DB2 10 for z/OS Planning and Experiences

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DB2 Information Management Software
DB2 10 for z/OS

- Fastest uptake
  - +2X customers
  - +3X licenses
  - 25% coming from DB2 V8

- Customers in Production
  - SAP, data warehouse and OLTP workloads
  - Skip-level and V2V

- Quality / stability solid

Production references
DB2 for z/OS Adoption

- DB2 10: Climbing Sharply
  - 10% of TOTAL NE/UNY at DB2 8
  - 75% of TOTAL NE/UNY/MI at DB2 9
  - 15% of TOTAL NE/UNY at DB2 10
  - 15% of TOTAL NE/UNY (significant majority of DB2 Data Sharing Customers)
DB2 10 Delivers Business Value

- 5-10% CPU reduction
- Increased ability to scale up
- Easier security compliance and audit
- Improved productivity
  - Temporal and more enhanced SQL & XML
  - Administration, scaling and performance
  - Skip level migration
- Ready for production, stable and available
Other Triggers Driving Customers in 2012

- **DB2 V8**
  - End-Of-Service effective: *April 31, 2012*
  - **50% off** Extended Service if purchase DB2 10 *before* July 1, 2012

- **DB2 9**
  - Withdraw-from-Marketing
    - announce: Dec. 6, 2011  effective: *Dec. 10, 2012*
  - End-Of-Service
    - announce: Feb. 7, 2012  effective: June 27, 2014 *(two years away)*
Thank You… Leveraging the Best of z!

“We had migrated five sub-systems to DB2 10 and have had no reported application issues running on this release to date.”

–LabCorp

“The ‘overall performance’ in DB2 10 is better compared to DB2 9.”

–HUK

Coberg

• VISIT the DB2 Best Practices
• JOIN the World of DB2 for z/OS
• JOIN the DB2 for z/OS group
• SHARE at DB2 for z/OS Exchange Forum

[The Temporal Data] feature will drastically save developer time, test time … and improve business efficiency and effectiveness …

–Bankdata

Our regression tests showed performance improvements just by running the workload on a DB2 10 CM member…

–Dillards
DB2 10 Experiences

Why DB2 10 Now?

- Reduced cost
- Improved performance
- Improved scalability

Benefits

- 20-30% CPU savings out-of-the-box
- 5-15% Performance improvements for batch, CICS, and DDF

Actual results may vary for other customers

Migration Tips

- Thorough preparation and planning
- Good maintenance practices

“We are pleasantly surprised with the out-of-the-box CPU savings we have seen during testing and early production phases.”

Terry Glover – Director IT Infrastructure
Dillard’s

Fully in Production
DB2 10

Benefits

- Reduced cost
- Improved scalability
- Improved resilience

90% Virtual storage savings
10% CPU savings on CICS transactions
30% CPU savings on test batch workload

Migration Tips

- Plan well, including good maintenance practices
- Rebind can get you the highest CPU savings
- Expect increase in real storage consumption to support and exploit DB2 10

"Our DB2 10 experience has given us confidence about the virtual storage relief and CPU savings. I am looking forward to continuing our rollout and reaping the benefits."

Niels Simanis
Senior Technology Manager
Danske Bank
# DB2 z/OS Availability Summary

<table>
<thead>
<tr>
<th>Version</th>
<th>PID</th>
<th>General Availability</th>
<th>Marketing Withdrawal</th>
<th>End of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5655-DB2</td>
<td>June 1997</td>
<td>December 2001</td>
<td>December 2002</td>
</tr>
<tr>
<td>6</td>
<td>5645-DB2</td>
<td>June 1999</td>
<td>June 2002</td>
<td>June 2005</td>
</tr>
<tr>
<td>7</td>
<td>5675-DB2</td>
<td>March 2001</td>
<td>March 2007</td>
<td>June 2008</td>
</tr>
<tr>
<td>8</td>
<td>5625-DB2</td>
<td>March 2004</td>
<td>September 2009</td>
<td>April 2012</td>
</tr>
<tr>
<td>9</td>
<td>5635-DB2</td>
<td>March 2007</td>
<td>December 2012</td>
<td>June 2014</td>
</tr>
<tr>
<td>10</td>
<td>5605-DB2</td>
<td>October 2010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Beneficial Activities

