

# DB2 for z/OS

## Today, Tomorrow, and the Future



DB2 z/OS 2009 Technical Conference



IBM INFORMATION ON DEMAND

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## Agenda

- **Business Overview**
- **Field Update on DB2 9**
- **Looking at DB2 X from a Stakeholder Perspective**
- **Questions**

## Top Challenges for

1. Reducing Costs of Information Technology
2. Continuous Service Availability
3. Boost Business Resilience and Reduce Risks
4. Deliver Differentiating Innovative Solutions
5. Security, Auditing and Regulatory Compliance
6. Accessing intelligent information on demand

3

3

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Let's summarize the challenges facing CIOs today – the four main challenges that keep CIO's up are :-

1. Reducing Costs of Information Technology – there is a need from the business to lower operating costs and increase profits.
2. There is a need to Boost Business Resilience and Reduce Risks in order to stay ahead of the competition.
3. There is a greater demand than ever before to drive more innovative solutions to gain Competitive differentiation, Business growth, and Increase market share,
4. And finally there is need to access the right information at the right time and make sense of it.

## DB2 for z/OS Technical Strategy

### ➤ **Extend the lead in availability, scalability and performance.**

- Parallel Sysplex: the best scale-out solution in the industry
- Tight integration between DB2 and the System z hardware and z/OS operating system
- Advanced solutions for compliance with data security and privacy regulations
- Workload consolidation: System z is the ultimate consolidation platform
- Eliminate all causes of outages

### ➤ **Reduce cost of ownership**

- DB technology that can handle large workloads with fewer people
- Storage and CPU optimization, including specialty engines
- Advanced autonomies to make the system more self-managing and self-tuning

### ➤ **Application enablement**

- Apps can easily connect to DB2 from anywhere
- Advanced SQL, XML capability, application portability

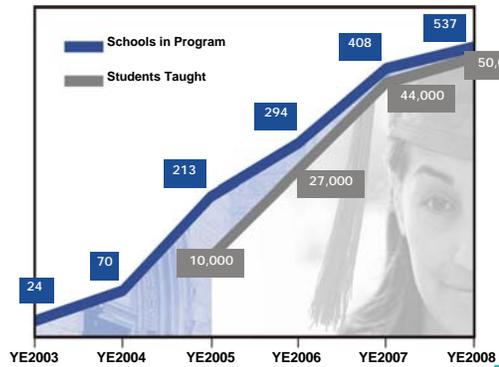
### ➤ **Improved data warehousing capabilities**

## Adding mainframe skills for the community

- Where am I going to find good skills

- DB2 Outreach and Academic Initiative Programs – Globally Growing University Skills
- Universities include: Marist, San Jose State, Illinois State University, Tonji University and in process in Brazil

### Growing Academic Initiative



- System z Academic Initiative by the numbers:

- Participation – 537 schools registered, >50,000 students attended mainframe education
- Courses – 30 (plus more under development) & Mastery Exam Certifications
- zCommunity – 25 z Roundtables events with Clients / Schools / ISVs / Business Partners
- Resources – Access to Mainframes worldwide for teaching (6 Univ hubs)
- Student MF Contests – 9 contests with 8,180 students, 1,136 schools...more planned WW
- IBM zSkills Help Desk (zskills@us.ibm.com) + over 300 IBM Mainframe ambassadors
- Assist Professors – Fourth annual Professor Summer Seminar, 5 Faculty awards & education

Web site - [www.ibm.com/university/systemz](http://www.ibm.com/university/systemz)

# DB2 9 Field Update

## DB2 9 for z/OS field update

- **DB2 9: Climbing Sharply**
  - 39% of Top 100                      31% of Top 200
  - Over 500 customers
  
- **How's the Quality (compared to V8)?**
  - Lower overall PMR volume
  - Less Severity 1 APARs
  - Lower PE rate
  
- **DB2 V8: Migration finishing in most of world**
  - 100% of Top 100                      Over 99% of Top 200
  - V7 End of Service: June 30, 2008
  - V8 Withdrawal from Marketing
    - Announced: Dec. 2, 2008
    - Effective: Sept. 8, 2009



7

7

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Now that DB2 9 has been generally available in the field for over 2 years, let's compare with V8 at the same point. For almost all of the key quality measures, DB2 9 is better. The most important issue for many customers is PTFs in Error (PEs), and the rate is lower on DB2 9. The PMR volume is lower and the number of field severity 1 problems is lower. V7 was widely regarded as a high quality version, and DB2 V8 total field experience is better than V7, with DB2 9 as the best of the three.

The largest DB2 customers have moved to Version 9. All of the largest 100 customers are running Version 8, and many large customers are implementing DB2 9 development, moving to production.

Part of the improvement in overall quality measures is due to more rigorous testing. Some of the improvement is due to the reduced amount of new function added in the service stream. Still these numbers represent the averages, and we know that our customers are not average. Individual customer results are highly skewed, so the average numbers might not reflect your individual experience.

DB2 V7 is now out of service after seven years of general availability. If you are still there, it is time to move now. V8 was withdrawn from marketing in early September this year.

