IBM z/OS Version 2.2 Accelerates
IBM z Systems for the Digital Enterprise

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Management Summary

Let's say, for the sake of illustration, that you commute by auto 20 miles (a bit over 32 kilometers) each way to your workplace each day, and that about three-fourths of the trip is on a very busy multilane highway; the remainder of the trip is on local downtown streets. One can easily infer that it does not make a whole lot of difference in your commute time whether you are driving a seven-year-old *Honda Civic* or a new *Corvette Stingray* (except, of course, for the many admiring glances of the latter). If you want to reduce your commute time, move closer to your office or move your office (your work) to your home. **Speed, the potential to go faster, matters but it is not the only thing that matters.**

And so it is in the field of information technology. Servers, storage devices, and networks continue to improve their efficiency and speed, but adopting the latest and greatest does not always yield faster results. Consider this case in point: an enterprise mainframe is the system of record, the home and the hub of 70% of your enterprise's data, and the host of your mission-critical transaction processing systems. *Does is seem logical to take a significant amount of your mainframe's resources to repeatedly extract, transform, and load (ETL) data from your system of record to another platform in order to perform the business analytics that are now so essential to the operations of your enterprise? How much latency should you tolerate between the need for a piece of information, the query, and the response from the distributed system?* **Consider this alternative: instead of moving the data to the analytics platform, move the analytics to where the data resides. More generally speaking, if you desire to improve the responsiveness (and accuracy and security) of your systems, move the analytics closer to the data residing in your mainframe.**

That is one of the key themes that have been aggressively pursued in the last few *IBM z Systems* announcements, most recently the *IBM z13*[1], and its supporting operating systems, most notably the most current versions of *IBM z/OS*. By numerous IBM enhancements to its mainframe platforms, the enterprise *systems of record* (on your mainframe) over the last several years also has undergone a critical transformation into the hub for satisfying your requirements for *systems of engagement* and *systems of insight* as well. The premise of this paper is that this construct is essential to meeting the many challenges of the infrastructures required to securely support the emergence of cloud, analytic, mobile, and social computing technologies that define the digital enterprise.

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[1] For more detail on the on the announcement of the IBM z Systems z13, see **The Clipper Group Navigator** entitled *The IBM z Systems and the New IBM z13 — Ready to Transform Your Enterprise* dated May 21, 2015, and available at http://www.clipper.com/research/TCG2015001.pdf. Reading that paper in concert with this one will allow you to more adequately understand how the z13 and z/OS complement each other.

What part does *z/OS Version 2 Release 2 (V2.2)*, generally available today, play in this? The first goal of the new release is to support more fully all of the technological advances introduced in the z13, in a number of cases exclusively, i.e., there are z/OS V2.2 features that will not be available on earlier mainframe models as z/OS V2.2 requires z10 or later. The second goal, but no less important, is to provide more value to the enterprise through improved functionality, usability, and security. Simplification and autonomic tooling is evident throughout the new release, which will be described in more detail in this paper. If this is of interest to you or you want to better understand how IBM z Systems can support your enterprise goals to tackle the challenges of any or all of the IBM specified cloud, analytics, mobile and social (CAMS) requirements, please read on.

Foundations of z/OS Version 2

z/OS Version 1 has been around for almost 13 years, evolving eventually to Release 13. IBM does not take lightly the decision to introduce a new version but several factors weighed heavily into introducing the new version, V2.1 in July 2013[2].

- **Very significant technology innovation and content** – over five-hundred new line items were included.
- **A new architectural level set was established** – zEnterprise z9 EC or z9 BC or later.
- **Changes in support or terms and conditions** –support of each new release would be extended from three years to five and the release cycle would two years instead of one.

z/OS Version 2.2 is available today and it includes significant technology innovation and content – including full support of the z13 and many features that will not be rolled back to V2.1.[3] **Also, a new architectural level set has been established – only *zEnterprise z10 EC or z10 BC* or later are supported. No pricing changes have been made – V2.1 and V2.2 are essentially price-equivalent.**

Another change being made, again demon-

strating the pervasive level of integration in the z Systems ecosystem, is the inclusion of the *z/OS Management Facility (z/OSMF)* as a part to the base z/OS V2.2 distribution. Prior to this, it was a separately ordered program, although at no charge. (More about z/OSMF later.)

z/OS V2.2 and IBM z13 Synergies

At its core, the focus of z/OS V2.2 is to support the ultimate scalability, performance, security, resiliency, and the industry standard for qualities of service of the IBM z Systems z13 to meet the current and future challenges of the digital enterprise. This is important.

