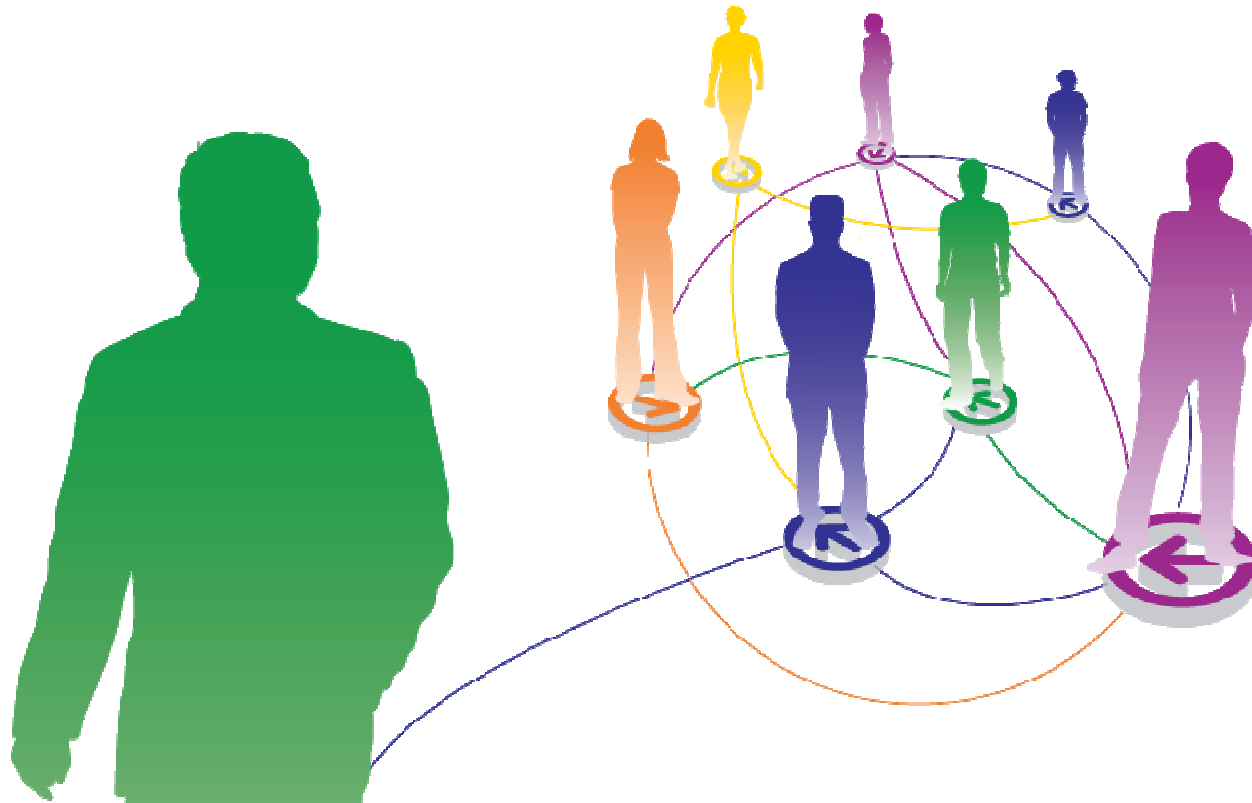


DB2 X Technical Preview

Jeff Josten, Distinguished Engineer, IBM, josten@us.ibm.com



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DB2 X for z/OS

- The next release of DB2 for z/OS
- Balanced release, satisfies major technical requirement across all major technology roadmap themes