## DB2 9 Best Practices and Recommendations

- **Leverage CST/RSU process: Start with latest RSU + Identified HIPERs**
  - Apply 2 to 3 preventative service drops annually
  - Exploit Enhanced HOLDDATA to be vigilant on HIPERs and PEs
- **Use the DB2 9 'Package Stability' function for static SQL**
  - Offers access path preserving option. Recovers to prior access path if regression is encountered
- **Minimize potential query performance issues**
  - Use Optimization Service Center to capture SQL statements
  - Run Stats Advisor to generate the recommendation for stats collection
  - Run RUNSTATS to ensure critical stats are collected as recommended by the advisor
- **Ensure a PMR is opened prior to migration start**
- **Migration Planning Workshop**
  - Contact your local DB2 Advisor for current information

8

8

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•As you migrate to DB2 9, some of the best practices and recommendations can help you have a better experience. The CST process is being used successfully by most customers. The current service level recommendation is to get to RSU0903 and some specific identified HIPER APARs as a minimum level.

•The DB2 package stability or access path stability function has been very helpful with customers who have access path regression in getting back to the old access paths. This process is noted in John Campbell's presentation and many others.

•Use the Optimization Service Center (OSC) to capture the SQL statements and related information. You can start using OSC on V8 to get the needed information and to help tune your queries.

•Run the statistics adviser to generate the recommended statistics to be collected.

•Get current RUNSTATS data, so that the DB2 9 optimizer is using DB2 9 statistics. Get the statistics noted in the item above.

•Work with your DB2 advisor to get current information and help. The Migration Project Workshop is a proven technique for transferring skill. Get other presentations from the web and from conferences to help with knowledge.



## What customers are saying about DB2 9



We are in great shape. **DB2 9 is very solid and stable.** Our reorgs are running great and **performance is the best that it has ever been.** We are a very happy customer!  
*-Mark Shackelford, VP Infrastructure Baldor Electric*



"Like a good wine, DB2 has certainly gotten better with age!"  
*-Debra L Cook, ExxonMobil Global Services Company*



"We needed a database that represented the future and DB2 9 is the future. DB2 9 compression capabilities are key in helping reduce the size of our databases — in one case by up to **83 percent.** This ultimately helps us **minimize storage costs and increase performance.**"  
*-Jean Holley, CIO, Tellabs, Inc.*



"Not only is our IBM infrastructure **rock solid.** Our total cost of ownership is very low compared to other solutions. Our administrative framework for health education is **far superior in terms of cost compared to any other implementation** I've seen on campus. It took us a **fraction of the time** to develop than it would have on any other platform, and it's providing us with a reliable, fast solution for moving our health education program forward into the future."  
*- Steve Ware, Systems Coordinator, University of Florida Computing & Networking Services*

9

## What customers are saying about DB2 9



**PETROL**

"DB2 9 for z/OS will result in an **increased level of performance** with our data warehousing environment. We also look forward to using the new XML capabilities in DB2 9 to provide even **greater efficiency and consistency our XML applications.**"

- *Pavel Batista, IT Director, Petrol*



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"The new security and compliance tracking capabilities of DB2 9 for z/OS will allow us to **simplify our existing process** for the management reporting of changes to our production database systems. In addition, we have evaluated the new **native XML support** that DB2 9 provides and view this as a **major technological advancement** to help us to integrate XML data into a format that will allow for more robust and efficient usage by applications."

- *Bob Perih, Senior Vice President, Citigroup*



**SAP**

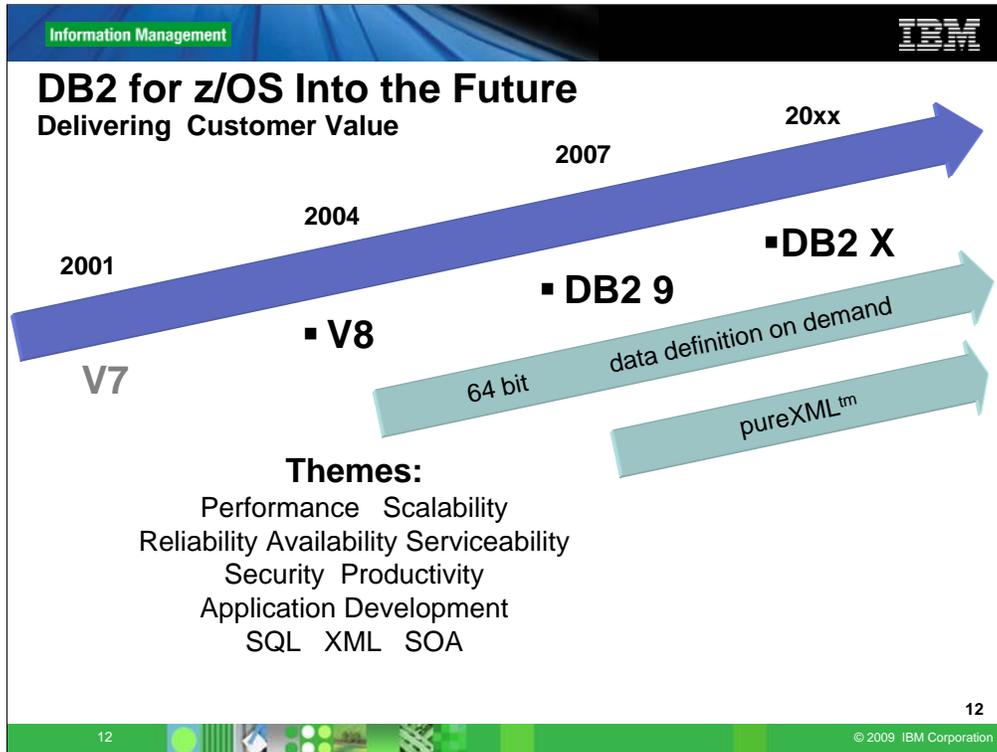
"IBM and SAP have cooperated very closely on DB2 9 for z/OS and we look forward to supporting our customers with these new capabilities. The SAP Banking Services 5.0 release, which will be released soon, will be the first SAP product to take advantage of many new beneficial features in DB2 9 for z/OS."

