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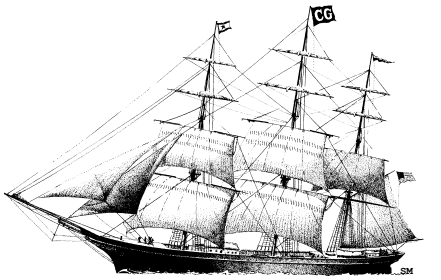

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IBM Continues Extension of z/VSE — More Function for Midrange Mainframe Users

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Management Summary

Long, long ago in a land far, far away, and way before the *Web-year* became the standard unit of time in the IT industry (actually it was in Washington, D.C., in the mid 1960's), there was a young sales rep who worked for a very large, prestigious computer company. In that young sales rep's briefcase were two binders, fairly thick, but manageable: one contained detailed descriptions and important elements of all the hardware products that his company sold and similarly the other contained all the company's software. For the most part, those binders contained all the building blocks required for almost any enterprise, public or private, to create, operate, and maintain an extensive information system to support their diverse missions. That is not to say that there weren't at least seven other companies whose sales reps could make the same claim as our young rep, but the other vendors' solutions were not as durable, as history demonstrated.

Fast forward, if you will, to the present. That large, prestigious company remains, but that company's products and services are far, far larger than whose descriptions could be contained within a few binders. Moreover, this company is surrounded, and we also would have to say intermeshed and interconnected, with numerous other vendors that now constitute this industry, one that seems to be expanding and being redefined almost exponentially. In the early 1950s, the most common unit of computer input and data storage was a hole in a paper card 7-3/8 by 3-1/4 inches (approx. 187.3 by 82.6 mm); now it is most often a digital stream that flows between end points located almost anywhere in the world and transmitted through or stored in a cloud of immeasurable dimensions. Every facet of our lives is influenced or touched by this phenomenon; one could argue that our modern culture could not exist without it. The constructs of the IT universe are manifold and their taxonomy is large and dynamic. However, not a week goes by in which some player in this mash up does not declare to have invented something new.

Thus, is there any wonder that something can easily get lost in the morass of information that surrounds this industry, even within the more limited universe of the IBM Corporation? For instance, let's stipulate that computer operating systems are a fairly erudite subject, but nevertheless an absolutely essential element of the IT universe and, as it turns out, one can count the developers and distributors of such on your two hands. (Let's not split hairs by arguing for the mega-multiple authorship of Linux.) Let's just count those that officially run on IBM server families. There is *AIX* and *IBM i* on *Power Systems*, *Linux* (from various distributors) on each family, Microsoft *Windows* on *System x* servers, and *z/OS*, *z/VM*, *z/TPF*, and *z/VSE* on System z. It would be no surprise if z/VSE is only vaguely familiar; it seems to have become the stepchild, but not a homely one, lost in the hyper-universe dominated by z/OS and Linux on zEnterprise systems. This seems to have become a dilemma for not only IBM but for its loyal z/VSE customers as well, but should they be concerned? We think not, but if you want to know why, then please read on.

IN THIS ISSUE

The Importance of z/VSE to Mainframe Customers

It would be a surprise to many to learn that about one-third of the mainframes currently installed are running a version of *VSE*.[1] In addition, many would be surprised to learn that these mainframes are distributed relatively evenly globally, though it is more prevalent in Europe and the U.S. So, how should we describe VSE customers? Typically, they have a long history with IBM mainframes and have made and accumulated a significant investment in proven, highly-evolved, and locally-developed core business applications and have the skills to support it. These tend to be smaller enterprises with less-demanding workloads, in terms of capacity, availability, and security (than would be typical of *z/OS* users). VSE users tend to be very focused on costs – whether it is for processors, storage, operating systems or middleware, or their technical support staff. Generally, they would not be described as IT "pioneers" yet their businesses are growing and their IT needs are advancing. However, if they are in any way progressive, it is in their vocal demand that their infrastructure provide the basis for continued, if conservative, evolution.