- **DB2 z/OS V10 Migration Planning Workshop**
  - When ready to ORDER

- **OPEN PMR for Upgrade/Migration**
  - When ready to BEGIN

- **Stay CURRENT on MAINT**
Education / Planning

- IBM Education

- CV303 Doing skip-level migration? New Functions and Features of DB2 9 and 10 for z/OS (5 days)
- CV311 DB2 for z/OS New Functions and Features in V10 (4 days)
- CV312 DB2 for z/OS - New Features in Version 10 Workshop (5 days)
- CV831 DB2 10 for z/OS Database Administration Part 1 (5 days)
- CV851 DB2 10 for z/OS System Administration (5 days)
- Coming Soon:
  - CV871 – DB2 10 Utilities Administration
- Also available as Instructor Led Online / Virtual Classroom
- Database Administration and System Administration Certification Crammer courses
Maintenance

- **Sound maintenance strategy is essential for all customers**
  - Recommended to exploit CST/RSU process
  - Apply 2 to 3 preventative service drops annually
  - Exploit Enhanced HOLDDATA to be vigilant on HIPERs and PEs
  - No one-size-fits-all strategy
  - Review installation guide and the material supplied to ensure that RSU only service is installed
  - Can enforce installing RSU only service by adding the SOURCEID (RSU*) option in the supplied APPLY and ACCEPT jobs
  - Note '*' will pull ALL RSUs off of a particular tape
# Migration and Planning …

- **CST and RSU example**

<table>
<thead>
<tr>
<th>CST4Q10 RSU1012</th>
<th>CST1Q11 RSU1103</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CST4Q10 RSU1012</strong></td>
<td><strong>CST1Q11 RSU1103</strong></td>
</tr>
<tr>
<td>All service through end Sept 2010 not already marked RSU + H&amp;PE through end Nov 2010</td>
<td>All service through end Dec 2010 not already marked RSU + H&amp;PE through end Feb 2011</td>
</tr>
<tr>
<td>Available at the beginning of January 2011</td>
<td>Available at the beginning of April 2011</td>
</tr>
<tr>
<td>RSU1101</td>
<td>RSU1102</td>
</tr>
<tr>
<td>H&amp;PE through end Dec 2010</td>
<td>H&amp;PE through end Jan 2011</td>
</tr>
<tr>
<td>Available at the beginning of February 2011</td>
<td>Available at the beginning of March 2011</td>
</tr>
</tbody>
</table>

H&PE = HIPER/Security/Integrity/Pervasive PTFs + PE resolution (and associated requisites and supersedes)
Prerequisite Summary

- Run DSNTIJPA pre-migration job
- Eliminate use of Private Protocol & DBRMs bound into Plans
- Check programming language requirements
  - DSNHPC7 included in the base for older COBOL and PL/I
- SMS managed catalog and directory
  - DSNTIJSS provided as a sample for configuration
    - A copy of DSNTIJSS can be obtained from developerWorks
      - Use hyperlink or search for file dsntijss.copy
- PDSEs required for SDSNLOAD, SDSNLOD2, ADSSNLOAD
  - See Consolidated Checklist
Removed Features

DB2 8 to DB2 10

- DB2 Managed Stored Procedures
- Legacy Java Drivers
  - Include WLM SPAS JCL
- Creation of Simple Table Space
- AIV & Text Extenders
- Visual Explain

DB2 9 to DB2 10

- Optimization Service Center
- Private Protocol
- DBRMs bound into Plans
- Explain tables before V8
- DB2 Management Clients Package
- Book Manager
- XML Extender
- REORG TABLESPACE SHRLEVEL NONE on LOB
- Several parameters
Deprecated Features

- V8 / V9 Explain Table formats
  - EBCDIC encoded PLAN_TABLEs
- Simple Table Spaces
- Mapping DSNHDECP
- Classic partitioning (NOT TRUE)
- DSNHPC7
- Several DB2 provided stored procedures
- Several parameters
DB2 10 for z/OS Documentation


Administration Guide
Application Programming Guide and Reference for Java
Application Programming and SQL Guide
Codes
Command Reference
Data Sharing: Planning and Administration
Installation and Migration Guide
Internationalization Guide
Introduction to DB2 for z/OS
Managing Performance
Messages
ODBC Guide and Reference
RACF Access Control Module Guide
SQL Reference
Utility Guide and Reference
What's New?
pureXML Guide

Diagnosis Guide and Reference
SDSNIVPD library member DSNDR
DSNTIJPM(A)...