- *Torsten Wittkugel, Vice President of Database and Operating System Platform Development, SAP*

10

- SAP – customers are rising and the biggest SAP implementation in the world is being done on z/OS. New workloads continue to happen.
- DB2 X ISV and Partner Early Program

## DB2 X - A Stakeholder View



DB2 for z/OS V7 became generally available (GA) March 2001, and V8 delivered three years later. DB2 9 became generally available in March 2007, three more years. We expect the next version will be roughly 3 years from DB2 9 GA to DB2 10 or DB2 X or whatever the name becomes.

The themes for future versions will continue to focus on core platform strengths of performance, scalability, reliability, stability, availability, resilience, and security. PureXML and Schema evolution or data definition on demand will be ongoing for a long time. In contrast, most of the 64 bit evolution should be completed in DB2 X.

The key interfaces for customers and vendors expand for both XML and for SQL. Information is a key leg of the SOA platform, and DB2 for z/OS provides many advantages for data management in SOA.

Standards, interoperability, portability and security along with secure access using the latest technologies are key touch points. Productivity improvements for application developers and for database administrators are very important as data grows in scale and complexity.

## DB2 X for z/OS At a Glance

<b>Application Enablement</b>	<ul style="list-style-type: none"> <li>• Versioned data or temporal queries</li> <li>• pureXML enhancements</li> <li>• Last committed reads</li> <li>• SQL improvements that simplify porting</li> </ul>
<b>RAS, Performance, Scalability, Security</b>	<ul style="list-style-type: none"> <li>• Wide range of performance improvements</li> <li>• Hash access to data</li> <li>• More online schema changes</li> <li>• Catalog restructure for improved concurrency</li> <li>• Row and column access control</li> <li>• Administrator privileges with finer granularity</li> </ul>
<b>Simplification, Reduced TCO</b>	<ul style="list-style-type: none"> <li>• 5 – 10 times more threads per DB2 image</li> <li>• Auto statistics    Data compression on the fly</li> <li>• Query stability enhancements</li> <li>• Reduced need for REORG</li> <li>• Utilities enhancements</li> </ul>
<b>Dynamic Warehousing</b>	<ul style="list-style-type: none"> <li>• Moving sum, moving average</li> <li>• Many query optimization improvements</li> <li>• Query parallelism improvements</li> <li>• Advanced query acceleration</li> </ul>

13

13

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DB2 X builds upon many themes: core platform strengths of performance, scalability, reliability, stability, availability, resilience, and security. All of this work helps with total cost. PureXML and Schema evolution or data definition on demand enhancements are included. Most of the 64 bit work should be completed in DB2 X.

XML, SQL, web services and other programming interfaces extend for usability. Information is a key leg of the SOA platform, and DB2 for z/OS provides many advantages for data management in SOA.

Standards, interoperability, portability and security along with secure access using the latest technologies are key touch points.

Productivity improvements for application developers and for database administrators are very important as data grows in scale and complexity. Warehousing continues to evolve, with key trends matching DB2 for z/OS strengths.

## Application Portability, Productivity

### Make porting easier

- SQL improvements that simplify porting (inline LOB, administrative privileges)
  - ‘currently committed’ locking semantics
    - Writer does not block readers
  - Implicit casting or weak typing
  - Timestamp with timezone
  - Greater timestamp precision
- Loading and unloading tables with LOBs
  - LOBs in input/output files with other non-LOB data

14

14

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- Improvements for LOBs include the ability to be placed inline in the data page when they are small, and better ability to unload and load to a sequential file, rather than needing a separate file for each LOB.
- ‘Currently’ committed’ locking semantics – Oracle semantic allows user to see what was there before it was changed.
- Instead of needing to explicitly cast each data type, more flexible data typing improves productivity. – compare number and characters without explicitly casting one to the other.
- Time stamps have the option to include a time zone and to have more precision (nanoseconds, rather than microseconds).
- LOBS – all Load or Unload data within 1 input file, including the LOB columns, usability and performance gain.

## Application Portability, Productivity

### Integrated XML Support

- XML schema validation in the engine for improved usability, performance
  - XML schema association with XML columns
  - Using z/OS XML System Services, 100% zIIP / zAAP eligible
- Native XML Date and Time in business processing
  - xs:date, xs:dateTime, and xs:dateTime support and XML index support
- Allow easy update of sub-parts of an XML document
- XML multi-versioning for more robust XML queries
- XML support in SQL PL stored procedures & user defined functions
  - Business logic standardization/performance with native SQL PL
- Performance enhancements, including binary XML between client and server.

