Josh Krischer & Associates GmbH
Enterprise Servers, Storage and Business Continuity

White Paper

About IBM zEnterprise, SAP HANA, and business analytics

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About SAP HANA, IBM zEnterprise and business analysis

Josh Krischer is an expert IT advisor with over 43 years of experience in high-end computing, storage, disaster recovery, and data center consolidation. Currently working as an independent analyst at Josh Krischer & Associates GmbH, he was formerly a Research-Vice-President at Gartner from 1998 until 2007. During his career at Gartner he covered mainframes, enterprise servers, storage-subsystems and disaster recovery techniques. He has spoken on these topics and others at a multitude of worldwide IT events, including Gartner conferences and symposia, industry and educational conferences, and major vendor events.

Executive Summary

Ever since SAP first introduced its High-Performance Analytic Appliance (HANA) in-memory appliance at the company's annual Sapphire conference in 2011, it has sought to convince users of the technology's ability to simplify IT landscapes and process massive amounts of data in seconds. Developed as a replacement for disk-based relational database management systems, SAP considers HANA and in-memory technology the centerpiece of its IT strategy going forward, and that it will eventually power all SAP applications.

SAP HANA is not an application; it is a software integration of number of SAP components including the SAP HANA transactional relational database management system (RDBMS), SAP LT (Landscape Transformation), real time replication and SAP HANA Direct Extractor Connection (DXC). This overall package is intended to help SAP displace Oracle and own more of the enterprise stack, budget, and mind share.

HANA uses in-memory analytics, an approach that queries data stored in random-access memory (RAM) instead of hard disk or flash storage, to reduce data access latency. However, despite the significant drop in the cost of RAM, it is still much higher and more volatile than disk[1].

In July 2010 IBM announced the IBM zEnterprise System, opening new horizons for SAP customers. zEnterprise is a workload-optimized system which enables a mixed set of workloads to be deployed on best-fit technologies to meet the business needs of today's multi-tier SAP landscapes. This hybrid infrastructure provides the broadest systems architecture for SAP by combining the industry's most robust data service and high availability with IBM's POWER7 and System x blades, and enabling them to be managed end-to-end as a single, virtualized system.

"The hybrid enterprise delivers a true end-to-end infrastructure delivering highly available and secure SAP applications"

A private high speed internal connection between the zEnterprise (zEC12) and IBM blades ensures better performance and throughput with the highest levels of security for mixed SAP workloads.

The *zEnterprise Unified Resource Manager* provides a single point of control to manage the SAP multi-system landscape. System z is an ideal database platform for DB2 on z/OS, while application servers can run on AIX on POWER 7 or on Linux on Integrated Facility for Linux (IFLs) or Windows on x86 blades inside a zEnterprise *BladeCenter Extension (zBX)*. Other SAP technology components such as Web-access tier

[1] Due to increased demand for smart phones and tablets and vendor consolidations, DRAM and NAND prices are increasing. For example, the 4Gb DRAM chip spot price increased about 284% from December 2012.

applications and third-party products, which are not supported on zEC12, can be deployed on zBX blades.
SAP ERP applications are based on three-tier architecture: database server, application servers, and the presentation clients connected via the Internet or Intranet. Customers typically run high-end SAP systems and environments on System z. Initial deployments used the mainframe as a DB2 database server with AIX-based UNIX or Windows as the application server. The connection between the two platforms was via external TCP/IP. So far, this has been the most popular deployment of SAP on System z; however, the Integrated Facility for Linux (IFLs) Linux capability of a mainframe is gaining popularity as the application server. Using Linux on System z provides the fastest possible connectivity between the database and application server which can be a critically important differentiator in many situations. Also, use of Linux on z can provide lower landed costs where a small Linux capacity is required. Linux on z with zVM combines the industry's gold standard of server virtualization with the highest internal server and data communications performance and qualities of service.

zEnterprise systems open new options for SAP ERP and other applications. zEnterprise can run AIX, Linux, and Windows applications unchanged on zBX-supported operating environments. zBX supports logical device integration between z1EC12 and distributed resources. *Unified Resource Manager* unifies resources and extends System z quality-of-service across the infrastructure to install, monitor, manage, optimize, diagnose, and service. In addition to SAP, the system is an ideal platform for multi-tier Web-serving, which is typical in banking, insurance, government, and healthcare use-cases, which require scalability and flexibility. Other examples are business intelligence / data warehousing applications, which exploit the POWER7 processor's speed and DB2 for z/OS features. Applications running on zEnterprise benefit from mainframe qualities such as unmatched security, high availability, and powerful disaster recovery techniques with HyperSwap and GDPS. Entire SAP landscapes with dozens or even hundreds of SAP production and non-production systems can be consolidated on a single zEnterprise instance.

zEnterprise is the most robust, the most secure, and, at the same time, the most versatile platform with the most advanced virtualization features supporting all System z operating systems, plus Java, Linux, AIX, and now Windows. The platform is highly automated, requiring little management, which translates to lower staff costs. The July 12th,2011 announcement introduced the entry-level zEnterprise 114 (z114) models with better software and hardware pricing, suitable for raised-floor and non-raised-floor data centers. The new model and the price reduction introduce affordable options for small organizations without mainframe experience to benefit from all the advantages of the zEnterprise. The hybrid zEnterprise delivers a true end-to-end secure infrastructure for SAP applications.

On August 28, 2012, IBM announced the zEnterprise EC12 (zEC12), based on the most advanced technology and delivering 25% faster processor performance with 50% more capacity than the zEnterprise (z196). In addition to boosted performance, the EC12 series offers enhanced security, more efficient energy consumption, and the ability to analyze and predict events, thus automatically improving system health and performance.

Executive Summary Conclusions

SAP HANA Is not panacea. Not every SAP user needs analysis, and not all analysis must be done fast. The SAP HANA appliance is SAP HANA software running on certified hardware with large and expensive memory. Migration to SAP HANA requires database migration. This is a special appliance running applications which SAP modified for HANA; it is not a general purpose processor as is System z. The viable alternative for fast query analysis is the IBM DB2 Analytics Accelerator, workload-optimized appliance, which requires no rewriting of applications or new database designs. The applications use DB2 on System z, the DB2 data is replicated onto the DB2 Analytics Accelerator, which is designed for fast analysis and can be activated and deactivated with the setting or clearing of a software switch. This solution can be deployed in a few days. Queries that took hours can be completed in seconds (see case studies section) in a highly secure and available environment.

SAP ERP on System z has always been a solid enterprise platform, but zEnterprise raises the bar by offering an integrated system for heterogeneous hardware as well as software platform that addresses the major infrastructure requirements of businesses looking for security, continuity, and performance. Practically any SAP application can run on a single zEnterprise system. The various blade technologies offer flexibility in selecting options for Web applications. The Unified Resource Manager acts as a central point of control **–** a centralized governance system that can manage multiple underlying z/OS, Linux on System z, AIX on POWER, or Linux and Windows on System x installations under a single-management umbrella, thus simplifying system management at lower management costs.