- JPA shipped for V8 & V9 with APAR PM04968
- Uses REXX Language Support
  - DSNTIJRX will bind needed packages if not done already
  - Requires use of a special package in collection DSNREXX_500 (see JPA job)
Checks for:

1. Check for previous-release sample database
2. User-defined indexes that reside on user-managed storage and are defined on DB2 catalog tables that are processed during enabling-new-function mode
3. User-defined indexes that reside on DB2-managed storage and are defined on DB2 catalog tables that are processed during enabling-new-function mode
4. Stored procedures that use the DB2 SPAS (from V8)
5. Plans that are autobind candidates in V10
6. Packages that are autobind candidates in V10
7. Use of external module DSNWZPR (from V8)
8. Incomplete table definitions
9. Incomplete column definitions
10. Occurrences of the DSN_PTASK_TABLE explain table with one or more column names that contain a hash mark character
11. Plans that contain DBRMs
12. Plans bound with ACQUIRE(ALLOCATE)
13. Static queries bound with query parallelism
14. EBCDIC explain tables
15. Explain tables that are not in current-release format
16. MQTs on the DB2 catalog that are affected by CATMAINT
17. MQTs on the DB2 catalog that are affected by CATENFM
18. Plans bound with DBPROTOCOL(PRIVATE) that can be converted to DRDA via REBIND
19. Plans bound with DBPROTOCOL(PRIVATE) that can be converted to DRDA via DSNTIJPD
20. Packages bound with DBPROTOCOL(PRIVATE) that can be converted to DRDA via REBIND
21. Packages bound with DBPROTOCOL(PRIVATE) that can be converted to DRDA via DSNTIJPD
22. Authorization IDs and roles that use EBCDIC-encoded routines for DB2 Metadata

Return to Migration Process
DSNTIJPM(A)...

- Checks for:
  23. Obsolete DB2-supplied objects
  24. Packages that use UDF `SYSFUN.DSN_XMLVALIDATE`
  25. Existence of inconsistent UTF-8 encoding of the collection IDs and the package names that were bound by a remote client system (must rebind on client).
  26. Reports those with EXECUTE authority on `SYSPROC.DSNLEUSR`. This is dropped / recreated during NFM migration.
  27. Reports on DATACAPTURE that will be disabled during migration to CM8.
  28. Reports on DATACAPTURE that will be disabled during migration to ENFM.
**DSNTXAZP (Job DSNTIJXZ)**

- Job to update the installation CLIST input (DSNTIDxx) to reflect current:
  - System parameters
  - Buffer pool settings

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**CLIST INPUT MEMBER GENERATION REPORT**

---

**CLIST PARAMETER REPORT:**

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Zparm/Bufferpool Parameter</th>
<th>Parameter Type</th>
<th>Data Sharing Scope</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
<th>Current CLIST Value</th>
<th>Current Installed Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001 ABEXP</td>
<td>ABEXP</td>
<td>CHAR</td>
<td>M</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>RETAINED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Zparm/Bufferpool Parameter</th>
<th>Parameter Type</th>
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<th>Maximum Value</th>
<th>Current CLIST Value</th>
<th>Current Installed Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>0030 AUDIT</td>
<td>AUDITST</td>
<td>CHAR</td>
<td>M</td>
<td>NONE</td>
<td>NONE</td>
<td>YES</td>
<td>1</td>
<td>UPDATED</td>
</tr>
</tbody>
</table>

**CHANGE SUMMARY REPORT:**

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Zparm/Bufferpool Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABEXP</td>
<td>SAME</td>
<td>YES</td>
</tr>
<tr>
<td>ASSIST</td>
<td>SAME</td>
<td>NO</td>
</tr>
<tr>
<td>* AUDIT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Return to Migration Process
DSNTXAZP Continued

- “*” in summary report indicates a change
- The new value is indicated along with the old value in “()”
- Maps CLIST field names to ZParm names
- DSNTIDxx will include opaque parameters
Migrating to DB2 10

- **FMIDs HDBAA10, HIYAA10, HIZAA10, HIR2230**
- **Complete pre-migration checks (DSNTIJPA)**
  - This will be the same as DSNTIJPM delivered with DB2 10
  - 28 reports
- **Plans and Packages prior to V6 will require REBIND**
  - This also impacts Package copies (PLANMGMT). SWITCHing to these requires REBIND
- **Check / correct incompatibilities**
  - The BSDS needs to be expanded to V8 format (DSNJCNVB)
  - If not done before migrating to V10, DSNTIJUZ will convert the BSDS(s)
  - Release Incompatibilities documented in:
    - Installation Guide
    - Application Programming and SQL Guide
    - For example:
      - Eliminate Private Protocol / DBRMs bound into Plans
      - Review the Release Incompatibilities in the MPW Checklist
- **Must be on DB2 for z/OS V8 or DB2 9 New Function Mode**
  - With the Fallback SPE
Migrating to DB2 10