IBM z Systems are the most efficient and trusted cloud system platform that transforms the IT economic scenario − the z13 server can be scaled up to 141 cores, 10 TB of main memory and 85 LPARs. Combined with *Simultaneous Multithreading (SMT)*, the most mature and robust virtualization capabilities, and unmatched system management and monitoring tools, the meeting of user demands is greatly facilitated.

Arguably, IBM z Systems and its predecessors are the world's premier transaction processing and data management systems. Driven by the explosion of intelligent end-points in the hands of a very heterogeneous (and largely undisciplined) mobile population, there are many new challenges to economic scale, resiliency, and security. The "system" must always be "on", deliver instantaneous response, and provide the most current information. In response, with z13 and z/OS V2.2 the number of active LPARs has been significantly expanded, cryptographic functions and performance have been enhanced, and there are several improvements to Communications Server, which is part of z/OS.

Real-time insights are realized through improved integration of transaction and analytics systems. Improvements to data compression, *Single Instruction Multiple Data (SIMD)* accelerated math functions, and compiler enhancements are key enablers.

Let's explore these z/OS V2.2 and z13 synergies in more depth.

Transactions and Data for the Mobile Generation

According to latest reports, more than 10 billion mobile devices are expected to be in the hands of consumers, doctors, sales leaders and the like by the end of the decade. This is what hackers would describe, using the words of a very famous naval aviator, as "a target-rich

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[2] For more detail on the announcement of z/OS V2.1, see **The Clipper Group Navigator** entitled *IBM z/OS Version 2 — Ready to Go* dated July 23, 2013, and available at http://www.clipper.com/research/TCG2013014.pdf.

[3] The z13 is supported by z/OS V1.12, V1.13, V2.1, and V2.2. However the exploitation of the z13's hardware capabilities differs by z/OS release level. z/OS V1.12 has not been generally available since September 30, 2014, but with an IBM Software Support Services service extension, z/OS v1.12 will run on a z13 that has appropriate update service applied.

environment." A more recent phenomenon is the emergence of payment systems enabled at these end-points. Enterprise transaction systems must be up to this challenge. There is no doubt that the growth in demand for mobile computing presents new and significant security risks to the enterprise to the point of seriously inhibiting its growth or even threatening its adoption. All enterprises will need to redefine their security standards and protocols to mitigate these risks. Security, being one of the primary pillars of the z Systems architecture, is one place where IBM continues to innovate and drive the hardware and software technology to meet the challenges of the global mobile world.

Faster processing speeds usually can be translated into improved economics, i.e., lower absolute costs or costs per transaction or the ability to do more business in a given amount of time. This is exemplified in the latest versions of the *Central Processor (CP) Assist for Cryptographic Function (CPACF)*, available on general purpose and *Integrated Facility for Linux (IFL)* z13 core types, as in prior generations of z Systems. The processing algorithms are two times faster than those of the *zEC12*[4]. To facilitate the use of *OpenSSH*[5], the support has been pre-integrated into z/OS. This will provide mainframe security support for *Kerberos* and *FIPS 140-2*[6] compliance.

Cryptographic functions also are provided, as in prior generations, at the network interface. The z13 includes a PCIe-based crypto coprocessor, the *IBM Crypto Express5S (CEX5S)* that complements the CPACF. New z/OS *Integrated Cryptographic Facility (ICSF)* functions are provided to help you preserve the encrypted format of cardholder data and help reduce the need for conversion routines. Performance is improved and there is new support for features (such as *VISA Format Preserving Encryption (VFPE)*[7] for payment processing and emerging protocols) and

standards (such as *EMVCo*[8]) are provided. The *Secure Socket Layer (SSL)* is the networking protocol mechanism used to provide privacy and reliability for communication between two end-point devices (client and server). *Handshaking* is essentially the mutual acknowledgement and exchange of certification. This is managed through the CEX5S crypto card, now capable of up to 5000 SSL handshakes per second when configured as a coprocessor, and of over 20,000 SSL handshakes per second when configured as an accelerator. Now, adding to flexibility in configurability, any CEX5S crypto cards may be shared by up to 85 LPARs, more than five times greater than with the zEC12.