The zEC12 and zBC12 announcements represent additional milestones in IBM's commitment to position the mainframe as the strategic platform, which will continue evolving to match customers' requirements. Also helping is the IBM entry cloud configuration for SAP solutions on zEnterprise, which automates routine tasks such as SAP and DB2 system refresh, clone, and copy, freeing staff to concentrate on SAP services business needs instead of spending time on managing the infrastructure.

SAP High-Performance Analytic Appliance (HANA) – pre-requisites, deployment

In the last few years SAP ERP new sales have stagnated. Maintenance income has been stable, but a corporation of this size cannot rely on maintenance as its major revenue source. An attempt to raise the service fee[2] faced strong resistance from major customers, forcing SAP to retreat. At the same time the storage vendors started to talk about "big data" and fast analysis of that big data, which was very beneficial to promote SAP's in-memory processing approach and prompt users to make new purchases.

The SAP HANA appliance consists of SAP HANA software running on certified hardware. SAP HANA is not an application; it is a software integration of several SAP components such as the SAP HANA transactional relational database management system (RDBMS), SAP LT

[2] In early 2008 SAP announced staged price rises for mainstream support, rising from 17 percent of license fees to 23 percent, which provoked the wrath of its user community. For example, Siemens one of the largest SAP customers, threatened to cancel its service contract. This year SAP raised the maintenance rate for new maintenance contracts with SAP Standard Support from 18% to 19%, effective July 15, 2013.

(Landscape Transformation), real time replication, and SAP HANA Direct Extractor Connection (DXC).
HANA uses “in-memory” analytics, an approach that queries data stored in random-access memory (RAM) instead of on ”hard disk” or “flash storage” to reduce data access latency. Deploying SAP HANA requires certified hardware, an appropriate application to support in-memory processing, large amounts of RAM, and database conversion. According to SAP, it can handle both analytic and transactional workloads, but it is questionable if it can handle large scale transactional workloads because they need to have all tables in column store.

SAP HANA software is based on the latest revision of the Business Warehouse Accelerator (BWA) appliance that SAP launched few years ago, which supports data in memory rather than on disk but in memory, allowing much faster processing by eliminating I/O operation latencies. The old saying, “the fastest I/O is no I/O”, remains true despite the lower disk latency and faster data transfers. Therefore in-memory processing is undoubtedly faster but also comes with a heavier price tag. Even if the processing is done in the memory, data changes continue to be logged to disk though therefore column store can slow down transactional workloads.

Relational Stores – SAP has further segmented the storage of In-Memory data into compartments within memory for speedier access. Data not needed immediately is stored on a physical disk as opposed to RAM. This allows quick access to the most relevant data. The in-memory columnar storage of the SAP HANA DB is a further development of the SAP TREX (Text Retrieval and Extraction) text engine and the SAP BI Accelerator (SAP BIA), which enabled fast processing of OLAP queries. The high-performance in-memory row-store is designed to address OLTP workloads.

The SAP HANA database houses four relational stores (or engines) that optimize query performance (see Fig.1).

1. The **Row Store** provides increased write performance and advantages in metadata storage and logging used in transactional type workloads. The Row Store is held fully in RAM.
2. The **Column Store** (derived from **TREX)** is also optimized for high performance of write operations and efficient data compression. It is a “key” to efficient in-memory computing in that it has the ability to significantly compress data,, and only data that is directly relevant to execution is accessed. Accessed columns are held fully in RAM.
3. The **Object Store** is an integration of SAP Live Cache Technology into the SAP HANA Database.
4. The **Disk Based Store** is used for data that does not need fast access such as "tracing data" or old data that is no longer used. The Disk Based Store is stored on a disk storage and fetched into RAM if required.

