z/VSE- 50 Years and still going strong

This document contains a very brief history of z/VSE. To the many seasoned z/VSE veterans with lots of experiences and memories, we apologize for leaving out so much. To the z/VSE newcomers, some of whom may not yet be 50 years old, we apologize for including so much.

Disclaimer: The facts contained here have been checked and rechecked. However, 50 years is a very long time and memories fade. There is no guarantee the author's memory is correct in every aspect of the last 50 years. Indeed, the reader may remember things differently. That does not necessarily imply that either view of the past is wrong.

For more information on the history of IBM Mainframes and IBM Storage:

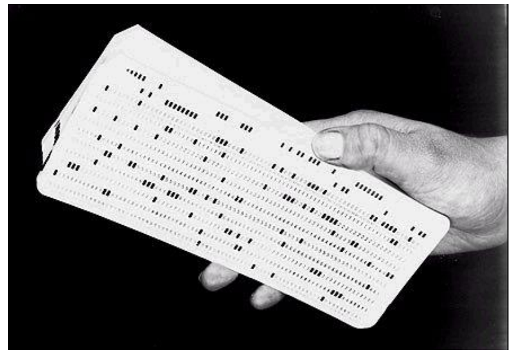
- IBM Mainframes – 45+ Years of Evolution by Jim Elliott
- IBM Archives - IBM Mainframes
- IBM Archives - IBM Storage

For more on the development of the IBM System/360:

- The 360 Revolution by Chuck Boyer

The 1960s

At the beginning of the 1960s, mid-sized IBM customers might have used one of two technologies.



A punched card could hold up to 80 alphanumeric characters or, if left unpunched, it was great for penciling in personal reminders such as your grocery list.

One option was 'unit record' technology. Punched card processing involved transfer of information to punched cards and lots of manual card handling; along with sorting, merging, reporting, and summarization using electromechanical unit record equipment. Many early S/360 systems simply automated these legacy unit record applications. Some of those applications may still be running today.

A large unit record installation - cards flying through a sorter was the public 'image' of DP in those days.

A second option was the IBM 1401 system. The all-transistorized 1401 was the first IBM computer designed for the 'mid-market'. The 1401 was quite successful and 1401 emulation was an important option for many early S/360 customers. Who knows? Some 1401 programs may still be running in 2005.

In 1964 IBM introduced a revolutionary family of computers that offered customers a wide range of compatible processors and common I/O peripherals. By today's standards, the capacity of even the largest S/360 system was feeble. Nevertheless, by the standards of the late 1960s, the S/360 was an extraordinary example of advanced design and technology.

A typical IBM 1401 System with card reader/punch, CPU, printer, and reel-to-reel tape drives.

Fortune magazine famously called the System/360 a US$5 Billion gamble. If one assumes US$1 in 1965 is worth more than US$6 today, that means it might be described as a US$30 Billion gamble (in 2005 US$). It was an extraordinary expression of confidence. The task merely involved concurrently designing a comprehensive, enduring, and extendable architecture; designing and building factories to produce and test state-of-the-art components; designing and building factories to produce and test a family of processors and related I/O products; designing, creating, and testing a new operating system, along with key components and utilities; plus hiring and training a new sales and support organization and doing it all while coordinating activities and resources on a worldwide basis in a time before the easy availability of cheap, high bandwidth communications. I am impressed.

The operating system planned for the System/360 was 'Operating System/360', or OS/360. IBM was apparently too busy in those days to give much thought to creative naming. Later, at some point in the development cycle, IBM realized OS/360 would not fit in the limited memory available on entry models. Since the S/360-30 offered ferrite core memory in the range of 16 to 64 K bytes, an alternative to OS/360 was needed.

