System z Hardware Exploitation in z/VSE

Ingolf Salm
salm@de.ibm.com

December 11, 2012

LiveVirtualClass 2012

http://www.ibm.com/zVSE
http://twitter.com/IBMzVSE

Trademarks

The following are trademarks of the International Business Machines Corporation in the United States and/or other countries.

IBM*
IBM Logo*

* Registered trademarks of IBM Corporation

The following are trademarks or registered trademarks of other companies.

Adobe, the Adobe logo, PostScript, and the PostScript logo are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States, and/or other countries.
Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc. in the United States, other countries, or both and is used under license therefrom.
Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.
Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.
INFINIBAND, InfiniBand Trade Association and the INFINIBAND design marks are trademarks and/or service marks of the INFINIBAND Trade Association.
Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.
UNIX is a registered trademark of The Open Group in the United States and other countries.
Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.
ITIL is a registered trademark, and a registered community trademark of the Office of Government Commerce, and is registered in the U.S. Patent and Trademark Office.
IT Infrastructure Library is a registered trademark of the Central Computer and Telecommunications Agency, which is now part of the Office of Government Commerce.

* All other products may be trademarks or registered trademarks of their respective companies.

Notes:
Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.
IBM hardware products are manufactured from new parts, or new and serviceable used parts. Regardless, our warranty terms apply.
All customer examples cited or described in this presentation are presented as illustrations of the manner in which some customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics will vary depending on individual customer configurations and conditions.
This publication was produced in the United States. IBM may not offer the products, services or features discussed in this document in other countries, and the information may be subject to change without notice. Consult your local IBM business contact for information on the product or services available in your area.
All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
Information about non-IBM products is obtained from the manufacturers of those products or their published announcements. IBM has not tested those products and cannot confirm the performance, compatibility, or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.
Prices subject to change without notice. Contact your IBM representative or Business Partner for the most current pricing in your geography.

Notice Regarding Specialty Engines (e.g., zIIPs, zAAPs and IFLs):

Any information contained in this document regarding Specialty Engines ("SEs") and SE eligible workloads provides only general descriptions of the types and portions of workloads that are eligible for execution on Specialty Engines (e.g., zIIPs, zAAPs, and IFLs). IBM authorizes customers to use IBM SE only to execute the processing of Eligible Workloads of specific Programs expressly authorized by IBM as specified in the “Authorized Use Table for IBM Machines” provided at www.ibm.com/systems/support/machine_warranties/machine_code/aut.html (“AUT”).

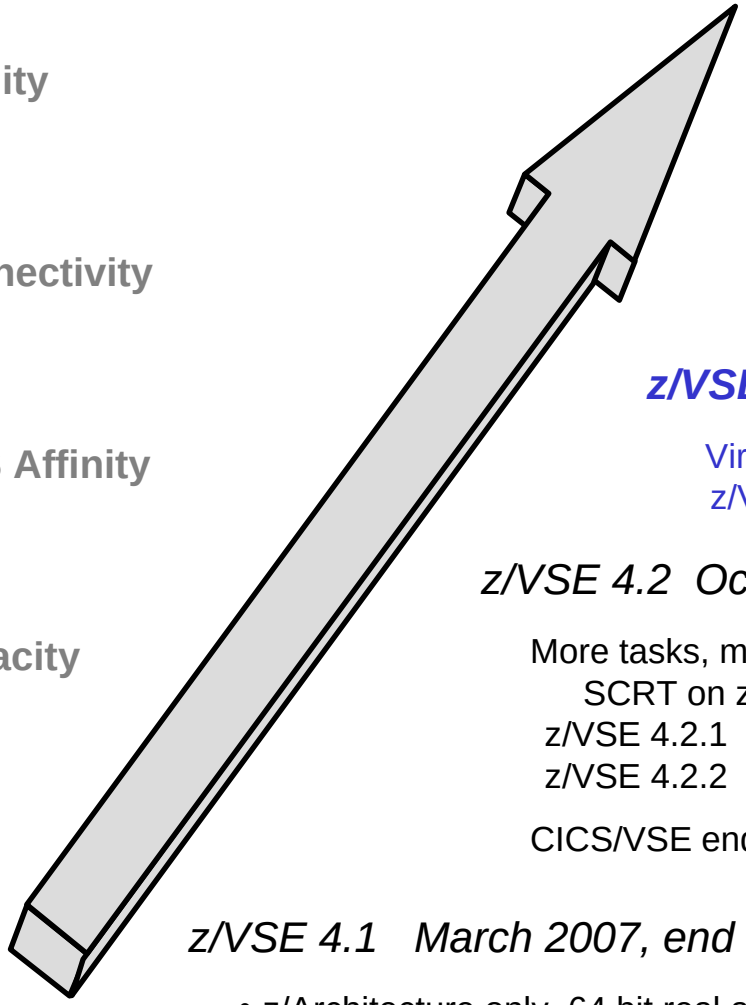
No other workload processing is authorized for execution on an SE.