15

15

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V9:

XML Type – native storage, native processor, index support

SQL/XML with XPath

Utilities and tools support

1. Any well-formed XML documents can be inserted into an XML column in V9. Schema validation is through a DB2-supplied UDF. XML schema association with XML columns (a.k.a. XML column type modifier) and automatic schema validation for insert/update
2. XML schema validation UDF runs in a WLM-established address space. Cannot be offloaded, and with document size limit to 50MB. (we are retrofitting this to V9). Using z/OS XML System Services, 100% XML schema validation is CPU intensive, and with 50MB size limit
3. Date and time was not supported in XPath. Workaround is through SQL date and time. Impact performance and usability.
4. Only whole document replacement is supported in V9. Sub-document update has to be done at the application. Furthermore, update to large documents impacts system performance.
5. Native SQL PL can use XML variable and parameters now to hold XML values. Before it has to be serialized to LOBs/VARCHARs. Performance and usability impacts.
6. The exchange format between the client and server is in textual format in V9. Repeated parsing can be avoided with binary XML format. Binary XML format is also supported in UNLOAD and LOAD.
7. Other: Utility enhancements to support CHECK DATA for XML: Check XML data consistency and perform schema validation in CHECK DATA for XML.

A range of XML improvements delivers a strong release 2 of the pureXML function. Customers use of DB2 9 pureXML shaped this delivery of improved performance and usability.

**Multi-versioning:** During the execution of an SQL statement, a row with an XML column can be kept in a work file. The row in the work file does not contain the actual XML document. Instead, the information needed for DB2 to retrieve the XML document from the XML table is cached in the work file. The problem occurs if the XML document in the XML table is deleted or updated. When the row in the work file is fetched, DB2 cannot find the expected XML document in the XML table, and the SQL statement fails with an error SQLCODE.

**XML UPDATE:** Applications which require parts of XML documents to be modified need to break apart the XML document into modifiable pieces, make the modification to a piece, and then construct the pieces back into an XML document.

**SP/UDF support:** XML variables inside SQL PL, XML arguments, transition variables.

## Temporal Data – Query ‘AS OF’

### Need to query data ‘as of’

- Temporal Query & Business Timestamp
- Table-level specification to control data management based upon time
- Two notions of time:
  - **System time:** notes the occurrence of a data base change
    - “row xyz was deleted at 10:05 pm”
    - Query at current or any prior period of time
    - Useful for auditing, compliance
  - **Business time:** notes the occurrence of a business event
    - “customer xyz’s service contract was modified on March 23”
    - Query at current or any prior/future period of time
    - Useful for tracking of business events over time, application logic greatly simplified
- New syntax in FROM clause to specify a time criteria for selecting historical data

16

16

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- User queries request historical data from base table. DB2 rewrites original query into UNION ALL query to get data from both tables.
- System Time – example, show me what my data looked like last month. Need to keep the history table for system time.
- Business Time – example, how long is this insurance policy valid. Don’t need separate table for business time.
- Table-level specification to control the management of data based upon time
  - New syntax in FROM clause to specify a time criteria for selecting historical data
  - New syntax to CREATE TABLE and ALTER TABLE to specify that a table has data versioning. ‘KEEP’ specification for how much history is kept.
- A history table is created to store the deleted/old values of a table defined with data versioning
  - Data is synchronously inserted into the history table when the base table is updated or deleted
  - Timestamp value used is consistent for all DELETE/UPDATE statements within the same logical unit of work



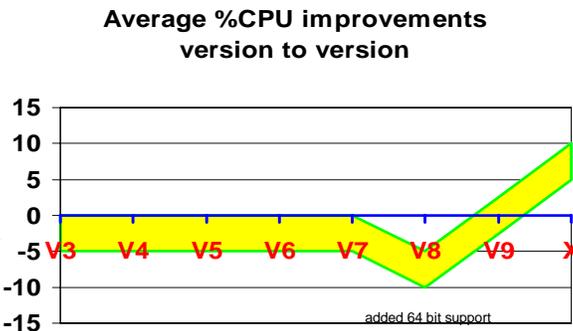
## Performance

### Constant Cost Pressures

- Performance improvements in key workloads: transactions, Batch, Insert, others
- Improve transaction times
- Lower CPU usage for large & small DB2 subsystems

### DB2 X Performance Objectives

- Historical goal of <5 % version-to-version performance regression
- Goal of 5% -10% performance improvement for DB2 X



17

17

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- Reducing CPU from DB2 9 to DB2 X without significant administration or application changes is the primary thrust of the performance work. Most of the changes work with CPU caching and path lengths, so that applications are not changed. Packages do not need to be bound. We can take advantage of new instructions without needing to have other techniques for older processors which do not have fast implementations of the new instructions.
- This work is very preliminary, but the performance plan for DB2 X is much more aggressive than in any recent version. The last version which contained significant improvements for reducing CPU time in transactions and batch was Version 2 in 1988. Versions 3 to 9 made improvements in queries and in utility CPU time and provided many scalability improvements, but little reduction in transaction CPU time, other than in specific situations.
- As customers move from DB2 V8 to DB2 9 CM, they generally find some CPU improvements, often in the utilities. As customers move to DB2 X CM, we anticipate a bigger reduction coming from transactions and batch work. REBIND will improve optimization. The largest improvements are expected for applications that can use the database changes, such as a hash for primary key access, and SQL improvements in DB2 X.
- We expect DB2 X to run only on z10, z9, z890, z990, and later processors, and to provide CPU reductions from the beginning, with improvements in CM, but more dramatic reductions for applications that can take advantage of the improvements in application design.
- 64 bit instructions were more expensive than 31 bit, recovered in 9 by staying flat and now exploiting it in X to gain improvement in virtual storage constraint relief.