- The DB2 10 Catalog & Directory must be managed by DB2 & SMS
  - Job DSNTIJSS provided to set up the SMS environment
  - SMS environment must be set up before migration
  - Not required to convert catalog / directory before migrating
    - Will be converted during the next REORG
  - Data Class attributes of
    - Extended Format
    - Extended Addressability

- Reestablish V8 or V9 IVP to test DB2 10 before NFM

- Assess ISV Requirements / Readiness
  - Tools and applications
  - Some vendors may add instructions for migration and / or require maintenance

- Assess the training requirements for your organization
Migrating to DB2 10

- Establish a project team and project plan
  - Review the Installation Guide checklists

- Develop conversion and coexistence goals
  - How did your V8 / V9 test plans work?
  - Reuse and improve upon your experiences

- Establish performance baselines

- Migration occurs in three familiar phases
  - Conversion Mode (CM)
  - Enable New Function Mode (ENFM)
  - New Function Mode (NFM)

- Numerical suffix mode names indicate the “migrate from” version
  - CM8 & ENFM8, or
  - CM9 & ENFM9
Migrating to DB2 10

- Use the proactive PMR process
- REBIND while in CMx
  - Use Plan Management (Package / Bind Stability)
- Single Version Charging (SVC)
  - Up to 12 months SVC when migrating from V9
  - Skip Level Migration (V8 to V10)
    - Up to 18 month SVC
      - See the Announcement Letter (ENUS210-380, or appropriate document for your country)
  - From the Announcement Letter:
    - “To elect single version charging, the customer must notify and identify to IBM the prior program and replacement program and the designated machine the programs are operating on.”
  - The SVC concern ends when in CM for a migration (not including fall back).
- Ensure no previous version libraries are being referenced
Migrating to DB2 10

- Develop conversion and coexistence goals
  - How did your V8/V9 test plans work?
  - Reuse and improve upon your experiences

- Establish performance baselines

- Migration occurs in three familiar phases
  - Conversion Mode (CM)
  - Enable New Function Mode (ENFM)
  - New Function Mode (NFM)
  - With more flexibility to move between modes
• Once started on the V8 to V10 path (DSNTIJTC) this path is committed.
• Falling back to V8 does not allow a subsequent migration to V9.
• Fallback can only be to V8
• There can be no DB2 9 members during data sharing coexistence.
DB2 10 for z/OS Migration Modes from V9

- Fallback can only be to DB2 9.
- There can be no DB2 V8 members during data sharing coexistence.

V9 Catalog

V10 CM9 Catalog

V10 Catalog

V10 Catalog
DB2 10 Modes

- **CMx Considerations (1)**
  - Address Incompatibilities before migration
  - Fall back SPE must be on all members (and restarted)
  - Catalog is tailored
  - Data Sharing group
    - V8 & CM8
    - V9 & CM9
  - Test, test, test
  - Fallback possible (CM8 to V8 OR CM9 to V9)
    - CM8 fall back to V8 CANNOT subsequently migrate to CM9
    - Fallback from CMx* not allowed
  - Backup and Recover catalog objects in the specified order of the “migrate from” version.
    - Add new objects per:
DB2 10 Modes

- **CM8 Considerations**
  - RUNSTATS
    - Collects DATAREPEATFACTOR added in V9
    - New Cluster Ratio formula

- **CMx Considerations (2)**
  - REBIND
    - Re-enable SPROCs
    - Find additional incompatibilities
    - Potential virtual storage and performance improvements
DB2 10 Modes

- **ENFMx Considerations**
  - This is running the same code as CMx
  - Catalog conversion takes place
  - All members of a data sharing group must be at the CMx level before converting to ENFMx
  - Can revert to CMx from ENFMx
  - Beyond CMx, Backup and Recover objects V10 specified order

- **NFM Considerations**
  - Can revert to ENFMx* or CMx*
    - Must be the same ENFM or CM mode as previous executed
      - CM8 / CM9
      - ENFM8 / ENFM9
  - REORG TABLESPACE for LOBs SHRLEVEL NONE no longer supported.
    - As of NFM, these jobs will complete with an RC=0, but will not do anything
DB2 10 Catalog...

- **V10 catalog restructure provides greater concurrency for catalog operations**
  - Concurrent binds

- **V8 migrations will include new Catalog table spaces for**
  - Real-Time Statistics
  - New page size for SYSOBJ
  - XML
  - Trusted Context
  - Extended Index definitions

- **V8 and V9 migrations see many table space changes for the catalog restructure**

- **Several LOB columns**
  - Using Inline LOBs
DB2 10 Catalog...