IBM offers SEs at a lower price than General Processors/Central Processors because customers are authorized to use SEs only to process certain types and/or amounts of workloads as specified by IBM in the AUT.

Agenda

- Roadmap
- VSE strategy
- z/VSE 5.1
- Processor support
- Device support

VSE Roadmap



z/VSE 5.1.1 (+ Enhancements) GA 06/15/2012

- CICS Explorer, LFP in LPAR, database connector

z/VSE 5.1 GA 11/25/2011

- 64 bit virtual, zEnterprise exploitation
- SOD: CICS Explorer, ALS: z9 or higher

z/VSE 4.3 11/2010

Virtual storage constraint relief, 4 digit cuus
z/VSE 4.3.1 08/2011, *end of marketing 06/25/2012*

z/VSE 4.2 October 2008, ***end of service 10/31/2012***

More tasks, more memory, EF for z/VSE 1.1, CPU balancing,
SCRT on z/VSE, SoD for CICS/VSE
z/VSE 4.2.1 07/2009 - PAV, EF for z/VSE 1.2
z/VSE 4.2.2 04/2010 - IPv6/VSE 05/2010

CICS/VSE end of service 10/31/2012

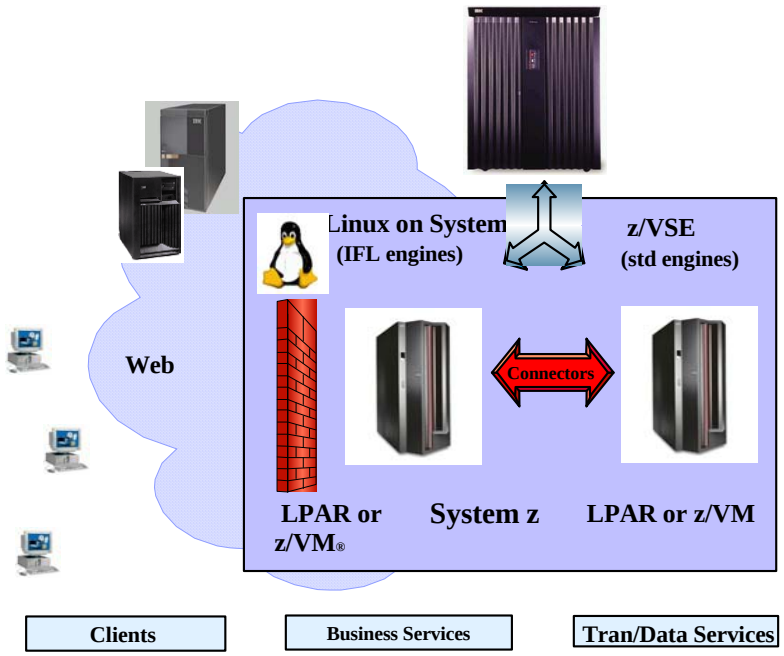
z/VSE 4.1 March 2007, end of service 04/30/2011

- z/Architecture only, 64 bit real addressing,
  MWLC – full and sub-capacity pricing

VSE Strategy

- Helps **Protect** your existing investments in core VSE programs, data, equipment, IT skills, *plus* business processes, end user training, etc.
  - modernize, i.e. extend VSE resources to Web
  - exploit IBM servers, storage, and software
- **Integrate** VSE with the rest of your IT based on open and industry standards
  - (IBM) middleware
  - VSE connectors and web services
- **Extend** with Linux on System z
  - infrastructure consolidation/simplification
  - add new infrastructure and/or line-of-business applications

Why Not Think Inside the Box?



