New Analytic Possibilities by Leveraging Mission Critical Data

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Agenda

- Analytics Overview
- Accelerator Review
- Analytics on Transaction Data
- IT Operational Analytics
- Accelerator Loader V2.1
- Atypical is now becoming Typical
- Questions
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Analytics have become Business Critical

Prevent Fraud

Today, analytics are integrated with transaction systems running on the mainframe and are critical to the business.

Reduce Customer Churn

Failure of these applications for any length of time can result in lost business, customer turnover, reputational risk, etc.

Cross-sell/up-sell to customers

These applications need to deliver insight in real-time or near real-time and integrate with business processes.

Operational Reporting

These applications may support a large concurrent user population with a high volume of requests.

Business Critical Analytic applications require superior qualities of service, including a high degree of reliability, continuous availability, scalability, security and low data latency.

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Analytics empowers every business function

- Build trust through risk aware decision making
- Create new business models
- Attract, grow, retain customers
- Prioritize IT investments for business innovation
- Increase operational efficiency and effectiveness
- Fight fraud and counter threats
- Transform financial & employee management processes

Systems of Insight
Driving the Need for Change

All Data | New Analytics | More People | Business Critical

Transactional/Legacy/Non-Relational Data

Can the traditional approach adapt? Can your organization exploit new ideas?
What’s holding organizations back?

- Significant complexity
- Analytics latency
- Lack of synchronization
- Data duplication
- Excessive costs
- Many different types of data
- Many device types/multiple personas
- Access to current “real” data
- Rapid growth in mobile transactions
- Integration with existing resources
- 24/7 always on applications
- Analytics for the “mobile moment”
Mainframe Data Integration Costs

- Majority of systems of record data is on the mainframe
  - 60%-70% of an organization’s data is on z/os
- Integrating mainframe data for analytical purposes in place is computationally expensive
- Avoiding mainframe processing costs drives the decision to move data off host
- Mainframe computers are the most secure operating system
- Customer options:
  - Traditional bulk-data movement with ETL
  - Point-to-point connectors
- Both options limit agility, add cost and complexity

“IBM study found that to move one terabyte of data, with three derivative copies each day, amortized over a four year period added up to $8,269,335.”
Why analytics on z/OS now?

z Systems Specialty Engines

DB2 Analytics Accelerator for z/OS

Evolved data warehousing architectures
Improved DB2 support

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IBM z Systems and DB2 Analytics Accelerator
Driving revolutionary change with 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
- Superior availability, reliability and security

DB2 Analytics Accelerator and DB2 for z/OS
A self-managing, hybrid workload-optimized database management system that runs each query workload in the most efficient way, so that each query is executed in its optimal environment for greatest performance and cost efficiency
IBM DB2 Analytics Accelerator for z/OS

A workload optimized, appliance add-on to DB2 for z/OS that enables the integration of analytic insights into operational processes to drive business critical analytics & exceptional business value.

SPEED
- Dramatically improve query response – up to 2000X faster – to support time-sensitive decisions

SAVINGS
- Minimize data proliferation
- Lower the cost of storing and managing historical data
- Free up compute resources

SIMPLICITY
- Simplify infrastructure, reduce ETL and data movement off-platform
- Non-disruptive installation

SECURITY
- Safeguard valuable data under the control and security of DB2 for z/OS
- Protected. Secured. Governed.

INTEGRATION
- Fully Integrated with DB2
DB2 Analytics Accelerator
*Further extending the features*

*Blending System z and PureData technologies to deliver unparalleled, mixed workload performance for complex analytic business needs.*

**More insight from your data**

- Unprecedented response times for “right-time” analysis
- Complex queries in seconds rather than hours
- Transparent to the application
- Inherits all System z DB2 attributes
- No need to create or maintain indices
- Eliminate query tuning
- Fast deployment and time-to-value
DB2 for z/OS Approach: Hybrid Database Management System

- Uniform and transparent access for transactional and analytical applications
- Application Interfaces (standard SQL dialects)
- DBA Tools, z/OS Console, ...
  - Operation Interfaces (e.g. DB2 Commands)
- System z
  - Superior availability, reliability, security, workload management, OLTP performance ...
- IBM DB2 Analytics Accelerator
  - Powered by PDA
  - True appliance, industry leading ease of performance
Query Execution Process Flow