IBM Endicott developed an alternative operating system designed for smaller members of the S/360 family. The first 'VSE' was Disk Operating System/360 (DOS/360). DOS/360 first shipped in 1965. It began with a single partition, but quickly grew to three for basic multiprogramming. Later, BTAM added primitive telecommunications. The belief inside IBM was that DOS/360 would cover the entry level for just a few years, then somehow fade away as users moved up to OS/360.

A typical IBM System/360 Model 30 with CPU and console, reel-to-reel tape drives, card reader/punch, and disk drives

Reel-to-reel tape drives - spinning tapes were the public 'image' of DP in the early days of computing.

In retrospect it may be difficult to understand that assumption. It must be one of those 'it seemed to make sense at the time' things. Clearly, VSE did not simply fade away. Instead, over 50 years later we are celebrating the contributions VSE made in the past, continues to make in the present, and is likely to make in the future of IT. z/VSE is a tribute to DOS/360. Even more importantly, z/VSE is a salute to the thousands of exceptional IBM customers who depend on VSE for robust, cost-effective IT solutions.

In 1965, an imaginary DOS/360 customer might have an S/360-30 system with 32K bytes of main memory, 3-4 IBM 2311 disk drives (each with 7.25 MB capacity per removable disk pack), 4 IBM 2401 reel-to-reel tape drives, a 2540 card read/punch, and a 1403 impact line printer.

The 1970s

IBM followed the success of S/360 by introducing System/370 in 1970. Virtual storage was added in 1972. Virtual storage expanded system capacity and made programming easier and more productive. Real memory options grew as monolithic memory technology replaced ferrite core. Real memory options for the S/370-135 ranged from 96 K to 256 K bytes. In disk storage, the IBM 3330 (100 MB per removable pack in early models) replaced older 2311 and 2314 technology.

A typical IBM System/370 Model 135 system with reel-to-reel tape, card punch, CPU and disk drives, TP controller, printer, and card reader. Addition of a TP controller to the picture shows that by the early 1970s, communications was becoming an important part of S/370 systems.

After 27 releases, DOS/360 became DOS/VS. DOS/VS offered five partitions (later 7) and a relocating loader for effective multiprogramming. POWER (Priority Output Writers, Execution Processors, and Input Readers) was added for I/O spooling. One can only imagine how long it took to come up with that acronym. A new VSAM file system for balanced random and sequential processing became part of DOS/VS. Database/Data Communication (DBDC) became a fundamental part of VSE as the use of CICS grew. A hierarchical database known as DL/1 was available as well. At this time, DOS/VS became something we would clearly recognize today as a VSE system.

After a brief partial detour to the Netherlands, responsibility for the VSE system was consolidated at the IBM lab in Boeblingen, Germany.

A full eight drive IBM 3330 unit. Each disk contained 100 MB per removable pack. Operators were frequently called upon to mount and unmount packs.

In 1972, an imaginary DOS/VS customer might have a S/370-135system with 192K bytes main memory, 4-6 IBM 3330 disk drives, 4 IBM 3420 reel-to-reel tape drives, a 3505 card reader and 3525 card punch, a 3211 line printer, and maybe a TP controller.

Starting in the mid-1970s, some VSE customers introduced VM to supplement the capabilities of their basic VSE environment. With the introduction of the S/370-138, an update of the basic 135 design, IBM began to implement selected 'VM assists' in processor microcode. The assists were designed to reduce the 'overhead' of VM. The effect was startling. Once the performance of VSE under VM became 'acceptable', many VSE customers began to exploit VM. They added multiple VSE guests for more processing capacity than a single

VSE guest, separated production and test guests to increase system integrity and improve staff productivity, and used CMS as their preferred interactive tool. In 2005, many VSE users continue to exploit the world-class virtualization technology of z/VM. In fact, the unsurpassed ability of z/VM V5 to run and manage multiple Linux guests adds new relevance to VM for many VSE customers.