More *System Management Facility (SMF)* data types now are available to simplify accounting and to improve security. It is now possible for the "system" to sign, that is to apply its signature, to sets of SMF records, thus providing a tamper detection capability crucial to many organizations for auditability. On the subject of auditors, RACF now supports read-only AUDITOR attribute, which allows users to be classified as "look-but-cannot-touch"; thus providing more separation of the duties of the auditor from those of the security administrator.

Larger Memory Opens Up New Opportunities

The z13 maximum main memory is up to 10 TB, over three times than that of the zEC12, and the maximum memory of each z/OS LPAR has been quadrupled to 4 TB. This offers new opportunities to greatly improve data access and transaction performance using in-memory data pools. The tuning of *DB2* and *IMS* workloads can be simplified and the potential to do more in-memory data searches may significantly decrease response times.

With more memory, batch-intensive workloads, such as sorts, can benefit by reducing CPU consumption as well as likely delivering improved elapsed times. Memory-intensive languages, such as *Java*, also can benefit. In fact, it is hard to imagine an application, middleware, or system function that does not benefit in some measurable way with the ability to access the much larger memory of the z13 with z/OS V2.2.

Satisfy the Need for Data with Smarter I/O Subsystems

The z13 more than doubled the I/O bandwidth that is available on the zEC12. Now z/OS

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[4] For more detail on the zEC12, see **The Clipper Group Navigator** entitled *The IBM zEnterprise EC12 - Bigger, Better, Faster*, dated August 28, 2012, and available at http://www.clipper.com/research/TCG2012019.pdf.

[5] OpenSSH is a suite of security-related networking based on the SSH (Secure Shell) cryptographic protocols.

[6] Kerberos is a network authentication protocol that allows nodes to communicate securely over a non-secure network by the use of a mutual authentication protocol. FIPS 140-2 (Federal Information Processing Standards) are U.S. government computer security standards that specify requirements for cryptography modules.

[7] VFPE requires a service agreement with *VISA, Inc*.

[8] EMVCo is Euronet's chip card solution. See http://www-304.ibm.com/partnerworld/gsd/showimage.do?id=31426.

V2.2 supports up to 4 subchannel sets with 64K subchannels per subchannel set which enable the user to define very large I/O configurations. (As in prior generations, the control and operation of I/O is substantially offloaded to the z13's *System Assist Processors (SAP)*).

Faster links are available on the z13 with the *FICON*[9] *Express16S* PCIe card. A 63% improvement in data rates is achievable compared to the zEC12's *FICON Express8S* channel card. For DB2 transactions and similar workloads, batch elapsed times are improved and data latency is reduced greatly. To help optimize the related bandwidth, *FICON Dynamic Routing* helps reduce costs by allowing clients to run *PPRC*[10] and FICON traffic across the same switching links. In addition, to assist in the management of these links z/OS V2.2 adds a new health check to monitor the dynamic routing fabric components.

In an industry leading move, IBM significantly improves the management and optimization of workloads by extending the z/OS WLM to provide I/O prioritization to the FICON fabric, in addition to the I/O subsystem and DS8000-series control units, so that the highest priority reads and writes are handled first. IBM has made the z13 running under z/OS V2.2 the smartest general-purpose system.

Place Your Trust in a Mainframe-Centric Cloud

A cloud computing infrastructure, even a rudimentary one, must be scalable, efficient, flexible, resilient, and secure. Many of the aspects of a secure computing environment have been discussed above, so *how has z/OS V2.2 on the z13 been improved to address these other needs?*

In addition to the larger main memory (up to 10 TB in total and up to 4 TB per LPAR), and the increase in the maximum number of LPARs (to 85), 141 user-configurable cores are available on z13, all of which may be defined as z/OS V2 enabled. However, many z Systems usually include the *Integrated Facility for Linux (IFL)* and/or the *z Information Assist Processor (zIIP)* special-purpose processors (cores) that accelerate certain specific z/OS processes[11]. Both of these specialty processors are greatly enhanced by the new Simultaneous Multithreading Function (SMT) intro-

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[9] FICON = Fibre Connection.