Application Interface

Optimizer

IDAA DRDA Requestor

DB2 for z/OS

SPU

CPU

FPGA

Memory

Heartbeat (DB2 Analytics Accelerator availability and performance indicators)

Queries executed without DB2 Analytics Accelerator

Queries executed with DB2 Analytics Accelerator

Queries executed with value of “ALL” may receive a SQL Error Code if the query cannot run on the accelerator

DB2 Analytics Accelerator

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S-Blade Data Stream Processing

FPGA Core

CPU Core

Field Programmable Gate Array

Decompress

Project

Restrict Visibility

SQL & Advanced Analytics

From

Select

Where

Group by

Stream via Zone Map From

Select State, Age, Gender, count(

(1) From Mult Table

Based on BirthDate 1960-01-01

And State in (FL, GA, SC, NC)

Group By State, Age, Gender)
The new approach: Transactions and analytics processed together

Bring analytics to your data for *right-time insight* at the point of impact

- Reduce Latency
- Minimize Cost & Complexity
- Improve Data Governance & Security

This integrated approach drives real business value

- Improve customer experience
- Increase revenue opportunities
- Improve response time
More users across the organization depend upon business critical analytics

Why limit your analytic opportunities to traditional relational data?
History of Legacy Data Analytics

- Desire to combine legacy potentially non relational data with other data
  - Social, DB2 z/OS data, SAS data, etc

- ETL legacy data into data warehouse
  - Mostly off z/OS
  - Data being sent to potentially many sources

- Security can be compromised

- Data is rich and very plentiful

- Performance historically not keeping up without $$$$$$
  - A customer was using over 2,000 peak time MIPS to process
  - Resources are needed to create new processes
  - Resources are needed to maintain existing processes
More users across the organization depend upon business critical analytics

The competitive advantages of exposing legacy data to Analytics via an Accelerator

- Mission critical analytic data is now exposed via a common SQL access
- Data is consolidated in one location without the need to replicate off platform
- Comprehensive Analytics – all data can be access together
- Security is maintained via z/os & DB2
- Fully Utilizing the power of an Accelerator
  - Query Speed
  - Abundance of Storage
  - 3% – 4% more compression compared to DB2 Compression
Accelerate Legacy Data Access - Proposed Solution

- Leverage Analytics Accelerator
  - Metadata resides in DB2
  - Copy Legacy Data into Accelerator Only

- DB2 manages queries and controls access

Advantages:
- Data never leaves z/OS
- Legacy workload unaffected
- Single server for z Analytics
- Join of all data types
- Less reason to ETL legacy data off platform
  - Save $$$
Expanding the Analytic Accelerator Opportunities

Facilitates loading data to the Accelerator

Bring your analytics to your data – save data replication costs

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Challenges of Processing Performance Data

- Incredible amounts of data
  - Large amount of time to process the data
    - Nightly Processing
    - Reporting is normally completed once a night or only by request
  - Large costly data to maintain
    - Customers summarize and lose granularity
    - Difficult if not impossible to compare detailed data over time

- Products are available to report on performance data
  - Most products are source dependent (not all)

- In a lot of cases one small group maintains
  - Adhoc requests become time consuming
  - One group can become a bottleneck
  - Near real-time trouble shooting/diagnostics can be a challenge

- Think about the added benefit if the performance data is exposed to the masses in an fast efficient method.....
  - Near real-time operational analytics
  - Accessible via SQL
  - Holistic enterprise view of your organization’s operational performance data
Operational Analytics

- SMF Records
- RMF Data
- Syslog
- Audit Data
- Custom Metrics
- DB2 Logs
- Websphere Logs
- CICS Logs
- SQL Performance
- Transactional Performance
Operational Analytics

- User/Usage Analysis
- Peak Time Analysis
- Forecasting & Planning
- Security & Forensics
- Proactive Alerting
- Trend Analysis
- Capacity Planning
- Root Cause Analysis
- Detailed Historical Analysis
- Root Cause Analysis
Non-Traditional Analytic Data Sources

Bring analytics to your data for *right-time insight* at the point of impact

Enhancing your organizational analytic capabilities by exploiting transactional/legacy/non-relational type of data!