DB2 for z/OS Technical Strategy

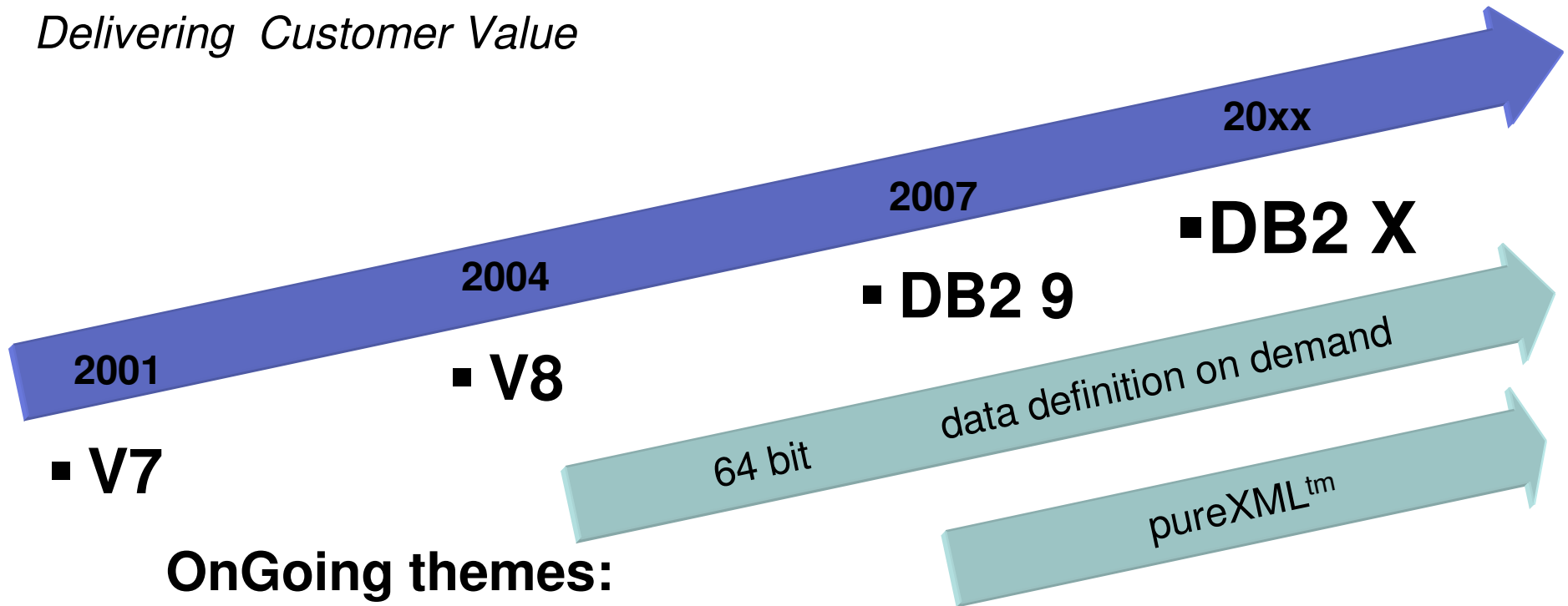
- Application enablement
 - Apps can easily connect to DB2 from anywhere
 - Advanced SQL, XML capability, application portability
- Extend the lead in availability, scalability and performance.
 - Parallel Sysplex: the best scale-out solution in the industry
 - Tight integration between DB2 and the System 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
 - Advanced autonomies to make the system more self-managing and self-tuning
 - Storage and CPU optimization, including specialty engines
- Improved data warehousing capabilities

DB2 X Major Focus Areas

- Performance, reduced MIPS consumption
- Scalability, more concurrent active threads
- Continuous availability
- Catalog contention reduction
- DBA/sysprog productivity
- Advanced application functionality
- Security advancements

DB2 for z/OS Into the Future

Delivering Customer Value



OnGoing themes:

Performance Scalability
Reliability Availability Serviceability
Security Productivity
Application Development
SQL XML SOA

DB2 X for z/OS Status

- The following slides represent DB2 Development's current thinking on some of the items that are candidates for DB2 X
- DB2 X is still in the development process, so details will change
- The intention is to give you some information on DB2's future technical directions
- DB2 Development values customer feedback

