DB2 11 for z/OS Technical Overview

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Proliferation of mobile and other network-connected devices is driving increases in:

- transaction workloads
- data volumes
- 24x7 requirements

Continued focus on cost containment and resource efficiency

Competitive pressures continue to drive an increasing need for innovation, analytics, and data integration

DB2 for z/OS has leading edge capabilities to support these requirements and DB2 11 makes important improvements
DB2 11 Major Themes

- **Out-of-the-box CPU Savings***
  - Improving efficiency, reducing costs, no application changes
  - Up to 10% for complex OLTP
  - Up to 10% for update intensive batch
  - Up to 40% for queries
  - Additional performance improvements through use of new DB2 11 features

- **Enhanced Resiliency and Continuous Availability**
  - Improved autonimcs which reduces costs and improves availability
  - Making more online changes without affecting applications
  - Online REORG improvements, less disruption
  - DROP COLUMN, online change of partition limit keys
  - Extended log record addressing capacity (1 yottabyte)
  - BIND/REBIND, DDL break into persistent threads

- **Enhanced business analytics**
  - Expanded SQL, XML, and analytics capabilities
  - Temporal and SQLPL enhancements
  - Transparent archiving

- **Simpler, faster DB2 version upgrades**
  - No application changes required for DB2 upgrade
  - Access path stability improvements
  - Product quality/stability: support pre GA customer production

*REBIND may be required for best results
DB2 11 OLTP/Batch Performance Expectations

- These are preliminary results from IBM testing
- Performance expectations vary depending on many factors, including
  - Access path selection, Read/Write ratio, Number of rows returned
  - Number and type of columns returned, Number of partitions touched
  - Schema - Number of partitions defined, DPSI, etc
  - RELEASE option, data compression

![DB2 11 CPU saving in OLTP/Batch (% of Total DB2 CPU reduction)](chart)
Significant CPU Reduction In Queries

DB2 11 Query Workloads - After REBIND w/o APREUSE
% of DB2 Class 2 CPU Reduction from DB2 10

- TPC-H benchmark queries
- TPC-H like queries
- Query Customer workload 4
- Query Customer workload 3
- Query Customer workload 2
- Query Customer workload 1
- Benchmark - SAP BW
- Benchmark - BI-Day long
- Benchmark - BI-Day short

- Most performance improvements are also available with APREUSE
- New and improved access path choices may be available without APREUSE
Performance Improvements – no REBIND needed

- DDF performance improvements
  - Reduced SRB scheduling on tcp/ip receive using new CommServer capabilities
  - Improved autocommit OLTP performance
  - DRDA package based continuous block fetch
- INSERT performance
  - Latch contention reduction
  - CPU reduction for Insert column processing and log record creation
  - Data sharing LRSN spin avoidance
- Automatic index pseudo delete cleanup
  - For fine-tuning, DBA work would be required
- IFI 306 filtering capabilities to improve Replication capture performance
- DGTT performance improvements
  - Avoid incremental binds for reduced cpu overhead
- Utilities performance improvements
Performance Improvements – REBIND required (with or without APRESUE)

- Query transformation improvements – less expertise required to write performance SQL
- Enhanced duplicate removal
  - Lots of queries require duplicate removal: e.g. DISTINCT, GROUP BY, etc.
  - Dup elimination via sorting can be expensive
  - New techniques: Index duplicate removal, early out
- In-memory techniques
  - In-memory, reusable workfile
  - Sparse index (limited hash join support)
  - Non-correlated subquery using MXDTCACH
  - Correlated subquery caching
- Select list do-once
  - Non column expressions in the select list can be executed once rather than per-row
- Column processing improvements
  - Xproc (generated machine code) for output column processing
  - Optimized machine instructions for input/output column processing
- Data decompression performance improvement
Performance Improvements – DBA or application effort required

- **Suppress-null indexes**
  - Index entries not created when all values for indexed columns are NULL
  - Reduced index size, improved insert/update/delete performance, compatibility with other DBMSes
  - Improved utility CREATE INDEX performance

- **New PCTFREE FOR UPDATE attribute to reduce indirect references**

- **DGTT performance improvements**
  - Non logged DGTTs

- **Extended optimization - selectivity overrides (filter factor hints)**
  - Improve optimizer’s ability to find the cheapest access path
  - Collect filter factors for predicates in a Selectivity Profile

- **Open dataset limit raised to 200K**
DB2 11 and zEC12 Synergy

- Faster CPU – 1.25x compared to z196
  - 5.5GHz processors, bigger/faster cache
  - 25% reduction measured with DB2 workloads
- 50% More System Capacity to help consolidation
  - Up to 3TB real memory per server
  - Excellent synergy with DB2 10 and 11 scalability
- New Features that DB2 11 Exploits
  - FLASH Express and pageable 1MB frames, used for:
    - Buffer pool control blocks
    - DB2 executable code
  - 2GB frame support for buffer pools
    - Performance improvement expected for extremely large memory sizes
- New zEC12 GA2 features that benefit DB2
  - zEDC Express for enhanced DB2 SMF data compression
  - RoCE Express for faster, cheaper z/OS to z/OS DRDA communication
    - Preliminary measurements show up to 2x DRDA transaction throughput increase
RAS and Usability Improvements