In 1979, IBM introduced the IBM 4300 system with Large Scale Integration (LSI) logic and solid-state memory based on an advanced 64K bit chip. Real memory options ranged from 512K to 4,096K (4MB) bytes. Integrated adapters lowered overall hardware costs. Along with the 4300, IBM introduced new disk systems based on Fixed Block Architecture.

A typical IBM 4331 system with on-line data entry (beginning to replace punched cards), non-removable disk drives, and CPU.

DOS/VS became DOS/VSE. E stood for ‘extended’, or perhaps ‘e Series’ (the internal code name for the 4300). DOS/VSE offered up to 12 partitions. MSHP was added to enhance service and control of the system. ICCF became the interactive component. ICCF was based on ETSS, a ‘field developed’ program commonly used at the time. DOS/VSE also offered improvements such as ASI procedures, missing interrupt handler, DASD sharing, etc. ACF/VTAM became a component of VSE. A major extension was support for FBA disk devices. During this period, the practice of charging for IBM software became widespread.

In 1979, an imaginary DOS/VSE customer might have an IBM 4331system with 512K bytes main memory, 6 IBM 3310 (with 65 MB per drive) FBA disk drives (or perhaps a workhorse 3350 CKD disk system), 4 IBM 8890 reel-to-reel tape drives, a 3211 line printer, and a number of 3270 CRT terminals for data entry. Use of punched cards began to fade.

The 1980s

In 1983, IBM 4361 and 4381 systems added new growth opportunities to the 4300 family (joining the 4331 and 4341).

In 1986, IBM announced the IBM 9370 family of mid-sized systems. The 9370 was designed to operate in an office environment and introduced a new form factor for mainframes. The 9370 was packaged for standard 19-inch racks. Four models were included in the initial announcement. Main memory ranged from 4 to 16 MB. In addition to the CPU itself, new rack mounted FBA disk (IBM 9332 and 9335) and tape (IBM 9347) products were introduced as well.

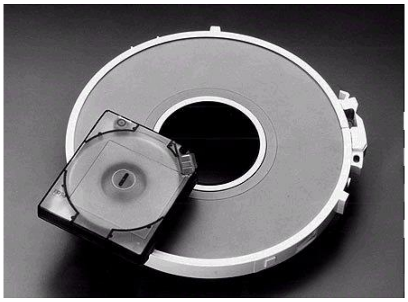
An IBM 9370 system in an office environment with rack mounted CPU and disks.

Slowly and deliberately, DOS/VSE transformed into VSE/Systems Package (VSE/SP). VSE/SP consisted of an integrated, pre-packaged VSE system. The metamorphosis began with the 'SIPO' concept. SIPO originated in IBM Canada and was a visionary attempt to provide a pre-configured system. SSX/VSE took integration even further and added a set of systems management dialogs. SSX ultimately proved to be too rigid for most customers. However, the basic approach proved sound. VSE/SP V1 and V2 refined the concept and made it more generally acceptable. The Fast Service Upgrade (FSU) process made release-to-release migration simpler.

By 1987, VSE/SP V3 implemented a packaging concept that remains visible to this day in z/VSE. The structure consists of base and optional products. The 'base' is an integrated package containing key, commonly used products. It is designed, developed, tested, delivered, and serviced as an integrated whole. 'Optional' products are coordinated so that the list contains the correct level of each product. Installation procedures and dialogs are provided. Following an order, base and optional products are stacked together on the delivery media. Service is coordinated for both base and optional products and appropriate prerequisite and corequisite levels and service are identified.

The goal of the packaging was a system with better quality and more stability, and one that was easier to install and service than before. VSE customers approved and the structure survives today. For example, z/VSE V3.1 base components include the supervisor, dialogs, POWER, VSAM, ICCF, LE, utilities, VSE connectors, HLASM, CICS TS VSE/ESA, ACF/VTAM, TCP/IP for VSE/ESA, DITTO, and DB2. Indeed, MVS adopted a similar approach to transform itself into OS/390 (now z/OS).