- SYSDBASE, SYSPLAN, SYSDBAUT, SYSVIEW, SYSGROUP and DBD01 had links
- These table spaces used page level locking because of the links.
- SPT01, SYSOBJ, and SYSPKAGE are also processed in ENFM.
- All of these table spaces will be removed and the tables within each will be moved to new PBG table spaces
  - Row level locking
  - New row format
  - Partition-by-growth
  - One table per table space
  - Referential Integrity in place of links
  - DSIZE 64 G
  - MAXPARTS 1
Improved availability ALTER...

- Classic Partitioned Table Space
- Range-Partitioned UTS PBR
- Single-Table Segmented Table Space
- Single-Table Simple Table Space
- Partition-By-Growth UTS PBG
- Hash

ALTER TABLESPACE...
DB2 for z/OS
The most robust and cost effective data server

DB2

- Deep synergy with System z
- HW Compression
- Consolidation
- Unmatched availability
- Unparalleled security
- Industry leading reliability

DB2 9
- 20%-30% Utility CPU savings
- Compress indexes, save 50% disk
- More CPU on specialty engines
- Flexible context and role security
- Expanded online schema changes
- Volume level backup & recovery
- Seamless integration of XML and relational
- Improved SQL
- Partition by growth
- OLAP expressions

DB2 10
- Save up to 20% CPU batch & transactions
- On-the-fly data Compression
- Temporal data support
- Skip-level migration
- Ten times more concurrent users
- More online schema changes
- More granular access control
- Enhanced query parallelism
- More SQL compatibility
- Improved pureXML and SQL PL

Efficiency
Resilience
Growth
Why Migrate to DB2 10 for z/OS?

- Business needs to save money
  - **Reduce CPU time**
  - Service Oriented Architecture
- Application developers need improved productivity and integration
  - pureXML for a faster, more capable interface to XML data
  - Powerful new SQL temporal enhancements & portability
- Database Administrators need
  - Improved performance
  - Availability, scalability & memory management
  - Simpler security and regulatory compliance
  - More productive database administration
DB2 10 Performance Objective

- Historical goal under 5% performance regression
- Goal 5% -10% initial performance improvement
- Many customers reduce CPU time 10% - 20%

Average %CPU improvements
version to version
DB2 10 for z/OS: Out-of-the-Box Savings

Up to 20% CPU reductions for transactions, queries, and batch
- Out-of-the-box CPU reductions of 5-10% for traditional workloads
- Out-of-the-box CPU reductions of up to 20% for new workloads
- Up to additional 10% CPU savings using new functions

Scales with less complexity and cost
- 5-10x more concurrent users – up to 20,000 per subsystem
- Significant scale-up capabilities in addition to existing scale-out support
- Consolidate to fewer LPARs and subsystems

Improved operational efficiencies and lower administration cost
- Automatic diagnostics, tuning, and compression

Even better performance
- Elapsed time improvement for small LOBS and Complex Queries
Running a Large Number of Threads

Pre DB2 10

- Data sharing and sysplex allows for efficient scale-out of DB2 images
- Sometimes multiple DB2s / LPAR

DB2A (500 thds)
DB2B (500 thds)
DB2C (500 thds)
DB2D (500 thds)
DB2E (500 thds)
DB2F (500 thds)

DB2 10

- More threads per DB2 image
- More efficient use of large n-ways
- Easier growth, lower costs, easier management

LPAR1
DB2A (2500 thds)
DB2D (2500 thds)

LPAR2
DB2B (2500 thds)
DB2E (500 thds)

LPAR3
DB2C (2500 thds)
DB2F (500 thds)
DB2 10 Sample Performance Improvements

- **DB2 10 CMx with REBIND**
  - Run time CPU reductions 5% - 10%
  - 1 MB page size 0% - 4%  z10, z196
  - Page fix buffers 0% - 8% since V8
  - Release deallocate 0% - 15% short trans, batch
  - Virtual storage constraints 0% - 5% memory, latches
  - Data sharing fewer members 1% for each 2 members
  - Insert 0% - 40% high volume insert
  - Predicate evaluation 0% - 60% complex predicates
  - Increased use of zIIP 0% - 3% IO, RUNSTATS, parallelism
  - Utilities (from V8) 3% - 20%

- **DB2 10 NFM**
  - Improved dynamic SQL cache 0% - 20% literals
  - Access: hash, index include 0% - 5% access improved
zIIP Expansion

- **DB2 10 parallelism enhancements**
  - When you use DB2 for z/OS to run parallel queries, portions of such parallel SQL requests are zIIP eligible and can be directed to run on a zIIP specialty processor.

