Establish an Analytics Hub on Linux on IBM z Systems & LinuxONE

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The Platform of Choice
integrate transactional and analytic processing

Reduced data movement, reduced complexity, reduced configuration resources, more accurate data, more secure, more available

Streamlined decision process

- Faster, more accurate modeling
- Faster transactions
- Faster, more accurate reporting
- Faster, more accurate scores
- Easier integration of other data sources

Faster data serving, faster operational efficiency, faster trusted and secure computing, virtually limitless scale.
IBM Z point-of-view

Building a foundation to grow with business needs

Why z13 and z13s or z14?
- Larger cache = in-memory analytics for faster insight
- MASS libraries = 2X to 10X improvement porting x86 analytic workloads
- SIMD improvements = 80% increase in CPLEX on z/OS modeling
- CPU enhancements = no performance impact to real-time scoring in transactions

Why IBM Z?
- Currency of data
- Reduce complexity
- Eliminate data duplication
- Improve synchronization
- Bring analytic function to the data
## Evolution of Analytics

**data is the resource for competitive advantage**

<table>
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<th>Descriptive</th>
<th>Predictive</th>
<th>Cognitive</th>
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</thead>
<tbody>
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<td><strong>Analytics by spreadsheet</strong></td>
<td><strong>Alerts &amp; suggest next actions</strong></td>
<td><strong>Identify &amp; immediately act</strong></td>
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<tr>
<td>A business management exercise</td>
<td>Studying business data to understand trends and predict the future</td>
<td>Expanding beyond business data for business opportunities</td>
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### Who
- Analysis by small teams
  - Owned by IT organizations
  - Lines of business

### What
- On historical structured data
  - Copy data to build data warehouses & data marts
  - Combine structured & unstructured data
- Using utilities or roll your own tools
  - Tools build models to learn from historical data
  - Discover & act using open source tools
- **Internal executive decision support**
  - Increase business opportunities
  - Embed analytics into business processes
**IT infrastructure matters not because of what you are doing now**  
**But because of what happens next**

<table>
<thead>
<tr>
<th>Now</th>
<th>What Happens Next</th>
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</table>
| Increasingly sophisticated analysis on static data | • Currency of data becomes the driver of business value  
• Embedding real-time analytics into the business transaction  
• Privacy of client data and issues of ethical use  
• Integration of structured and unstructured data: Bringing business level QoS to a large scale with clustered and unstructured data  
• Analytics evolving into Cognitive: Power of Inference |
| Virtualization | • Orchestration, automation, and control of all resources: On-premise and off-premise  
• Splitting of application and data layers  
• Hybrid Cloud and Multi-architecture integration  
• Data privacy and security |
| “Let’s talk to the iPhone” | • “Remember the lessons of the PC”- Today's toy can run tomorrow's world  
• Broader access → unprecedented and unpredictable transaction and data volumes → fluid scale  
• Unpredictable timing dictates 24x7 response and availability  
• Security: Data integrity and privacy with broader transaction access |
Imagine the possibility of leveraging all of your data assets

“Here’s a question, what’s the answer?”

“Here’s some data, are there correlations?”

**Transformational** benefit comes from integration of new data sources with traditional corporate data.
IBM Systems with z Architecture

IBM Z

IBM z13

IBM z13s

IBM LinuxONE Systems

IBM LinuxONE Emperor

IBM LinuxONE Rockhopper

The world’s fastest processor
Massive I/O throughput
Dedicated cryptographic processors
IBM LinuxONE Systems
Linux your way, open & without limits

An open source community and ISV eco system to support a data serving environment

**Database**
- Oracle
- IBM Db2
- MariaDB
- MongoDB
- PostgreSQL
- Cassandra
- CouchDB

**Analytics**
- IBM Cognos
- IBM SPSS
- IBM Watson Explorer
- Apache Hadoop
- Python
- R
- Scala
- Clojure
- JavaScript

**Languages**
- Java
- Ruby
- PHP
- ERLANG
- OCaml

**Distributions**
- SUSE
- Red Hat
- Ubuntu (Supported by Canonical)
(2) The Enterprise Analytics Hub on Linux on z Systems

Build an end-to-end Analytics and Real-time fraud detection environment on Linux on z Systems
## The Enterprise Analytics Hub on LinuxONE