DB2 X for z/OS At a Glance

Addressing Corporate Data Goals

| | |
|---|---|
| <p>Application Enablement</p> | <ul style="list-style-type: none"> • pureXML enhancements • Temporal queries • Last Committed reads • Timestamp with timezone • SQL improvements that simplify porting |
| <p>RAS, Performance, Scalability, Security</p> | <ul style="list-style-type: none"> • Wide range of performance improvements • More online schema changes • Catalog restructure for improved concurrency • Fine grained access control • Hash access to data • New DBA privileges with finer granularity |
| <p>Simplification, Reduced TCO</p> | <ul style="list-style-type: none"> • Full 64-bit SQL runtime • Auto stats • Data compression on the fly • Query stability enhancements • Reduced need for REORG • Utilities enhancements |
| <p>Data Warehousing</p> | <ul style="list-style-type: none"> • Moving sum, moving average • Many query optimization improvements • Query parallelism improvements • Advanced query acceleration |



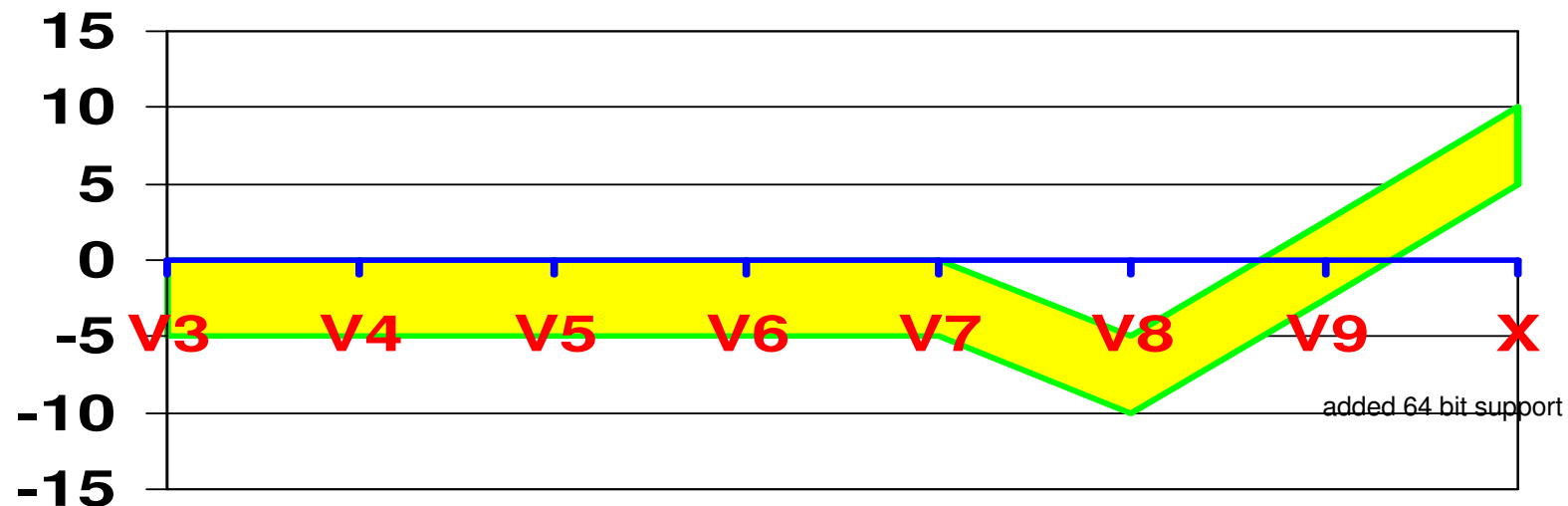
DB2 X Performance, Scalability Objectives

- Significant scalability and performance improvements
 - Synergistic operation with latest System z hardware
 - High n-way scalability
 - Large real memory exploitation
 - Hardware level optimization
 - Improve transaction times
 - Lower CPU usage for both large and small DB2 subsystems
- Virtual storage is most common constraint for large customers
 - Can limit the number of concurrent threads for a single member/subsystem
- Increasing the number of concurrent threads will expose the next tier of constraints, which should also be addressed

DB2 X Performance Objectives

- Historical goal of <5 % version-to-version performance regression
- Goal of 5% -10% performance improvement for DB2 X
- More improvements will be possible through exploitation of new features

Average %CPU improvements version to version



Performance Enhancements Requiring No Changes (“free”)

