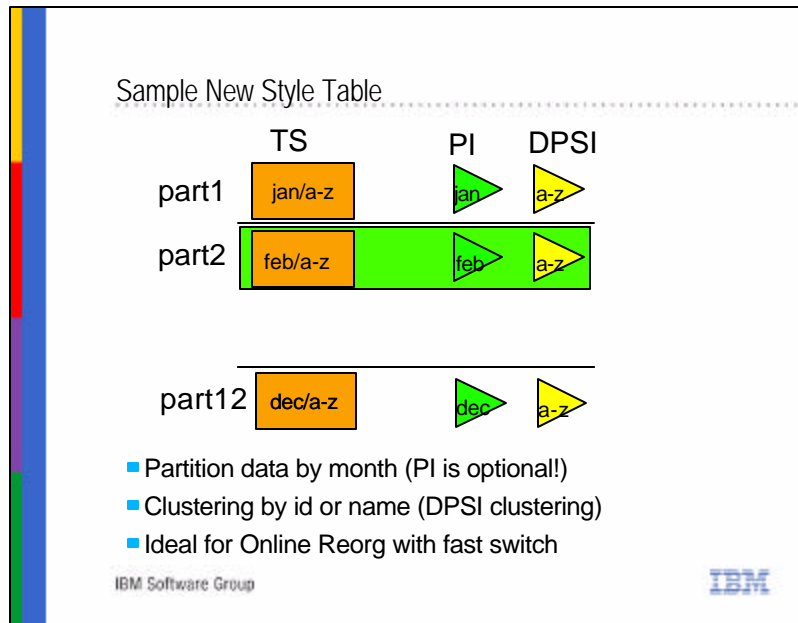
- Overview
  - ▶ DPSI = physically partitioned secondary index
  - ▶ Number of parts in DPSI = Number of parts in table
  - ▶ Keys in part 'n' of DPSI refer only to rows in part 'n' of table
- Benefits include:
  - ▶ More efficient utility processing
  - ▶ Higher availability
  - ▶ Streamline partition level operations
  - ▶ Potential for lower data sharing overhead
- Potential impact to query performance
- 3 kinds of indexes now:
  - ▶ Partitioning Index (PI).
    - ─ As today, except optional in Vnext and may or may not be partitioned
  - ▶ New Data Partitioned Secondary Index (DPSI).
  - ▶ Non Partitioned Secondary Index (NPSI) As today's NPI

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- ▶ The data partitioned secondary index (DPSI) provides physical clustering with the same clustering as the table.
- ▶ This approach can provide many benefits, improving availability and performance, but there are some important considerations to understand.

- ▶ This is a new type of index that does not fit into the old categories. It is a secondary index, but it is partitioned. The partitioning is according to the table and might be columns that are not part of this index.



- ▶ This is an example of the new style table, with table-based partitioning, rather than index-based partitioning. Note that the data is partitioned by month. An index is not required for the partitioning. Clustering for the data is by the id or name within each partition of the DPSI. This is an ideal organization for online reorg of a single partition. The BUILD2 phase is not required. If the month is not provided, a name search using the DPSI may need to search in every partition.

### 4096 Partitions

- Max number of parts raised from 254 to 4096
  - ▶ Table spaces and indexes
  - ▶ Table space use DSSIZE to go beyond 254 parts
- ALTER TS ADD PART adds partitions to the end
- Max table size remains 16TB for 4 KB pages
- Dataset naming convention
  - ▶ 'Axxx' - partitions 1-999
  - ▶ 'Bxxx' - partitions 1000-1999
  - ▶ 'Cxxx' - partitions 2000-2999
  - ▶ 'Dxxx' - partitions 3000-3999
  - ▶ 'Exxx' - partitions 4000-4096
- Max number parts allowed depends on page size and DSSIZE
  - ▶ 4K page size, DSSIZE=1GB => 4096 parts allowed, 4TB max table size
  - ▶ 4K page size, DSSIZE=64GB => 256 parts allowed, 16TB max table size

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- ▶ The maximum number of partitions goes from 254 to 4096, so that you can have one partition per day for more than 11 years. Do not define all of the partitions, since you can add new partitions at the end.
- ▶ While the maximum size remains 16 terabytes for 4K pages, larger page sizes can exceed 16 terabytes for a single table. DSSIZE is recommended, although LARGE also allows more than 254 parts.
- ▶ This change requires changes in the data set naming convention.