VSE/SP V3 also offered major enhancements, including some first introduced in VSE/SP V2. For example, VSE/SP V3 included a new librarian, conditional JCL, and Virtual Address Extensions (VAE). VAE was an attempt to extend the capacity of VSE. It provided up to 3 address spaces, each with no more that 16 MB. Each address space contained all common and shared space. During this period, IBM moved toward a capacity-based software pricing model.



Compact tape cartridges begin to replace traditional reel-to-reel tapes.

In 1987, an imaginary VSE/SP V3 customer might have an IBM 9370 Model 60 with 8 MB of main memory, 6-8 IBM 9332 (185 MB per actuator) disk drives, and a 9347 tape unit.

Tape processing declined. Tapes were largely used for backup, archiving, and data interchange. With the IBM 3480, self-contained, easy-to-handle, cartridges (‘square’ tape) replaced traditional reel-to-reel (‘round’ tape) media.

During the 1980s, some customer applications began to bump up against the limitations of the S/370 24-bit (16 MB) architecture. S/370-XA (eXtended Architecture) extensions added 31-bit (2GB) real and virtual addressing in response to customer needs. Because VSE/SP did not implement 370-XA architecture, it began to look as if VSE might be left behind.

The 1990s

The ES/9000 was announced in September 1990. The ES/9000 family included three design points: a rack-mounted ES/9221, an air-cooled ES/9121, and a water-cooled ES/9021. ES/9000 processors implemented Enterprise Systems Architecture (ESA), an extension of 370-XA.

An IBM 3390 DASD subsystem

To the delight of VSE customers, VSE experienced a major revitalization in the 1990s. VSE/SP became VSE/ESA Version 1. VSE/ESA V1 kept the best parts of VSE/SP and focused on quality, capacity, and MVS 'affinity'.

For increased capacity, VSE/ESA V1 first implemented 31-bit for real memory, then added 31-bit virtual addressing. VSE/ESA V1 offered dynamic partitions (limited by available tasks). VSE/ESA V1 offered virtual storage constraint relief (VSCR) by moving ACF/VTAM and POWER out of shared partitions. It introduced dynamic channels (the XA channel subsystem), ESCON channels, and up to 1024 devices for added I/O bandwidth. In later releases, VSE/ESA V1 added support for ESA data spaces and Virtual Disk in storage. VSE/ESA V1 exploited ESA access registers. New versions of CICS/VSE, ACF/VTAM, and VS COBOL II were added for greater MVS affinity.

The lab began to work closely with ISVs. Prior to VSE/ESA, ISVs had to wait like everyone else until General Availability. Only then could they adapt their own products to the latest VSE release. The result was that few customers could exploit the latest release of VSE until the ISVs changed their products. The delay served no one's interest. The practice is now to involve ISVs as soon as possible. ISVs have early access to VSE plans, design specifications, and code.

A rack mounted, air-cooled ES/9221 with rack mounted disk and tape.

In 1993, an imaginary VSE/ESA V1.3 customer might have an IBM ES/9221-150 with 128MB of main memory, 8 IBM 9336 (470 MB per actuator in early models) disk drives, and an IBM 3490 tape unit.

VSE/ESA V1 also established itself in distributed processing. Distributed capabilities, many of which were first introduced in VSE/SP V4, allowed VSE systems to be managed from a central location. During the 1990s, several large IBM customers were able to manage enormous numbers of remote IBM MicroChannel/370 (9371) systems. However, this proved to be a temporary 'niche'. For some customers, consolidated, centralized solutions replaced distributed ones. For others, newer network technology replaced the comparatively rigid, centrally managed approach.

In 1994, after many 'experts' had declared 'big iron' dead, IBM boldly reinvented the mainframe. At the time, the fastest systems used bipolar semiconductor technology. Unfortunately, bipolar has the disadvantage of being expensive and using lots of power (more heat). Large mainframe systems based on bipolar technology often required large water-cooling units.