What are some of the approaches to populate non-traditional data sources to an Accelerator?
Extraction Considerations and Methods

- Considerations
  - Availability requirements
  - Frequency of refresh?
  - Impact to OLTP workload
  - What data is needed?
    - Entire database, certain segments, multiple DBs?
  - Consistency of data?
  - How do you maintain?
Extraction Considerations and Methods

- Extraction Tools and Methods
  - Custom Application
    - Additional online workload
    - Data can still be changing
  - Database Clone (IMS Cloning Tool)
    - Group of databases at a point in time
  - Image Copies/Unload Files
    - Additional knowledge of structure needed
  - Mapping and ETL Tools
    - IMS Explorer
    - Data Stage, Informatica
    - Data Virtualization
    - IMS Catalog via JDBC
    - Other tools

- Improved data quality and consistency
- Improved data accessibility and utilization
- Improved data security and compliance
- Improved data integration and interoperability
- Improved data monitoring and management
- Improved data governance and stewardship
IBM DB2 Accelerator Loader V2.1
IBM DB2 Analytics Accelerator Loader: Mission

- DB2, the Accelerator and z/OS together provide best and most secure platform for analytics
  - At many sites, majority of operational data is already on z/OS
  - Advantageous to perform analytics on the platform where data “lives”
  - Copying data off-platform for analysis is expensive and time consuming, and introduces data security and governance challenges

- The Analytics Accelerator Loader facilitate loading data into an Accelerator
  - Reduces elapsed time and CPU consumption when loading Accelerator
  - Provides capability to quickly and easily load data from non-DB2 sources
  - Supplies additional features above and beyond native load processes
  - Reduces administration time for loading data into an Accelerator

- Ultimately, the DB2 Analytics Accelerator Loader provides a simple end-to-end process to consolidate data from multiple sources into an Accelerator
Announced the IBM DB2 Analytics Accelerator Loader for z/OS
  – High speed, zIIP enabled accelerator loading with additional functions

Addressed challenges in loading the Accelerator
  – Elongated two-step process
  – Fast load from data in a file to accelerator only
  – Related set of tables put into read-only state
  – Inability to load to desired point-in-time
  – Plus
    • zIIP-eligible data preparation to load data faster
    • Load stand-alone backups directly to accelerator
Identified challenges in loading non-DB2 data

- Complexity in converting non-relation data to relational
- Manual / ETL process
- Slow, due to intermediate write to disk
New Product Offering

- **IBM DB2 Analytics Accelerator Loader for z/OS V2.1**
  - Superset of IBM DB2 Analytics Accelerator Loader for z/OS
  - Existing jobs supported and profile migration provided

- **Addressed challenges in loading non-DB2 data**
  - Complexity
  - Manual or ETL process
  - Slow, due to intermediate write
  - Plus
    - Mapping facility and data validation
    - LOAD RESUME
    - Remote DB2 and other relational data

- **Currently supported data sources**
  - VSAM
  - IMS
  - SMF
  - DB2 for z/OS
  - DB2 LUW
  - Oracle
  - Adabas
  - Sequential
IBM DB2 Analytics Accelerator Loader – The user must:
- Extract data from source (IMS, VSAM, Oracle, etc.)
  - Convert extracted data to DB2 external load file format
  - DataStage or other tooling can be used
- Create a DB2 table that matches format of extracted data
- Add newly created table to the Accelerator
- Construct a DB2 Load utility field specification that describes the input data
- Run Accelerator Loader batch job to load data to accelerator

Accelerator Loader V2.1—Automates entire process:
- User builds a select statement from data source(s) (IMS, VSAM, Oracle, …)
- **Automatically** creates the DB2 table
- **Automatically** adds table to Accelerator
- **Automatically** extracts specified source data
- **Automatically** converts data to necessary DB2 format (in memory)
- **Automatically** loads data to Accelerator
- **Automatically** enables table for acceleration