## System Level Point In Time Recovery

- Easier, more efficient, less disruptive
- Two new utilities are introduced
  - ▶ BACKUP SYSTEM
  - ▶ RESTORE SYSTEM
- New HSM construct called a COPYPOOL
  - ▶ Named set of SMS storage groups
  - ▶ Each DB2 system defines one Copypool for data, one for logs
  - ▶ z/OS V1R5 required
- New DFSMS construct called "copy target" storage group
  - ▶ Storage group reserved to be target of FlashCopy

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## Data Sharing Enhancements

- Batching of GBP writes and castouts
  - ▶ Write/castout multiple pages in a single CF operation
  - ▶ Improved data sharing performance, especially for batch updates
  - ▶ Requires z/OS V1R4, CFLEVEL=12
- Reduced global contention for tablespace L-locks
  - ▶ Reduced XES-level contention across members
  - ▶ Improved data sharing performance, especially for OLTP
  - ▶ RELEASE(DEALLOCATE) may not be needed
- Changed pages written to GBP at Phase1 instead of Phase2
  - ▶ Transactions invoking other transactions at syncpoint for same data
  - ▶ Unusual "record not found" from another member
  - ▶ Easier to manage
  - ▶ Equivalent performance
- More efficient index split processing for data sharing

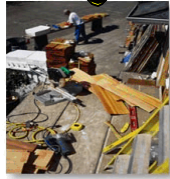
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- ▶ Batching of GBP writes and castouts
  - ▶ Write/castout multiple pages in a single CF operation
  - ▶ Improved data sharing performance, especially for batch updates
  - ▶ Requires z/OS R4, CFLEVEL=12
- ▶ Reduced global contention for tablespace L-locks
  - ▶ IX/IX and IX/IS TS locks no longer hit XES-level contention across members
  - ▶ Improved data sharing performance, especially for OLTP
  - ▶ Recommendation for RELEASE(DEALLOCATE) can be softened
  - ▶ New locking protocol enacted only with New Function mode
- ▶ Changed pages written to GBP at Phase1 instead of Phase2
  - ▶ Some Tx Managers spawn other transactions at syncpoint
  - ▶ Spawned tx can encounter "record not found" if it tries to read originating tx's update from another member (rare, but a few customers have reported it)
  - ▶ Moving writes up to Phase1 by default removes need to monitor for this and to set IMMEDIATE PH1 Zparm or Bind option if needed
  - ▶ Equivalent performance for Ph1 vs. Ph2 writes
- ▶ More efficient index split processing for data sharing

## Utility Improvements

- ▶ **Schema Evolution**
  - ROTATE partitions FIRST TO LAST
  - REBALANCE
- ▶ **On-line REORG Enhancements**
  - DISCARD
  - Avoid BUILD2 with DPSI
  - REORG DB2 catalog SHRLEVEL REFERENCE
- ▶ **LOAD & UNLOAD delimited**
- ▶ **SCOPE PENDING**
- ▶ **RUNSTATS non-uniform statistics on non-index columns**



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## VLDB: DB2 for z/OS

### Very Large Database Improvements



- **Separate partitioning from clustering**
- **Partition without an index**
- **Data-partitioned secondary indexes**
- **4096 Partitions**
- **Add partitions**
- **Rotate partitions**
- **Extend columns**

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- ▶ Many utility enhancements are part of the base changes in this version, supporting long names, Unicode, 64 bit addressing, DPSIs and schema evolution. These items need utilities to complete their function.
- ▶ Schema evolution uses utility support to rotate the first partition to the last partition. The new REBALANCE function can balance the sizes of a partition range or of all partitions.
- ▶ The REORG DISCARD can be performed with SHRLEVEL CHANGE. DPSIs can be reorganized without a BUILD2 phase. The DB2 catalog tables can all be reorganized in SHRLEVEL REFERENCE or read only mode.
- ▶ Delimited files can be used as input to LOAD or output from UNLOAD.
- ▶ SCOPE PENDING provides improved usability. SCOPE PENDING indicates that only partitions in a REORG or AREO\* state for a specified table space or partition range are to be reorganized.