<table>
<thead>
<tr>
<th>Product</th>
<th>SPARK</th>
<th>dashDB local*</th>
<th>Cognos Analytics</th>
<th>SPSS</th>
<th>Watson Explorer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Analyze the context of data in structured &amp; unstructured data</td>
<td>Analyze the context of data in structured &amp; unstructured data</td>
<td>Analyze current &amp; historical data</td>
<td>Predictive Analytics</td>
<td>Analyze and predict from the context of data using structured &amp; unstructured data</td>
</tr>
<tr>
<td>UI</td>
<td>commands, Scala IDE or Notebooks</td>
<td>Jupyter Notebook</td>
<td>Report Studio for visual, interactive, self-service business users</td>
<td>SPSS dashboard</td>
<td>Explorer dashboard</td>
</tr>
<tr>
<td>Main APIs</td>
<td>SPARK SQL, ML, GraphX</td>
<td>SPARK APIs SQL, ML, GraphX</td>
<td>JDBC</td>
<td>JDBC, ODBC</td>
<td>Various interfaces i.e JDBC, JSON</td>
</tr>
<tr>
<td>Analytics results</td>
<td>Reports, scoring, Machine learning In memory processing</td>
<td>DB2 BLU Warehouse &amp; in memory analytics</td>
<td>Interactive reports and dashboards</td>
<td>Predictive models, statistics, scoring</td>
<td>Interactive reports, Predictive, statistics</td>
</tr>
<tr>
<td>Data sources</td>
<td>Structured &amp; unstructured data, MESOS, Hadoop FS</td>
<td>Structured &amp; unstructured data, MESOS, Hadoop</td>
<td>Structured data</td>
<td>Structured data</td>
<td>Structured-, unstructured data and Watson cloud services</td>
</tr>
</tbody>
</table>

* - offering not yet available
Get Started – Exploit Your Data
download free software to start a project

- Federated, data-in-place analytics – reduce ETL
- Performance gains from co-location with data
- z Systems: SMT2, zEDC, SIMD, Large Pages, very high zIIP use

- Find insights from structured & unstructured data with Apache Spark

IBM Packages for Apache Spark
Exploit the big data analytics capabilities of Apache Spark with this new package for IBM platforms.

Downloads
These are the available downloads of the IBM Packages for Apache Spark:

- Linux on Power Systems
- Linux on System x
- Linux on z Systems
- z/OS

https://www.ibm.com/developerworks/java/jdk/spark/
IBM z Systems provides an optimized platform to derive insights from all client data without moving it. Accurate – Secure – Federated analysis in a hybrid cloud model.

Spark Analytics on Linux on z and z/OS

Leverage Linux on z virtualization benefits

Leverage z/OS data and transactions

*RDD – Resilient Distributed Dataset

Spark is the Java of data analysis!
IBM Machine Learning for z/OS - Overview

Linux on z
- Machine Learning User Interface
- Machine Learning Application

z/OS
- IBM z/OS Platform for Apache Spark
- Data

IBM Machine Learning for z/OS
**IBM dashDB Local for Analytics**

* dashDB Local is the premier private cloud data warehouse optimized for analytic workloads for Software Defined Environments (SDE) such as private clouds, virtual private clouds and other infrastructures that support Docker container.

**Benefits of dashDB Technology with Fast Deployment into Private Cloud Environment**

- Highly flexible data warehouse
- Optimized for fast and flexible deployment into **private or virtual private clouds**
- Uses **Docker** container technology
- Built on top of **dashDB technology**, it shares the benefits of
  - BLU Acceleration in-memory columnar technology
- Massively Parallel Processing (**MPP**) with automated scaling capabilities to increase infrastructure efficiency

* - offering not yet available
dashDB local*

Streaming data using the built-in Apache Spark infrastructure in dashDB Local
- runs in Docker containers
- UI using Jupyter Notebook

* - offering not yet available
DB2 w/ BLU Acceleration – inside dashDB

Solution

- DB2 with BLU Acceleration is the preferred solution for customers who would like to run analytics with z Systems & Linux data
- Satisfy requirement for a columnar in-memory db
- Alternative of Linux on z Oracle installations
- Enhanced for distributed consolidations onto z Systems
Predictive Analytics: IBM SPSS on Linux on z
learn from historical data to make predictions

Techniques used to analyze data
- Data mining
- Statistics
- Modeling
- Machine learning
- Artificial intelligence

Example use cases
- Market Basket Analysis
- Fraud Detection
- Cross Sell – Up Sell Opportunities

Common Problems
- Copies of data created for specific needs
- Created complexity in managing data
- Data Synchronization
- Excessive Costs

Why IBM Z

Currency of data
Reduce Complexity
Eliminate data duplication
Improve Synchronization
Bring analytic function to the data
Predictive Analytics with Linux on z Systems technology
an open ecosystem for innovation

Co-locate for Right-Time insights
- Reduced latency allowing for better insights
- Minimize cost & complexity
- Improve data governance & security
- Open the aperture on innovation
- Cost efficiencies through consolidation
- Efficient HiperSocket LPAR connections

Why IBM Z

SIMD delivers accelerated analytics processing for mathematical optimization
SMT delivers more throughput for Linux and zIIP-eligible workloads
zEDC reduces data transfer time and storage cost by up to 75%
16 Gbps FICON links reduce latency for workloads such as Db2
Cache increased to enable faster in-memory insights
10-32 TB of real memory ← even more critical with Linux

Freedom & Agility Standards Based Developer Productivity
Descriptive Analytics: IBM Cognos Analytics
the analysis of historical data

1960s to early 1970s: Analytics expanded with the introduction of computers

Decision Support Systems provided business data for analysis.

