The Never Ending Value of z Systems

Focus on Analytics & Big Data

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It all started with a $5 billion dollar bet.

Constant evolution driven through **co-creation** with our clients
Today’s IBM z Systems is … an « optimized » Hybrid System …

- The world’s most trusted transaction processing, batch server and data server for business critical applications
  - Optimized for mixed workload
  - Shared-everything design
  - Single point of operation

- The world’s most cost-efficient platform for data center consolidation and virtualization
  - Efficiency at scale

- The world’s most dependable and scalable hardware and middleware platform for new business applications
  - Trusted resilience for unmatched security and reliability
  - Analytics where the data is created
  - Ready for unpredictable mobile workload

- A thoroughly modern application environment for traditional and cloud delivery models
Today’s IBM z Systems is ... an «optimized» Hybrid System ... with Modern Capabilities

- Process complex analytics queries up to 2000x faster
- Manage tens of thousands of virtual servers in a single system
- Delivers the highest certification level for enterprise-class servers
- Real-time operational analytics
- Enterprise data hub
- High-volume transaction processing
- Elastic, scalable, virtually limitless expansion
- Shared everything design
- Hybrid computing
- Ultimate security
- Built-in cryptography
- Unmatched resiliency and availability
Announcing the z13 - Not legacy but the most technically advanced platform

Mainframes account for 68% of production workloads, but only 6% of IT spend.

Up to 56% better throughput on z13 and Java8 than Intel Haswell for IBM middleware solutions.

Mainframe organizations demonstrate an average of 35% lower IT Cost of Goods; and computational growth roughly 3x more economically efficient.
Integrated analytics and transaction processing

The greatest value is achieved when analytics are run where the transactions and data originate

Insights on every transaction

Analytics as part of the flow of business

Avoid data movement
- Eliminate complexity
- Eliminate cost
- Eliminate redundancy

Deliver real-time insights at the point of impact
- Improve customer experience
- Increase revenue opportunities
- Improve response time

More transaction throughput
Faster data access
Increased analytics performance

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IBM z13 designed for Analytics

*Accelerate insight and simplify implementation*

- **IBM DB2 Analytics Accelerator** accelerates queries for faster insight
  - New innovative use cases, such as in-database transformation and advanced predictive analytics

- **Large memory allows** new opportunities for in-memory computing
  - per system & per LPAR

- **SMT2** for increased zIIP & IFL cores capacity

- **SIMD** delivers accelerated analytics processing for complex queries
  - Enable vector processing capabilities to z Systems

- **More**
  - Optimized math libraries and compilers that will speed up and simplify application development
  - Faster thread speeds
  - z Enterprise Data Compression (zEDC) to improve the economics of keeping data on z Systems
Accelerated database analytics for z Systems

- **IBM DB2 with BLU Acceleration**
  - Provides accelerated database analytics for Linux on z Systems
    - Software based (load and go) with seamless integration with DB2 LUW
    - Up to 100x acceleration factor
    - Petabytes scalability
  - Combines proven in-memory and columnar data store capabilities with advanced compression and hardware exploitation techniques.

- **IBM DB2 Analytics Accelerator**
  - Provides accelerated database analytics for z/OS on z Systems
    - Plug and play appliance with seamless extension of DB2 for z/OS
    - Up to 2000x acceleration factor
    - Terabytes scalability
  - Allows best performance for transactional and for analytical workloads, without tuning
  - Cost Savings thru High Performance Storage Saver
IBM’s 10TB BI Day Query workload
- 166,160 Reports: Cognos BI generated SQL
- 80 users: Mix of Tactical / Intermediate / Complex Analytics queries

**3X reduction in processing time!**

- **z196 with DB2 10 + IBM DB2 Analytics Accelerator N1001-010**
  - 8.8 hr

- **zEC12 with DB2 10 + IBM DB2 Analytics Accelerator N2001-010**
  - 5.2 hr

- **zEC12 with DB2 11 + IBM DB2 Analytics Accelerator N2001-010**
  - 4.5 hr

- **z13 with DB2 11 + IBM DB2 Analytics Accelerator N3001-010**
  - 2.8 hr

**Note:** Pre-Accelerator, this same workload required 198 hours of processing on z196 w/DB2 10. 70X better today

- The times represent the sum of the elapsed processing time for: Tactical - Executed on DB2 native; Intermediate/Complex - Executed on IBM’s DB2 Analytics Accelerator.
- z196 w/DB2 10 & N1001 results were projected based on previous published query performance for both z196, as compared to zEC12 and N1001, as compared to N2001.
Traditional approach: ETL on a different platform

- Disadvantages:
  - process driven movement of large amounts of data
  - aged data for analytics/reporting depending on performance of data movement and transformation process
IBM z Systems Analytics System – z/OS Specific
Improving data movement and transformation process