- SQL runtime improved efficiency
- Parallel index update at insert
- Faster single row retrievals
 - Open/fetch/close chaining
- INSERT improvements for UTS
- LOB streaming between DDF and rest of DB2
 - Faster fetch and insert, lower virtual storage consumption
- Workfile spanned records, PBG support, and in-memory enhancements
- Index list prefetch
- SQLPL performance improvements
- High Performance DBATs
- Exploitation of SSD

Performance Enhancements requiring DDL, BIND, etc. changes (but no app changes)

- Inline LOBs
- DEFINE NO for LOBs (and XML)
- MEMBER CLUSTER for UTS
- Efficient caching of dynamic SQL statements with literals
- Buffer pool enhancements
 - Utilize z10 1MB page size
 - “Fully in memory” option
- Hash access path
 - Alter + Reorg + rebind to activate
- Index include columns
 - Alter + Rebuild + rebind to activate

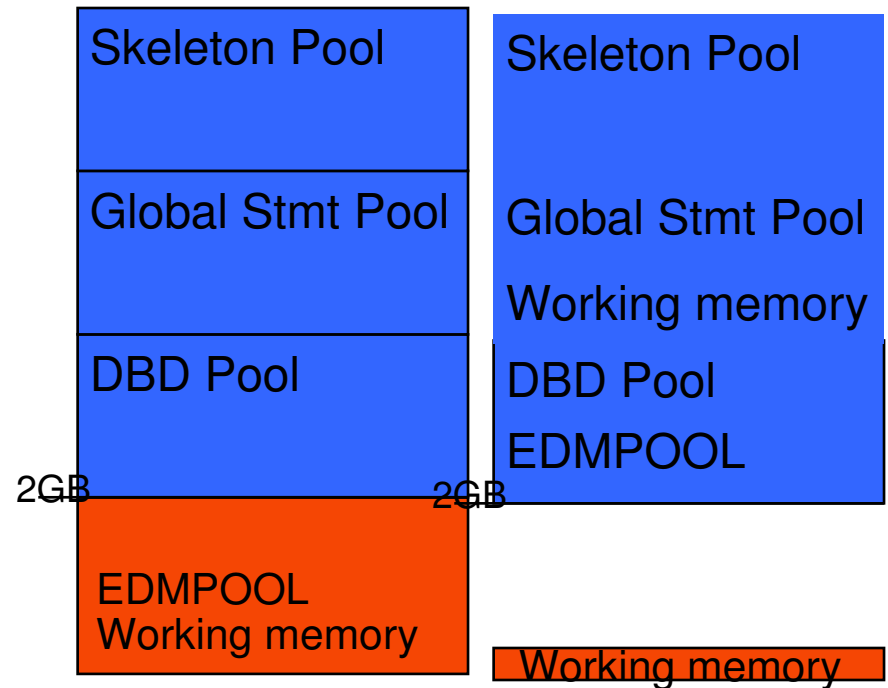
Performance Enhancements requiring REBIND (but no app changes)

- SQL paging performance enhancements
 - Single index access for complex OR predicates:
 - New EXPLAIN access method
- IN list performance
 - Optimized Stage1 processing (single or multiple IN lists)
 - Matching index scan on multiple IN lists
 - New EXPLAIN access method
- Query parallelism improvements
- More stage 2 predicates can be pushed down to stage 1
 - New DSN_FILTER_TABLE info to indicate stage1 or screening
- More aggressive merge of views and table expressions
 - Avoid materialization of views
- REBIND enables further SQL runtime improvements

DB2 X: 64 bit Evolution (Virtual Storage Relief)