Some metrics will illustrate some useful contrasts to those of you more familiar with VSE's "big brother", z/OS. The core functions of *z/VSE* are contained in approximately 5 million lines of code; z/OS is estimated to be several orders of magnitude larger.[2] More significantly, the difference in cost is more tangible and profound. A typical VSE stack that consists of *CICS*, *DB/2*, *VTAM*, TCP/IP, and *WebSphere MQ* could cost $12-$14K in Monthly License Charge (MLC).[3] A typical z/OS stack is very likely to cost significantly more.[4] These are the principle factors responsible for VSE customers' loyalty and persistence. They are more concerned with simplicity than leading-edge functionality; they are more concerned with stability than ultimate capacity; they are more concerned with cost than "pushing the envelope".

The evolution of VSE is reflected in some differences in the environment that VSE shares with other mainframe operating systems. Worldwide, 50% of the VSE systems run under z/VM, though this mix is much more common among European users. Likewise, many VSE servers also run some version of *MVS*[5], over 15% by current estimates. The diversity of mainframe operating system structures are the logical outcome of the diversity of information systems requirements among IBM's customers, large and small. The VM hypervisor[6] has allowed VSE customers to expand their capacities with multiple VSE images, facilitated resource sharing with MVS and, in some cases, the migration to MVS, has enabled growth by adding applications that are uniquely supported by z/OS or Linux on System z, and has been a major element in many consolidation scenarios. The latter point is demonstrated by the relatively high propensity of VSE systems to embrace Linux on System z as well: about 30% have adopted that computing model with its largest penetration being in Europe. The pulse of VSE is steady and strong, but is it enough?

What z/VSE Can Do For You Now – and What It Can't

Despite its many capabilities, VSE has its limitations. Although it supports n-way System z processors, realistically it is limited to three or four at the most. VSE is more optimized for large serial processes so that faster engines typical of each new mainframe generation offer the best way to achieve increased capacity. Aside from the *IFL (Integrated Facility for Linux)* specialty engine, VSE does not support the *zIIP* or *zAAP* special engines.[7]

[1] The generic reference to VSE includes all versions of both VSE/ESA and z/VSE.

[2] That would also put the z/VSE code base as significantly smaller than for Windows Server 2008.

[3] According to IBM; prices vary by nation. Version 4 introduced a new pricing metric for z/VSE systems on current hardware – the Midrange Workload License Charge (MWLC) with sub-capacity mode.

[4] Rigorous and valid cost comparisons are difficult to achieve due to differences in system size, its usage characteristics, and the wide range of system software and middleware combinations. The comparison provided here is for illustrative purposes only.

[5] The generic reference to MVS includes the several versions of MVS, OS/390, and z/OS.

[6] z/VM is IBM's mainframe virtualization technology, with a history almost as long as VSE. It enables the support of multiple mainframe operating systems or Linux images each with its unique, isolated, and secure set of resources.

[7] zIIP: Integrated Information Processor and zAAP: Application Assist Processor, both special-purpose engines supported by z/OS.

Understanding the History of z/VSE Helps Set the Stage

VSE was born as *DOS/360*, when it was discovered that the operating system announced with *System/360* in 1964, *OS/360*, would not really fit within the modest main memories (as low as 8K) that were available on the smaller members of the mainframe family. (There was a tape-based version of DOS known as *TOS/360* for those users who were trying to save their precious disk space. Obviously, its performance was unacceptable and IBM dropped support very quickly.) The OS specifications were modified and the Endicott Laboratory quickly delivered a single partition operating system that was, of course, fully compliant with and fully exploited the System/360 architecture. It grew to include multiprogramming in three partitions and basic telecommunications. In reality, DOS/360 was supposed to be only a stopgap measure for early customers that IBM assumed would bridge eventually to OS/360. This never happened in any great numbers despite IBM's many efforts to encourage its DOS (and, later, its VSE) customers to do so. In summary, DOS/360 worked well, it was simple, it was efficient, and it was resource friendly.