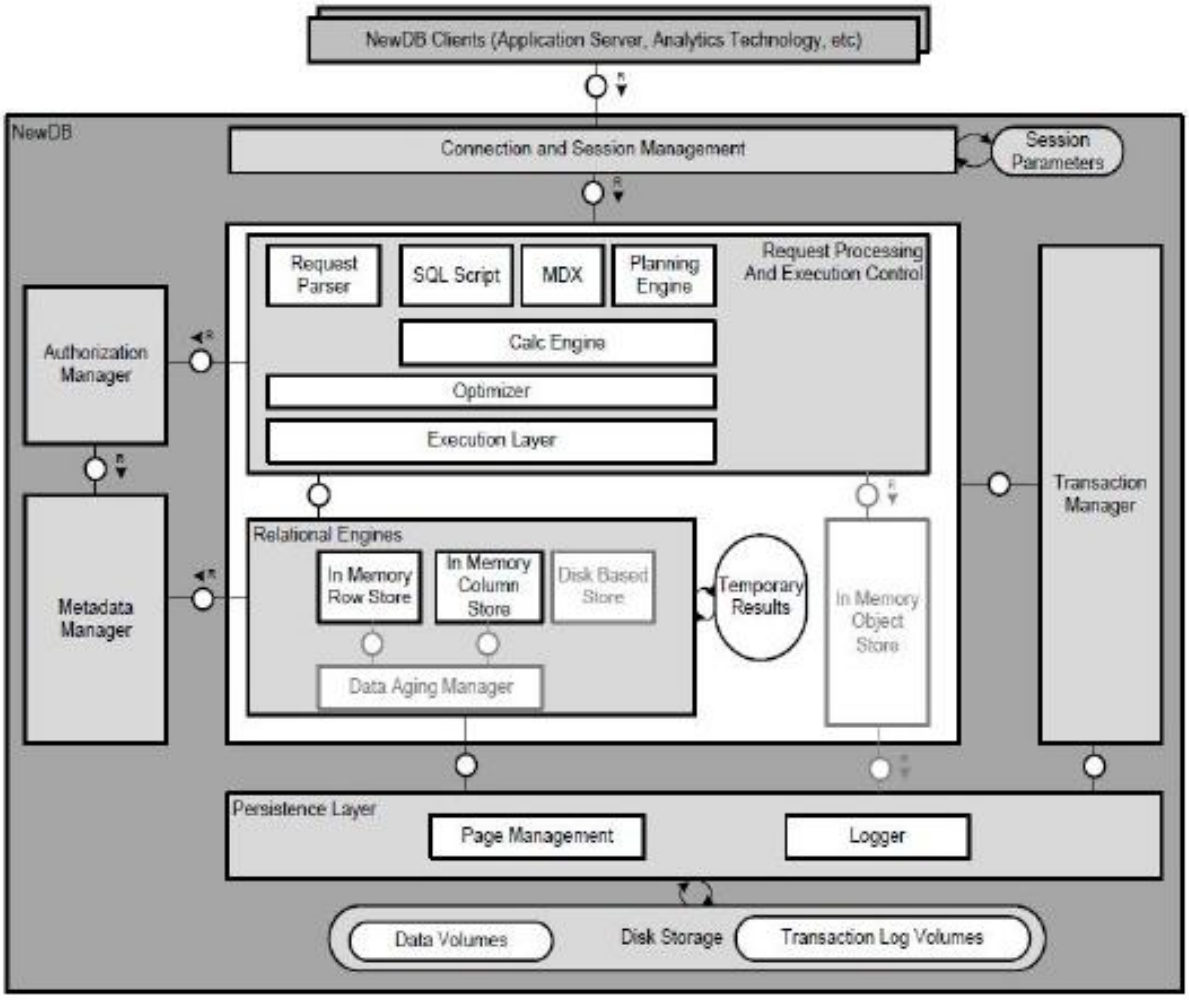

Figure1: In-Memory Computing Engine. Source SAP

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The **Disk Based Store** is used for data that does not need fast access such as "tracing data" or old data that is no longer used. The Disk Based Store is stored on a disk storage and fetched into RAM if required. The **Persistence Layer** is required because the main memory is volatile and the data is lost in shut-downs, power outages, etc. Data needs to be stored in a non-volatile way to allow backup and restore as well.

The persistence layer (see fig.1) stores row and column data by using regular “savepoints” (a fully persisted image of the DB at the time of savepoint), along with logs capturing all DB transactions since the last savepoint (redo logs and undo logs written). Like other databases, HANA logs all data changes to disk by the time a transaction commits. It allows DB restoration from the latest savepoint onwards, along with the ability to create "snapshots", and is also used for backups.

SAP HANA Database

The SAP HANA database is a hybrid in-memory database that is part of the SAP HANA Appliance and that combines row-based, column-based, and object-based database technology. It is optimized to exploit the parallel processing capabilities of modern multi-core CPU architectures. Exploiting SAP HANA requires migrating from standard databases to the SAP HANA DB. SAP promises migration help in this direction but does not support migration back when SAP HANA does not meet expectations or ROI can't be achieved in the foreseeable time. The SAP HANA DB provides main-memory centric data management to support SQL for traditional applications or more expressive interactions for SAP applications. Relational data resides (compressed) in tables in column or row layout. The data structures are optimized for cache (in-memory) instead of disk I/O. Licensing costs for existing SAP customers are equivalent to the cost of conventional databases.

The IBM zEnterprise Systems

In July 2010 IBM announced the zEnterprise series with the introduction of the z196 with ca. 40% more performance than its predecessor z10, and the zBX Model 002, which combines hybrid configurations of System z mainframes and POWER7 blades (zEnterprise BladeCenter Extension -zBX). The blades run AIX and use PowerVM as the virtualization hypervisor. PowerVM ensures high resource-utilization and the ability to meet peak demands. The connection between the z196 and the zBX is via an internal private high-speed data network – traffic on user networks is not affected. This private network does not require encryption, eliminating encryption overhead, which translates to higher performance. Both z196 and zBX support optional water cooling. The zBX can reside on non-raised-floor data centers through use of optimal overhead cabling, but must be within 25 meters of the z196. The z196 and the zBX solutions introduce tighter integration between the database and the applications that need access to System z data, but run on a distributed platform (see Figure2).

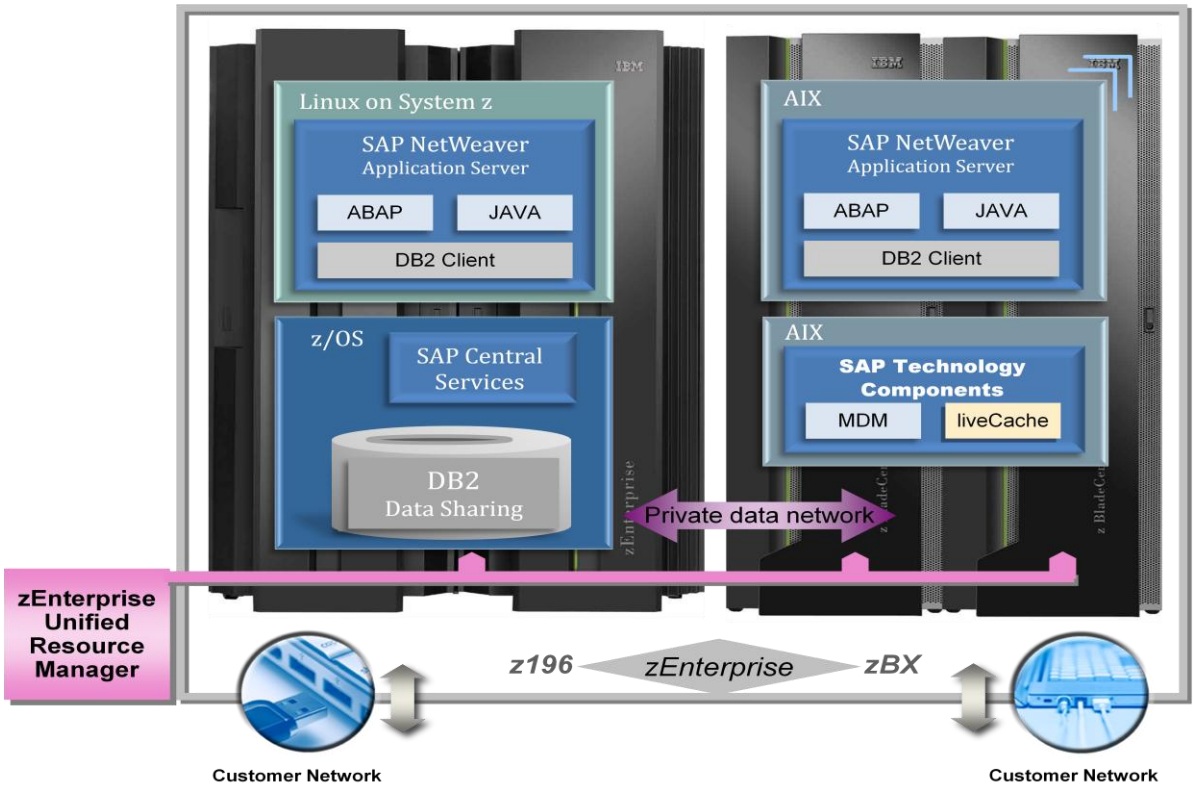

Figure 2: SAP on IBM zEnterprise System, Business Suite Reference Architecture. Source IBM.

The central point of management for heterogeneous platforms reduces the need to manage individual resources and significantly reduces manual tasks. The automated multi-tier management also provides higher levels of utilization on all managed platforms.