- Expanded RBA/LRSN. Expand to 10 bytes (1 yottabyte addressing capacity)
- BIND / DDL / Online REORG concurrency with persistent threads
  - Avoid having to shut down apps to get a REBIND through, e.g. for application upgrades
- More online schema changes
  - Alter partitioning limit keys
  - DROP column
  - Point in time recovery support for deferred schema changes
- Autonomics improvements
  - Automatic index pseudo delete cleanup
  - Overflow row reduction
  - Optimizer externalizes missing stats to enable automated RUNSTATS
- Plan management improvements - APREUSE(WARN) support
- Data sharing improvements
  - Group buffer pool write-around
  - Restart light enhancements
  - Index split performance and other indexing improvements
  - Full LRSN spin avoidance
Let's Check that High Order RBA

- Until DB2 11, the DB2 Log RBA range maxed out at x’FFFFFFFFFFFFFFF’
  - If end of RBA reached, Manual recovery actions are needed
    - In a Data Sharing environment, the impacted member can be shutdown and a new member started.
    - In a Non-Data Sharing environment, an extensive outage is required with a reset all PGLOGRBA values back to zero required
- Validate RBA usage
  - Capture number of bytes being used in a time period
  - Determine number of bytes remaining between current RBA and x’F00000000000’
  - Divide number of bytes remaining by number of bytes in time period
  - Multiply result by the time period
  - Rough Estimate for when the RBA will reach x’F00000000000’
How about the LRSN

- The data sharing Log Record Sequence Number (LRSN) is derived from the 8-byte time-of-day clock which hits end of range in 2042.
- In some cases, a non-zero LRSN delta exists.
  - This may occur when migrating from non-data sharing to data sharing to circumvent RBA nearing end-of-range.
  - With a non-zero LRSN delta, end of range is before 2042.
    - Use DSNJU004 to determine if you have a non-zero LRSN delta value.
    - A “delta” value could have been set when data sharing is enabled or re-enabled.
- 6-byte LRSN value has precision to only 16 microseconds.
  - Can cause LRSN ‘spinning’ which burns extra cpu and aggravated log latch contention.
  - V9 NFM and V10 NFM addresses most LRSN spin situations.
    - Some spins still exist due to the 16 usec granularity.
The extended RBA/LRSN solution

- Increase the RBA and LRSN to 10 bytes
  - RBA addressing capacity of 1 yottabyte ($2^{80}$) – a Trillion terabytes!
  - LRSN extended on left by 1 byte, on the right by 3 bytes
    - >30,000 years and 16Mx more precision
  - 8 bytes is not sufficient to solve LRSN issues and may not give sufficient capacity for the longer term
- NFM only
  - If you don’t care about larger RBAs/LRSNs then you don’t have to convert
  - But performance will be better if you convert BSDSs (avoid internal conversion overhead on log write) - BSDSs can be converted without converting pagesets
- Once in NFM, DB2 continues to use 6-byte values until you take action to convert
  - Convert BSDSs to new format to enable logging with larger RBAs/LRSNs
  - Convert pagesets over time to new page format with LOAD REPLACE, REBUILD and REORG
    - UTILITY_OBJECT_CONVERSION subsystem parameter
    - RBALRSN_CONVERSION utility parameter
Summary of DB2 11 Utilities Improvements

- **Availability**
  - Online data repartitioning
    - REORG REBALANCE SHRLEVEL(CHANGE)
  - Online ALTER of limit keys
  - Online REORG availability improvements
    - SWITCH phase reduction
    - Improved drain processing (less disruption to applications)
  - Part level inline image copies for REORG

- **Usability**
  - Online REORG automated mapping tables
  - Improved utility parallelism and control
  - DISPLAY UTILITY enhancements

- **CPU reduction**
  - More zIIP offload for LOAD and RUNSTATS

- **Performance**
  - Faster LOAD processing
  - Inline statistics improvements, reduced need for RUNSTATS
  - Optimizer input to statistics collection
  - Reduced system resources for utilities (MRU buffer management)
  - DSNACCOX performance
Expanded Analytics Capabilities

- Query performance improvements
- Temporal data enhancements
  - Support for views
  - Special register support
  - Integrated auditing support (planned)
- Transparent archive query
- SQL Grouping Sets, including Rollup, Cube
- Hadoop access via table UDF
  - UDFs shipped with BigInsights
  - Uses new V11 generic table UDF capability
- JSON support
Transparent Archive Query