Virtual storage was introduced in 1970 with *System/370* and, after 27 releases; DOS/360 became *DOS/VS*. This new version offered effective multiprogramming with up to seven partitions, POWER for I/O spooling, VSAM, and effective database/data communications solutions via *CICS* and *DL/1* hierarchical databases. It was during this period that DOS/VS customers began to exploit the hypervisor technology incorporated in VM, *VM/370* at that time. This version was now a clearly recognizable precursor to current day *z/VSE*. In 1971, the development of DOS/VS was consolidated at the IBM Laboratory in Boeblingen, Germany, and remains there to this day. The wildly popular *IBM 4300* midrange mainframe family was introduced in 1979, in which real memories were extended to 4MB. Fixed Block Architecture (FBA) disk storage was also announced and became a staple technology for IBM's smaller systems customers. DOS/VS became *DOS/VSE*, the added "E" for "extended", offering up to 12 partitions, an enhanced service and control system, an interactive interface (ICCF), disk sharing, and advanced communications functions (ACF/VTAM).

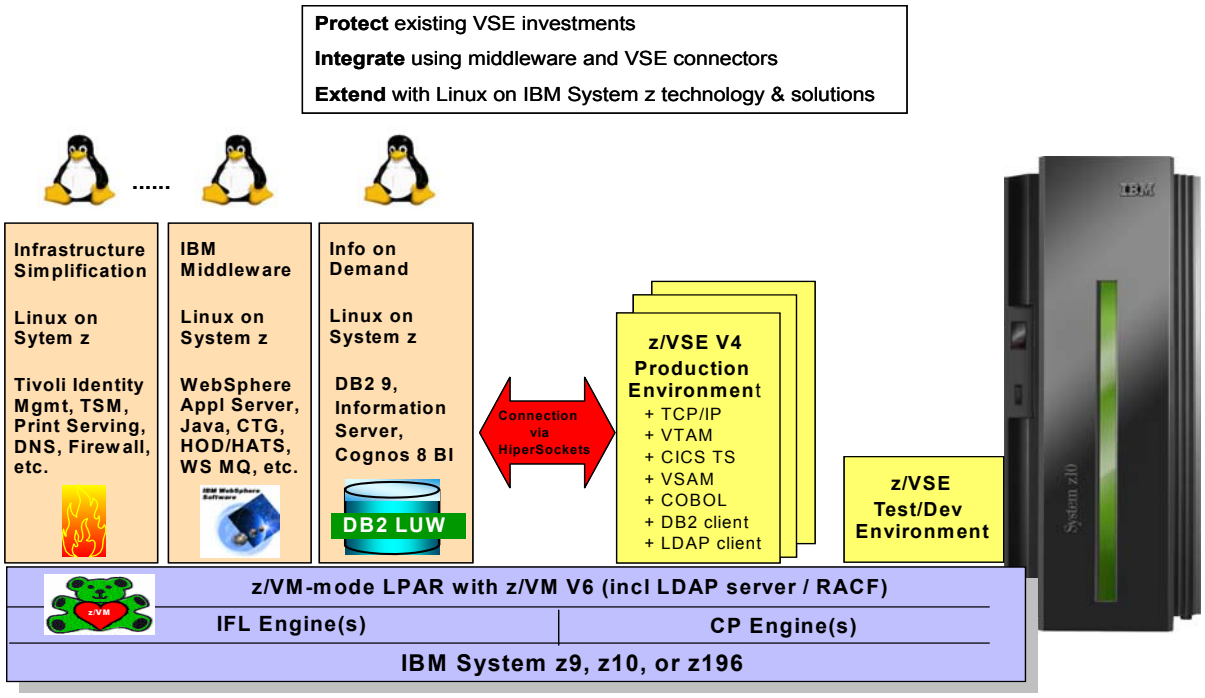
In 1983 when the limitation of 24-bit addressability (16MB) became apparent, IBM announced *S/370-XA (eXtended Architecture)* providing 31-bit (2GB) addressability within the architecture. This was implemented in the *MVS* world, but VSE was left behind, the thinking being that IBM's small mainframe customers were not constrained by the older limits. But progress did not stop and, in 1984, DOS/VSE was transformed into *VSE/SP*, in which a number of standardized components, previously separately orderable programming, were integrated into a single pre-configured distribution designed to facilitate quick, simple, and less-complex upgrades and was fully realized in Version 3 by 1987. This is the packaging concept that survives with improvements in z/VSE today, where all the service and upgrades for each of the components is completely coordinated offering better quality and stability. Notably enhancements to the basic system included a new library structure, conditional JCL, and Virtual Storage Extensions that provided up to three virtual address spaces of up to 16 MB each.