Single batch job!
Accelerator Loader Benefits

- **LOAD RESUME support**
  - Avoid the need for full LOAD replace
  - New function to append data from a file to existing data in a table
    - Replaces the need for full data replace
  - LOAD RESUME can provide significant CPU / elapsed time savings vs. REPLACE
  - LOAD RESUME to both DB2 table and Accelerator table in parallel
  - LOAD RESUME to Accelerator only and to Accelerator-only tables

- **Accelerator-only tables (AOTs) – new in Accelerator V4.1 PTF5!**
  - New table type in DB2 for z/OS
    - Data resides only in Accelerator version of table, not in front-end DB2
  - All queries targeting these tables are routed to Accelerator
    - All SELECT statements automatically routed to Accelerator
    - INSERT/UPDATE/DELETE also supported
    - No logging or point in time recovery
  - Without tooling, data must be inserted to load
    - Insert directly to Accelerator-only table
    - If data sourced from outside DB2, multi-step process to load
Accelerator Loader Benefits

Load Resume Examples

Elapsed Time

Seconds

2,630
756
468

DB2 LOAD followed by Accelerator Load
Loader* to Accelerator and DB2 (IDAA_DUAL)
Loader* to Accelerator ONLY (IDAA_ONLY)

200 GB Initial Load – One week of Load Resume 10 GB
DB2 Accelerator Loader – LOAD RESUME Advantages
CPU/zIIP Time

- Scenario 1: DB2 LOAD followed by Accelerator Load
  - 3,499 seconds

- Scenario 2: Loader* to Accelerator and DB2 (IDAA_DUAL)
  - 1,130 seconds for GCP Time (CP+SRB ONLY)
  - 1,059 seconds for zIIP CPU Time ONLY

- Scenario 3: Loader* to Accelerator ONLY (IDAA_ONLY)
  - 363 seconds for GCP Time (CP+SRB ONLY)
  - 1,032 seconds for zIIP CPU Time ONLY

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Accelerator Loader High Availability Load

Loads to multiple Accelerators are performed in parallel!

1. Reduced Elapsed Time
2. Reduced CPU
3. Simplified Operations

Requires APAR PI59666
IBM DB2 Analytics Accelerator Loader V2.1

- Provides a complete solution to load DB2 and non DB2 data to the Analytics Accelerator
- Supplies a relational view of non-relational data sources
  - VSAM, IMS, Sequential, Adabas (tentative)
- Allows users to code familiar SQL against data sources for purpose of loading the Accelerator
- Consistent access to the data no matter the source
- Provides end-to-end support for data extraction, conversion, and loading to accelerator in one step
  - No data is landed in any intermediate files
  - Automates process of creating DB2 and Accelerator tables
- Leverages zIIP for
  - Data Extraction
  - Data Conversion
  - Data Loading to the Accelerator
Accelerator Loader V2.1
Inter Server Communication

Accelerator Loader V2.1
Batch Load Job

Supported Data Sources

DRDA

Access to non
z/OS data sources
through DB2 LUW
Federation Server

Inter-Server Communication

TCP/IP

JDBC

Requires
APAR PI56636

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Analytics Accelerator Loader V2.1
In Memory Data Transformation
Lab Test Results Loading VSAM Data

VSAM KSDS 200 GB Data

VSAM Load Performance

COBOL EXTRACT OF VSAM + STANDARD DB2 LOAD + STANDARD ACCELERATOR LOAD

COBOL EXTRACT OF VSAM + LOADER V1.1 USED TO LOAD ACCELERATOR

LOADER VERSION 2.1 DIRECT LOAD FROM VSAM

Minutes

General CPU

Elapsed

Environment

<table>
<thead>
<tr>
<th>Processor</th>
<th>z13 Model 739: z/OS LPAR with: 4 Dedicated CPs, 14 Dedicated zIIPs MT=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>65 GB</td>
</tr>
<tr>
<td>z/OS</td>
<td>V2R2</td>
</tr>
<tr>
<td>DB2</td>
<td>V11</td>
</tr>
<tr>
<td>Accelerator DB2 SPs</td>
<td>V51</td>
</tr>
<tr>
<td>Accelerator H/W</td>
<td>N3001-010 (Mako full-rack)</td>
</tr>
<tr>
<td>Accelerator S/W</td>
<td>V51 Beta w/NPS 7205</td>
</tr>
<tr>
<td>Loader V21</td>
<td>Pre-GA: Code Drop 12</td>
</tr>
<tr>
<td>Loader V21</td>
<td>ACCEL_LOAD_TASKS = 16 MR Threads = ENABLED</td>
</tr>
</tbody>
</table>

zIIP Processor Utilization

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1%</td>
</tr>
<tr>
<td>B</td>
<td>1%</td>
</tr>
<tr>
<td>C</td>
<td>50%</td>
</tr>
</tbody>
</table>