Using Accelerator-Only Tables and ELT logic in the Accelerator

Advantages:
- Simpler to manage
- Better performance and reduced latency

To get a backup copy of an AoT, they could be loaded into a DB2 z/OS regular or accelerated table again
Large Memory for innovation with in-memory computing

- **Up to a maximum of 10 TB**
  - Up to 2.5 TB per model increment
  - Leadership reliability and availability with RAIM
  - z/OS 2.1 (with SPEs) to support up to 4 TB per LPAR
  - z/VM 6.3 to support up to 1 TB per LPAR

- **Adding more memory can enable you to...**
  - Cut response time – up to 70% reduction seen with SAP transaction processing
  - Achieve faster decision making by leveraging in-memory data
  - Shrink batch windows with no change to applications
  - Deploy and support more Linux workloads in the same system footprint
  - Improve system performance, minimize constraints, and simplify management of applications with database exploitation of additional memory
  - Get more work done
Large Memory for innovation with in-memory computing

Benefit per workload

- Provides CPU time savings and processing efficiency
  - DB2 Buffer Pools, and DB2 tuning made easier
  - Cognos Dynamic Cubes eases cube deployment and scale
  - Fix page IMS Full Function database buffers
  - MDM larger DB2 buffer pools CPU and response time savings
  - IBM MQ V8 helps message volumes and efficiency
  - Java right-sized heaps improves CPU time and latency

- Provides practical guidance to trade off memory for performance
  - T-WAS Garbage Collection tuning and Java large page use
  - MQ v8 64 bit buffer pool tuning for CPU and response time
  - CICS paging reduction for several CICS in-memory facilities
  - TCP/IP FTP performance improvement
  - DFSort I/O reduction for batch workloads
  - Fixed large pages
  - Dump buffers increase improve availability
  - VSAM RLS buffers
  - Software AG Adabas buffer pools
Simultaneous multithreading allows instructions from more than one thread to execute in any given pipeline stage at a time
  – Can increase processing efficiency
  – Addresses memory latency, resulting in overall throughput gains for many workloads
  – Can be turned on or off by an operator command and also set up through parmlib

Currently applies to Linux (IFL) and zIIPs
  – Not CPs

Number of concurrent threads limited to two

Performance in some cases may be superior using single threading

**Which approach is designed for the highest volume of traffic? Which road is faster?**

*Illustrative numbers only*
**z13 Two-way simultaneous multithreaded (SMT)**

- **Performance:** up to +10-40% capacity increase vs single HW thread
  - zIIPs/IFLs combined for CPU time and throughput benefit
  - e.g. SAP banking workload app server with just IFLs enabled for SMT up to 29% ITR
    - IFLs average about 20%; zIIPs average about 25%
  - Can maximize z13 performance by helping to minimize # required CPUs
  - Positive results with
    - DB2 BLU, i.e. up to 35%
    - Cognos, +50% to +63% ITR on z13 SMT vs zEC12
    - SAP, up to +40% ITR on z13 SMT vs zEC12, 29% non-SMT/SMT

- **Management and accounting**
  - Measures and delivers meaningful z/OS capacity and accounting information
  - z/OS use of a fill/spill algorithm in dispatching threads provides more consistent performance in an SMT enabled environment
    - Expect predictable capacity, accounting, latency, response time
    - SMT transparent to virtual OSes and apps for centralized LPAR management
**z13 SIMD (Single Instruction Multiple Data)**

*Increased parallelism to enable analytics processing*

- Smaller amount of code helps improve execution efficiency
- Process elements in parallel enabling more iterations
- Supports analytics, compression, cryptography, video/imaging processing

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**Value**
- Enable **new** applications
- Offload CPU
- Simplify coding

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**Scalar**

**SINGLE INSTRUCTION, SINGLE DATA**

```
A3 + B3 = C3  
A2 + B2 = C2  
A1 + B1 = C1  
```

*Instruction is performed for every data element*

---

**SIMD**

**SINGLE INSTRUCTION, MULTIPLE DATA**

```
\{ A3, A2, A1 \} + \{ B3, B2, B1 \} = \{ C3, C2, C1 \}  
```

*Perform instructions on every element at once*
Business Analytics, Workloads using Certain Millicoded instructions, Everyday Java workloads

Cobol, C/C++, PL/1, HLASM, Metal C

Transparent Execution

Transformational Execution

IBM/ISV Product (e.g. IBM CPLEX Optimizer, z/XDC Colesoft)

Java8 (with WAS support)

Compiler Toolchain

Math Library (MASS, ATLAS)

z CPU with Integrated SIMD Accelerator

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z13 SQL/NoSQL Data serving performance