Then in 1990, *Extended System Architecture (ESA)* was announced introducing the *ES/9000* family of processors; *System/370* became *System/390*. VSE/SP leapt forward with the support of 31-bit (2GB) addressability, greatly extending its capacity and it became *VSE/ESA V1*. It offered many advancements to improve its MVS affinity, an effort to keep the principal mainframe operating systems in closer synchronization; this included the language environment, as well with new versions of *CICS*, *VTAM*, and *COBOL*. Dynamic Partitions were implemented, as well as Data Spaces, and Virtual Disk in storage for temporary files. Another advance came in 1994, with VSE/ESA V2 supporting n-way processors and turbo-dispatching in support of the *9672* family of systems (the first mainframes to be implemented with the much more cost, space, and power efficient Complementary Metal Oxide Semiconductor (CMOS) technology). That family of processors was among the great bold leaps forward taken by IBM to advance mainframe technologies in the face of its critics that claimed that the dinosaur, the mainframe, was dead. At the same time, IBM was giving its VSE customers encouragement by assuring them that their investments in processes and applications were being protected; VSE was keeping up the pace of systems technology advancements. Late in that decade, a native TCP/IP stack was introduced. This was followed by greatly improved MVS affinity with the launch of *CICS Transaction Server (CICS/TS)*, a direct port from the OS/390 version. In addition, cross memory services were implemented, allowing the execution of programs in different address spaces.

The z*Architecture* was announced in 2000 and delivered with the *z900*, followed a year later by the lower capacity *z800*. Along with numerous architectural extensions, including 64-bit addressability (providing an address space of 16 exabytes, slightly more than a billion gigabytes. Notably, the mainframe became open and capable of executing *Linux*. To facilitate that extension, a special processor was developed, the *Integrated Facility for Linux (IFL)*, where the Linux kernel and most extensions are sold and supported by external distributors. While the new level of extended (64-bit) addressability was not exploited immediately by VSE, progress has continued to facilitate the participation in open systems technologies that surrounded *System z*. *VSE Connectors* were introduced to provide the translation between the several different modes of data communication. Initially they were introduced to allow access from JAVA applications to VSE resources such as *VSAM*, *DL/1*, and *VSE/POWER*. Subsequently, connectors were introduced for *VSE Script* and Simple *Object Access Protocol (SOAP)*. In the course of several releases of VSE/ESA V2, additional elements of z/Architecture were implemented including *Hipersockets* (which allows for secure memory-to-memory data transfers between programs, among other benefits) and hardware cryptographic functions. In 2005, VSE/ESA V2 was rebranded to become z/VSE V3 and SCSI disk support was added, to facilitate data sharing and compatibility with z/VM and Linux on System z. z/VSE V4 was announced in March 2007 and will be discussed in more detail later in this report.

What this almost 50-year history demonstrates, notwithstanding a few minor interruptions in the progress, is that IBM is very much committed to the support, extension, and growth of VSE in order to continue to extend the many benefits of the z/Architecture to the vibrant community of the smaller mainframe owners.

