DB2 12 for z/OS Overview

Randy Ebersole
DB2 Technical Specialist
DB2 for z/OS Lab Services, IBM Analytics
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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user’s job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.
Agenda

• The Approach
• DB2 Highlights
• Brief Discussion on DB2 and Cloud
DB2 Dynamics: The market is moving, forcing businesses to transform

Explosion in transaction growth

Analytics is moving to Cognitive real-time

Hybrid cloud is the new standard

driven by mobility and the Internet of Things
capture new opportunities at the point of impact
delivering service, agility, trust and efficiency

The market is moving, causing **DB2** to transform
DB2 for z/OS Strategy

Extend the core
reliability:availability:scalability:security

Empower the future
analytics:autonomics:cloud:mobile
DB2 12 for z/OS – GA Oct. 21, 2016

Redefining enterprise IT for digital business and the mobile app economy

Scale and speed for the next era of mobile applications
Super fast ingest rate – 11.7 Million Inserts per second achieved for powering IOT, Mobile and Cloud apps
280 trillion rows in a single DB2 table, with agile partition technology

In-Memory database
Advanced in-memory techniques in DB2 12 mean faster transactions at lowered overhead

Deliver analytical insights faster
Up to 2-10x improvement for modern analytics workloads
Individual modern analytic queries may see up to 100x improvement

API Economy - Next Gen application support
384 million transactions per hour through RESTful web API

The launch pad for Continuous Delivery

Hundreds of other new enhancements in DB2 12
Extended core availability and performance
Empowering next gen workloads:
  DevOps and Agile development
  More schema and partition flexibility
  Easier to use, more self-optimizing system
Cloud-style as-a-Service provisioning
Improved Analytics, application porting, and developer productivity
DB2 12 was years in the making

DB2 12 ESP ("beta") started in March, 2016

Nearly 50 customers and partners have been testing DB2 12 in the ESP
A new Index Fast Traverse Block (FTB) is introduced

- Memory optimized structure for fast index lookups
- Resides in memory areas outside of the buffer pool
  - New zparm INDEX_MEMORY_CONTROL
  - Default=AUTO (min. of 500 MB or 20% of allocated BP storage)
- UNIQUE indexes only, key size 64 bytes or less

DB2 automatically determines which indexes would benefit from FTB

DISPLAY STATS command shows which indexes are using FTBs

New SYSINDEXCONTROL catalog table
  - Specify time windows to control use of FTBs for an index

New IFCIDs 389 and 477 to track FTB usage
Simple Look-up : Faster & Cheaper

Up to 23% CPU reduction for index look up using DB2 12 In-memory index tree

CPU Improvement (%) from Simple Lookup in DB2 12

<table>
<thead>
<tr>
<th>Index Levels</th>
<th>Improvement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>4</td>
<td>16%</td>
</tr>
<tr>
<td>5</td>
<td>23%</td>
</tr>
</tbody>
</table>
DB2 12: CPU Reductions for Transactions

DB2 12 CPU Reduction (%) from DB2 11 NFM

(Pre-GA measurements)

OLTP-simple4 (SPROC)
OLTP-complex (SQLPL)
OLTP-simple8 (CICS/DB2)
OLTP-simple1 (IMS/DB2)
OLTP-simple2 avg (Distributed)
OLTP-simple5 (IMS/DB2)

FTB=AUTO  FTB=Disable
Insert workloads are amongst the most prevalent and performance critical

DB2 12 delivers significant improvements for Non-clustered insert: journal table pattern

- UTS, MEMBER CLUSTER

Advanced new insert algorithm to streamline space search

- Default is to use the new fast algorithm for qualifying table spaces
  - INSERT ALGORITHM zparm can change the default
  - INSERT ALGORITHM table space attribute can override zparm
Simulated stock exchange transactions
Utilizing DB2 12 features: New insert algorithm and scalability enhancements
All done with single z13 box
   12 way DB2 data sharing with 4 way sysplex with high availability
DB2 12: CPU Reductions for Query Workloads