- ▶ Very large databases face the combined challenge of very high performance needs, continuous availability and complexity. Improvements in scale and flexibility are more important in this area. Being able to have more partitions and to add them with ALTER are a big improvement.
- ▶ Often it is useful to partition by date, so that we can archive or delete an entire partition, but processing will be much more efficient with another clustering order, such as by customer. Before this change, the clustering order was the same as the partitioning. This flexibility offers many opportunities for improved performance and availability.
- ▶ Some customers have an index that is used only for partitioning the data or have extra columns at the beginning of the index. Being able to avoid the extra index or columns can improve our efficiency a lot.
- ▶ For these very large tables, the ability to have more partitions, to add new partitions and to be able to rotate partitions is crucial.

## UNICODE Evolution



- UNICODE encoding scheme can represent codepoints of characters of many different geographies & languages
  - ▶ More than one byte to represent many characters
  - ▶ Different languages in the same table
  - ▶ CCSID UNICODE
- V5 ASCII data and Unicode for Java
- V7 UNICODE data storage & manipulation
- OS/390, z/OS, z/Architecture and zSeries

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## Unicode Enhancements

- Able to join Unicode with EBCDIC or ASCII
- SQL in Unicode, statements, literals, object names, mixed CCSIDs
- Most DB2 character catalog columns in Unicode
- Collating sequence change
- Lengths and maximum lengths can change



[www.unicode.org](http://www.unicode.org)

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- ▶ Multinational companies that engage in international trade often store data from more than one country. Some countries use different coded character set identifiers.
- ▶ Previous releases of DB2 have offered support for numerous code sets of data in either ASCII or EBCDIC format. However, there was a limitation of one code set per system.
- ▶ Version 7 of DB2 for OS/390 & z/OS delivers support for Unicode encoded data. The encoding scheme can represent the code points of many different geographies and languages. You can easily store multilingual data within the same table or on the same DB2 subsystem.
- ▶ These changes are supported by new function in OS/390, z/OS, the z/Architecture and the zSeries machines. See [www.unicode.org](http://www.unicode.org)

- ▶ The key improvements for Unicode allow much more flexibility, with the ability to join a Unicode table to one that is ASCII or EBCDIC. SQL statements and literals can be Unicode or EBCDIC. Many of the DB2 catalog character columns will be converted to Unicode, so Unicode is for everyone. SQL is converted to Unicode before parsing to allow code-page dependent parsing.
- ▶ The collating sequence for Unicode is similar to ASCII, with numbers sorting lower than letters. The lengths and maximum lengths of strings can change as they are converted to Unicode, so treat lengths as variable.



DB2 for z/OS Vnext



**DB2 and IRLM will be 64-bit exclusive**

**Base Pre-requisites:**  
**zSeries z800, z900 or later**  
**z/OS R3 or above**

**Major catalog changes:**  
**Long fields**  
**Unicode**


**Migration Process:**  
**From Version 7 only**  
**Multi-step process**  
**V7 and Vnext data sharing coexistence supported in compatibility mode only**

**Building the e-infrastructure**

- ✓ Continuous Availability
- ✓ Systems Management, Security
- ✓ Performance/Capacity
- ✓ Connectivity
- ✓ Productivity
- ✓ Synergy: DB2 family & zSeries