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## Performance

### Improved performance on day 1

- Internal performance optimizations
  - Improved CPU cache performance
  - Exploit new z10 z/Architecture instructions
  - Streamlined DDF, RDS, DM, Index Mgr. performance-critical paths
  - Buffer pool enhancements: utilize z10 1MB page size
  - Virtual Storage Relief (64 bit exploitation)
  - New Access Path possibilities

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V9 – improvements were mainly in utilities. In X we now have improvements across the board.

Internal performance optimizations (approximately 10 Line Items)

Improved CPU cache performance – z10 processors are so fast we had to change our software to ensure our data is in our cache.

Exploit new z10 z/Architecture instructions

Streamlined DDF, RDS, DM, Index Mgr. performance-critical paths

Buffer pool enhancements: Utilize z10 1MB page size. (page sizes for table spaces is still limited to 32K) This is a memory topic, not table spaces.

Virtual Storage Relief (64 bit exploitation) – get even more once you REBIND

New Access Path Possibilities – performance improvement when you REBIND

Being able to have a column that is unique, but includes extra columns can improve performance substantially in some situations, and makes the DB2 family more consistent.

If you want to have a table be completely in memory, then the new option can make the process easier. System z10 and z/OS 1.10 allow a 1 megabyte page size, instead of a 4 kilobyte page size, improving efficiency for large amounts of memory.

Many of the performance do not require changes in applications or administration. The CPU cache performance and new hardware instructions can reduce CPU time without customer action, other than moving to this version.

## Performance

### Improved performance in NFM

- Hash access path
- Index include columns
- Inline LOBs
- Efficient caching of dynamic SQL statements with literals
- Exploitation of Solid State Disk (SSD)

19

19

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•Hash access path - Hashing is a faster alternative to index access for a key = value lookup, not needing to touch the index pages. DBA needs to do an ALTER when in NFM. Performance and CPU reduction. Take key and apply algorithm to get direct access to a row. No index involved.

•Index include columns - Indexes can be updated in parallel to speed the process when many indexes must be maintained. DBA needs to do an ALTER when in NFM

•Inline LOBs – V9 LOBs are in separate LOB Table Space. In X you are able to take a LOB table and put it in the base row along with the other column data. Resulting in a performance improvement because you don't have to go to a separate LOB Table Space. Just as fast as VARCHAR. Inline LOBs resolve the common performance problem of having large objects where most LOBs are small, by keeping part of the LOB on the page with the rest of the data. Streaming for LOBs improves distributed processing. Define NO lets DB2 avoid data set definitions. DBA needs to do an ALTER when in NFM

•Efficient caching of dynamic SQL statements with literals - Even if the dynamic SQL has literal values, rather than host variables or parameter markers, DB2 can use the dynamic statement cache effectively.

•Exploitation of Solid State Disk (SSD) - Solid state disk is working today with DB2, and integration can improve the performance and value. Solid state disk is expected to improve substantially in size and value in the next few years. SSD is a disk that doesn't spin (Memory Stick for Shark Offload).

•A single row select is another common process that is speeded up in this release.

•Member clustering is now allowed for data sharing situations with frequent updating for universal table spaces.

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## Scalability

- **Need DB2 to continue to scale with my business**
  - 64 bit support: Many more concurrent workload, simpler growth
  - Reduce DBA workload, eliminate time-consuming tasks
- **DB2 9 helped (~10% - 15%)**
- **DB2 X expect 80% to 90%**
  - More concurrent work
  - Reduce need to monitor
  - Able to consolidate LPARs
  - Reduced cost
  - Easier to manage
  - Easier to grow

20

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- Virtual storage is most common constraint for large customers. Virtual storage can limit the number of concurrent threads for a single member or subsystem.
- The DB2 9 virtual storage objective was 10-15% relief. The DB2 X target is 80% to 90% of the DBM1 address space. We expect the result to be the ability to run much more concurrent work, with an early guess of 3 to 5 times more threads.
- Storage monitoring should be drastically reduced. Customers are consolidating LPARs. Sometimes they need to have more than one DB2 subsystem on an LPAR, costing real storage and CPU. With these changes, work can run in one DB2 subsystem, rather than needing more members.
- The net for this change is expected to be reduced cost, improved productivity, easier management, and the ability to grow DB2 use much more easily.
- Increasing the number of concurrent threads will expose the next tier of constraints. DB2 X will address a number of the next items, such as utility locking, catalog concurrency..