Late 1970s: Relational databases created to eliminate data redundancy / inconsistency and improve structure of data
- data was organized around records
- relationships were enforced
- indexing for hi-speed access
- SQL was standardized

Reporting evolved from DB utilities to the creation of specific data marts for data manipulation
- creating cubes
- providing dashboards

Why IBM Z
System of Record for data

To handle volume and velocity of data

To accurately report the state of the business
IBM Cognos Analytics is an enterprise BI platform for governed data discovery and managed reporting that automates the creation of reports and dashboards so users have the freedom to do it on their own. The user experience is designed for business professionals so they can easily prepare, create and visualize content using the built-in intelligence to guide them.

“We are excited about the new self service and visualisation capabilities of Cognos Analytics, it will enable our users to make more informed decisions.”
Lizette Robles
BI Project Leader
Universidad de Guadalajara

Analytic when, where, and how you need them
• Simple intuitive interface
• Smart search works in context
• Personalized experience
• Scheduling and alerts
• Interactive content available on-line or off-line

Bring your data to life
Cognos Analytics is ready when you are with a unified experience that works the same on web or mobile devices, enabling you to quickly find, analyze, create and share insight.
• Intuitive interface lets all users quickly author content
• Dashboards created using drag and drop on mobile device or desktop
• Best visualizations automatically recommended
• Templates and styles to let you format reports instantly
• On demand menus for access to full capabilities over a clean workspace
• Single interface to create ad hoc or pixel perfect reports, frees up IT

Analytics you can trust for confident action
Confident action comes from access to curated data that eliminate risk and debate over numbers.
• Data protected with layers of permissions, authentication, and history
• Report integrity maintained regardless of range of inputs across business
• Controls to protect data whether you’re creating one report for many or many are creating one report
• Scheduling and alerts

http://www-03.ibm.com/software/products/en/cognos-analytics#othertab1
What is **Cognitive Analytics**?

**Cognitive**: Psychological processes involved in acquisition and understanding of knowledge, formation of beliefs and attitudes, and decision making and problem solving.

What is **Cognitive computing**?
Cognitive Analytics: IBM Watson Explorer

Systems that learn, understand, reason & interact

Cognitive Business requires **access to the right data, a trusted system** to hold that data and the ability to gain meaningful insights in time to affect outcomes.

Cognitive requires keeping up with the customer via mobile devices and **connecting to other sources of information** through the cloud to see the full picture of what’s happening.

Cognitive requires systems with **analytics integrated into the business process** so that intelligence can be gained and actions taken while they still matter.

*Cognitive brings all these qualities together*
Cognitive Analytics = Digital Business + Digital Intelligence

IBM Watson Explorer

Analytics – Foundation for Digital Business
Watson technology – the Digital Intelligence for Cognitive Computing

IBM Watson Services

Interpret
- Question Answer
- Relationship Extraction
- Concept Expansion
- User Modeling
- Language Identification
- Machine Translation
- Message Resonance
  ... more ...

Watson Developer Cloud

ibm.com/watson/developerclose/services-catalog.html
Analytics workloads run faster on the Linux on z platform

- Test using independent OLTP brokerage database and analytical queries
  - Apache Spark with map-reduce script performs fetch, query and aggregation
    - 1 master and 4 worker JVMs
  - Oracle used for OLTP database, hosted on our platform
    - 348 M rows of brokerage trade data
- Spark co-located on our platform drove up to 3x more throughput than Spark running off platform on x86

Test ran one LinuxONE guest, RHEL 6.5 on LinuxONE & z/VM 6.3 with 32 vCPUs (16 cores with SMT) and 512GB memory, Spark 1.5.0, IBM JDK1.7-SR3
Test ran on unvirtualized x86 with 16 cores on Intel(R) Xeon(R) CPU E5-2698 v3 @ 2.30GHz, 512GB memory running SLES 11.3, Spark 1.4.1, JDK1.8
TPC-E 20K scale on Oracle database V12
Scala map-reduce script (aggregation query) on TPC-E 20K scale Trade table using 1 master and 4 worker JVMs
Out-of-box, default parameters, no tuning
Linux on z Systems Technology: Not a “box” but “Linux Your Way”