= Total Cost of Ownership

**Ready for e-business**

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DB2 Catalog Vnext

- Longer names (128 byte varchar Unicode)
  - ▶ table, view & alias
  - ▶ column (30)
  - ▶ schema or authorization id
  - ▶ UDF, stored procedures, triggers, package
- Some page sizes greater than 4K
  - ▶ 4K, 8K, 16K, 32K pages in DB2 catalog
- Indexes longer than 255 bytes
- Contains Unicode data

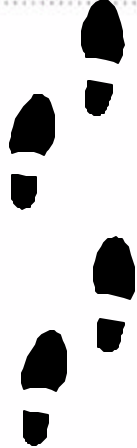
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- ▶ Here is some early information for your planning, while the information is not announced yet, what you will want to do to get ready for the next version of DB2 is to migrate to current versions of hardware architecture, operating system and DB2.
- ▶ Note that z/OS R3 requires the WLM to be in goal mode. We expect to require VS COBOL II or IBM COBOL, no longer supporting the 20 year old OS/VS COBOL. Later versions of CICS TS V1.3, V2.2 and IMS V7 are expected.

- ▶ This is a discussion about possible changes in the DB2 catalog beyond Version 7. The changes are more substantial for the catalog than for any prior release, with the possible exception of V1R2.
- ▶ Note that you will migrate to Version 7 before you can use the standard process to migrate. The migration process from Version 6 is to Version 7, then another migration.

Four step process for Migration


- Test with New Install & Migrate
- Apply the Fallback SPE to all members
  - ▶ Start all members at SPE level
- Migrate to new release without new function (COMPAT mode)
- Enable New Function Mode
  - ▶ Then in **New Function Mode**



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Tighter Migration Customer Value

- More robust migration process
  - ▶ Fewer migration & fallback errors
  - ▶ All customers apply the Fallback SPE
- Customer control for migration process & timing for using new function
- Reduced risk of problems in Fallback SPE
  - ▶ Reduced number of modules, fewer changes
- Improved ability to deliver new function, while still supporting fallback & coexistence

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- ▶ We are thinking that the process of migration will take four steps.
- ▶ Use a new install on a separate subsystem and practice migration on the separate subsystem. This will be used to ensure that you are ready to move forward.
- ▶ Apply the fallback SPE on every member of each data sharing group and on all subsystems to migrate. Applying the SPE was required only for data sharing, but is now required for all subsystems.
- ▶ Migrate to the new release in compatibility mode. You are using the new code but almost no new function.
- ▶ Finally, after all of the members of a data sharing group are running the new version, you can switch to new function mode.

- ▶ We think that the new process is formalizing what customers have done and adding some new controls.
- ▶ The process should make the process more robust by avoiding a technique that has caused many problems.
- ▶ There is a way to control the use of new function, so that falling back to a prior release is easier from COMPAT mode.
- ▶ There will be fewer modules to change in the old release to tolerate changes from the later version.
- ▶ We think the new technique provides a method that will make it easier to deliver new function and still support fallback and coexistence, even with many fundamental changes.

### Primary Incompatible Changes

- ▶ Use valid host variable declaration for PREPARE
- ▶ Valid VCAT required no x.y (V5 and up)
- ▶ No COMPJAVA, Use JIT
- ▶ CREATE, ALTER PROCEDURE WLM ONLY
- ▶ Unicode used in DB2 catalog, changes order
  - SQL statements, translation, lengths may change, Instrumentation
- ▶ Java Universal Client, SQLJ process
- ▶ Index default is variable length, NOT PADDED
- ▶ REORG SORTDATA and SORTKEYS default
- ▶ REORG Implicit clustering index
- ▶ No SQL FLAGGER

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### Getting ready for Vnext

- **Migrate to z/OS V1R3 or later**
  - ▶ z/OS V1R3 requires WLM goal mode
  - ▶ Some functions require z/OS V1R4, V1R5
- **zSeries, z/Architecture 64 bit mode**
- **COBOL: no OS/VS COBOL or VS COBOL II**
  - ▶ Can run load modules under LE
  - ▶ IBM COBOL
- **IMS V7**
- **CICS TS V1.3, V2.2**