z/VSE V5.1

- z/VSE 5.1: GA 11/25/2011, z/VSE 5.1.1: GA 06/15/2012
- 64-bit virtual addressing
- Introduces Architectural Level Set (ALS) that requires System z9 or later
- IBM zEnterprise 196 (z196), IBM zEnterprise 114 (z114), IBM zEnterprise EC12 (zEC12)
  - Support Static Power Save Mode for MWLC clients with subcapacity option (z196 and zEC12 only)
  - 4096-bit RSA keys with Crypto Express3 for enhanced security
  - Support of OSA-Express for zBX (CHPID OSX) to participate in an Intra Ensemble Data Network (IEDN) in z/VM guest or LPAR
- Exploitation of IBM System Storage options
  - Copy Export function of TS7700 Virtualization Engine for disaster recovery
  - Multi-Cluster Grid support of the TS7700 Virtualization Engine Series (TS7700)
  - IBM Storwize V7000 Midrange Disk System (z/VSE 4.2 and later)
  - IBM XIV (z/VSE 4.2 and later)
- Fast Service Upgrade (FSU) from z/VSE 4.2 and z/VSE 4.3
- Pricing
  - Midrange Workload License Charge (MWLC) pricing with sub-capacity option
  - z114: Advanced Entry Workload License Charge (AEWLC) pricing with sub-capacity option

z/VSE V5.1

- Networking enhancements
  - IPv6 support for Linux Fast Path
  - z/VSE z/VM IP Assist (VIA) exploitation
  - TCP/IP communication using Layer 2 (Data Link Layer)
  - Virtual Local Area Network (VLAN) support for OSA Express and Hipersockets
    - Global VLAN supported by TCP/IP for VSE/ESA and IPv6/VSE
    - General VLAN supported by IPv6/VSE

- IPv6/VSE
  - Large TCP window support, can increase throughput
  - 64 bit virtual exploitation, large TCP window storage allocated above the bar
  - Layer 2 support (OSA Express, IPv6 only)
  - VLAN support

- System management enhancements
  - SNMP Trap Client Extension monitoring – API

- High availability and disaster recovery enhancements
  - Copy Export function of TS7700 Virtualization Engine for disaster recovery
  - Multi-Cluster Grid support of the TS7700 Virtualization Engine Series (TS7700)
  - GDPS (Geographically Dispersed Parallel Sysplex) client (in a z/VM guest)
    - z/VSE supports heartbeat only
    - GDPS K-system can only monitor z/VSE
    - GDPS K-system can manage z/VM and therefore can manage z/VSE indirectly

z/VSE 5.1 Additional Enhancements

- GA 06/15/2012 – contained in z/VSE 5.1.1:
  - CICS Explorer for z/VSE
  - Linux Fast Path in LPAR
  - Linux Fast Path via z/VSE z/VM IP Assist (z/VSE VIA)
  - IBM System Storage Tape Controller 3592 Model C07
  - z/VSE database connector
  - VSE/POWER enhancement to ease job output handling
  - New symbolic parameter IJBVMID containg the z/VM userid if running on z/VM

- New functionality in upcoming PTFs:
  - 64-bit input/output (I/O) processing for applications
  - IPv6/VSE V1.1 enhancements (encryption support)

Supported System z Environments

- z/VSE 4.3 support
  - IBM e-server zSeries processors (z800, z900, z890, z990)
  - IBM System z9 (z9 BC, z9 EC)
  - IBM System z10 (z10 BC, z10 EC)
  - IBM System zEnterprise (z114, z196, zEC12)

- z/VSE 5.1 supports
  - IBM System z9 (z9 BC, z9 EC)
  - IBM System z10 (z10 BC, z10 EC)
  - IBM System zEnterprise (z114, z196, zEC12)

… and can run on
  - uni- and multiprocessors
  - In basic mode (z800, z900 only), in LPAR mode or in z/VM guest
  - z/VSE 4.3 and 5.1 run under all supported z/VM releases.

VSE Support for System z

VSE Release	z800 / z900	z890 / z990	System z9 / z10 / z196 / z114 / zEC12	VSE EoS
z/VSE V5.1	No	No	Yes	tbd
z/VSE V4.3	Yes	Yes	Yes	tbd
z/VSE V4.2	Yes	Yes	Yes	10/31/2012
z/VSE V4.1	Yes	Yes	Yes	04/30/2011
z/VSE V3.1	Yes	Yes	Yes	07/31/2009
VSE/ESA V2.7	Yes	Yes	Yes	02/28/2007
VSE/ESA V2.6	Yes	Yes	Yes	03/2006
VSE/ESA V2.5	Yes	No	No	12/2003
VSE/ESA V2.4	Yes	No	No	06/2002
VSE/ESA V2.3	No	No	No	12/2001