### DB2 X expect 90%+

- More concurrent work
- Reduce need to monitor (can monitor 1 vs 5 for example)
- Able to consolidate LPARs
- Reduced cost (of having fewer Members/LPARs, reduces workload, system workload and CPU cost)
- Easier to manage
- Easier to grow (each DB2 can contain more workload)

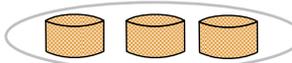
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## Running a Massive Number of Threads

Today

Coupling Technology

LPAR1	LPAR2	LPAR3
DB2A (500 thds)	DB2B (500 thds)	DB2C (500 thds)
DB2D (500 thds)	DB2E (500 thds)	DB2F (500 thds)

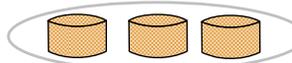


- Data sharing and sysplex allows for efficient scale-out of DB2 images
- Sometimes multiple DB2s / LPAR

DB2 X

Coupling Technology

LPAR1	LPAR2	LPAR3
DB2A (2500 thds)	DB2B (2500 thds)	DB2C (2500 thds)



- More threads per DB2 image
- More efficient use of large n-ways
- SSI constraints are relieved
- Easier growth, lower costs, easier management
- Data sharing and Parallel Sysplex still required for HA and XXL scale

21

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Today: 100's of active threads per DB2 image. High end customers require 1000's, and growing. Sysplex gives a solution, but n-ways have gotten much bigger and customers want to consolidate to fewer DB2 images, fewer LPARs. Also, sysplex limits become a concern.

Examples: Bridgestone (SAP), wants to consolidate # of DB2 members. #1 requirement from SAP customers, and others. WF already at 15-way, could have 3x increase in workload. WalMart, new SAP.

Increasing thread count to mitigate impact of increased memory latency on newer machines.

Two or three DB2 members in our DS group in 1 LPAR. For example, if you have 20 members today, potential to move to 8 members after moving to DB2 X. Approximately 6% CPU savings = 1/2% CPU savings for each member.

Customers are constrained by virtual memory to various degrees. This slide shows a relatively extreme situation experienced by some customers today. With a maximum of 500 threads (very dependent upon workload) in a DB2 subsystem, this customer is using two DB2 subsystems in the same data sharing group on a single LPAR. This is not efficient for memory or CPU, but avoids the memory constraints with fewer LPARs. Additional relief for virtual storage comes with IMS V11 and other products.

This example allows customers to run 10 times as many threads in a single DB2 subsystem, improving efficiency for storage and CPU. The biggest change is easier management and simpler growth. Most customers use data sharing for high availability, and that need still exists. Extreme scale continues to need data sharing, but fewer data sharing members can mean easier management and reduced resource consumption.

## Business Security & Compliance Needs

- **Simplify compliance**

- Simpler, easier security privileges with finer granularity authority
- Ability to have administrators without data access, better auditing



- **Fine grained access control**

- Allow masking of value
- Restrict user access to individual cells

*Use disk encryption*

22

22

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•Customers are being pressed for a wide range of improved security and compliance. Data retention is a growing need. Protecting sensitive data from the privileged users and administrators is required. Separation of authority for security, access, and some common tasks, like EXPLAIN will help. Auditing for privileged users can also make compliance simpler.

•In DB2 X, we expect to have a form of temporal data or the ability for a table to contain both current and historical data, and to query the information as of a specific point in time.

•Access control is refined in several ways with better granularity for the administrative privileges and with finer grained access control at the row and column level, including the ability to mask access to some fields. Auditing is also enhanced.

•Restrict user access to individual cells (splitting out of SYSADM)

## Productivity

### Need to do more with less

- More online schema changes – ALTER & Online REORG
  - Table space type to universal
  - Page size
  - Data Set Size - DSSIZE
  - Member cluster with UTS
- Catalog restructure for improved concurrency and usability
  - Multiple BINDs at same time with DDL, Grants and Revoke
  - Query your SQL statements with SQL without having to write a program

Manual invocation of

- RUNSTATS
- COPY/BACKUP SYSTEM
- QUIESCE
- MODIFY RECOVERY
- REORG

23

23

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- Continuous availability requirements continue to escalate. Large batch and maintenance windows are in the past. Those windows are being closed on the fingers of DBAs. DBAs increasingly need the ability to make all changes and to do all maintenance activities online or around the clock.
- DB2 X allows more online schema changes with an ALTER for a PENDING change, then an online REORG to take effect. ALTER a simple or segmented table space containing a single table or a partitioned table space to a universal table space. Page size and member clustering can be altered. Index changes become less disruptive. Pending changes which have not been completed with a REORG can be dropped.
- Online REORG usability and performance enhancements are provided.

More online schema changes – ALTER & Online REORG (ALTERs that cannot take effect until the next REORG – before user had to drop and recreate table)

- Table space type to universal
- Page size
- Data Set Size – DSSIZE
- Member cluster with UTS (for fast insert)

Catalog restructure for improved concurrency and usability (you could have been getting the wrong answers because of how SQL statements were split between rows in SYSPACKSTMT)

- Multiple BINDs at same time with DDL, Grants and Revoke
- Query your SQL statements with SQL without having to write a program

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## Productivity

### Need to do more with less

- REORG SHRLEVEL CHANGE for LOBs
- Consistent image copy without quiesce
- Inline copies to allow for data set-level Flash Copy
- Online REORG usability and performance enhancements
- Auto statistics collection
- Compression 'on the fly'
  - avoid need to run utility
- Checkpoint intervals based on both time and # log records
- Much simpler memory management

24

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• In V9 we gave you share level reference for LOB Table Space. In DB2 X you get share level change