Query workloads Performance difference (%)  
DB2 11 vs 12  
(Pre-GA measurements)

- CPU Reduction %

- UNION ALL w/View Complex Outer Join, UDF
- Complex reporting, large sort
- Simple query or large data scan

- SAP SFIORI
- WAS portal (selective)
- Customer 3cl
- SAP SFIN
- Biday short
- Customer 2
- TPCH NP ID=1
- TPCH NP ID=Any
- Customer 4
- Customer 1
- TPCH-SQLPL
- TPCD
- SAP BW
- Bidad long
DB2 12: Simplicity and RAS

- Dynamic SQL Plan Stability
  - Stabilize performance of repeating dynamic SQL statements

- RUNSTATS automation
  - Optimizer automatically update profile with RUNSTATS recommendations

- RLF control for static packages

- LOB compression
  - Using zEDC hardware

- DRDA Fast Load
  - Callable command for fast load of data into DB2 directly from files on distributed client
Dynamic SQL Plan Stability

• Problem:
  – Unstable performance of repeating dynamic SQL statements
  – Environmental changes can result in change in access path or performance regression, and this can be tough to manage
    • RUNSTATS
    • applying sw maintenance
    • DB2 release migration
    • zparm changes
    • schema changes

• Static SQL has several advantages
  – Access path established at BIND time
  – Static plan management gives advanced management functions

• Objective: extend static SQL advantages to dynamic SQL
Dynamic Plan Stability

- **DB2 12 plan – base infrastructure**
  - Opaque parameter CACHEDYN_STABILIZATION
  - Capture
    - Command with / without monitoring
    - Global variable
  - FREE
  - EXPLAIN (current, invalid)
  - Invalidation
  - LASTUSED (identify stale statements)
  - Instrumentation (query hash, explain, cache + catalog hit ratio)
  - APPLCOMPAT is part of matching criteria

- **Key DB2 12 limitations**
  - Temporal stabilization not currently included
  - REBIND support not included
    - No PLANMGMT/SWITCH/APREUSE
DB2 12 DRDA Fast Load

• **Problem:**
  • DB2 provides the DSNUTILU stored procedure to load data from a client
  • But this is difficult to use, app must xfer data to z/OS file

• **Solution:**
  • DB2 Client API (CLI and CLP) for remote load into DB2
  • Easy/fast loading of data from file that resides on client
  • Internal format (SAP), as well as delimited and spanned (LOB data)
  • Overlap network operations with data ingest on the DB2 server
  • Measured results show as fast or faster than DB2 LOAD utility
  • zIIP eligible
Several SQLPL Improvements

- SQLPL in triggers, including versioning and debug support
- SQLPL obfuscation
- Support for constants
- Dynamic SQL in SQLPL UDFs and stored procedures

ARRAY and LOB global variables

JSON function improvements for easier retrieval of JSON data
DB2 12: application enablement...

- Enhanced MERGE support
- New SQL Pagination syntax
- Piece-wise modification of data (DELETE)
- XMLModify multiple update support
- Bi-temporal improvements
  - Inclusive/inclusive support
  - Temporal RI
  - Logical transaction for system time
Enhanced MERGE

• DB2 z/OS initial support for MERGE statement with limited functionality was delivered with Version 9:
  • Limited to UPDATE and INSERT and only one of each
  • Focused on use of host variable column arrays to provide multiple rows of input data
• In DB2 12, DB2 z/OS MERGE statement will be aligned with behavior defined in SQL Standard and DB2 family.
  • Source data as a table-reference
  • Multiple MATCHED clauses
  • Additional Predicates with [NOT]MATCHED
  • Support DELETE operation
  • Allow IGNORE and SIGNAL
With the growth of web and mobile applications, application developers are looking for more efficient ways to develop good performing applications.