64 bit real addressing

- Processor storage support up to 32 GB
- 64 bit real addressing only, introduced with z/VSE 4.1
- z/VSE 5.1
  - Virtual address space > 2 GB
  - 64 bit virtual addressing
- Data space size remains at max. 2 GB
- Implementation transparent to user applications
- Performance: 64 bit real can reduce / avoid paging
- Many z/VSE environments can run without a page dataset (NOPDS option)

IBM zEnterprise exploitation

Following functions are not supported in z/VM guests:

- Large page (1 megabyte page) support for data spaces (z10, zEnterprise)
  - Better exploitation of large processor storage, may improve performance
  - No configuration options required
  - Transparent to applications

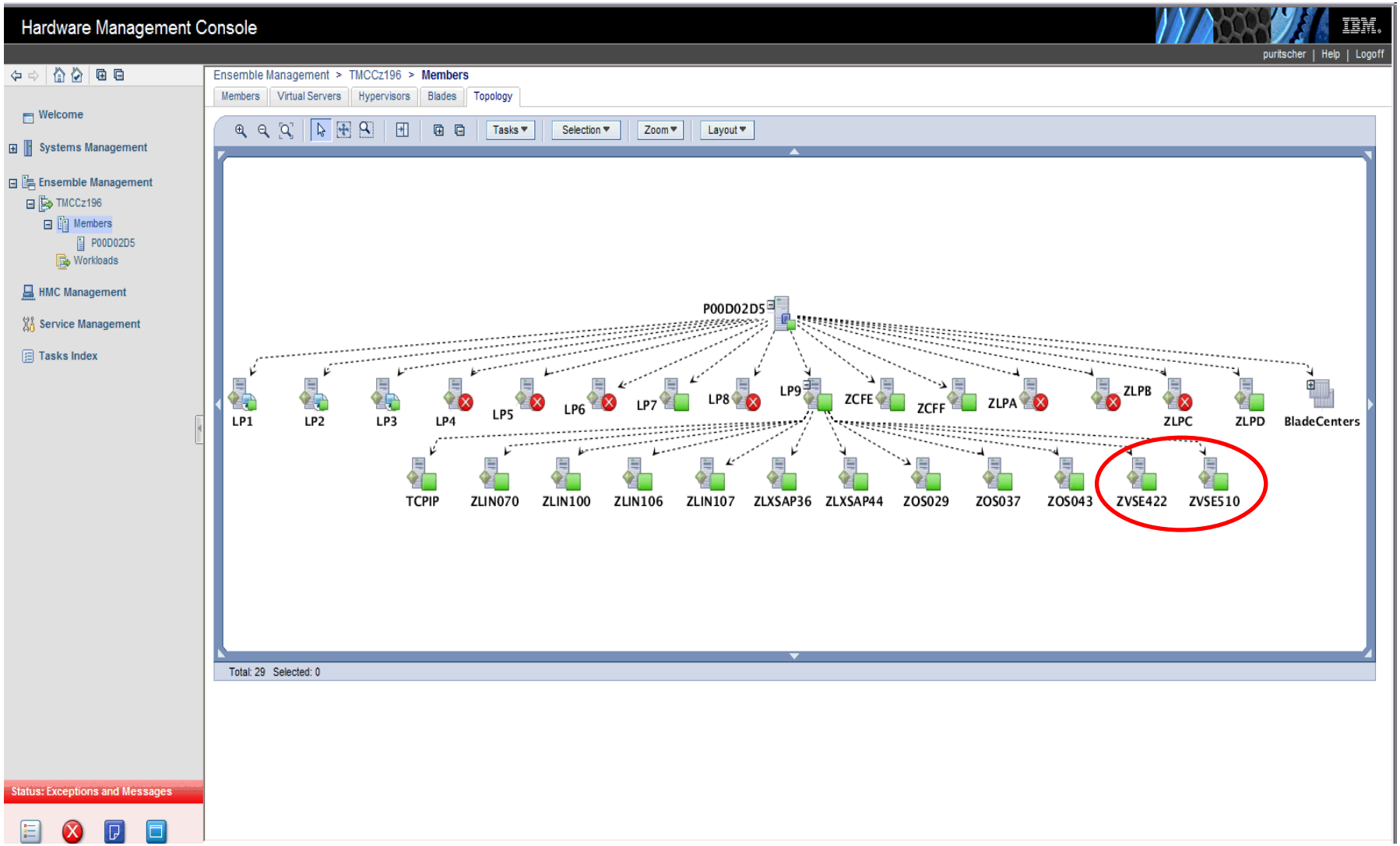
- Dynamic add of logical CPs (z10, zEnterprise)
  - Ability to dynamically add logical central processors (CPs) without preplanning
  - Logical processor add from HMC/SE
  - Allows adding CPs to LPAR without re-IPL of the z/VSE system
  - Capacity of the z/VSE V4.3 system may be in-/decreased dependent on workload needs
  - New SYSDEF TD parameters (STARTSBY / STOPSBY) to manage the additional CPs

```
query td
AR 0015  CPU    STATUS     SPIN_TIME     NP_TIME  TOTAL_TIME  NP/TOT
AR 0015    00   ACTIVE             0       16367       26978   0.606
AR 0015    01   INACTIVE
AR 0015    02   INACTIVE
AR 0015    03   STANDBY
AR 0015                   ----------------------------------------
AR 0015 TOTAL                       0       16367       26978   0.606
AR 0015
AR 0015                  NP/TOT:  0.606       SPIN/(SPIN+TOT):  0.000
AR 0015  OVERALL UTILIZATION:     0%          NP UTILIZATION:     0%
AR 0015
AR 0015  CPU BALANCING:          NOT ACTIVATED
AR 0015
AR 0015  ELAPSED TIME SINCE LAST RESET:        4026069
AR 0015 1I40I  READY
```