- **DB2 10 RUNSTATS utility**
  - In DB2 10, portions of the RUNSTATS utility are eligible to be redirected to run on a zIIP processor. The degree of zIIP eligibility depends upon the statistics that you gather. If you run RUNSTATS with no additional parameters, the zIIP eligibility can be up to 99.9%.

- **DB2 10 buffer pool prefetch and deferred write activities**
  - Now dispatchable to a zIIP

- **z/OS sort utility (DFSORT)**
  - In z/OS V1R11, DFSORT is modified to allow additional zIIP redirect for DB2 utilities in case of in memory object sort operations of fixed length records. When the additional zIIP redirect takes place, DFSORT issues message ICE256I: ICE256I DFSORT CODE IS ELIGIBLE TO USE ZIIP FOR THIS DB2 UTILITY RUN

- **DRDA workloads**
  - In DB2 10, the zIIP eligibility for DRDA workloads are increased from 55% to 60%.

- **z/OS XML system services**
  - DB2 10 pureXML uses the z/OS XML system services for XML schema validation and XML parsing and, therefore, is 100% eligible to be executed on a zIIP
Information Center

- Primary documentation delivery mechanism
  - IBM LookAt web site still supported with Messages and Codes

- Installable IC for local use

- Search capabilities across
  - Redbooks
  - Whitepapers
  - Technotes
  - APARs

- See the Consolidated Checklist (Migration section – Documentation)
If you are considering Skip Level Migration....

- **DB2 9 delivers lots of value**
  - Including CPU savings of its own

- **Consider the decision points around skip level migration**
  - Earlier adoption of a major DB2 version
    - Do you have adequate testing environments?
    - Do you test frequently / thoroughly?
  - Code matures over time
    - Do you actively monitor and apply DB2 maintenance?
      - HIPER / PE watch
      - Frequent Enhanced HOLDDATA

- **Consider attending a DB2 9 Migration Planning Workshop as well**
  - The next few slides *highlight* the landscape of DB2 9
DB2 10 for z/OS

- Base Pre-requisites:
  - zSeries z890, z990, z9, z10, z196 or later
  - z/OS V1.10 or above
  - Defined shared memory objects (V9)

- Catalog changes:
  - Additions for new features
  - Hashes and links removed
  - Many tables changed to:
    - Single table, table spaces (UTS, PBG)
    - Row level locking
    - Using Inline LOBs

- DB2 Connect Minimum Levels
  - V9 FP1 / V9.7 FP3a for new features
  - PM24292 for Sysplex Workload Balancing

- See CST RSU for current recommendation

- Migration Process:
  - From Version 8 or 9 NFM
  - Data sharing coexistence in CM8 or CM9
  - DSNTIJPA in V8 or V9 / DSNTIJSS for SMS
Summary of DB2 10 Business Value

- Time Travel Queries with Temporal (Versioned) Data support.
- Extending the lead with Security enhancements
- Performance
- Manageability
- Extended Distributed Computing Performance
- Virtual Storage Management
- Data Warehousing
Basic Temporal Concepts

- **Business Time (Effective Dates, Valid Time, From/To-dates)**
  - Every row has a pair of TIMESTAMP(6) or DATE columns **set by Application**
    - Begin time: when the business deems the row valid
    - End Time: when the business deems row validity ends
  - Constraint created to ensure Begin time < End time
  - Query at current, any prior, or future point/period in business time

- **System Time (Assertion Dates, Knowledge Dates, Transaction Time, Audit Time, In/Out-dates)**
  - Every row has a pair of TIMESTAMP(12) columns **set by DBMS**
    - Begin time: when the row was inserted in the DBMS
    - End Time: when the row was modified/deleted
  - Every base row has a Transaction Start ID timestamp
  - PM31314 (9/2011) allows the use of TIMESTAMP WITH TIMEZONE
  - Query at current or any prior point/period in system time

- **Times are inclusive for start time and exclusive for end times**
Basic Temporal Concepts

- **Bi-temporal**
  - Inclusion of both System Time and Business Time in row

- **Temporal Uniqueness**
  - PK or Unique Key with BUSINESS_TIME WITHOUT OVERLAPS
  - Support for a unique constraint for a point in time
  - This is optional, however without it:
    - Unique constraints will likely return errors due to multiple rows per key

- **History Table**
  - Table to save “old” rows when using System Time
Business Value of Optimization Evolution

- Dynamic and Static enhanced workload stability
- Performance via exploitation of enhanced index usage
- More parallelism value via better workload distribution
- Reduced administration for statistics maintenance
Hash Access Candidates

- **Candidate Tables**
  - For queries needing single row access via the unique key
  - Queries having equal predicates on keys
  - With known and static approximate size of data
  - Having large N-level indexes