[10] PPRC = Peer-to-Peer Remote Copy, aka, Metro Mirror

[11] Specialty processors (cores) customarily are priced well-below standard z/OS processors, as they incapable of running native z/OS code.

Exhibit 1 — The z System zIIP

The *z Systems Integrated Information Processor* is exploited under z/OS for designated workloads, which include:
- Java Virtual Machine (JVM) task and Java application code;
- Various XML System Services (parsing for DB2 and COBOL);
- IPSec offload for end-to-end network encryption;
- Certain parts of DB2 DRDA, complex star schema queries, and selected DB2 utilities;
- *HiperSockets* for large messages (XML, HTTP, SOAP, Java, and traditional file transfers benefit by helping to lower general purpose processor utilization for such TCP/IP traffic);
- The IBM GBS *Scalable Architecture for Financial Reporting*; and
- A number of functions of *OMEGAMON,* RMF monitoring, and *Virtual Tape for Mainframe (VTFM)* data compression.

(This is not an all-inclusive list of zIIP capabilities.)

All *zAAP* (*zApplication Assist Processor)* eligible workloads – only available on the zEC12 and earlier generations – can run on the zIIP (a.k.a. "zAAP on zIIP").

Source: IBM

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duced for the z13 and are most fully exploited by z/OS V2.2 and other software being delivered in concert with this release. The SMT architectural extension operates identically for the IFL and the zIIP, but the spotlight in this paper is on the zIIP's functionality. (See Exhibit 1 above for a brief description of the zIIP's capabilities.)

SMT Drives Throughput on zIIPs

Envision a railroad right-of-way; a single track is acceptable but two would be better. Two trains traveling at 50 MPH haul more freight than one at 70 MPH. The z13 core, when defined as a zIIP (or IFL)[12] supports up to two software threads running simultaneously within its processing pipeline and is known as two-way multithreading (a.k.a. *SMT2*). The z13 is a superscalar processor capable of running up to 10 instructions per core that can be issued to the 14 different execution units. Often, a single program thread cannot make use of all this capacity,

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[12] SMT is not supported on cores defined as z/OS standard processors at this time.

commonly due to latencies in other processor functions, such as memory access. A second thread running concurrently allows the processor to work on one thread's instructions while the other thread is waiting or is suspended. The z13 core alternates between the two threads thus achieving higher throughput by sharing and managing its "spare" capacities more efficiently.[13] An average capacity improvement up to 38% additional zIIP capacity can be achieved using multithreading technology when compared to the zEC12.[14]

Other V2.2 improvements in scalability that will enhance the performance and scalability of cloud enablements include enhancements to *UNIX System Services* that support scaling up to ten-times the current limit of 32K threads, thus facilitating larger *IBM WebSphere* deployments. Also, the *z/OS Communications Server* has enabled the management of the *TCP/IP* stack in 64-bit addressing mode and an enhancement to support nodes with a very large number of *Enterprise Extender*[15] connections extending into the thousands.

Enabling Improved Productivity

The z/OS Management Facility (z/OSMF) is a primary example of improved productivity enablement. As mentioned earlier, z/OSMF now is a base element of the z/OS V2.2 distribution. Prior to this time, it needed to be ordered separately, though available at no charge. This suggests that the z/OS folk want to encourage their clients to have access to its functions because so many essential system management, monitoring, and automated features will be channeled through it, resulting in much tighter integration. A brief list of new z/OSMF capabilities includes the following.

- New REST APIs for the Software Management plug-in that allow creation, retrieval of information about, change, and delete software instances.
- An enhanced File and Data Set REST API that enables editing and browsing data sets and files up to 8 MB.

- Enhancements for the workflow engine – a REST API to enable exploiters to initiate, monitor, and terminate workflows; and support for one workflow to call another.
- Support for the definition of systems and user-defined groups to drive actions across them; plus a graphical interface enables a topology view.
- A new task to support external applications, enabling the importation of them into z/OSMF in a way that makes them appear in the z/OSMF navigation tree.
- Support in the REST Jobs API to hold and release jobs.
- Two new z/OSMF REST services that enable viewing list of data set and to view list of z/OS UNIX files and directories.
- Workflow enhancements to enable configuration of z/OSMF plug-ins quickly and easily.
- In the Resource Monitoring application, the capability to retrieve and display recent historical performance information can be exported for analysis to popular spreadsheet programs.