Exhibit 1 — z/VSE Strategy —
A Hybrid Environment Leveraging z/VSE, z/VM, and Linux on System z



Source: IBM

On the software front, there is no native *JAVA*, *C++*, *WebSphere Application Server* (for SOA), or *Lotus Notes* or *Domino*, nor is there direct support for popular non-IBM software provided by SAP or Oracle, for example, as exists for z/OS and *zLinux*. For VSE, IBM's Rational tool set is somewhat limited and VSE has been largely ignored by Tivoli's system management tools, though several other vendors' tools do work with VSE.

However, for existing VSE customers there is a need to respond to their enterprise's reach much farther beyond their VSE-based solutions. Inevitably, they will be faced with the question of whether they can do this on their current platform or must they deal with that always-painful question: *Where do I go from here?* Leaving aside the option of a complete outsourcing of their information systems, they must resolve the choice of platforms. Obviously, they could leave the mainframe platform, Microsoft *Windows* on x86 being a popular new choice, but the costs of migrating to a new architecture are likely to be high, the application risks may be prohibitive, and a long lead time to achieve perhaps marginal benefits. However, for those who are wed to the core values of IBM's z/Architecture, several options available are realistic. Migration to z/OS is a logical choice then, but the operating costs are surely much higher. Moreover, the history of VSE customers, particularly in the last few decades, has demonstrated that this path has not been popular unless the strategic imperatives of their enterprise, such as a major consolidation, acquisition, or rapidly-growing capacity requirements, force their hand.

IBM's strategy is three-fold:

(1) Protect their VSE customers' embedded investments and their knowledge base,

(2) Through the use of middleware and interconnectivity integrate VSE with its other technologies, and

(3) Extend the platform with new solutions based on Linux for System z.

Let's explore how IBM is currently and in the future will accomplish these goals.

One avenue is to continue to improve the functionality of the core components of most VSE customers' portfolios, namely CICS, VSAM, and COBOL-based application programs. This is accomplished, in some part, by improving VSE's affinity with MVS, adopting or adapting selected functionality of the larger

operating system. Performance of the base system continues to be improved by implementing or extending technical improvements, such as CPU Balancing, larger Dataspaces, multiple I/O operations on a common device (PAV), support of the latest I/O devices, and support of the cryptographic functionality built into all z/Architecture processors. z/Architecture mode only was introduced in z/VSE V4 and 64-bit addressability was implemented but was limited to real addressing only.

Just as importantly, IBM introduced the *Midrange Workload License Charge (MWLC)*, a re-tiering of the prices of the key elements of the VSE software stack, which resulted in significantly lowering the charges for most customers. This represented a very significant price-performance improvement for the platform, particularly for larger-capacity configurations, and, in addition, implemented a usage-based (sub-capacity) model that relieved the software cost of carrying unused engine capacities. This more aggressive pricing strategy for VSE suggests that IBM is not "cashing out" but is serious about continuing to play an important role in the midrange mainframe marketplace, now and in the future.

Additional releases of V4 have added support for up to 512 tasks for capacity growth and 4-digit device addressing (CUU). Most recently, at the announcement of the availability of z/VSE V4.3, a statement of direction (SOD) was published announcing the intent to support 64-bit Virtual addressability for user applications, sometime in the future.[8]

Connectivity

Connectivity is enhanced with the support of IPv6/VSE.[9] IPv6 extends network addressing from 32 bits to 128 bits and is required to meet the certain governmental agency compliance requirements and in anticipation of a shortage of IPv4 addresses. IPv4 continues to be supported and all TCP/IP stacks can run concurrently within one z/VSE system. Internally, z/VSE core applications, for instance CICS/TS, VSAM, or a COBOL batch program can connect to any other compliant system program, middleware, or application running on System z via the *Hipersockets* facility, a technology that provides high-speed TCP/IP connectivity within a central processor complex. It eliminates the need for any physical cabling or external networking connection between servers running in different LPARs or different engines (cores). The communication is through the system memory of the processor, so servers are connected to form an "internal LAN".