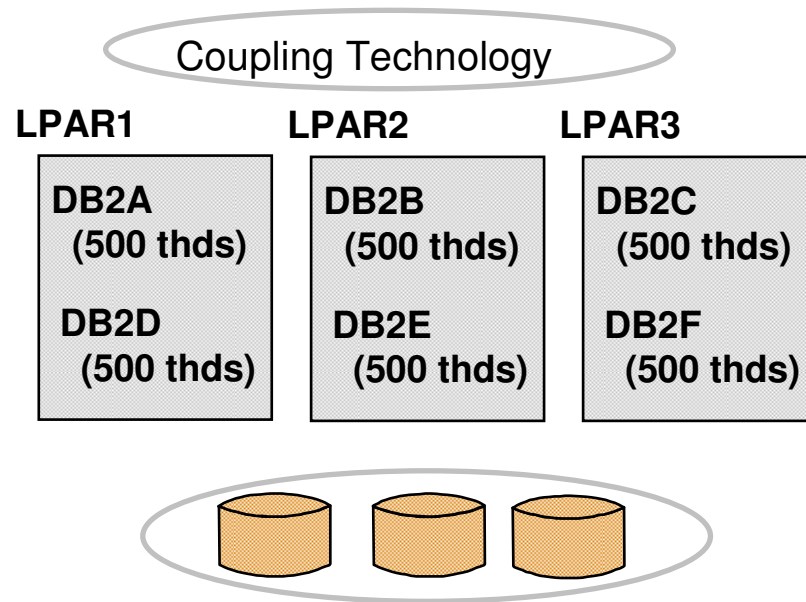
Scalability: Virtual storage constraint is still an important issue for many DB2 customers.

- DB2 X expects to move 80-90% of thread storage above the bar
 - More concurrent work
 - Reduce need to monitor
 - Consolidate LPARs
 - Reduced cost
 - Easier to manage
 - Easier to grow



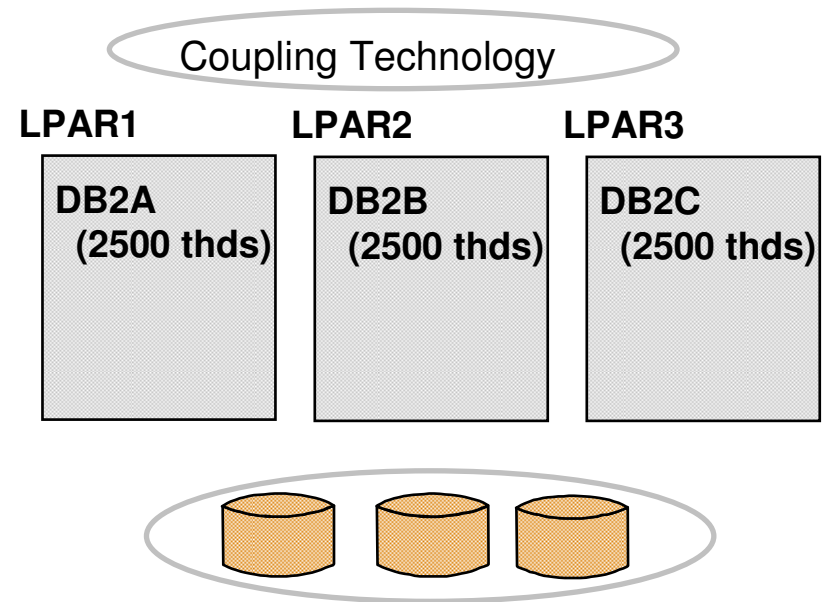
Running a Large Number of Threads

Today



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

DB2 X



- More threads per DB2 image
- Potential for fewer members / LPARs
- More efficient use of large n-ways
- SSI constraints are relieved
- Easier growth, lower costs, easier management
- Data sharing required for continuous availability and XL scale

Other System Scaling Improvements

- **Remove other potential bottlenecks**
 - reduce latching and other system serialization contention
 - new option for readers to avoid waiting for updaters
 - eliminate UTSERIAL lock contention for utilities
 - Exploitation of 64-bit common storage to avoid ECSA constraints
- **Improved DDL/BIND/Prepare concurrency**
 - restructure parts of the DB2 catalog to avoid the contention
- **Remove SPT01 64GB limit**
- **Lower overhead for very large buffer pools**

Continuous Availability



Availability

- More online schema changes for table spaces, tables and indexes
Online REORG instead of DROP/CREATE or REBUILD INDEX
Alterations are manifested with REORG, unless noted otherwise
 - Page size for table spaces and indexes
 - DSSIZE for table spaces
 - SEGSIZE
 - MEMBER CLUSTER
 - Convert single table segmented into UTS PBG
 - Convert single table simple into UTS PBG
 - Convert classic partitioned table space into UTS PBR
 - Convert UTS PBR to UTS PBG
 - Convert PBG to hash (immediate, but RBDP index)
 - Ability to drop pending changes
- Online REORG for LOBs, other Online REORG / utility improvements
- Online add active log