- REORG SHRLEVEL CHANGE for LOBs - REORG is improved to allow SHRLEVEL(CHANGE) for LOBs.
- Consistent image copy without quiesce - Consistent image copies can be provided without a quiesce.
- Inline copies to allow for data set-level Flash Copy - Inline copies to allow for data set-level FlashCopy. Image copies taken by load and reorg. Flash Copy – HW/SW outside DB2. Copy is made asynchronously. When we write a page the FlashCopy makes a copy before making the change.
- Online REORG usability and performance enhancements ([enables you to repartition with LOBs, move LOBS from one table space to another](#)). Online REORG usability and performance enhancements are provided. – Details on slide 26
- Auto Statistics collection – [REALTIME stats stored in catalog real time statistics table](#).
- Data Compression 'on the fly' – avoid need to run utility. Today have to do a reorg to get compression. In X, DB2 will begin to compress automatically without doing a reorg.
- Checkpoint intervals based on both time and # log records – you can now set time interval. [Records all open data sets, inflight actions. During a restart you can go back to that time interval that was set.](#)
- Memory Management – less constrained with 64 bit exploitations so you don't need to manage as closely.



## Optimization Stability and Control

### REBIND without fear

- Query stability enhancements
- Plan Stability

Provide unprecedented level of stability for query performance by stabilizing access paths:

- Static SQL
  - Relief from REBIND regressions
  - Enable REOPT support
- Dynamic SQL
  - Remove the unpredictability of PREPARE
  - Extend Static SQL benefits to Dynamic SQL

### Support

- Access path repository
- Versioning
- "Fallback"
- "Lockdown"
- Manual overrides
- Hints: easily influence access paths without changing apps
- Per-statement BIND options

25

25

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### •Give overview of DB2 9 Package Stability

•Continuous availability requirements continue to escalate. Large batch and maintenance windows are in the past. Those windows are being closed on the fingers of DBAs. DBAs increasingly need the ability to make all changes and to do all maintenance activities online or around the clock.

### Access path lock-in and fallback for dynamic SQL

Remove the unpredictability of PREPARE  
Extend static SQL benefits to dynamic

Access path repository in DB2 catalog (both static and dynamic)

Policy (introduced in V9) can be used to identify candidates for stabilizing

At PREPARE, DB2 checks if an access path was previously captured for a query

YES -- it is used as a "hint" for the compilation

NO -- the query is compiled without a "hint." The resulting access path captured if query is a candidate for stabilization.

Once prepared, the statement could be cached

Rebinding dynamic SQL: new REBIND QUERY command

Allows DB2 to generate new access paths at next prepare  
Filtering capabilities based on queryno, or user-specified tag  
Also allows for fallback to prior access path (REBIND QUERY SWITCH)

Optimizer hints integrated into access path repository to enable hints for dynamic without requiring changes to the app

BIND options at statement level granularity

Statistical views

Dynamic SQL: access path repository in DB2 catalog. For dyn and static. Versioning. Fallback. Lockdown. Manual overrides. Profile table (introduced in v9) can be used to determine the plan/pkg and dyn stmts for stabilizing. Zparm and BIND options also available.

At PREPARE, DB2 checks if an access path was previously captured for a query. YES -- it is used as a "hint" for the compilation. NO -- the query is compiled without a "hint." The resulting access path captured if query is a candidate for stabilization. Access paths stored in SYSQUERY/SYSQUERYPLAN. Once prepared, the statement could be cached

## Utilities Enhancements

- Improved online processing
  - Online REORG enhancements
    - SHRLEVEL(CHANGE) support for all catalog/directory objects
    - Option to cancel blocking threads
    - Faster SWITCH phase
    - Allow disjoint partition ranges
  - REORG SHRLEVEL(CHANGE) for LOBs
  - Increased utility & catalog concurrency
- Improved processing for LOBs data inline
- FlashCopy for faster, less disruptive operations
- Repartition with LOBs
- More productive, reduced need to run utilities

26

26

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- Continuous availability requirements continue to escalate. Large batch and maintenance windows are in the past. Those windows are being closed on the fingers of DBAs. DBAs increasingly need the ability to make all changes and to do all maintenance activities online or around the clock.
- DB2 X allows more online schema changes with an ALTER for a PENDING change, then an online REORG to take effect. ALTER a simple or segmented table space containing a single table or a partitioned table space to a universal table space. Page size and member clustering can be altered. Index changes become less disruptive. Pending changes which have not been completed with a REORG can be dropped.
- REORG is improved to allow SHRLEVEL(CHANGE) for LOBs.
- Consistent image copies can be provided without a quiesce.
- Inline copies to allow for data set-level FlashCopy.
- Online REORG usability and performance enhancements are provided.
- Repartition with LOBs – In V9, LOB table space for each partition: you would have had to drop, redefine, and reload the table. In X we can move a LOB value from one LOB table space to another when it's base row changes partitions.

## Data Warehousing

- Moving Sum, Moving Average
- Enhanced query parallelism technology for improved performance
  - Remove query parallelism restrictions
- In-memory techniques for faster query performance
- Advanced query acceleration techniques



27

27

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DB2 warehousing capabilities continue to be enhanced at a rapid pace. Improvements in the SQL and XML were noted earlier. Improvements in optimization and additional parallel processing allow faster query processing.

Example – 200 TB Warehouse in the next few years.

