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 autonmics 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](chart)

- Batch: local set of various batches
- Batch: distributed concurrent Insert Seq
- OLTP: distributed simple
- OLTP: local simple dshr basic RBA
- OLTP: local simple dshr extended RBA
- OLTP: distributed SAP Banking dshr
- OLTP: distributed complex SQLPL
- Utility: set of utilities

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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’FFFFFFFFFFFFF’
  - If end of RBA reached, Manual recovery actions are needed
  - In a Data Sharing enviroment, the impacted member can be shutdown and a new member started.
  - In a Non-Data Sharing envornment, 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
  - Multiple 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

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**IBM BigInsights**

**Integrate**

**Merge**
JSON Database Technology Preview
Providing the best of both worlds

Plan to ship in DB2 10 and 11 by end year

Tools for higher Productivity
Established Security

Tunable Consistency
Performance & Scalability

JSON API
SQL + JSON API
SQL API

JSON

Referential Integrity
Check constraints
Transactions
Geo-spatial
Scalability
Temporal
Security
Joins

Performance & Scalability

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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
DB2 11 Planning

- 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 z/IM 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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