MariaDB 10.1.5

1.8x to 2.1x throughput improvement on Sysbench Benchmark

MongoDB 3.0.4 (WiredTiger, no sharding)

Up to 1.8 to 2.1x throughput improvement on YCSB Benchmark

PostgreSQL 9.4

1.6x to 2.2x throughput improvement on pgBench Benchmark

AcmeAir Throughput vs Data Size in MongoDB

Extreme scale-up of database

Consolidate up to 32 nodes into a single MongoDB instance leveraging 1TB without the overhead, cost and complexity of sharding!
Big Data, Hadoop & Spark History

Developed in 2009 at UC Berkeley AMPLab, open sourced in 2010, Spark has since become one of the largest OSS communities in big data, with over 200 contributors in 50+ organizations.

“Organizations that are looking at big data challenges – including collection, ETL, storage, exploration and analytics – should consider Spark for its in-memory performance and the breadth of its model. It supports advanced analytics solutions on Hadoop clusters, including the iterative model required for machine learning and graph analysis.”

Gartner, Advanced Analytics and Data Science (2014)
Spark processes and analyzes data from ANY data source

- Apache Spark is an open source, in-memory processing engine designed for Big Data.
  - in-memory processing capability,
  - interfacing with multiple data sources,
  - ability to be written with multiple programming languages.

- It was designed with 3 key tenants in mind
  - Fast, simple, able to run in many environments.

- Apache Spark is NOT
  - A data store
    - Spark attaches to other data stores but does not provide its own
  - Only for Hadoop
    - Spark can work with Hadoop (especially HDFS), but Spark is a separate, standalone system
  - Only for machine learning
    - Spark includes machine learning and does it very well, but it can handle much broader tasks equally well
  - A replacement for Streams
    - Spark Streaming is micro-batching, not true streaming, and cannot handle the real-time complex event processing that true streams do

Source: TypeSafe, Apache Spark Survey 2015, Databricks - How Companies are Using Spark
z Systems & Apache Spark: Strategic Direction

Fast, expressive, cluster computing system leveraging in-memory framework for analytics

Unified Analytics Platform
- Flexibility & Agility with multi-language support
- Efficient Structure – 100x vs. in-memory map reduce
- Rich set of built-in functions with consistent APIs: Spark SQL, Spark Streaming, GraphX, ...

Leverage LoZ virtualization benefits

Leverage call center, external, social, sentiment data …

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Co-locate Spark with Competitor Database on Linux on z13 outperforms running Spark off-platform up to 3x for aggregation analytical query

Use case
- Operational Analytics for a Brokerage running reports on top of OLTP Trading data

Key message:
- Co-locating Spark on z13 to run Analytical queries on top of OLTP Competitor database running in z13 outperforms running Spark off-platform

Results
- Spark on z13 provides up to 3x for aggregation analytical query

Test
- 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
IBM z13: The new possible

Mobile
Deliver up to 36% better response time, up to 61% better throughput, and up to 17% lower cost per mobile transaction

Analytics
Deliver insights up to 17x faster and with 13x better price performance than closest competitor

Cloud
Enable superior Cloud services at up to 40% lower cost than x86 Cloud and up to 65% less than Public Cloud over three years

Security
Accelerate speed of encryption up to 2x over the zEC12 to help protect the privacy of data throughout its life cycle

Official IBM z Systems Claims document available here
# Real Time Analytics capabilities at the WW Client Centers

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IBM z Systems Analytics support offerings by Montpellier

1. Functional & Technical Awareness
   - On demand workshops dedicated or including Analytics for z topics such as:
     - IBM z Systems value points for Analytics focus on z13 specific Analytics features
     - Data transformation & High performance Analytics capabilities
     - Real Time Analytics / In Transaction Analytics
     - High Availability & Disaster Recovery solutions with Analytics on z
     - Data Governance

2. Live demos and Hands-On access
   - Operational Analytics & Real-Time fraud detection showcase
   - Real time Analytics demo & Hands on Labs (ODM-SPSS-DB2 Scoring Adapter)

3. Design Workshops
   - FastStart Analytics assessment to:
     - Assess functional and technical requirements in existing analytics solution
     - Explore high-level architecture and technical options on z Systems
   - Design Information architecture – Data lake value points on z
   - Design architecture for Real Time Analytics solutions
   - Data governance workshop – Data security- life cycle management – data quality

4. Technical support - PoC & benchmarks
   - Functional tests & Proof points involving IBM DB2 Analytics Accelerator, SPSS Modeler, Cognos BI, InfoSphere Information Server, IBM BigInsights for Apache Hadoop, MDM, ODM on IBM z System.
   - Sizing, performance, scalability, availability tests proving Analytics on z Systems solutions versus competition
THANK YOU