With these z/OSMF enhancements, existing skills are extended, quality and productivity are improved, and there are fewer opportunities for error.

Additionally, in a move to more open standards, a new HTTP Server powered by *Apache* (which supports IPv6 and 64-bit execution) replaces the earlier server based on *Domino*[16]. There is a new *z/OS Client Web Enablement Toolkit* provides a flexible interface that allows z/OS clients such as applications written in COBOL, PL/I, and High Level Assembler to access web services. The toolkit provides a z/OS JSON parser able to process text coming from any source, to build new JSON text, or to add to existing JSON text; and an HTTP/HTTPS protocol enabler that uses interfaces similar to other industry-standard APIs.

Automation Protects System Availability

Can a capable SysAdmin detect an anomaly in a z/OS system faster than the system itself? The definitive answer is NO! For many generations, z/OS autonomics not only has been for simplifying system operations but also for assisting in maintaining its availability.

The *z/OS V2.2 Communications Server* extends the function of the z/OSMF-based *IBM Configuration Assistant* plug-in. It is designed to support creating and storing new configuration

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[13] For more detailed information on the implementation of SMT on the z13, see http://www.ibmsystemsmagmainframedigital.com/nxtbooks/ibmsystemsmag/mainframe_20150506/index.php#/44.

[14] Based on results from IBM internal laboratory measurements.

[15] Enterprise Extender allows use of an IP network for the transport of SNA traffic thus preserving SNA application investment while exploiting the advantages of a consolidated IP backbone.

[16] Formerly, IBM *Lotus Domino*.

profiles for TCP/IP stacks, with integrated help to guide novice users. This new function, which builds on existing capabilities for the policy agent, is intended to make it faster and easier to create and maintain TCP/IP configurations. In addition, IBM has issued a statement of direction (SOD) to further extend the capabilities of the Configuration Assistant, including enhancements designed to support making dynamic configuration changes to an active TCP/IP configuration and also a function designed to import existing TCP/IP profile data to make future configurations easier.

In a prior release of z/OS V1, a server health factor was added to *Enterprise Workload Manager (WLM)* routing recommendations, used by Communications Server's *Sysplex Distributor* to guide routing decisions. Later, a service was added that enables a server in a *Parallel Sysplex* to tell the WLM load balancer that its health checker indicates the need to send it less work. In z/OS V2.2, this facility is enhanced by enabling a server to, in effect, tell WLM that "the other server is not feeling well, so send it less work." *XCF*[17] is planned to exploit this when servers are not keeping up with their XCF messages, to reduce the number of situations that can affect an entire Sysplex. Both XCF and XES processing are designed to provide server health adjustment factors to WLM, lowering or raising the health factors as circumstances require.

Keeping all the z13 resources busy necessarily also will include efficient management of the batch job streams. This is the purpose of the *Job Entry Subsystem 2 (JES2)*, where a number of improvements have been added in z/OS V2.2. The JES2 checkpoint dataset now may be dynamically increased in place, thus eliminating the need for manual tuning or a cold restart Scale is dramatically increased – now supporting a maximum of one million (1,000,000) active jobs – a 2.5 times improvement over the prior maximum. This is intended to enable more jobs to be stored on the spool (jobs queue) at a time, which, in turn, can enable running more work over shorter periods and increasing spool retention time.

JES2 also will be getting some new features that are similar to those of its sister, *JES3*; specifically, ad hoc batch scheduling is added. In JES3, these facilities are called *deadline scheduling* and *dependent job control*. JES2 is designed to

provide similar functions, with some additional capabilities designed to make it easier to submit jobs intended for later execution, thus eliminating the need to log onto a system when the CPU time is cheap just to type and enter a "submit" command. To facilitate migration from JES3 to JES2 environments, functions to allow specification of a number of JES3 job execution control language (JECL) statements can to be converted to their JES2 equivalents, if that function exists.