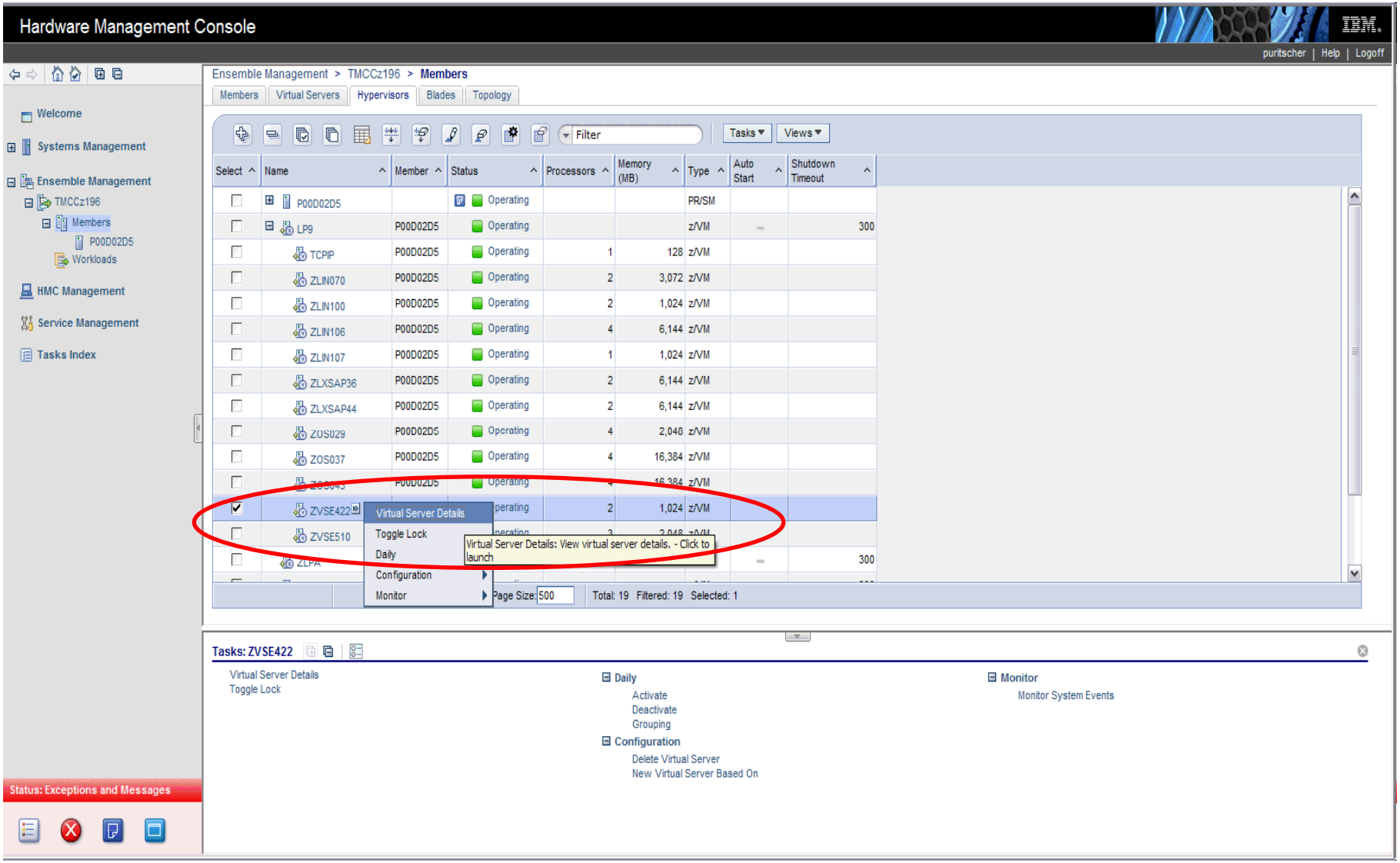
IBM zEnterprise exploitation …

- 4096-bit RSA key support with configurable Crypto Express3 (z10, zEnterprise)
- Crypto Express4S support (z/VSE 5.1 + PTF)
- Linux Fast Path (LFP) in z/VM mode LPAR (z10, zEnterprise)
- Hipersockets Completion Queue (zEnterprise)
- zEnterprise and zEnterprise BladeCenter Extension (zBX) support
  - "native" Intra Ensemble Data Network (IEDN) – z/VSE 5.1
  - IEDN communication using the z/VM VSWITCH – z/VSE V4 and 5.1
- Static power save mode supported for SCRT (z196, zEC 12 only)