DB2 X Utilities Enhancements

- REORG SHRLEVEL(CHANGE) for LOBs
- Online REORG enhancements
 - SHRLEVEL(CHANGE) support for all catalog/directory objects
 - Option to cancel blocking threads
 - Faster SWITCH phase
 - Allow disjoint partition ranges
 - Permit movement of rows between partitions when LOB columns exist
 - Allows REBALANCE or shrinking of PBG even though LOB columns exist
 - Allows DISCARD to delete associated LOB values
 - Messages to estimate length of REORG phases and time to completion

DB2 X more utilities enhancements

- Support of spanned records for UNLOAD of LOB data
 - Currently unload of LOBs >32K must use FRVs
 - This allows inlining of LOBs with base row in unload data set
 - Provides portability of data
- Performance enhancement for FRV processing with PDS data sets
 - UNLOAD 33% elapsed time reduction
 - LOAD 84% elapsed time reduction
- Extend support for UTF-16
 - Date, time & timestamp fields currently unloaded in UTF-8
 - Cannot specify a char value for a graphic column in WHEN clause

DB2 X: More Utility Improvements

- Improved COPY CHANGELIMIT performance
 - Use RTS instead of SM page scans
- Data set level FlashCopy option
- FlashCopy backups with consistency and no application outage
- FlashCopy backups as input to:
 - RECOVER (fast restore phase)
 - UNLOAD
 - COPYTOCOPY, DSN1COPY
- RECOVER “back to” log point
- REPORT RECOVERY support for system level backups
- MODIFY RECOVERY improved performance
- RUNSTATS enhancements to support auto stats

Reduced Catalog Contention

Catalog Restructure for improved concurrency

- Remove links from the catalog and directory
 - DSN1CHKR no longer needed
- Row level locking enabled for the catalog and directory
- Done during ENFM for migrated systems
- BIND, PREPARE, and DDL will run with better concurrency, fewer timeouts/deadlocks

Other Catalog Changes

- Partition-by-growth (PBG) catalog/directory table spaces
 - Allow SPT01 to grow beyond 64GB
 - V8/V9 APAR PK80375 adds zparm for SPT01 compression
- DB2 managed catalog and directory data sets
 - DFSMS required
 - Eases admin and management burden
- New CLOB columns for storing SQL statements
 - Today, SQL statements can be split into several records with sequence numbers
 - CLOBs will make it easier to query SQL statements
- Convert SYSCOPY from EBCDIC to UNICODE.
- Online REORG enabled for all catalog/directory objects

Advanced Application Functionality



Application Enablement, Portability

- Allow non-NULL default values for inline LOBs
- Loading and unloading tables with LOBs
 - LOBs in input/output files with other non-LOB data
- ‘Last committed’ locking semantics
- Implicit casting
- Timestamp with timezone
- Greater timestamp precision
- Moving Sum, Moving Average

Application Enablement, Portability ...

- SQLPL in Scalar and Table UDFs
- 64-bit ODBC Support
- Special null indicator to indicate value not supplied or default
- Allow caching of dynamic SQL statements with literals

pureXML Enhancements

- XML schema validation in the engine for improved usability, performance
- Binary XML exchange format for improved performance
- XML multi-versioning for more robust XML queries
- Allow easy update of sub-parts of an XML document
- Stored proc, UDF, Trigger enhanced support for XML
- XML index matching with date/timestamp
- CHECK XML utility