The key component of zEnterprise is the *Unified Resource Manager* (URM). This provides advanced management of both System z and zBX platforms, and – like System z *Workload Management* (WLM) – supports automated resource management based on user-defined goals and policies. The United Resource Manager manages the heterogeneous resources as one, dynamically assigning resources to meet user-specified service-level objectives. The central point of management for heterogeneous platforms reduces the need to manage individual resources and significantly reduces manual tasks. The automated multi-tier management also provides higher levels of utilization on all managed platforms.

On July 12, 2011 IBM announced the new entry-level z114 for midrange businesses, a new I/O subsystem for improved system connectivity, increasing the range of the z114 models to 26 - 3100 MIPS, offering a granularity that should suit any organization. In addition, IBM announced System x Blades (x86 platform) for the zBX running Linux and Windows. The Unified Resource Manager will load the blades with a KVM-based hypervisor. Up to 112 Blades are supported on a single zBX, allowing mix-and-match of POWER7 and System x blades in the same system. This creates a real hybrid multi-platform, multi-OS system. A zEnterprise node is a z196 with up to 1 zBX. Up to 8 zEnterprise nodes with up to 896 blades may be configured into a zEnterprise Ensemble. zEnterprise Unified Resource Manager can manage a zEnterprise Ensemble as a single logical virtualized system.

"The z196 and the zBX solutions introduce tighter integration between the database and the applications that need access to System z data but run on a distributed platform."

On August 28, 2012 IBM announced the zEnterprise EC12, introducing a system based on the most advanced technology, which delivers 25% faster processor performance and has 50% more capacity than the zEnterprise (z196). The 60 sub-capacity settings allow finer tuning of capacity to each individual demand.

The more than $1 billion investment in R&D of this series resulted in many enhancements, the most significant of which are:

- The **Crypto Express4S**, a tamper-resistant cryptographic co-processor, which ensures security for transactions and sensitive data. The machine achieved Common Criteria Evaluation Assurance Level 5+ security classification, which is the highest security level granted for commercial server.
- **Flash Express,** internal solid state technology as an additional memory tier (up to a maximum capacity of 6.4 TB), which improves the performance of data-intensive applications. It is designed to "smooth" the performance requirement peaks during bursts of system activity experienced at high demand transitional periods such as when financial markets open or on holiday periods when online retail transactions are heavy (e.g. "Black Friday").
- **IBM zAware** offers system-internal analytics capabilities to analyze system messages and provide a near real-time view of the system's health, including any potential problems. The technology learns from the messages to recognize patterns and quickly pinpoint any deviations, using the information to identify unusual system behavior and minimize its impact. zAware is probably the most interesting of the new developments.

It is an out-of-band mainframe monitor that runs as firmware in a separate logical partition (LPAR) and can execute either on a general processor or an Integrated Facility for Linux (IFL) engine.

- **An option to order zEC12 without a raised data centre floor** — a first for high-end IBM mainframes. Two cooling options: external water cooling or closed-loop system that circulates water through an air-cooled radiator are also available. The new overhead power, optional cooling and cabling support allows more flexibility in data center infrastructure.

On 23rd July 2013 IBM announced the IBM zEnterprise BC12 (zBC12) with 36% performance boost per core, 62% more total system capacity and x2 increase in the size of RAIM memory. Announced were also better granularity (choice of 156 capacity settings) and 27% improvement in price/performance for Specialty Engines.

System z as DB2 database server

DB2 on the mainframe provides large database scalability, performance, I/O sharing, very high availability, and advanced disaster recovery techniques. An SAP ERP can span multiple servers in a Parallel Sysplex cluster with real parallel read/write data-sharing capabilities. Mainframe internal hardware compression on all paths may save up to 70% of disk space and dramatically reduce data transfer times. For two decades DB2 has used quasi “in-memory” techniques; newly inserted rows are loaded into DB2 bufferpools in main memory. When reading data, often 96% of buffer pool hit ratios are achieved.

Users using DS8870 storage system can utilize the specialized cache algorithm which optimize DB2 list prefetch operations by multiple, parallel data fetches. Using simple FICON, the storage system would read a single page per protocol exchange. zHPF reduces the Host-to-Storage System I/O protocol to a single protocol exchange for the full I/O CCW chain. DB2 List Prefetch Optimizer with zHPF, enables the storage system to read all 32 DB2 pages in parallel, transferring all 32 pages back to the host in a single exchange. At any point in time, DB2 has two List Prefetch I/Os outstanding; therefore the DS8870 is always reading 64 DB2 pages in parallel.

In addition, part of DB2 execution can be offloaded to special zIIP engines, which are priced significantly lower than z/OS processors[3].The major reasons to select System z as a database server for SAP applications are:

- High availability and manageability of large databases without the need for database splitting, which may result in losing a single view of the enterprise data.
- Automated Service Levels (SLAs) management by the Workload Manager (WLM) in System z or Unified Resource Manager for zEnterprise models. The ability to use hardware compression without any additional charge, saving up to 70% of disk space and reducing data transfer times dramatically.

[3]The System z offload engines: System z Integrated Information Processor (zIIP) is used to offload DB2; System z Application Assist Processor (zAAP) supports Java code execution; Integrated Facility for Linux (IFL) runs Linux on the mainframe; Internal Coupling Facility (ICF) provides support for Parallel Sysplex clustering.
All of these offload engines are priced significantly lower than the usual z/OS engines. The computing power (MSUs) of these engines is excluded from software charges. Users who skilfully employ these engines can off-load their z/OS MIPS, stem z/OS growth requirements, and thus, lower TCO.

- Online database reorganization and DB2 release upgrades.
- Effective data sharing between systems in a Parallel Sysplex cluster.
- The ability of a single mainframe to handle multiple SAP database servers and databases.
- Synergy between SAP and DB2 on System z. - IBM has implemented more than 100 feature requests over different DB2 for z/OS versions.

System z Analytic capabilities

Several techniques can accelerate DB2 access and provide fast analysis:
The IBM DB2 Analytic Accelerator (IDAA) for z/OS, based on technologies acquired from Netezza, to deliver mixed workload performance for complex analytic requirements.
IBM Cognos BI for Linux on System z and s/OS, that delivers a broad range of Business Intelligence (BI) capabilities and presentations such as analysis, reporting, dashboards, real time monitoring.
IBM SPSS Modeler for z Linux, that increases the speed and accuracy of results in real-time by imbedding the scoring algorithm in DB2 for z/OS and running it directly within the transaction application.