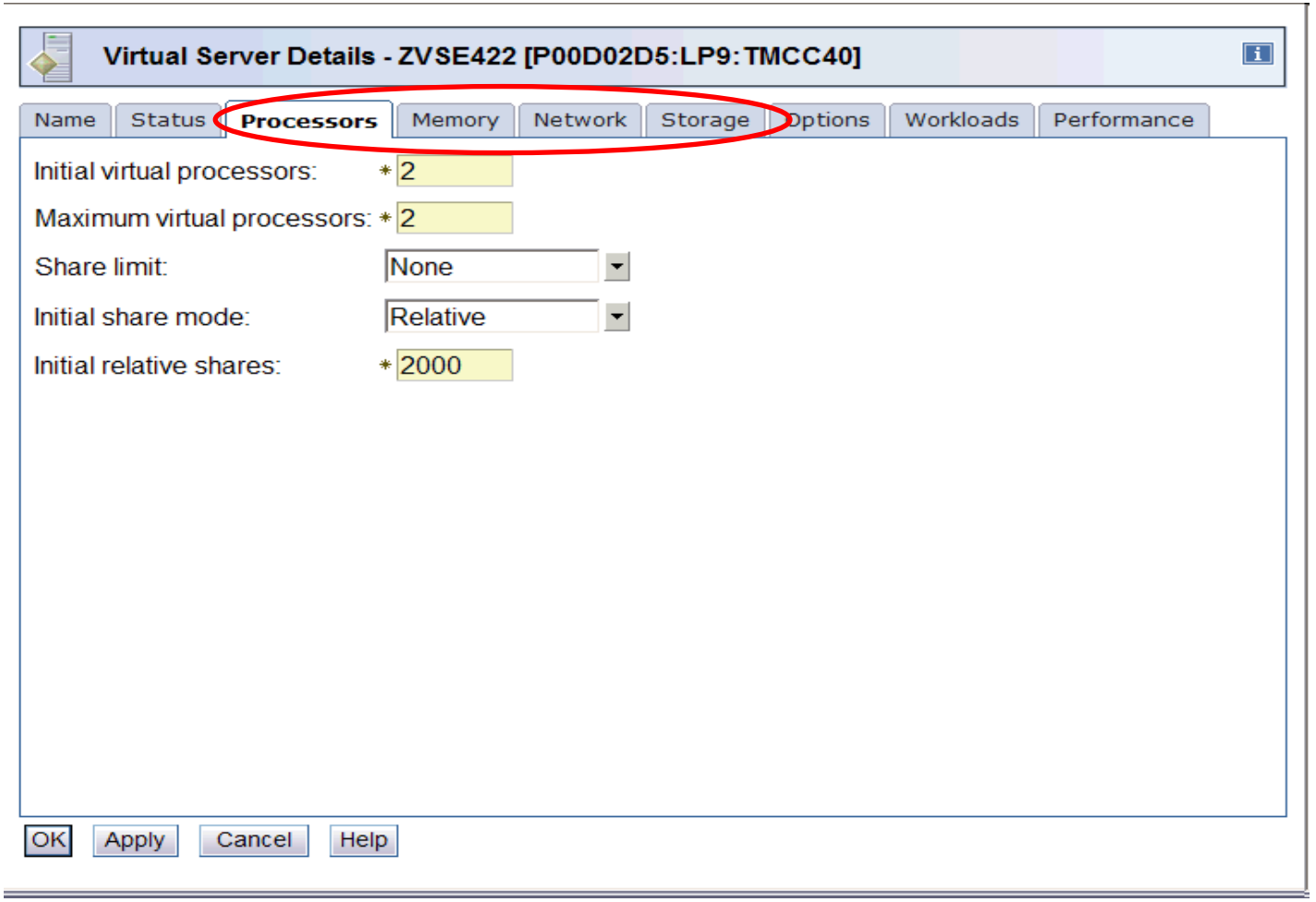
zEnterprise zManager (HMC) and z/VSE



zEnterprise zManager (HMC) and z/VSE



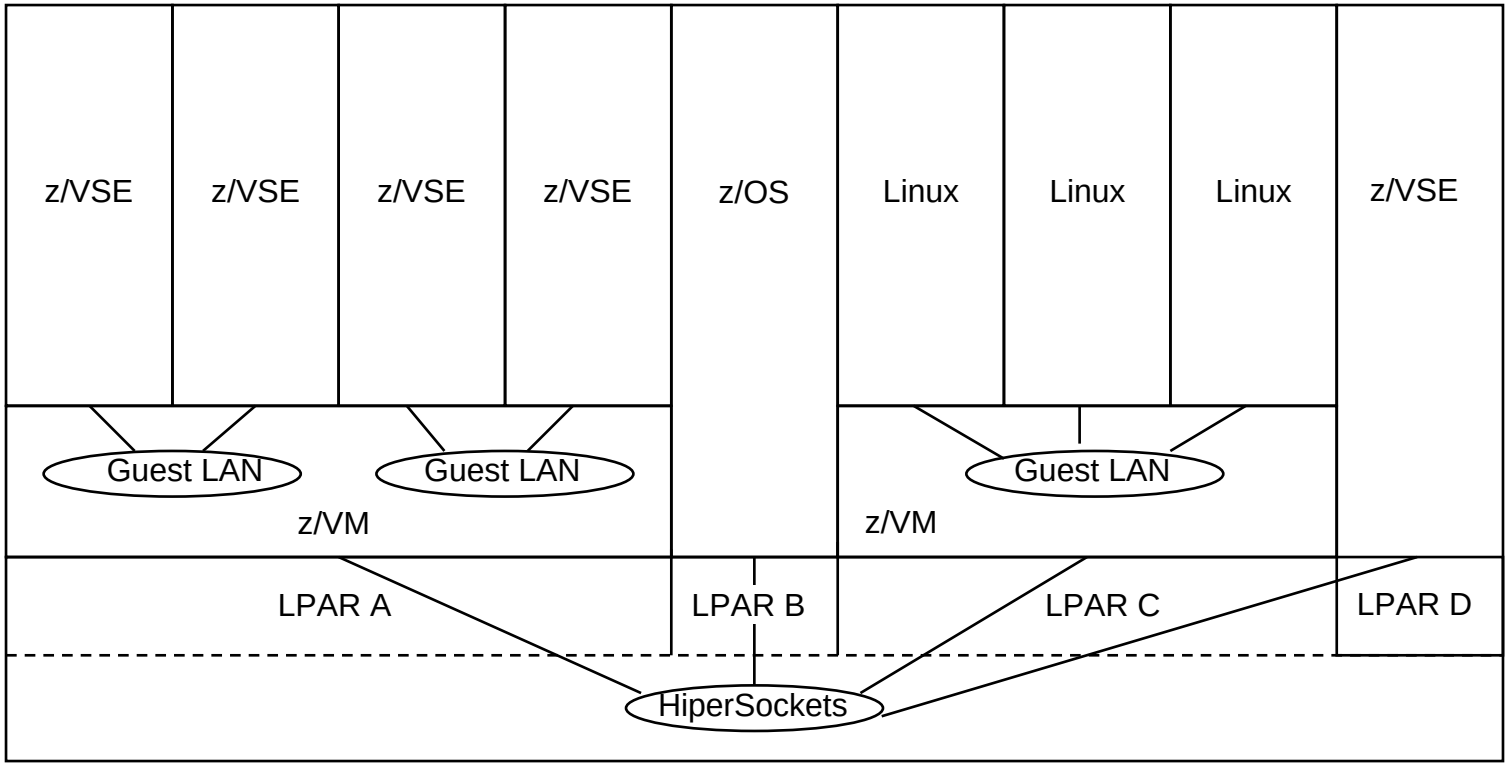
zEnterprise zManager (HMC) and z/VSE