- ALTER TABLE DATA_INFO ENABLE ARCHIVE USE ARCHIVE TABLE ARCH_DATA_INFO;
- SYSIBMADM.GET_ARCHIVE global variable YES or NO
  - Applications can query current + archive with no SQL changes
  - DB2 automatically converts SQL to UNION ALL via dynamic plan switching technique (high performance)
- Archiving process is user-controlled
  - SYSIBMADM.MOVE_TO_ARCHIVE global variable allows DELETEs to be automatically archived
Integrating Big Data Analytics with DB2 for z/OS

- Much of the world’s operational data resides on z/OS
- Unstructured data sources are growing fast

- Two significant needs:
  1. Merge this data with trusted OLTP data from zEnterprise data sources
  2. Integrate this data so that insights from Big Data sources can drive business actions

- Connectors to allow BigInsights to easily & efficiently access DB2 data
- DB2 is providing the connectors & the DB capability to allow DB2 apps to easily and efficiently access hadoop data sources

New V11 features enable this

- New user-defined functions and generic table UDF capability
JSON Database Technology Preview

Providing the best of both worlds

Plan to ship in DB2 10 and 11 by end year
New Application Features...

- **Global variables**
  - Named memory variables that you can access and modify through SQL
  - Share relational data between SQL statements
    - Without the need for application logic to support the data transfer

- **SQLPL improvements (performance, manageability, function)**
  - Autonomous transactions
  - Array data type support

- **Alias support for Sequence objects**

- **Row/Column Access Control UNION/UNION ALL support**

- **Unicode column support for an EBCDIC table**

- **BIND support for DBRMs with long & mixed cased names in zFS input files**
XML Enhancements

- **New Features**
  - Basic xQuery (retrofit to v10, PM47617, PM47618)
  - COBOL samples for XML (published on Developerworks website)

- **Features Enhancements**
  - Implicitly add doc node during insert/update
  - Crossloader support
  - Support xquery constructor as the source expression of insert and replace

- **Performance Enhancements**
  - Binary XML validation (*retrofit to DB2 V10*)
  - Partial validation after update
  - Date/Time Predicate Pushdown
  - XQuery(FLWOR) and XMLQUERY enhancement
  - Optimize Index Search Keys
  - XML Operator Improvements, use less storage and CPU
  - XQuery deferred construction
  - XMLTABLE pushdown cast
  - Avoid validation of validated binary XML data during LOAD
Easier DB2 Version Upgrade – application compatibility

- New DB2 releases can introduce SQL behavior changes which can break existing applications
  - For example, changes for SQL standards compliance
  - Example: DB2 10 CHAR function with decimal input no longer returns leading zeros when there is a decimal point

- Application Compatibility (APPLCOMPAT) – new option for enforcement
  - Provide mechanism to identify applications affected by SQL changes
  - Provide seamless mechanism to make changes at an application (package) level or at a system level
    - This mechanism will enable support for up to two back level releases (N-2)
    - DB2 11 will be the initial deployment of this capability
    - DB2 10 will be the lowest level of compatibility supported
Easier DB2 Version Upgrade...

- Faster ENFM processing
  - Fewer catalog changes in V11
  - Lab measurement showed 18x faster in V11 vs. V10 using a large customer catalog
- Access path stability improvements
- Higher code quality stability levels
- New SQL Capture/Replay tooling can help testing of DB2 version upgrades
Dual mode migration (CM, ENFM, NFM)
DB2 10 is the platform for migration
z/OS 1.13 or above. z10 or above.
No pre-V9 bound packages
DB2 Connect V10.5 FP2 is the recommended level for V11
  • This level is required to exploit most new V11 features
  • Any in-service level DB2 Connect supports V11
Sysplex query parallelism support is removed
QMF 11: Business Analytics for the zIM Enterprise

QMF Analytics for TSO
• Brand new component available in QMF Enterprise Edition 11
• Delivers unprecedented charting and statistical analysis capabilities directly to the mainframe
• Completely menu driven

Faster up and running with QMF reporting
• Adhoc Reports and Quick Reports
• Allows users to quickly and easily create their own sophisticated reporting objects using an open canvas

Analytics on unstructured data sources
• Text Analytics allows users to extract entities from unstructured data sources (either file-based or database-based) and display the results graphically

Increased support for the business user
• Dynamarts allow users to save their result sets with their query objects for offline use
• Mobile device support for iPad and Android tablets
DB2 Cypress: Early Thoughts

• Out-of-the-box performance improvements
  • No application or DBA changes needed
  • In-memory and hw/sw optimizations to reduce cpu
  • Insert performance - quantum leap

• Ease of use improvements
  • Application developers: more transparent SQL performance optimization, SQL, XML enhancements
  • DBAs: easier SQL tuning, large table management improvements, improved system autonomies

• RAS Improvements
  • More online schema change capabilities, enhanced Parallel Sysplex capabilities, utilities improvements

• Expanded SQL and analytics capabilities
Thank You

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