**Numeric-based pagination**

   SELECT * FROM tab OFFSET 10 ROWS FETCH FIRST 10 ROWS ONLY

**Data-dependent pagination**

   Existing syntax
   WHERE (LASTNAME = 'SMITH' AND FIRSTNAME >= 'JOHN') OR (LASTNAME > 'SMITH')

   New equivalent syntax
   WHERE (LASTNAME, FIRSTNAME) > (SMITH, JOHN)
Piece-wise Modification of Data

- Mitigate the effects of locking and logging when potentially millions of rows could be affected by a simple statement like: "DELETE FROM T1 WHERE C1 > 7"

- Solution
  - Allow the fetch clause to be specified on a searched delete statement

  ```sql
  DELETE FROM T1 WHERE C1 > 7 FETCH FIRST 5000 ROWS ONLY;
  COMMIT;
  ```
• Relief for table scalability limits
• Simplify large table management
• Improve availability
• Agile schemas (more online schema changes)
• Security and compliance improvements
• Streamline migration process
• Utility performance, availability, usability
Partition By Range Current Limitations

- Maximum table size limited to 16Tb (4k pages) or 128Tb (32k pages)

- Maximum number of partitions is also dependent on DSSIZE and page size
  - E.g. if DSSIZE = 256 GB and page size = 4K then Max Parts is 64

- DSSIZE is at Table Space Level not Part Level
  - All Parts inherit the same DSSIZE set at Table Space
  - No ability to have differing Partition sizes
  - Altering DSSIZE requires REORG of entire tablespace
New PBR tablespace structure called ‘PBR RPN’
- Relative page numbers (RPN) instead of absolute
- Remove dependency between #partitions & partition size
- New RID is Relative RID
  - Part Number stored in Partition Header Page
  - Page number stored in Data Page, relative to start of the partition
- Up to 1TB Partition Size, or 4 Petabytes (PB) per table space
- Maximum number of rows with 4K pages increased from 1.1 to 280 Trillion
  - @1,000 rows inserted per second, more than 8800 years to fill!
- Increasing DSSIZE is supported at partition-level
- New DSSIZE support for indexes
- These infrastructure changes position DB2 for future enhancements
  - Increase in partition limits, increase number of rows per page
  - Attribute variance by partition, schema changes via REORG PART
Insert partition

Online deferred ALTER INDEX COMPRESS YES
  – Previously placed indexes in RBDP

Option to defer column-level ALTERs
  – Materialize through online REORG
  – Avoid availability constraints & conflict with other deferred alters

TRANSFER OWNERSHIP
Data Sharing Improvements

- Support for global transactions

- DDF shared session data across group
  - DDF transaction re-routing, session token for client fail-over

- Data sharing performance improvements:
  - Improved lock avoidance checking to reduce CF lock requests
  - In-memory indexes can reduce GetPages and CF GBP requests
  - Improved insert space search can avoid P-lock contention and streamline inserts
  - RUNSTATS and UNLOAD ISOLATION(UR) to avoid CF page registration
Data Sharing Improvements …

- New data sharing peer recovery option
- Retry of automatic LPL and GRECP recovery
- Asynchronous CF Lock duplexing (planned GA Oct. 28, 2016 with z13 GA2)
  - Reduces overhead for system managed duplexing of CF LOCK1 and SCA structures
  - Secondary structure updates are performed *asynchronously* with respect to primary updates
  - DB2 will sync up with z/OS to ensure data integrity i.e., all modify locks have been “hardened” in the secondary lock structure before the corresponding undo/redo record for the update is written to DB2 the active log on DASD
  - Increases the practical distance for multi-site sysplex operations while duplexing of CF LOCK1 structure
  - Planned as 4Q 2016 deliverable with
    - z/OS 2.2 APAR
    - z13 GA2 CFCC 21
Migration Prerequisites – Hardware & Operating System

- **Processor requirements:**
  - z196, or higher, processors running z/OS V2.1, or later
  - DB2 12 will probably require increased real storage for a workload compared to DB2 11 for z/OS

- **Software Requirements:**
  - z/OS V2.1 Base Services, (5650-ZOS), or later
  - DFSMS V2.1, or later
  - Language Environment Base Services
  - z/OS V2.1 Security Server (RACF), or later
  - IRLM Version 2 Release 3 (Delivered with DB2 12)