The alternative technology, CMOS, was comparatively slow (at the time), but used less electricity (less heat). In addition, since it was more widely used, CMOS components were cheaper to design and build. IBM was confident that CMOS technology would advance quickly and eventually surpass bipolar. The decision turned out to be the right one. In 2005 the most powerful zSeries servers (the z990) are based on CMOS.

An IBM 9672 G1 server

The IBM S/390 Parallel Enterprise Server G1 was introduced in 1994. More powerful S/390 CMOS models followed quickly. S/390 Servers also featured an Open Systems Adapter (OSA) for fast, economical network connectivity.

To exploit IBM's CMOS servers, VSE/ESA V2 replaced V1 in 1994. VSE/ESA V2 introduced the Turbo dispatcher. For the first time VSE supported n-way servers. VSE/ESA V2 also introduced Language Environment technology and newer levels of COBOL, PL/1, and C for increased MVS affinity. ACF/VTAM V4.2 was added as well.

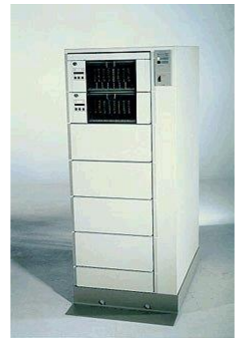
IBM also used S/390 technology to create systems designed for smaller customers. For example, in 1996 the IBM S/390 Multiprise 2000 offered up to 5 processors (CPs), up to 288 GB internal disk (using 3380/3390 ECKD format), and OSA adapters. The Multiprise 2000 was a very good match for many VSE customers.

An IBM Multiprise 2000 with the signature yellow 'speed bump'.

VSE/ESA V2.2 shipped in late 1996. It was the first VSE to be 'Year 2000' ready.

The Year 2000 'problem' had its origins in the early days of S/360 when memory was a precious resource and 2000 seemed far in the future. Widespread practice was to store and process only the last two digits of the year. For example, "1972" was stored as "72", "1996" was "96", and "2000" was "00". As 2000 approached, systems and business applications were exposed. For example, subtracting 72 from 96, the correct answer is 24. However, subtracting 72 from 00, the answer is negative 72 (mathematically OK, but incorrect for its intended use). This simple, seemingly trivial mistake had the potential to seriously disrupt both the financial integrity and the operational effectiveness of many companies.

During this period, TCP/IP became the de facto standard for networking. In 1997, VSE/ESA V2.3 introduced a native TCP/IP (licensed from CSI International) implementation.


An IBM 3490E Magnetic Tape Subsystem

In 1998, an imaginary VSE/ESA V2.3 customer might have an IBM Multiprise 2000 with 2 CPs, 1 GB of main memory, up to 288 GB of internal disk drives (3380 or 3390 format), and an IBM 3490E tape unit.

VSE/ESA V2.4 launched CICS Transaction Server for VSE/ESA (although CICS/VSE continued to ship along with CICS TS VSE/ESA for compatibility reasons). Because CICS TS VSE/ESA was built on the same code base as the equivalent MVS product, it represented a major expansion of MVS affinity.

Many VSE customers spent the last years of the 1990s enabling their systems and applications to be ‘Year 2000 ready’.

The 2000s

In late 1999, the S/390 Multiprise 3000 (based on G5 technology) replaced the earlier Multiprise 2000. The Multiprise 3000 offered 1 or 2 processors (the second processor could be configured as either a CP or as an Integrated Facility for Linux – IFL) and up to 216 GB internal disk (with 3380/3390 ECKD format) in a single frame. The Multiprise 3000 was popular among VSE customers. In fact, at the time of this article (early 2005), many VSE customers still have these systems installed.

In late 1999, IBM also introduced the innovative IBM TotalStorage Enterprise Storage Server (also known as Shark). With fast channels and large cache memory, ESS yielded superb I/O performance. ESS delivered impressive capacity and scalability as well. The ESS design featured redundant components and RAID options for high availability. Finally, advanced copy features such as FlashCopy and PPRC helped improve operations. Shark set a new standard in mainframe disk storage.