Note: Average zIIP Process utilization was < 1% in the first two scenarios and ~ 50% in the Loader V21 scenario

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Accelerator Loader V2.1 Direct Data Load Details

- Only Accelerator version of table will be loaded
  - If data desired in both DB2 and accelerator, extract to file and use external Dual Load

- Load RESUME will be supported
  - User in control of what data is appended

- Source data is not locked during load
  - User can control (at the source) if necessary for data consistency
  - Cloning Tool an option for IMS data

- Performance can be tuned
  - Read Parallelism: VSAM and Sequential now
  - Write Parallelism: Number of pipes to accelerator

- Data Validity Checking – Discard Processing
  - Data type checking performed during load
  - Only messages issues on invalid data (no discard file support)
  - No duplicate key checking
    - Can be done via SQL post load
  - Roadmap for improvement
New Accelerator Loader Functionality

- **LOAD RESUME Support when loading from a file**
  - Will append data to Accelerator table
  - Will append data to DB2 and Accelerator table

- **Support for tables in replication mode when loading from a file**
  - Only valid for dual Load
  - Not supported for loading non-DB2 data
  - Requires Accelerator 4.1 PTF 5

- **Eliminate the need for field specification when data in default format**

- **Optionally add the table to the accelerator if not there**

- **Performance Improvements:**
  - Elapsed time improvement for non-parallel dual loads
  - Enhance Accelerator only load to use parallelism when underlying table is not partitioned, or a PBG

- **Simplified ISPF interface**

- **Install verification procedure**
## Potentially supported data sources Roadmap

**Databases**
- Oracle
- PostgreSQL
- MySQL
- DB2 LUW
- Microsoft SQL Server
- Sybase
- Microsoft Access
- Derby
- H2
- HSQL
- Ingres
- Informix
- MetaMatrix
- Teradata
- Generic ANSI SQL - for any JDBC/ODBC source

**Web Services and NoSQL**
- **Web Services**
  - SOAP
  - REST
  - Arbitrary HTTP(S)
- **OData**
- **Big Data / No SQL / Search Engines / JCR and Other Sources**
  - Amazon SimpleDB
  - Apache Accumulo
  - Apache Cassandra DB
  - Apache SOLR
  - Greenplum
  - Hive / Hadoop
  - ModeShape JCR Repository
  - Mongo DB
  - Mondrian OLAP
  - Netezza data warehouse appliance

**Enterprise**
- **Enterprise Systems**
  - SalesForce
  - SAP Netweaver Gateway
  - Applications running on IBM i, UNIX, Windows
- **Object Sources**
  - JDG / Infinispan
  - Intersystems Cache Object Database
  - JPA sources
- **LDAP**
  - RedHat Directory Server
  - Active Directory
- **Files**
  - Delimited / Fixed width
  - XML
- **Spreadsheets**
  - Excel
  - Google Spreadsheet
Customer Example
Customer Clearing/IDAA PoC Challenge / Response

- The foundation of this process are ISO-8583 records
  - This is a very loose standard with a bit map identifying groups / subgroups of data
- This data was considered too voluminous to maintain online in transactional systems
- The IDAA platform (along with it’s compression capabilities)
  - Offered the storage at an acceptable price point
  - Provided a platform for potentially intense queries that would not interfere with the transactional environment
  - Natural fit for existing execution environment
- The IDAA Loader (Rocket Software) provides for:
  - Loading the appliance without having to load the data into DB2
    • Can provide parallelism for this load (even from tape)
  - Has plan to load multiple accelerators in parallel
  - Has virtualization capabilities to federate many non-DB2 sources
  - Mapping exits / Rocket consulting to develop mapping routines for complex formats
  - Provides LOAD RESUME capabilities (possible future use)
Questions