IBM DB2 Analytics Accelerator (IDAA)

Following the announcement of the zEnterprise EC12, IBM announced new analytics offerings to enhance its platform for operational analytics under the name IBM DB2 Analytics Accelerator (IDAA). This hybrid solution, ideal for zEnterprise models, combines the best of two worlds, leading System z transactional capabilities with massive parallel processing and the computing power of POWER 7+ technology, and Netezza analytics. The zEnterprise hybrid structure facilitates both transaction-oriented applications and analytics into a single platform for operational business analytics. A transactional inquiry (OLTP) is executed in System z, which also keeps the metadata, while analysis types of inquiry are routed (via internal connections) to Netezza appliance. The blades create an Asymmetric Massively Parallel Processing (AMPP) engine, which uses special-purpose hardware accelerators to decompress and filter data for relevance to the query before it is loaded into memory and given to the processor for aggregation. It results in elimination of the I/O wait time and processing overhead and removes the need for tuning. This setup accelerates select queries, with unprecedented response times. Complex queries run up to x2000 faster while retaining single record lookup speed.

The solution is fully integrated in DB2 and provides transparency to all applications and tools such as IBM Cognos, which are entirely unaware of the accelerator. All the data is still maintained in DB2; all of the queries that target that data are directed to the DB2 Analytics Accelerator (see figure 3). Users and applications like SAP see only an IBM DB2 for z/OS interface; they can use their existing skills and applications without requiring the type of conversion or retraining normally associated with deploying SAP HANA. All database administration tasks continue to be accomplished in DB2.
In addition to fast analysis, the system reduces cost by offloading z/OS MIPS when transferring data to the IDAA.

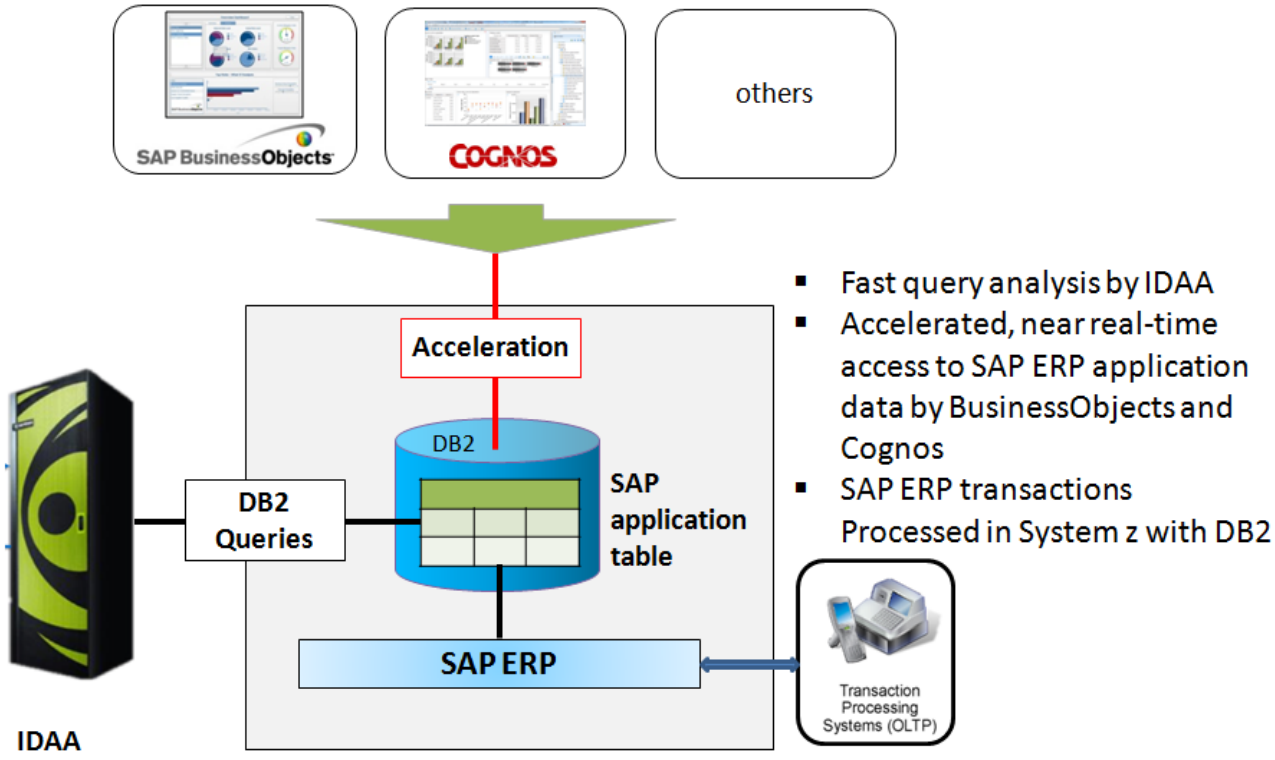

Figure 3: OLTP for SAP ERP Transactional Data, BI and query processing enabled by Cognos & IDAA

Data that is maintained on the IDAA inherits all DB2 for z/OS data attributes, including security and recoverability. To protect against intrusions all data is loaded, backed up and retrieved through DB2 with no external connections to the IDAA. The IDAA protects against data corruption by mirroring all user and temporary data, bad sectors are refreshed or relocated, and failed drives are automatically recreated. As a result, disk failures have no impact on continuous operation.

No database migration or changes to applications are required. Users simply install, load the data, and run. Such infrastructure can be production-ready in two or three days, set up by a single person. Once the data is loaded, reductions in query-response times from minutes and hours down to seconds are typical and not exceptional. A by- product of offloading the query to the accelerator is that CPU MIPS that were once consumed on System z are now available to do other applications or reduce System z hardware and software costs.

IBM Cognos BI for Linux on System z and z/OS

Cognos Business Intelligence on z/OS uses the same platform as transactional data. Therefore it can reduce the time it takes to deliver and access critical business information. It provides business analytics solutions and predictive analytics that enable fast taking smart, proactive business decisions.

Cognos is built on a standardized base, and is standardized across all the platforms. However, System z is a premier platform for BI tools and for core analytics technology. The common code base allows the same capabilities, such as integrated real time monitoring, integrated mobile, integrated dashboard, report and score carding, etc., across all platforms, providing a rich portfolio of tools to convert data to user friendly information.

Reporting with Cognos Business Intelligence on z/OS addresses any organizational reporting needs from simple inventory lists to high volume billings to ad hoc business reporting. The reports are tailored for different user types to ensure it delivers the right information to the right users at the right time.
Cognos BI on z/OS provides multi-lingual support from a single metadata layer.

SPSS Analytical Decision Management for Linux on System z

SPSS Analytical Decision Management for Linux on System z combines the power of predictive analytics with the performance, scalability, and availability of the System z platform. It enables organizations to optimize high-volume transactional decisions before deployment, so that they can consistently maximize outcomes. The best possible data-driven decisions are achieved by using a combination of predictive models, business rules, optimization and scoring. With SPSS Analytical Decision Management for Linux on System z, an organization can optimize transactional decisions, deliver recommended actions at the point of impact, perform data mining and text analysis, (based on predictive models, local rules, decision logic, scoring, and optimization) and make real-time, adaptive decisions.