- **Additional details:**
Migration & Catalog

- Single phase migration process
  - No ENFM phase
  - New function activated through new command: -ACTIVATE FUNCTION LEVEL
  - BNFA vs. ANFA
  - APPLCOMPAT rules, fallback rules continue to apply

- BSDS conversion to support 10 byte log RBA is pre-requisite

- No pre-V10 bound packages
  - Get rid of 31-bit runtime, some performance improvements

- BRF is deprecated
  - BRF page sets still supported, but zparm and REORG options are removed

- Temporal RTS tables
  - Defined in catalog, enablement is optional
IBM DB2 12 Utilities – key to enabling DB2 function

- Continuing evolution of REORG utility
- Diminishing importance of data re-clustering for application performance
  - Optimizer improvements, I/O performance improvements, caching improvements, contiguous buffer pools
- Increasing use of IBM REORG for schema evolution
  - Insert partition
  - PBR RPN conversion
  - Deferred column-level alter
  - LOB compression
- Improved PBG partition management
  - Overflow to new PBG partition to ensure successful partition-level REORG of PBGs
DB2 12 Utilities Maximizing Efficiency & Eliminating Application Impact

- Improved efficiency
  - Further reduction in CPU cost & more offload to zIIP
    - REORG up to 57% zIIP offload
    - LOAD up to 90%
  - REGISTER NO option to eliminate data sharing overhead for RUNSTATS, UNLOAD
  - COLGROUP statistics CPU cost reduced by up to 25%, elapsed time up to 15%
  - More efficient handling of compressed data to reduce CPU and elapsed time across range of utilities
  - REORG avoidance: Immediate increase of partition DSSIZE with PBR RPN
  - Improved FlashCopy support
    - Multiple DFSMS COPYPOOL support for SLBs & better messaging
    - Improved FlashCopy handing in REORG & template support for MGMTCLAS, STORCLAS

- Eliminating application impact
  - Improved LOAD utility support for sequences with automatic handling of MAXASSIGNEDVAL
  - Online LOAD REPLACE – non-disruptive refresh of reference tables
  - Skip invalidation of cached statements by RUNSTATS
  - Removed recoverability restrictions for PBG table spaces
IBM DB2 Utilities and Tools – Moving from Automation to Self-Management

- Continue to build upon existing self-management infrastructure
- Managing statistics in DB2 12
  - Direct update of statistics profiles
    - Optimizer
    - DDL
  - Utility inline statistics support for USE PROFILE
  - Automation Tool completes the cycle to detect profile changes & drive new statistics gathering

“The RUNSTATS enhancement with profiles, inline stats and optimizer ability to update, completes the picture for us. We are extremely satisfied.”

Walter Janißen, ITERGO
DB2 12 for z/OS Accelerated Value

Deliver desirable, consumable capabilities to the marketplace with speed and quality

- DB2 for z/OS is moving to a Continuous Delivery model based upon DB2 12

- Why?
  - Faster delivery of easily consumable new features
  - Integrates perfectly with new DevOps methodologies being adopted by our users
  - Eased deployment burden enables faster adoption of new technology

- Available on Replay
  http://ibm.biz/DB2zContinuousDelivery
Hybrid Cloud -- The marriage of one or more public or private clouds to an on premise DB2 and its data. The first example is DB2 query acceleration in the cloud.

DbaaS (DB2 as a Service) -- Easy provisioning and de-provisioning of DB2 resources via non traditional audiences (non administrators).

DaaS – (DB2 Data as a Service) -- DB2 data can be provided in a on demand basis to new service oriented applications with a simple, open call API. DB2 12 provides an embedded REST end point. Using this model, the actual platform on which the data resides is irrelevant to developers.

Provisioning — The process where you create and prepare a set of resources for users. For DB2, this could mean creation of whole DB2 systems or an application’s set of tables and associated resources.