Moving Ahead to Real-Time Analytics

The Clipper Group has written extensively on the many benefits of mainframe analytic processing and the necessity of bringing those into real-time, if possible.[18] Many enterprises now have a plethora of data that has been accumulated and may now be languishing in an archive somewhere without any attempt to derive any useful business intelligence or insights from it. In many cases, the enterprise has acknowledged this need but the analytical engines tend to be outside of the domain of the mainframe – making answers expensive to obtain and slow to come thus making them much less useful to analysts and decision makers. The continued goal of IBM's z Systems, z/OS, and much of its supporting ecology is to make it the most cost-effective and flexible infrastructure in support of this need, beginning with the *Vector Extension Facility,* an additional set of mathematical instructions that were announced with the z13 in May 2015 and described below.

SIMD Accelerates Analytics Through Vector Processing

One hundred thirty-nine new instructions, the *Single Instruction Multiple Data (SIMD)* instruction set[19], have been introduced for all processor unit types on z13. These include 66 for vector integer, 46 for vector support, 21 for vector floating-point, and 6 for vector string operations, all on 32 new 128-bit registers. SIMD will provide significantly improved performance for

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[17] (XCF) Cross-system Coupling Facility and (XES) Cross-system Extended Services processing are designed to provide server health adjustment factors to WLM, lowering or raising the health factors as circumstances warrant.

[18] See **The Clipper Group Navigator** entitled *Addressing New Business Analytics Challenges — When the IBM zEnterprise Really Makes Sense* dated December 21, 2012, and available at http://www.clipper.com/research/TCG2012030.pdf and my colleague Mike Kahn's paper, **The Clipper Group Navigator** entitled *Why the IBM Mainframe is the Right Place for Enterprise Systems of Engagement and Insight* dated February 15, 2015 and available at http://www.clipper.com/research/TCG2015002.pdf.

[19] SIMD has also been implemented on IBM POWER processors, the IBM Cell Processor, and several non-IBM processors prior to the z13 however its implementation on the z13 architecture is unique.

Exhibit 2 — An SIMD Example – Next-Best Action Solution

The following scenario describes the actions needed to provide an agent with a series of automated potential solutions to a mainframe customer's inquiry or issue; the activity that may arise thorough various channels, such as mobile apps, email, text, chat or telephone interactions.

1. Decision models are created by data analysts who curate the structured and unstructured customer activity date to identify unique patterns. This discovery step is highly parallel and benefits from SIMD operations.

2. The curated data then is the used to train decision models that also are highly amenable to SIMD acceleration. Business rules then are incorporated to complete these models. As new customer activity data is accumulated, it is fed back to the model from successful (or unsuccessful) encounters. The resulting continuous learning is applied, the models are incrementally updated, and rules revised appropriately.

3. For a customer interaction, usually a mix of structured and unstructured data, the process of extracting data from incoming sources also is highly parallel and SIMD acceleration can be applied. The data is mined for "triggers", the source's channel, subject, context, phrases, and "buzzwords" that would help to narrow the context of the range of the response to the customer. It also is extremely useful at this point to identify any prior interactions with this customer. Again, the functions in these steps, because they involve processing multiple data elements simultaneously, are suitable for SIMD acceleration.

4. The trigger is communicated to a real-time decision engine where the decision model is run with data inputs extracted from the interactions context. The model execution is also amenable to SIMD acceleration because it involves data-parallel machine-learning algorithms, such as classification and distance vector computation. Upon execution of the model, the engine communicates a recommended action to the customer service agent for action.

The need for processing several independent elements at the same time, coupled with the diversity of data (numeric and floating-point integer, string), makes next-best action systems ideal for SIMD acceleration. They can improve an organization's ability to produce more accurate decision models in ever-shrinking time windows with higher throughput. It also provides the ability to make real-time decisions faster, even *during* customer interactions.

Source: IBM and The Clipper Group

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vector computations and complex mathematical modeling characteristic of many business analytics applications; up to 80% throughput advantage on select functions is being claimed by IBM. Programming language exploitation is currently planned through:

- *Enterprise Cobol for z/OS*, V5.2
- *Enterprise PL/I for z/OS*, V4.5
- *z/OS XL C/C++*, V2.1.1
- *XL C/C++ for Linux on z Systems*, V1.1
- *JAVA 8 for z/OS*

In addition, the *Mathematics and Linear Algebra Libraries* (*MASS* and *ATLAS*[20]), accessed through C/C++, will be updated to exploit SIMD. Also, the *z/OS XML System Servers (XMLSS)* parser will use SIMD for character and string manipulation. Early measurements have demonstrated very significant performance improvement in these programs, according to IBM. The greatest benefits likely are to be observed in real-time data analytics applied to transaction and semi-structured or unstructured data streams that are being monitored for unusual patterns or other anomalies.