Temporal Data - Summary of Proposal

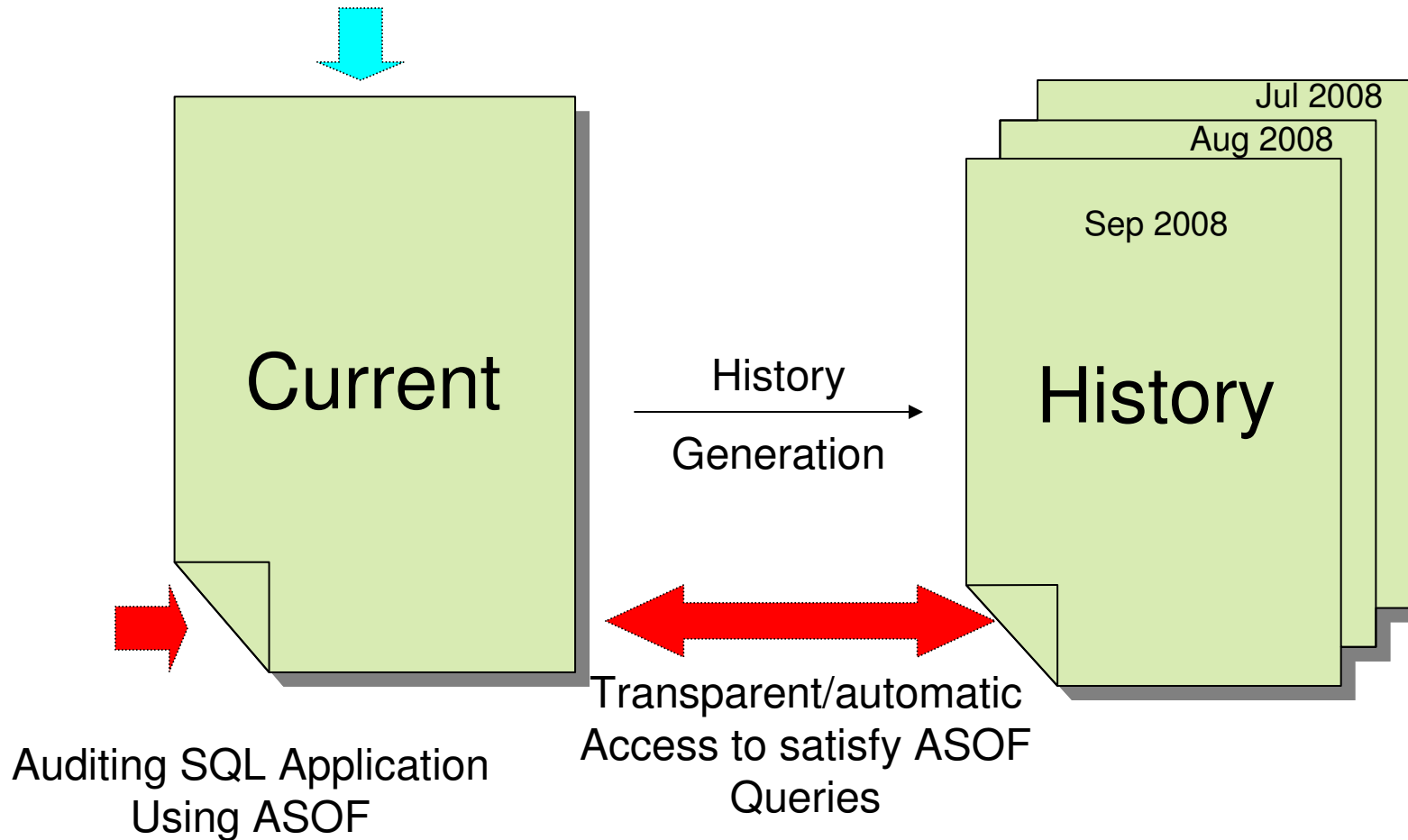
- **Business Time (Effective Dates, Valid Time)**
 - Every row has a pair of time stamps set by App
 - Start time: when the business deems the row valid
 - End Time: when the business deems row validity ends
 - Query over current, any prior, present or future period in business time
 - Useful for tracking of business events over time, app logic greatly simplified

- **System Time (Assertion Dates, Knowledge Dates, Transaction Time)**
 - Every row has another pair of time stamps set by DBMS
 - Start time: when the row was inserted in the DBMS
 - End Time: when the row was modified/deleted
 - Modified rows start time is the modification time
 - Query at current or any prior period in system time
 - Useful for auditing, compliance

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

Current and History

Current SQL Application



Temporal UPDATE example (business time)