Case Study I: IBM DB2 Analytics Accelerator at Nova Ljubljanska banka (NLB)

About the bank:
43 % market share in Slovenia,
6,735 employees,
46 companies in 14 countries,
NLB Group: 47 companies in 13 countries (banks, leasing, insurance, etc.),
Total Assets: ~EUR 13,000 million,
3,713 employees.

NLB infrastructure

System z196, 5CP, 2zIIP, 128 GB RAM,
z/OS V1.12,
DB2 10 for z/OS,
IBM DB2 Analytics Accelerator for z/OS,
IBM IDAA 1000-3: (3 S-blades, 24cpu, 8TB uncompressed),
4 LPARs: Production, UAT, Test, Development,
8 DB2 subsystems – 2 per LPAR.

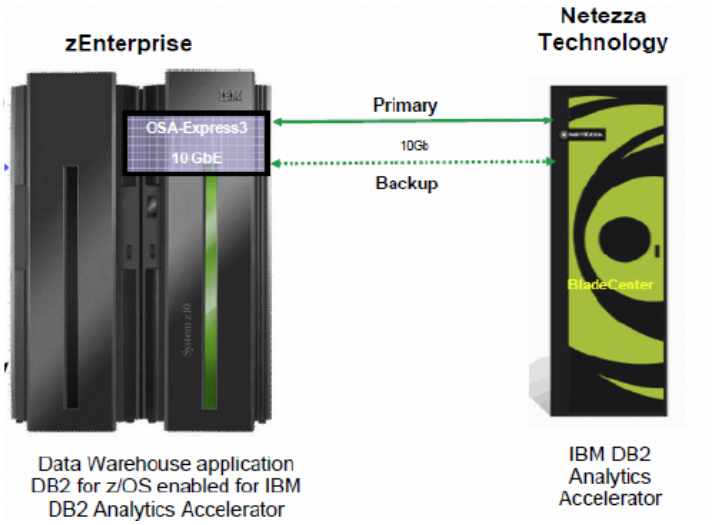

Figure 4: NLB infrastructure (source NLB)

Design Principles

- DB2 continues to own data (both OLTP and Data Warehouse):
  - Access to data (authorization, privileges, …),
  - Data consistency and integrity (backup, recovery, …),
  - Enables extending System z QoS characteristics to BI/DW data.
- Applications access data (both OLTP and DW) only through DB2:
  - DB2 controls whether to execute query in DB2 mainline or route to DB2 Analytics Accelerator for z/OS,
  - DB2 returns results directly to the calling application,
  - Existing applications do not have to change,
  - Enables mixed workloads and selection of optimal access path (within DB2 or Analytics Accelerator) depending on access pattern.
- DB2 Analytics Accelerator for z/OS as a virtual DB2 component:
  - DB2 provides key Analytics Accelerator status and performance indicators as well as typical administration tasks by standard DB2 interfaces and means,
  - No direct access (log-on) to IBM DB2 Analytics Accelerator for z/OS,
  - Enables operational cost reduction through skills, tools, and process consolidation.

IBM DB2 Analytics Accelerator for z/OS Benefits in NLB

- Fastest SQL query processing, even twice as fast as native Netezza
- Less time for tuning of SQL statements
- No DB2 maintenance (define tables/refresh data)
- Faster agile development
- Coexistence of OLTP and DWH databases on same LPAR
- CPU MIPS and cost saving because of offloading/redirecting execution to IBM DB2 Analytics Accelerator for z/OS.

Case Study II: IBM DB2 Analytics Accelerator in Banco do Brasil

About the bank:
US$500 Billion Assets,
55 M Clients,

18,655 Service Points,
5,266 Branches,
58,580 ATMs,
113,404 Employees.

CICS transactions:
25 Billion Monthly Average,
1.3 Billion Day Peak.,
DB2 Mainframe Objects
579,777 Packages,
248,212 Alias,
68,517 Indexes,
48,543 Tables,
45,787 Tablespaces,
3,180 Databases.

Bank's problems and Challenges in Reporting Process

- Increasing report complexity
- Fast business growth
- Increasing delays in reports' delivery
- High cost of report generation
- Impact on bank business and affectivity

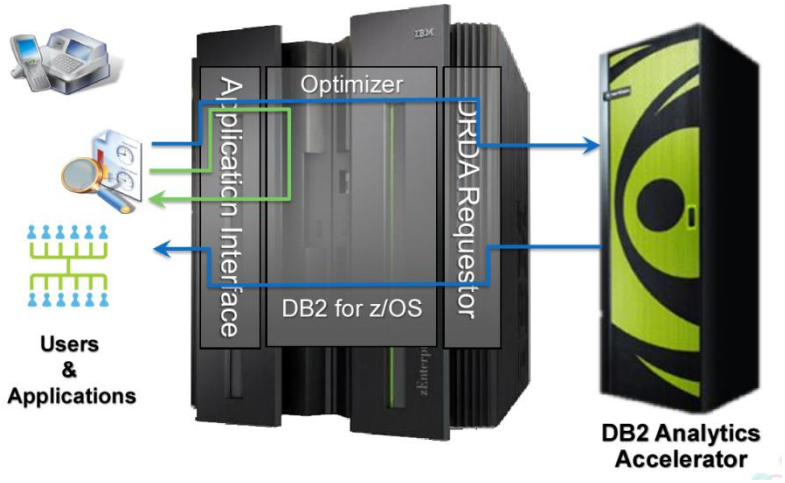

Figure 5: Bank do Brasil Infrastructure (source Bank do Brasil)

Some results:

1. Dramatically improved SQL response time; in average from 428.1 seconds in DB2 to 13.9 with accelerator
2. The most significant gain; from 11 hrs to 26 seconds!
3. Main daily report generation down to 00:02:45 from 11:32:46.

Bank do Brasil benefits:
Cost reductions

- Offloading System z by routing the queries to the accelerator
- Simpler infrastructure, fewr operation costs

Productivity

- Less tuning required
- Simpler storage administration
- No indexes
- No migration required

Improved SLAs

- Much faster response time
- Future scalability
- Mainframe security and availability

Case Study III: Cognos Business Intelligence in Miami-Dade County

About the Miami-Dade County

Miami-Dade is one of the largest counties in Florida, with a population of three million citizens. It encompasses the city of Miami, one of the state's major tourist destinations, which welcomes more than 38 million visitors each year.