The Vector Extension Facility brings a new capability to the z13 system to further accelerate already existing commercial workloads. In the past, this kind of acceleration was only available to scientific applications (such the ones written in Fortran, C/C++ or Assembler and running in platforms that had Vector and SIMD capabilities).

With this new hardware implementation in the z13 processor, many existing commercial programs written in COBOL or PL/I need only be recompiled with the appropriate options to take advantage of these new capabilities while some others, like IBM Java workloads, will exploit them automatically and innovatively with the newest version. See Exhibit 2, above for an SIMD example.

This new architectural extension includes

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[20] MASS = Mathematical Acceleration Subsystem; ATLAS = Automatically Tuned Linear Algebra Software.

instructions that allow reduced processor quiesce effects, lower cache misses, lower pipeline disruption, and increased parallelism with instructions that process several operands in a single instruction; this is the heart of SIMD and where the name originates. IBM currently is engaging with ISVs to allow the enablement of their products and solutions for use with SIMD acceleration. All forthcoming IBM products and solutions that are enabled for SIMD acceleration will be announced as SIMD-capable when released.

More Fuel for the Analytics Engine

IBM continues to expand the mainframe ecosystem by establishing new partnerships to broaden the options for exploiting those capabilities even further. This past July they announced the enablement of *Apache Spark for IBM z Systems.* Sometimes described as the *operating system for analytics,* it is a key move in IBM's overall strategy of expanding the z Systems ecosystem. Apache Spark has been enabled for *Linux on z Systems* and is expected to be enabled later this year for z/OS. Highly versatile in many environments, Apache Spark is known for its ease of use in creating algorithms that harness insight from complex data. Data scientists can use Apache Spark's common programming framework to take advantage of z Systems' advanced analytic capabilities without having to worry about the specific format of the data.

Conclusion

While the virtues of IBM z Systems z13 *and* z/OS V2.2 have been extolled, this question may remain: *Why are they the optimum combination?* Let's point to a number of exclusive functions delivered only by this combination (i.e., new features not rolled back to z/OS V2.1), some of which have been described above.
- Support for up to 1 million active JES2 jobs simultaneously.
- Flexible batch "on demand" with parallel execution – new, more dynamic batch.
- 64-bit TCP/IP enablement for greater scale and better performance.
- zFS (z File System) performance improvements for directory update processing, support for 64-bit addressing enabling use of much larger data and object caches, and running zFS in the z/OS UNIX address space.
- Dynamically allocate system log data sets in advance – designed to improve availability.
- Dynamically resize the JES2 checkpoint without requiring tuning and an IPL/cold start.

- Digitally-signed SMF records to help surface any tampering with audit records.
- A customizable Knowledge Center shipped with z/OS, including local access to information.
- TCP/IP stack/profile guided configuration via the Communications Server Configuration Assistant.
- The z/OS WLM can provide routing recommendations for Parallel Sysplex workload balancers based on application health. VSAM record-level sharing to reduce contention at the index level, benefiting both client and server.

As the old saying goes: "There must be a pony in there, somewhere." And there are!

If the exclusives are not sufficient to get your attention, consider the fact that the IBM z Systems platform is the world's premier transaction and data engine, which is richly enabled for meeting the demands and business opportunities of the mobile generation. It is by far the most efficient and trusted cloud system that transforms the economics of information technology. Moreover, it has been demonstrated to be a truly superior integrated transaction and analytics system for real-time insights at the point of impact.

In turn the platform is supported by z/OS's support for advanced middleware, secured information management, fast communications, flexibility, and availability. It provides the most advanced security, analytics accelerators, compression, and scale. All of this is fueled by specialty engines, SMT capabilities, SIMD, extreme multi-program scale, and large memory management.

As stated at the outset, speed (which z13 delivers in spades) is not the only important criteria for meeting your transaction and analytics needs. z13 with z/OS V2.2 is a whole, multi-faceted solution, which is what you should be seeking. Now is the time to take a closer look.

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