New with z/VSE V4.3, when both the z/VSE image and the z/Linux images are being managed as z/VM virtual machines, *Linux Fast Path (LFP)* is an alternative high-speed connection facility that uses an *Inter-User Communications Vehicle (IUCV)* connection. The IUCV provides a way for program-to-program communications within a single z/VM system. A program using IUCV can communicate with itself, with a CP system service, or with another program on the same system. It bypasses the z/VSE local TCP/IP stack using a daemon on the Linux side.

Storage Support – IBM Offers Several Options

Direct Access Storage Devices (DASD), more commonly called *disks* in the open systems world, are a two-pronged offering with z/VSE:

(1) High-performance, natively attached, typically Extended Count-Key-Data (ECKD) or Fixed Block Architecture (FBA) devices connected via ESCON or FICON channels and

(2) Small Computer System Interface (SCSI) FBA devices that are typically shared with Linux for System z or z/VM using Fiber Channel Protocol (FCP) connections.

Typical of the first type is the IBM System Storage *DS8000*, which provides not only very high-capacity, performance, and resiliency but offers features such as Remote Mirror and Copy, Full Disk Encryption, and Solid State Disk. The DS8000 is also capable of emulating SCSI devices with multi-pathing and sharing capability.

The second type is exemplified by the IBM *XIV Storage System*. This system is designed as an open system that provides ease-of-use, high-availability, and low cost of ownership by using commodity components in a uniquely architected grid. Its capacity extends up to 240 TB.

[8] SODs are usually promulgated by IBM to inform customers of a technology enhancement that is beyond an announcement horizon, about 1 year, but is not committed.

[9] Licensed from Barnard Software, Inc. (BSI).

Also fitting into the second type is the IBM *Storwize V7000,* a virtualized storage system to complement virtualized server environments that provides unmatched performance, availability, advanced functions, and highly-scalable capacity targeted to meet requirements typical of midrange systems. It features rack-mounted chasses, automatic migration of frequently-accessed data to high-performing solid-state drives (SSD), and up to 24 TB of physical storage per enclosure.

Also working with z/VSE are:

- The IBM *System Storage SAN Volume Controller (SVC)*, currently V6.1, is a storage virtualization system that enables a single point of control for storage resources to help support improved business application availability and greater resource utilization.
- The IBM *TS7700 Virtualization Engine* is a family of mainframe virtual-tape solutions that are designed to optimize tape processing. With one solution, the implementation of a fully-integrated, tiered-storage hierarchy of disk and tape leverages the benefits of both technologies to help enhance performance and provide the capacity needed for today's tape processing requirements.
- The IBM *System Storage TS7680 ProtecTIER Deduplication Gateway* for System z combines a virtual tape library solution, with IBM's unique and patented *HyperFactor* deduplication technology and integrated native replication technology to provide users an optimal disk-based target for Systems z applications that traditionally use tape.

Support for the z/VSE Application Portfolio

There are over two dozen very active Independent Software Vendors (ISVs) that primarily are developing and supporting the z/VSE core environment; some vendors have written specifically for VSE while others have ported their products from z/OS. Examples of the former are Barnard Software, Inc. (*DataCrypt, Opti-Audit,* etc.), illustro International (*z/Ware 2.0, z/IPMon,* etc.), and Connectivity Systems International (systems, network, data, and security management tools, etc). A small sample of vendors who supported products shared with z/OS (or z/VM) include Software AG (*Entire Operations, Adabas,* etc.), BOS (*tcJanet, tcVision,* etc.), and CA (*CA Datacom, CA Top Secret,* etc.).

In addition, there is a large portfolio of applications enabled for Linux on System z applications; more than 3000 have been enabled to date and the list continues to grow. Through this portfolio, enterprises with VSE as their core mainframe environment can reach virtually anywhere in the modern web-enabled world. Existing VSE systems can be extended to completely new application portals for the enterprise supported by the core values of the z/Architecture. Several examples of vendor offerings certified for Linux on System z include:

- *Finnova – Finnova* integrated banking solutions.
- *VeriFone, Inc. – PAYware Transact* is a highly-scalable transaction switch that supports high-volume, multi-threaded transaction processing.
- *PAYware Transact* is e-transaction middleware for businesses that process a large volume of payment transactions.
- *AquiTec Ltd. – SCM Warehouse*: Warehouse and Supply Chain Management.
- *Edifecs, Inc. – Edifecs* enrollment, claim, and payment management for the healthcare industry.