- **Not for Tables**
  - Needing sequential processing
  - Frequently updated
  - Either using BETWEEN or > and <

- **Follow-up**
  - Run REBIND with EXPLAIN option and query the PLAN_TABLE to check access path
  - SYSTABLESPACESTATS.REORGHASHACCESS
    - Number of times data is read using hash access in the last time interval
  - Check LASTUSED & REORGINDEXACCESS on overflow and other indexes to validate HASH access
  - PM25652 adds REORG recommendations to DSNACCOX
Business value of index enhancements

- Application performance and CPU savings
  - Sequential insert operations see a vast improvement
  - Lessen frequency of REORG utility while maintaining access path consistency
  - Less waiting on I/O operations for applications
I/O Parallelism for Index Inserts...

- Transactions that perform inserts into tables with many indexes defined on the table previously may have had high response times due to index I/O wait time.
  - DB2 executes index updates sequentially

- I/O parallelism: overlap the I/Os against non-clustering indexes
  - Utilized if there are more than 3 indexes defined on the table and one of them is a clustering index, or 2 indexes if neither is a clustering index
  - DB2 can prefetch pages from different indexes defined on the same table into buffer pool in parallel for insert operation.

- New ZParm INDEX_IO_PARALLELISM with default YES
- This functionality is enabled for DB2 10 Conversion mode
Additional Non-key Columns In An Index

- Indexes are used to enforce uniqueness constraints on tables
- To achieve index only access on columns not part of the unique constraint, additional indexes are often created for the non-unique columns
  - Slower DB2 transaction time
  - Increased storage requirements
- In DB2 10 Additional Non-key Columns can be defined in a unique index to reduce total amount of needed indexes
- Indexes that participate in referential integrity (RI) will support additional columns, but INCLUDE(d) columns will not be used to enforce RI
- Improves:
  - insert performance as less indexes need to be updated
  - space usage
  - Can stabilize access path as optimizer has fewer similar indexes to choose from
Security for Today’s Challenges

- Concerns about security
- New Access Control Authorities
- New Bind Options
- New Audit Capabilities
- Row/Column Access control
## Administrative Authority …

<table>
<thead>
<tr>
<th>Collections</th>
<th>User data, Plans, packages &amp; Routines</th>
<th>All schemas</th>
<th>JARS Sequences</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBADM ON SYSTEM</td>
<td>CREATEIN, ALTER INDEX REFERENCES TRIGGER</td>
<td>BIND COPY, CREATEIN ALTERIN DROPIN</td>
<td>ALTER</td>
<td></td>
</tr>
<tr>
<td>DATAACCESS</td>
<td>SELECT INSERT UPDATE DELETE, EXECUTE</td>
<td>USAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACCESSCTRL</td>
<td>GRANT REVOKE REVOKE BY</td>
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<td>GRANT REVOKE REVOKE BY</td>
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<tr>
<td>SECADM</td>
<td>GRANT REVOKE REVOKE BY</td>
<td>GRANT REVOKE REVOKE BY</td>
<td>GRANT REVOKE REVOKE BY</td>
<td>GRANT REVOKE REVOKE BY</td>
</tr>
<tr>
<td>SQLADM</td>
<td>NONE</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1 – Except tables defined with row permissions or column masks

The information on this slide and the next slide can be found in the Administration Guide under the topic Administrative authorities.
### Administrative Authority

<table>
<thead>
<tr>
<th>Administrative Authority</th>
<th>Distinct types</th>
<th>User databases</th>
<th>System privileges</th>
<th>Catalog tables (Update when available)</th>
<th>Issue Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DBADM ON SYSTEM</strong></td>
<td>USAGE</td>
<td>CREATETAB</td>
<td>BINDADD</td>
<td>SELECT INSERT UPDATE DELETE</td>
<td>Able to issue most commands</td>
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<td>privileges on</td>
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<td>BINDAGENT</td>
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<td>BUFFERPOOLS</td>
<td>DISPLAYDB</td>
<td>CREATEALIAS</td>
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<td>TABLESPACE</td>
<td>DROP</td>
<td>CREATEDBA</td>
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<td>STOGROUP</td>
<td>IMAGECOPY</td>
<td>CREATEDBC</td>
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<td>RECOVERDB</td>
<td>CREATETMTAB</td>
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<td>STARTDB</td>
<td>DISPLAY</td>
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<td>STATS</td>
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<td>STOPDB</td>
<td>MONITOR1/MONITOR2</td>
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<td>STOPALL</td>
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<td>USAGE</td>
<td>RECOVERDB</td>
<td>DEBUGSESSION</td>
<td>SELECT INSERT UPDATE DELETE</td>
<td>ALTER UTILITY</td>
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<td>MONITOR2</td>
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<td>EXPLAIN</td>
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</tbody>
</table>