“Linux Your Way” means a commitment to:

- **An Open Source Ecosystem**
- **Unmatched TCA with unmatched scale**
- **The best performance**

Linux and z Systems: The Most Efficient Platform for Cloud and Consolidation

**Linux WITHOUT LIMITS**

- **30B RESTful web interactions per day** with over **470K database read and writes per second**
- **2x better performance for open SQL and NoSQL database**
- **Scale out**: Scale out to 20K virtual servers in a single system, less than thousands of containers.
- **Scale up**: Supports tens of thousands of concurrent users; run test, dev and production in a single system. Shared resources and greater productivity.
- **Built for speed**: The industry’s fastest processor, biggest IO pipe, 10TB memory, four levels of cache... and more to deliver sub-second end user response time to thousands of concurrent users.
- **On-demand resourcing**: Spin up containers and virtual servers in minutes. Add physical resources automatically (permanently or temporarily) in seconds. Enjoy automated resource provisioning and reallocation. Run at 100% utilization.

**Differentiate yourself in a world of standards. Lightning fast response times and virtually unlimited scale gives your apps the premium Linux experience they deserve.**

**Largest single DB node with response times under 5ms; avoid cost, complexity, and overhead of sharing**

**Delivering the fastest virtual Linux servers on the planet to users for less than $0.70 per day**
**Business Challenge**
How to improve customer service and satisfaction in order to drive greater revenue.

**Technical Challenge**
Existing analytic processes were unable to manage the analysis of historic and transaction data from Petrol’s retail stores, service stations and home oil/gas businesses.

**Solution**
Implemented IBM DB2 Analytics Accelerator to support high performance queries and IBM SPSS to make real time, point of sale product recommendations.

“IBM provides us with tools that align with smarter commerce, enabling us to deliver the right message to the right person at the right time, to understand product affinities and intelligently drive the sale all in a customer centric way”

External Links: [Case Study]
Building an open & flexible strategic analytics platform for the future

**Business Challenge**
SDV is a German Bank providing retail services for over 100 years. They needed to find the right platform that will fulfill regulatory requirements and expand to provide high-end, real-time analytic solutions.

**Technical Challenge**
The existing infrastructure was challenged in meeting the fulfillment and regulatory requirement of BCBS 239 and was not capable of supporting the requirements of new projects.

**Solution**
Selecting the IBM LinuxONE System allows the bank to consolidate their analytic environment on one platform using DB2 on z Systems Linux. The platform provides an innovative, flexible infrastructure to expand their analytic capabilities to an open community-driven ecosystem provided by Linux.
**Business Challenge**
Growing fast, Brazilian credit union system Sicoob must cope with extra transactions at short notice. How could it combat the increased IT complexity that resulted without impacting service quality.

**Technical Challenge**
To keep pace with their rapid business growth Sicoob did not have the IT infrastructure to support reliable 24/7 service and mobile access for their customers.

**Solution**
Selecting IBM z Systems as the strategic platform. Sicoob migrated and consolidated member databases to IBM DB2 LUW with BLU Acceleration. They deployed IBM InfoSphere DataStage and IBM Cognos running in a Linux environment on the mainframe.

"IBM Challenges and opportunities have led us to restructure our technology infrastructure and adopt IBM System z technology, which guarantees greater stability and performance for our products and services. This facilitates our growth, by lowering the cost of maintenance and administration in the production environment, and by reducing power consumption in the data center...."

– Denio Rodrigues, IT Executive

**External Links:** [Case Study2](#), [YouTube Video1](#), [YouTube Video2](#)
**IBM Z = SOR+SOI+SOE in a Box**

System Of Record (SOR), System Of Insight (SOI), System Of Engagement (SOE)

- Compose high-performance scalable applications
- Dynamically and seamlessly re-allocate resources between micro-services
- Provide right-time analytics
- Provide powerful engagement

https://www.youtube.com/watch?v=VWBNoIwGEjo
Putting it all together – Open Source running LinuxONE and IBM z Systems Demo: “Scalable Financial Trading Analysis & Insights”

Input Data

- S&P Dow Jones Indices
  Historical S&P 500 Index
- Yahoo!
  News Feed
- AlchemyAPI
  Sentiment Analysis
- Trade Transactions
- Geospatial Analysis

https://www.youtube.com/watch?v=VWBNolwGEjo
Linux your Way - Greater flexibility and choice includes Analytics

Choose the distribution, runtime, hypervisor, database and analytics – it’s the Linux you know and love with the openness, flexibility and agility you need for your business.
Questions?

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