Hardware:

2 x System z10 Business Class (z10 BC) with Integrated Facility for Linux (IFL)

Software:

z/VM, Cognos Business Intelligence, WebSphere Application Server, z/OS

Operating system:

Novell SUSE Linux

Project targets:

Ability to deliver reliable, highly available IT was the main criteria for continuing with System z platform. Some of the users such as the police, fire department, hospitals need 24/7 service. To improve the service the county wanted to deploy analytics on a much greater scale, not only providing its own employees with seamless access to reporting and analysis tools to help them make better decisions, but also extending access to the county's three million citizens via its website.

Solution:

The county deployed IBM Cognos Business Intelligence in a Linux environment on its existing IBM System z mainframe platform, along with query Analytics IDAA and Predictive Analytic SPSS (see Figure 6). Employees and citizens can access reports using a standard web browser.

Some results:

1. Much faster reporting
2. HR warehouse analysis which that enables the County's better succession planning, budgeting and hiring
3. The "Financial Transparency" which opens the County's checking account register to the public
4. "PowerITDown" which reports statistics on energy conservation in public buildings
5. Significantly improved availability and disaster recovery capabilities

Miami-Dade County benefits:

Cost reductions

- Consolidating on System z in comparison to multiple platforms – estimated savings of $25 million over five years years through consolidation
- Simpler infrastructure, less operation costs
- More effective manpower management

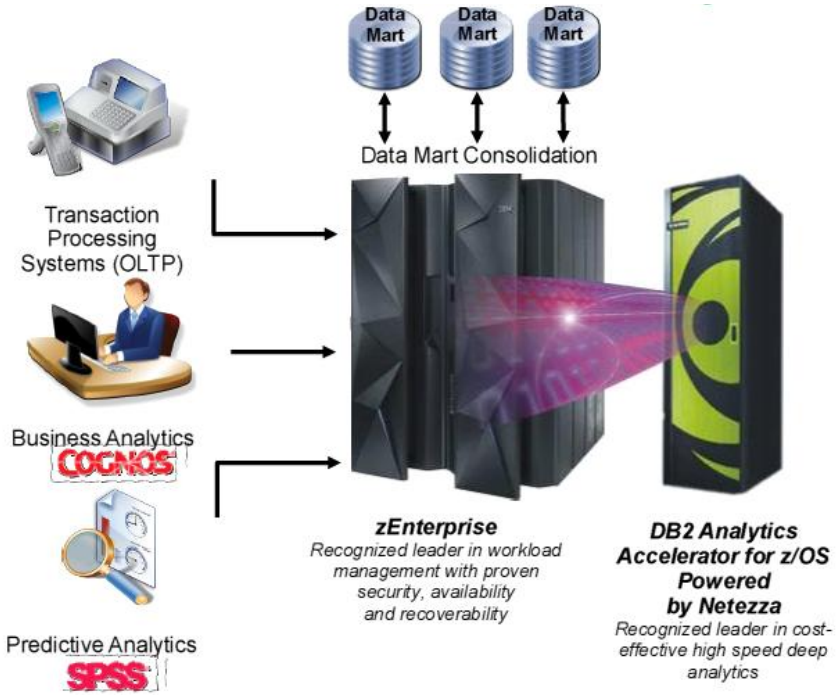

Figure 6: Miami Dade County Analysis Infrastructure

Productivity

- Fast creation of new virtual Linux servers under VM
- Simpler administration

Improved SLAs

- Much faster response time, on-line reporting
- Faster crime analysis
- more transparency about public spending, giving people more insight into where their tax money is going
- Mainframe security and availability

Business continuity of SAP on System z

One of the strongest arguments in favor of deploying SAP ERP on System z is the high standard of hardware and software availability and advanced disaster recovery capabilities of this platform. High-availability systems are designed to have no single-points-of-failure (SPOF) and no single-points-of-repair (SPOR) through the use of redundant components and architectures. Non-disruptive upgrades and micro-code updates also play a crucial role in achieving high availability.

System z supports Parallel Sysplex as a local or remote cluster. Up to 32 local or remote mainframes can participate in a single cluster. System z Parallel Sysplex also works in conjunction with IBM's disaster recovery software called Geographically Dispersed Parallel Sysplex (GDPS). GDPS enables automated complete site fail-over with no or minimum loss of

data. IBM's GDPS for System z is a multi-site application availability solution, with fast recovery time and highly-automated control. It manages application availability in and across sites for both planned maintenance and unplanned situations, such as a site failure or full-blown disaster.

Another availability function is *HyperSwap*. This is probably the most important business-continuity and availability improvement for IBM mainframes. While disasters rarely occur in reality, disk subsystem failures are far more likely. In current integrated and complex application environments – assuming a highly-available data-sharing Parallel Sysplex environment – disk becomes a single point of failure for the entire Sysplex. The HyperSwap function, which is used by multiple GDPS solutions, is controlled by GDPS automation. It can eliminate an outage caused by planned maintenance or disk failure by reducing the time needed to switch disks between sites to a matter of seconds and allowing the primary site to use the secondary site's disk storage subsystems.

"Another availability function is the HyperSwap *function. This function is probably the most important business-continuity and availability improvement for IBM mainframes."*

Basic HyperSwap between two remote or locally-installed storage subsystems in order to provide automated fail-over for planned or un-planned outages can be deployed with z/OS alone, without requiring multi-site GDPS. As with GDPS, no other platform other than System z and System p has an equivalent functionality.

System z Security

System z has provided robust hardware and software solutions to answer cryptographic security needs for almost two decades. For more than a decade, IBM mainframes have been certified at the highest security level. The follow-on generations of cryptographic-coprocessor features have received similar certification for secure-key processing.
On March 2003 IBM's eServer zSeries 900 (z900) was the first server to be awarded EAL5 security certification (the highest commercial level at that time). The subsequent mainframe generations were awarded the same level. The z196 and the EC12 have received EAL+5 security certification.

Total Cost of Ownership

Considering TCO in the lifetime of the product is usually the weakest point in IT procurements. Most users compare the hardware and software purchase price only, some consider maintenance and energy costs as well, but almost nobody takes into consideration the financial damage that can be incurred as a result of planned or un-planned downtimes, for example. What, then, are the factors which in reality reflect the true TCO value?
Purchasing price or leasing rates (determined by interest and residual value) for hardware and software,
Estimated upgrade costs over the lifetime of the equipment,
Hardware and software maintenance,
Energy costs (power and cooling),
Floor space,
Personnel costs,
Professional services,
Financial damages caused by downtime.