**SEC**
DB2 Audit Capability …

- **New audit capabilities without additional data collectors**
  - New Audit Policies are managed in the catalog
    - Audit policy provides wild carding of table names
  - Ability to Audit privileged users
  - Ability to audit SQL activity against a table
    - Audit policy does not require AUDIT clause to be specified
    - Audit policy generates records for all read and update access, not just first access in the transaction
    - Audit policy includes additional records identifying the specific SQL statements reading or updating an audited UTS table
  - Ability to audit distributed identities
DB2 Audit Capability …

- Auditors can identify any unusual use of a privileged authority during the day
  - Audit policy records each use of a system authority to access data
  - External collectors only report users with a system authority
Row and Column level access …

- **What is the purpose of row level security?**
  - Filter rows out of answer set
  - Policy can use session information like SQL ID is in what group or user is using what role to control when row is returned in result set
  - Applicable to SELECT, INSERT, UPDATE, DELETE & MERGE
  - Defined as a row permission:
    
    ```sql
    CREATE PERMISSION policy-name ON table-name FOR ROWS WHERE search-condition ENFORCED FOR ALL ACCESS ENABLE
    ```

  - Optimizer inserts search condition in all SQL statements accessing table. If row satisfies search-condition, row is returned in the answer set
Row and Column level access …

- What is the purpose of column level security?
  - Mask column values in answer set
  - Applicable to the output of outermost subselect
  - Defined as column masks:

    ```sql
    CREATE MASK mask-name ON table-name FOR COLUMN column-name RETURN CASE expression ENABLE;
    ```

  - Optimizer inserts CASE statement in all SQL accessing table to determine mask value to return in answer set
Row and Column level access …

- **Define a column or row policy based on who is accessing the table**
  - **SESSION-USER**
    - Primary authorization ID of the process
  - **CURRENT SQLID**
    - SQL authorization ID of the process
    - `SET CURRENT SQLID = some authorization id`
  - **VERIFY_GROUP_FOR_USER** (new BIF)
    - Get authorization IDs for the value in SESSION_USER
      - Gets both primary and secondary auth ids
      - Return 1 if any of those auth IDs are in the argument

```
WHERE
VERIFY_GROUP_FOR_USER(SESSION_USER, 'MGR', 'PAYROLL') = 1
```

- **VERIFY_ROLE_FOR_USER** (new BIF)
  - Get the role for the value in SESSION_USER
  - Return 1 if the role is in the argument list

```
WHERE
VERIFY_ROLE_FOR_USER(SESSION_USER, 'MGR', 'PAYROLL') = 1
```
Row and Column level access

- **Row and Column Access Control**
  - When activated row and column access controls:
    - Make row permissions and column masks become effective in all DML
      - All row permissions are connected with ‘OR’ to filter out rows
      - All column masks are applied to mask output
      - Rebind required for dependent packages
      - Modified statements shown in DSN_PREDICAT_TABLE
      - IFCID 145 names the Mask / Permission enabled at prepare / bind time
    - Halts all access to the table if no user-defined row permissions
  
  ```sql
  ALTER TABLE table-name
  ACTIVATE ROW LEVEL ACCESS CONTROL
  ACTIVATE COLUMN LEVEL ACCESS CONTROL;
  ```

  - When deactivated row and column access controls:
    - Make row permissions and column masks become ineffective in DML
    - Opens all access to the table
      
      ```sql
      ALTER TABLE table-name
      DEACTIVATE ROW LEVEL ACCESS CONTROL
      DEACTIVATE COLUMN LEVEL ACCESS CONTROL;
      ```

Row and Column level access – Banking example …

- Determine access control rules for customer service rep
  - Allow access to all customers of the bank (a row permission)
  - Mask all INCOME values (a column mask)
    - Return value 0 for incomes of 25000 and below
    - Return value 1 for incomes between 25000 and 75000
    - Return value 2 for incomes between 75000 and 150000
    - Return value 3 for incomes above 150000
  - All are in the CSR group (who)

- Create a row permission for customer service representatives

```sql
CREATE PERMISSION CSR_ROW_ACCESS ON CUSTOMER
FOR ROWS WHERE
VERIFY_GROUP_FOR_USER (SESSION_USER,'CSR') = 1
AND BRANCH = 'B'
ENFORCED FOR ALL ACCESS;
```