An IBM TotalStorage ESS (Shark)

On New Year's Eve 1999, the lab had extra staff available to handle whatever emergencies might arise as midnight on January 1, 2000 began in the Pacific and then circled the globe. The critical moment came and went. Nothing much happened. After a while, the extra staff simply went home to their families. Apparently, customer efforts in the last years of the 1990s actually worked.

In the early 2000s, IBM introduced the IBM eServer zSeries 900 and 800 mainframes. Later, the z990 (2003) and z890 (2004) were added to the zSeries family. zSeries servers offer ESCON, FICON, and Fiber Channel Protocol (FCP) channels.

The IBM System z9 Business Class (z9 BC) is the latest in a distinguished line of VSE mainframes. The z9 BC is a cost/effective offering with greater capacity, added granularity, and new connectivity options and hardware-assisted encryption capabilities when compared with the z890. The z9 BC offers up to seven processors and 73 capacity settings, along with 8 – 64 GB main memory. The z9 BC Model R07 can have 1 - 3 central processors (CPs) and 0 - 6 Integrated Facility for Linux (IFL) specialty engines. The z9 BC Model S07 can have 0 - 4 CPs and 0 - 7 IFLs. CPs can run z/VSE and z/VM, IFLs run only Linux plus z/VM. In all cases the sum of CPs and IFLs cannot exceed 7.

An IBM eServer zSeries 890

In 2000, few customers have VSE and nothing else. Most have several kinds of server platforms installed. Hybrid applications (involving one or more platform) use data and/or processing logic from a number of local or remote platforms. As a result, interoperability between VSE and other commonly used platforms became a key requirement.

With the introduction of VSE/ESA V2.5 in 2000, VSE added interoperability to the VSE objectives of quality, capacity, and z/OS affinity. VSE/ESA V2.5 included e-business connectors at no extra charge. These connectors have components that run on VSE, plus Java-based components designed to run on another platform. Because they are based on open and industry standards, VSE connectors allow each VSE customer to construct hybrid solutions using their platform(s) of choice. Hybrid solutions can involve VSE plus Linux on zSeries, VSE plus Linux on xSeries, VSE plus AIX on pSeries, etc.

Linux on zSeries emerged as a serious option for cost-effective, industrial-strength on demand solutions as well as infrastructure simplification. Some VSE customers began to exploit Linux on zSeries to supplement the capabilities of their basic VSE environment. VSE connectors and IBM Middleware supply programming interfaces based on open and industry standards. zSeries HiperSockets provide high bandwidth. IFLs can offer robust, low cost servers. Finally, z/VM brings it all together by providing a flexible and manageable environment for multiple Linux images.

An IBM TotalStorage 3494 Virtual Tape Server

In 2005, VSE/ESA V2 became z/VSE V3. Like z/VM and Linux on zSeries, z/VSE V3.1 supports FCP-SCSI disks. New or enhanced storage support includes IBM TotalStorage 3494 Virtual Tape Server, 3494 Tape Library, plus DS8000 and DS6000 series disk. z/VSE V3.1 also supports new Advanced Copy functions. z/VSE can execute in 31-bit mode only. It does not implement zArchitecture, and specifically does not implement 64-bit mode capabilities. z/VSE is designed to exploit selected features of IBM System z hardware.

In 2005, an imaginary z/VSE V3.1 customer might have an IBM eServer zSeries 890 with 8 GB of main memory, an IFL, IBM TotalStorage ESS (Shark) with 1 TB or more of ECKD and/or SCSI disk, and an IBM 3494 Virtual Tape Server.