RESTful API — Is an application program interface (API) that is simple to use and is in wide use in internet & mobile apps that interact with services like DB2.

DB2 Customers want to utilize hybrid clouds, DbaaS, and they want DB2 Data as a Service for improved administration with lower skills required, and for their next generation application development.
**DB2 Data as a Service**

**DB2 Cloud/Mobile modernization with RESTful APIs and JSON**

- Many modern application developers work with REST services and JSON data formats
- DB2 12 (and DB2 11 APAR PI66828) ship a Native DB2 REST service
  - Easier DBA management of DB2 RESTful services, means easier adoption
  - z/OS Connect Enterprise Edition (zCEE) integration

Native DB2 REST service provider now available

Serving mobile data directly from z/OS is 40% less expensive than exporting to a system of engagement
IDAA: Hybrid transaction/Analytical processing

The hybrid computing platform on z Systems

- Supports transaction processing and analytics workloads concurrently, efficiently and cost-effectively
- Delivers industry leading performance for mixed workloads
- The unique heterogeneous scale-out platform leads in the industry
- Superior availability, reliability and security

DB2 Analytics Accelerator and DB2 for z/OS

A self-managing, hybrid workload-optimized database management system that runs every query workload in the most efficient way, so that each query is executed in its optimal environment for greatest performance and cost efficiency
Announcing a new dimension for the DB2 Analytics Accelerator . . .

**DB2 Analytics Accelerator on Cloud Version 1.1**

*High-speed analysis of enterprise data with cloud agility, flexibility and ease of deployment*

- **High-speed analysis**
  Rapid insight from enterprise data in a secure cloud environment

- **Fast and Simple Deployment**
  Improved agility and quick time to value

- **Secure cloud environment**
  Comprehensive data encryption capabilities based on a dedicated, bare-metal deployment

- **Reduce cost**
  Speed implementation on analytics projects to reduce overall implementation costs

**DB2 Analytics Accelerator for z/OS Version 6.1**

*Integrated on-prem and cloud solution supporting transactional and analytics workloads for right-time insight*

- **New dimension of deployment**
  Support for the IBM DB2 Analytics Accelerator on Cloud Version 1.1

- **Flexible hybrid cloud**
  A hybrid model with tight integration between cloud and on-premise deployment options

- **Speed and Simplify**
  Quickly deploy new or additional Accelerator instances by deploying applicable workload in the cloud

- **Support for Data Science using R**
  Support of R functions enabling in-database analytics on DB2 for z/OS using R - the most popular language used by data scientists
What are our customers saying about DB2 12?

**DB2 12 rules the API Economy**

The RESTful API is yet another way where DB2 is at the leading edge – and again cementing DB2’s and the mainframes position as a full capable server in the IT infrastructure of today. Using these REST-services Mobile applications can both be built faster and run faster!

Frank Petersen
Chief Architect
BankData

**DB2 12 Cost Savings**

The biggest benefit with DB2 12 comes with Index in memory optimization (Fast Traverse Block) which provides incredible costs savings with lower CPU consumption for OLTP – nearly 9-10% after Rebind. This should bring down our mainframe operating costs.

Jacek Surma
DII, Zespół Systemów Mainframe

**DB2 12 – Exciting new capabilities**

We love the “agile partition technology” that DB2 12 offers. This feature makes it easier for ITERGO to address “hot spots” where “new data” is inserted. This is particularly important when enterprises are looking for scale, speed and reduced costs.

Walter Janissen
Chief Architect
ITERGO

**DB2 12 Availability & Security**

We are very pleased with many of the new DB2 12 features, especially with Transfer Ownership and Pending Alter Column feature this give our Enterprise higher availability and security which are “critical” in the banking industry.

Jacek Surma
DII, Zespół Systemów Mainframe

**DB2 12 - The #1 Enterprise Server for Mission Critical Data!**

We are really excited about Performance Enhancements in DB2 12 especially advance "in-memory" (Fast Traversal Blocks FTB) capabilities. During testing we have seen up to 5% CPU reduction and this clearly relates to enormous potential cost savings and positions DB212 as a leader in Enterprise Database market.