Mainframe procurement costs are usually higher, but a detailed TCO calculation can prove that the TCO over the whole life-cycle of a mainframe system is lower than that of other platforms. In other words, mainframes are not cheap, but they represent the best value for money in current IT.
IBM has responded to competitive workload pricing for SAP on the System z platform with the introduction of solution edition pricing for new workloads. The IBM System z Solution Edition for SAP allows existing and new customers to cost-effectively deploy new SAP workloads on the platform where prior pricing metrics made the economics cost-prohibitive for customers who desired the platform's advanced capabilities. When combined with specialty engine pricing for Linux and Java, three-tier SAP applications that need the scalability of System z, especially for multi-landscape deployments on SAP, can be competitively priced[4]. The IFL and the zIIP engines cost a fraction of z/OS engines. z/VM pricing is value-based and dependent on the number of engines. Additional cost reduction can be achieved by IBM's DB2 Analytics Accelerator (IDAA), which saves z/OS MIPS by offloading analytic inquiries to POWER blades, as demonstrated in the two case studies.

Major TCO savings can be achieved through the reduction of processors and manpower. For example, Oracle software charges are based on the number of processors, and one mainframe engine can replace several RISC or x86 processors. The several users I have interviewed all emphasized the reduction in manpower requirements after consolidation from UNIX or Windows to the mainframe. Additional savings can be achieved as the result of lower energy and floor space requirements. With skillful negotiations, SAP ERP on System z may cost 20%-25% more than comparable deployments on UNIX; however, because of the large potential savings, the return on investment (ROI) can be reached in a relatively short time.

IBM continues to improve the hardware and software costs of its mainframes with every announcement, making mainframe pricing more attractive.
With the announcement of the EC12 models, there was no price raise, which means users benefit from a ca. 20% $/MIPS price/performance improvement for standard and special engines due to the performance boost in compared to the previous model z196.

Additional savings can be achieved by lower maintenance costs for hardware and software and better channel granularity in comparison to the System z10. The largest reductions are on the entry level, making the z114 even more attractive for SMEs and new users. The internal network between the system z and the zBX yields additional savings by eliminating external network components.

Conclusions

We can think about SAP marketing efforts of SAP HANA in terms of user needs. In reality not every SAP user need analysis and not every user who needs analysis need it fast. The requirements for facial recognition analysis for airport security vastly different than those for customer purchasing patterns in supermarkets. A survey done among more than a thousand IT and business professional shows that only 20percent (SMBs) and 23 percent (large

[4] Solution Edition is a bundled offering of hardware, software and maintenance, all at a single, affordable bottom line price. Each Solution Edition is tailored to meet key business needs at the lowest cost.

organization) need fast analysis. [5]Jim Hagemann Snabe, co-CEO at SAP, announced the general availability of HANA on its Business Suite ERP software at Sapphire 2013. However, not every ERP System needs fast analysis, but each of them uses OLTP. Therefore investment in large memory may emerge as waste. In addition, migrating existing SAP ERP systems to HANA, which is relative new, could pose operational and business risks. Using SAP on System z with IDAA means that the SAP OLTP transactions continue to rely on DB2 and only the analytics workloads queries are routed to IDAA. Users that need Business Intelligence (BI) analytics may use Cognos (or BusinessObjects) directly on SAP ERP transactional data (see Figure 3).
Despite the SAP focus on HANA, SAP stated in Open Choice and Full Support to Customers *"SAP remains committed to support its customers' choice of database technologies and vendors. SAP will continue to provide innovation for all databases supported and work with its database partners to support these innovations, which may include in-memory optimizations."*[6]

Despite its steadily growing base, as of October 2013 only about 2100 organizations were using HANA according to SAP. Most probably, the majority of the organizations using SAP HANA are using it in parallel to existing SAP infrastructure, which increases the TCO. The HANA DB has remarkable compression capabilities (According to SAP from x2 to more than x10)[7] but is still new and not totally proven in comparison to DB2. SAP offers professional services help in database migration to HANA DB, but we have not heard about help in migrating the other direction, which may create a "lock-in" situation. SAP HANA Service Pack 5, SAP customers can use a HANA appliance as both a database and an application server, which may save servers but still each SAP requires x86 server. However the SAP HANA appliance and external storage require SAP certification, which limits the user in hardware selection and may increase the cost because of economies of scale procurements. The price of memory DRAMs was attractive in 2012 but significantly increased in 1Q13, which impact the costs.

"As alternative the users may use the proven SAP on System z solution with the analytic capabilities of IBM DB2 Analytic Accelerator and Cognos Business Intelligence on z/OS."

As an alternative the users may use the proven SAP on System z solution with the analytic capabilities of IBM DB2 Analytic Accelerator and Cognos Business Intelligence on z/OS.
SAP ERP on System z has always been a solid enterprise platform, and the zEnterprise platform now adds even more reasons to consider this option. zEnterprise raises the bar by offering an integrated system for heterogeneous hardware, as well as software platforms that address the major infrastructure requirements of businesses looking for security, business

[5] Source: *Big Data @ Work survey,* a collaborative research survey conducted by the IBM Institute for Business Value and the Saïd Business School at the University of Oxford. © IBM 2012

[6] SAP Corporate Newsroom on January 10th, 2013. http://www.sap.com/corporate-en/news.epx?articleID=20221

[7] Field experience shows modest compression ratios. For example factor 2 to 3 for SAP BW. It is possible to achieve a compression ratio of factor 4 to 6 first but then needs to provide enough room for the delta object, so that effectively every data is kept twice. This is reflected in SAP's sizing guidelines for HANA .

continuity, and performance. Practically any SAP application can run on a single zEnterprise system. The various blade technologies offer flexibility in selecting options for Web applications. The *Unified Resource Manager* acts as a central point of control – a centralized governance system that can manage an underlying z/OS, Linux on System z, AIX on POWER, or Linux and Windows on System x under a single-management umbrella, thus simplifying system management at lower management costs. The dedicated private network eliminates the need for external, security-vulnerable connections, reduces the number of hops, reduces latency, and eliminates the need for inter-platform encryption.

GDPS and HyperSwap provide a unique solution to reach the highest level of business continuity and availability. New pricing options and skillful negotiations can price these solutions at an acceptable level without compromising on business requirements. A holistic security design protects the system from external and internal threats.

The 2012 and 2013 announcements and price reductions open new options for existing users, as well as making SAP on zEnterprise very attractive to current non-mainframe users.
All these benefits position the zEnterprise as an ideal platform to enable SAP infrastructure consolidation for organizations of any size looking to consolidate their SAP instances on the most suitable platform.

IBM's Global Technology Services provide migrations and deployment services, while IBM Finance can finance the deployments, the software, and the hardware (including third-party components).

ThezEC12 and zBC12 series significantly improves the proposition by delivering more performance at a comparable price. The IBM entry cloud configuration for SAP solutions on zEnterprise SAP creates an integrated end-to-end solution for managing complex SAP landscapes. The IBM DB2 Analytics Accelerator is an optimized solution for both high-speed analytics and a mixed workload of business analytics and operational transactions, which, in addition to huge performance benefits, simplifies operation, reduces costs, and allows achieving better business value.