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## Key details about DB2 X

- CM, ENFM, NFM
- Probable Prerequisites
  - z/OS V1.10
  - System z10, z9, z890, z990, and above (no z800, z900)
- Eliminated:
  - Private protocol → DRDA (new help in DSNTP2DP)
  - Old plans and packages V5 or before → REBIND
  - Plans containing DBRMs → packages
  - ACQUIRE(ALLOCATE) → ACQUIRE(USE)
  - XML Extender → XML type
  - DB2 MQ XML user-defined functions and stored procedures → XML functions
  - DB2 Management Clients feature (DB2 Administration Server, Control Center, & Development Center) → IBM Data Studio application & administration services
  - msys for Setup DB2 Customization Center → install panels
  - BookManager use for DB2 publications → Info Center, pdf

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Here are a couple of thoughts about what might be required in hardware and software to run DB2 X. Much will depend upon the timing of the deliveries and market acceptance. Moving forward as quickly as possible means that some of the past must be left behind. See the list of deprecated functions from prior versions.

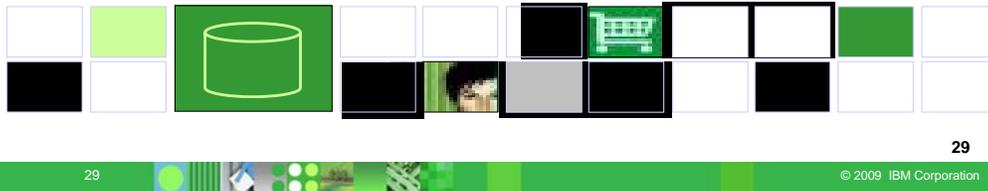
The above features are still included in DB2 9 and may be dropped from future versions. Note the direction indicated to the right of the arrows, as these are the functions provided to replace the existing function. If you are using any of these functions, you are advised to move to the new function.

See the Installation Guide section, “Functions that are deprecated” and the announcement material for more information on these changes.

[http://www.ibm.com/common/ssi/rep\\_ca/8/897/ENUS206-098/ENUS206-098.PDF](http://www.ibm.com/common/ssi/rep_ca/8/897/ENUS206-098/ENUS206-098.PDF)

## Why Migrate to DB2 X for z/OS?

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



DB2 X has a lot for everyone. Here are just a few of the strategic highlights.

The business needs include CPU cycle reductions that deliver for batch and transactions, and pureXML™ improvements to build a strong foundation for SOA and XML initiatives.

Database Administrators (DBAs) need improved database performance, scalability, and availability. Memory management is dramatically reduced, so growth is much simpler. DBAs also get more flexible security to help with regulatory compliance. A wide range of enhancements improve ERP application and data warehouse functionality and performance. Large object (LOB) performance and flexibility are improved. Many DBA tasks are simplified.

Application developers are most excited by the second release of pureXML, which improves the SQL and XML interface to access XML data stored in a native format. Application developers need powerful new SQL enhancements. Improved SQL and data definition compatibility with other DB2 platforms makes porting much easier.

# Questions?

The words "Thank You" are rendered in a large, 3D, light blue font. Each letter is hollow, and the faces of diverse people are visible through the openings of the letters. The "T" shows a man's face, "h" shows a woman's, "a" shows a man's, "n" shows a woman's, "k" shows a man's, "Y" shows a man's, and "O" shows a woman's.

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31

31

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## Information Management Software for z/OS Solutions Information Center

- Find the latest product information for DB2® for z/OS®, IMS™, DB2 QMF™, IBM® DB2 and IMS Tools, Replication and Event Publishing, and Data Warehousing and Analytics.
- Learn how to use the information center by taking the animated tours that are available from the home page.
- Subscribe to RSS feeds for automatic notification of updates; information is frequently updated.
- Find troubleshooting information (search for Technotes, APARs, PTFs, and IBM Redbooks).
- Find product information through Google searches.





## DB2 for z/OS Deep Synergy With System z

The key is leveraging integration points throughout the system

- Data sharing (availability and scale out)
- Hardware data compression
- zIIP specialty engines
- Unicode conversion
- Encrypted TCP/IP communication (SSL), encrypted data
- Cross-memory, memory protection keys
- Sorting
- Multi-core, large N-way
- 1 MB page size (z10 – DB2 X)
- Decimal float arithmetic (z10)
- 64-bit addressing and large memory
- z/OS Workload Manager
- z/OS Security Server (RACF)
- z/OS RRS integrated commit coordinator
- Channel and disk



33

33

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Two examples:

- 1) zIIP: Baldor, SAP. 40% at LPAR level, 54% at workload level. Citi, 5 zIIPs, helped on TCO, now considering DW. iFlex, almost 54% zIIP offload for their use of V9 native SQL SPs.
- 2) Sysplex: Toronto Dominion Bank: sysplex continuously available for > 10 years

Data compression: a) we think the per-row costs are significantly less on z vs. p, and b) h/w is about 4x faster than s/w on z/OS, at least on the old machines

- DB2 inherits all the quality of service characteristics of its zSeries host, augments them and add new ones through a tight integration with the underlying hardware and z/OS operating system and its own leading edge database technology features.
- For the typical and frequently executed database functions special zSeries hardware assist capabilities are exploited resulting in superior performance, reliability, availability and serviceability