İbrahim Parlak
IT Manager
Garanti Bank

**DB2 12 – Offering Advanced “in-memory” technology**

“We are looking forward to exploiting the advanced "in-memory" technology that DB2 12 offers (Index Fast Traverse Block) this gives us an opportunity to reduce CPU resource consumption and performance cost by using more real memory. It is very cost effective trade off for enterprises like us that run DB2 12 on z13 machines. During testing we have seen up to 23% CPU reductions in specific test cases.”

Henrik Henriksen
DB2 DBA
Danske Bank

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DB2 12 – More Control over Dynamic Plan Stability

“Dynamic Plan stability give us much better options to control and manage dynamic SQL. It is very important for us, as dynamic SQL becomes more and more popular. Dynamic SQL becomes an increasing part of our workload and we want to have the same control of Dynamic SQL as we have had for Static SQL for years.”

Henrik Henriksen
Danske Bank
Mainframe & Midrange Services

Gaining Deeper Insight with DB2 12

“I am excited about all of the great new SQL functionality that is coming with DB2 12. Things like FETCH FIRST on DELETE, simpler pagination, and of course, tons of performance enhancements, will make it easier than ever to get insight from our DB2 databases.”

Craig Mullins
IBM GOLD Consultant
IBM Champion for Analytics

DB2 12 - The #1 Enterprise Server offering “in-memory” technology

“In the past few releases of DB2 for z/OS, IBM has systematically removed the most significant virtual storage limits DB2, so that customers can more fully exploit the real storage available in their System z servers. The “in-memory” features of DB2 12 take this a step further, allowing customers to really take advantage of today’s larger memory configurations in order to significantly reduce operational costs and improve application performance. There’s more still to do, but DB2 is now a bona fide in-memory database.”

Julian Stuhler
DB2 Specialist, IBM Gold Consultant, IBM Champion for Analytics

DB2 12 – RESTful API helping enterprises to be Agile

“Restful API in DB2 12 for z/OS allows you to develop mobile and other apps with scalable performance in a matter of minutes. Do you want to be quick and agile? Use Restful API in DB2 12 for z/OS”

Kurt Struyf
IBM GOLD Consultant
IBM Champion for Analytics
What are our customers saying about DB2 12?

We have seen a significant speed-up of analytical queries from Core Data Services in SAP software with DB2 12. In addition, DB2 12 has outstanding capabilities and online DDL improvements that can make it an excellent foundation for SAP solutions.

Dr. Bernd Kohler
Development Manager, SAP on IBM z Systems & DB2 for z/OS

Immediate SAP certification of DB2 12 *

* See SAP Note 2302997
Summary

- DB2 for z/OS continues to aggressively evolve to meet the demands of modern application workloads
- Many DB2 12 features were rolled back to field releases for speedier delivery
  - NoSQL RESTful API
  - Cloud-style aaS provisioning
  - JSON enhancements
  - SQL performance for SAP and other apps
  - Simulated buffer pools
  - Numerous utilities enhancements
- DB2 12 delivers many new innovations for optimizing existing workloads and enabling for new cloud, mobile, analytics opportunities
- DB2 is moving to a continuous delivery model to deliver faster with high quality and easier upgrades for customers
  - DB2 12 has new infrastructure for CD support
Thank You

IBM
DB2 12 – More Information

- DB2 12 website & webcast

- DB2 12 Business Value whitepaper

- DB2 12 Technical redbook

- “Scaling Progressive SAP Solutions with DB2 12 – Immediate SAP Certification of DB2 12 at IBM General Availability”

- DB2 12 GA Announcement
  https://www-01.ibm.com/common/ssi/rep_ca/7/897/ENUS216-077/ENUS216-077.PDF

- World of DB2
  http://www.worldofdb2.com/

DB2 12 for z/OS

For mission critical data providing secure, seamless integration for analytics, mobile and cloud.