With solutions such as *WebSphere Portal (WSPortal), WebSphere Application Server (WAS), and Host Access Transformation Services (HATS)*, existing VSE CICS, VSAM, and COBOL applications can be Web-enabled, improving and simplifying their interface, extending these applications with new business logic and, thus, enabling new workloads, all with the most modern Internet standards. A breath of vigorous life can be given to older, unfriendly, but nevertheless still functional and valuable green-screen applications.

z/VSE systems can be extended to become rich, centralized data store for the integration and consolidation of the all enterprise's operations and transaction data. Extended with Linux-enabled tools such as *DB2 LUW (Linux-UNIX-Windows), Infosphere Warehouse, and Cognos BI,* and connected synchronously with Hipersockets or Linux Fast Path, VSE data captured in VSAM and DB2/VSE, and DL/1 databases offer opportunities for business intelligence, decision support, evaluation tools that can extend the reach and effectiveness of the enterprise.

Beyond this, z/VSE has an active and strong customer base represented in two primary user groups – *World Alliance of VSE*

VM Linux (WAVV) in the United States and *Guide Share Europe (GSE)* in Europe. Both groups meet in technical and general sessions throughout the year and work very closely with the IBM to represent the needs of their respective communities.

What the Future May Hold – z/VSE and zEnterprise Systems

z/VSE supports the latest zEnterprise System announced in July 2010[10], more specifically the *z196* but with the limitations that have been described above. If nothing else, the new processor provided a significant increase in capacity in the range of 40% for VSE workloads and perhaps more on the Linux IFL side, based on personal inference suggested by the enhanced processor cycle time. Although z/VSE images can happily run in this new system, it, along with *z/TPF,* are not included in the environments and resources that are be integrated through the *zManager*, the unified resource management tool. As with the prior z9 and z10 *Business Class (BC)* systems, we expect a midrange equivalent of the z196 by the third quarter of this year. Furthermore, we expect that this announcement will include all of the functionality included in last year's announcement, but with a lower entry point and limitations on performance, capacity, and configuration. Additionally, we anticipate the formal announcement of 64-bit Virtual Addressability for z/VSE (to be delivered later), which would fill out z/VSE implementation of the z/Architecture. With respect to applications that may be running on *zBX Power* or *x86 Blades*, interconnectivity to z/VSE applications running on the z196, or its expected little brother, should not be an issue. The design and implementation of the z/VSE connector strategy essentially is configuration neutral. This leaves open the issue of whether and how z/VSE will be defined, or not, within the scope of the zManager. IBM may address this in the future but it will be based on whether it perceives that need from z/VSE customers' requirements.

Conclusion

The z/VSE platform on small-to-medium z/Architecture systems remains a very viable base for enterprises with lower capacity requirements. However, this architecture now embodies many extensions that allow the z/VSE core environment to reach well beyond the limits imposed by its more modest functionality and capacity, when compared to z/OS, and is certainly comparable in flexibility and simplicity to most non-mainframe operating environments.

If you haven't guessed, I was that young sales rep back in the 1960s, mentioned on Page 1. A lot has changed since then but not the affinity of many customers for their collection of VSE applications, and for good reason. This environment continues to meet the needs of its customers. The architecture has evolved and remains contemporary by using applications and extensions that are hosted on zLinux and the Business Class machines, past, present, and future, continue to make operational and economic sense. This glass certainly is more than half-full for most of the enterprises now running z/VSE. Don't presume otherwise, without a thorough evaluation.

[10] See **The Clipper Group Navigator** dated June 22, 2010, entitled *The IBM zEnterprise System Reaches Out — Higher, Wider and Deeper*, and available at http://www.clipper.com/research/TCG2010033.pdf.

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