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- ▶ The new version will probably have some new incompatible changes:
- ▶ Host variable declarations for PREPARE and EXECUTE IMMEDIATE must declare the correct length. V7 made this change, removed in PQ50494.
- ▶ Note that a valid VCAT (one level) is enforced in V5, V6 and V7 with APAR PQ53145.
- ▶ Only the Java JIT compiler will be supported. COMPJAVA or HPJ depend upon JDK 1.1.8, which is out of support.
- ▶ While stored procedures created earlier will run, creating or altering a stored procedure will require WLM environment.
- ▶ Unicode changes will require migration work.
- ▶ Migration will be permitted only from Version 7

## DB2 Family Summary

### Integrated Information Infrastructure

- **Web Services**
- **Portfolio XML-ization**
- **Content Management**
- **Information Integration**
- **SMART Databases**

#### IBM Data Management Foundation

Performance, Scalability,  
Availability, Security,  
Connectivity, Productivity

**IMS DB2 Informix**

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- So that was a fast summary of the work in DB2 and the wider group of work across data management. We are building upon the strong foundation in our product lines: IMS, DB2 and Informix. We are using innovative technology from our research and products across a broader spectrum.
- The key work for building a robust infrastructure to integrate information includes building web services, making the entire portfolio able to work with XML, and moving the XML support into the engines. Our Content Management work handles non-structured data with the other related information. Information integration is our work to expand the replication and federation capabilities, as well as the XML initiatives. Several initiatives are aimed at getting a life for DBAs, with SMART, eLiza and autonomic projects.

- Some parts of this presentation are more like looking into a crystal ball than at measurements. This crystal ball is cloudy, and gets fuzzier the farther we look into the future. The only near certainty is that there will be changes. My best guess is that fewer than 10% of the items will change their delivery time. I would expect some new items to come in, some to come early, and others to deliver in stages. More will have major changes in their design.
- Do you need Answers to Frequently Asked Questions?
  - Hints and Tips? Product Information?
  - Technical Presentations? Redbooks? White Papers?
- Support is on the web. Click Support on DB2 web pages.

Session Title: Technical Overview: Vnext

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**ibm.com/software/db2zos**

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- ➔ Large Objects with DB2 for z/OS and OS/390, SG24-6571
- ➔ Version 7 Selected Performance Topics, red paper
- ➔ Version 7 Performance Topics, SG24-6129
- ➔ Version 7 Using the Utilities Suite, SG24-6289
- ➔ Powering the World's e-business Solutions, SG24-6257
- ➔ Version 7 Presentation Guide, SG24-6121
- ➔ Performance Management Tools, SG24-6508
- ➔ Application Programming Topics, SG24-6300

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- ▶ Are you looking for additional support? Have you had problems finding answers to your questions? Would you like to see hints and tips for some of the techniques you use? Do you want to get recent technical presentations? Do you need to be able to search for DB2 Redbooks more effectively? Do you need white papers?
- ▶ Improved Support is on the web now. Click on the Support entry on your DB2 web page. We have added more than one thousand answers to frequently asked questions and hints and tips documents. Click on the Frequently asked questions (FAQs) line to see answers to the most frequently asked questions. Click on Hints & Tips to get brief information on installation, configuration, troubleshooting, and usage. The DB2 library has been on the web, and it is also accessible from this page. Many recent DB2 technical presentations can be downloaded by clicking on Technical Presentations. Some customers need to have a more effective search for Redbooks. The Support page lists recent red books, but you can also narrow down the search and filter results by adding keywords. You can also find a selection of recent white papers.

- ▶ If you want to look across the DB2 family, start at
  - ▶ [ibm.com/software/db2](http://ibm.com/software/db2)
  - ▶ Click on Support or start at
  - ▶ <http://www.ibm.com/software/data/support/>
  - ▶ Then choose a product.
- ▶ If you want to look at DB2 for z/OS & OS/390, start at
  - ▶ [ibm.com/software/db2zos](http://ibm.com/software/db2zos)
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  - ▶ <http://www.ibm.com/software/data/db2/os390/support.html>
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