Simple table definition (Policy#, start, end, coverage)

Table has 1 row of (123,'01/01/2001', '12/31/2001', 1000)

```
UPDATE policy p
  FOR BUSINESS_TIME FROM DATE('03/01/2001') TO DATE('03/31/2001')
  SET coverage = 2000;
```

Result of the update statement is 3 rows:

```
(123,'01/01/2001','03/01/2001',1000)
(123,'03/01/2001','03/31/2001',2000)
(123,'03/31/2001','12/31/2001',1000)
```

DBA/Sysprog Productivity

Optimization Stability and Control

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

- Static SQL
 - Relief from REBIND regressions
- 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
-
- Safe query optimization: assess “reliability” of access path choices
 - RID pool overflow to workfiles

DB2 X: Productivity – Doing More with Less!

- Auto statistics collection
- Compress ‘on the fly’
 - Avoid need to run utility
- Timeout / deadlock diagnostics:
 - Identify SQL statements
- Automatic config of IBM supplied UDFs and SPs
- Access path stability
- Reduced need for REORG
 - Build compression dictionary on the fly
 - Index list prefetch enhancements
- Allow tailored names for DSNHDECP

| Name | Monitoring Status | Data Server Status | Critical | Warning | Alert | System | Database | | | | | | |
|-------------|-------------------|--------------------|----------|---------|-----------|------------|--------------|---------|-----------------|-------------|--------------|---------|-------------|
| | | | | | CPU Usage | Disk Space | Memory Usage | Locking | SQL Performance | Connections | Transactions | Logging | Maintenance |
| Production | 🔴 | 🟢 | 3 | 8 | 🔴 | 🟢 | 🟡 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Web | 🟢 | 🟢 | 1 | 1 | 🔴 | 🟢 | 🟡 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| eCommerce | 🟢 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Support | 🟢 | 🟢 | 1 | 1 | 🔴 | 🟢 | 🟡 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Retail | 🔴 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| New York | 🔴 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Los Angeles | 🔴 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Accounts | 🟢 | 🟢 | 2 | 3 | 🔴 | 🟢 | 🟡 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Marketing | 🟢 | 🟢 | 0 | 4 | 🟡 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Test | 🟢 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |
| Development | 🟢 | 🟢 | 0 | 0 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 |

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Manual invocation of
 • RUNSTATS
 • COPY/BACKUP SYSTEM
 • QUIESCE
 • MODIFY RECOVERY
 • REORG

Autonomics and DBA Productivity...

- Checkpoint intervals based on both time and # log records
- Run 'must complete' backout under pre-emptable SRB
- Identify unused packages
- SQL Statement level monitoring
 - Statement ID introduced
 - Trace records & messages extended to include statement ID
 - New trace class for statement detail
 - GetPages, Locks, I/Os, cpu/elapsed time, etc. at statement level
- Manage max threads, connections, idle thread timeout on an application basis
 - Warning or exceptions issued when threshold is hit

Security Enhancements

DB2 X: Business Security & Compliance Needs

- Protect sensitive data from privileged users
 - SYSADM without data access
- Separate authority to perform security related tasks
- Allow EXPLAIN without execute privilege or ability to access data
- Audit privileged users

- “As of” query, temporal or versioned data
- Fine grained access control
 - Allow masking of value
 - Restrict user access to individual cells



Use disk encryption

Key details about DB2 X

- CM, ENFM, NFM is planned
- Probable Prerequisites
 - z/OS V1.10
 - DFSMS required for DB2 catalog
 - DB2 9 for z/OS in NFM
 - z890, z990, z9 and above (no z800, z900)
- Eliminated:
 - Private protocol → DRDA (new help in DSNTDP2DP)
 - Old plans and packages V5 or before → REBIND
 - Plans containing DBRMs → packages
 - ACQUIRE(ALLOCATE) → ACQUIRE(USE)
 - Workload capture through profile monitor
 - 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



Data Management Communities for DB2

- IDUG – the worldwide community of DB2 users
 - Membership is FREE – join today! www.idug.org

- Data Management Community – share and interact with peers around the world
 - www.ibm.com/software/data/management/community.html

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