In March 2007, IBM delivered z/VSE V4.1. z/VSE V4.1 continued the emphasis on SOA, interoperability, and integration with Linux on System z. z/VSE V4.1 is designed to support z/Architecture and 64-bit real addressing. It does not support 64-bit virtual addressing. z/VSE V4.1 exploits IBM System z9 Enterprise Class (z9 EC - formerly IBM System z9 109) and z9 Business Class (z9 BC) servers, as well as z990, z890, z900, and z800 servers. In addition, z/VSE V4.1 introduced an attractive new pricing metric called Midrange Workload Licence Charge (MWLC) for V4 users running on z9 BC or z9 EC servers.

In 2007, an imaginary z/VSE V4.1 customer might have an IBM System z9 BC server with 16 GB of main memory, Linux on System z running under z/VM on an IFL, an IBM Systems Storage DS8000 with more than 1.1 TB of ECKD and/or SCSI disk attached via FICON Express4/FCP and shared between z/VSE, Linux on System z, and other servers, TS 1120 encrypting tape, and an IBM 7700 Virtualization Engine.


IBM System z10 Busines Class

In October 2008, IBM delivered z/VSE V4.2. z/VSE Version 4 Release 2 is the latest release in the ongoing evolution of z/VSE. z/VSE V4.2 continues the z/VSE focus on scalability, security, interoperability, and service-oriented architecture. It is designed to help protect and leverage existing investments in VSE information assets. At the same time IBM announced the IBM System z10 Business Class (z10 BC), the smaller sister of the IBM System z10 Enterprise Class (z10 EC) announced in February 2008.

In 2008, an imaginary z/VSE V4.2 customer might have an IBM System z10 BC server with 64 GB or more of main memory, thereof 32 GB dedicated to a production z/VSE in one LPAR, as well as additional z/VSE images under z/VM in another LPAR. On the IFL processors, multiple Linux on zSeries under z/VM may serve Web applications, an Information Warehouse, and other consolidated Linux application servers.

The 2010s

z/VSE V4.3 has shipped in November 2010, and z/VSE V5.1 has shipped about a year later, in November 2011. This new version introduced 64-bit virtual addressing among other enhancements. z/VSE V5.2 has shipped in April 2014, and again delivered several new features and enhancements. z/VSE V6.1, has been generally available since November 2015 and has integrated several enhancements to the product including new versions of CICS TS and TCP/IP.

Many customers started to adapt the VSE strategy of leveraging the combination of z/VSE and Linux on z Systems. The strategy embraces a robust z/VSE that helps protect customer investments in core VSE applications, a VSE that uses standards to help integrate VSE and the mainframe into the customer's network, and a VSE that can be extended by exploiting other platforms - including Linux on z Systems.

Where Does VSE Go From Here?

The z/VSE operating system is used by a large number of IBM z Systems customers around the world. Most run a significant portion of their business applications on z/VSE in an LPAR or under z/VM. For that reason, IBM is committed to maintaining proven standards of excellence in the support and maintenance of z/VSE into the future. Customers can continue running their core, proven business-critical applications on z/VSE with confidence.

z/VSE has a heritage of over 50 years of ongoing refinements and innovation. The most current release, z/VSE Version 6.2, is generally available since December 2017 and has integrated several enhancements to the product including new releases of CICS TS and TCP/IP. The focus of z/VSE V6.2 is online transaction processing, security, and connectivity to improve the integration of z/VSE in a heterogeneous environment using web-based business solutions. Together with hardware exploitation, ease-of-use functionality, and support of the latest IBM Z and IBM System Storage technology, z/VSE V6.2 delivers additional functionality that may provide additional benefits to z/VSE clients. It helps clients with growing z/VSE workloads, and allows them to better protect their investments in the z/VSE platform. These newest releases confirm our successful z/VSE **"PIE"** strategy: **P**rotect existing investments, **I**ntegrate with other systems, and **E**xtend for new workloads.

Trademarks

Comments and Questions

Comments or questions on this documentation are welcome. Please send your comments to: zvse@de.ibm.com