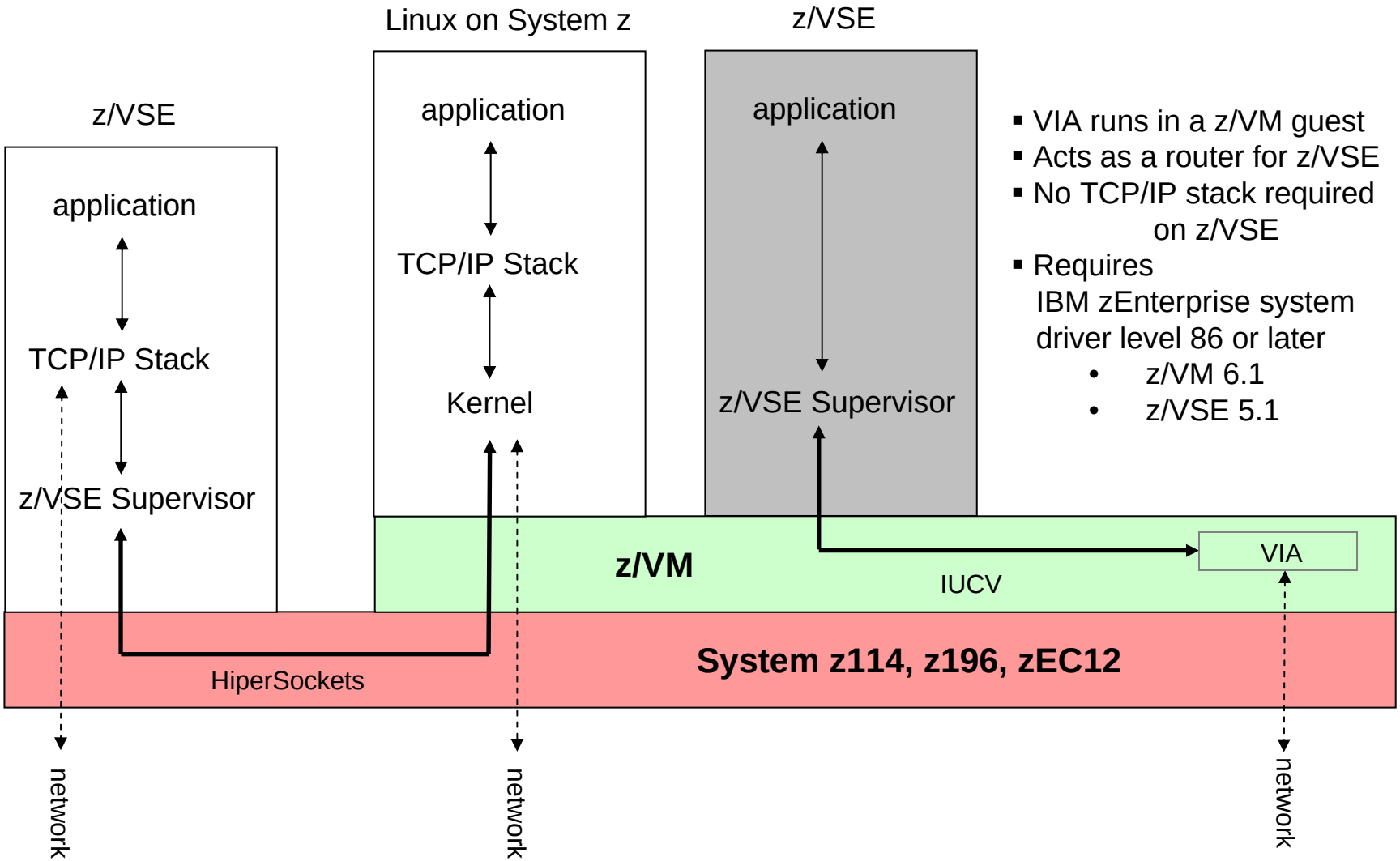
System z HiperSockets

- "network in the box",
  TCP/IP based communication at near memory speed within one system
  - System z Logical Partitions (LPARs)
  - z/VM guests (via virtual guest LAN)
  - z/VM guests and LPARs
- z/VSE may communicate with
  - Linux on System z
  - z/OS
  - z/VM
  - z/VSE V4 or z/VSE 5.1
- Virtual HiperSockets via z/VM Guest LAN support

HiperSockets Example



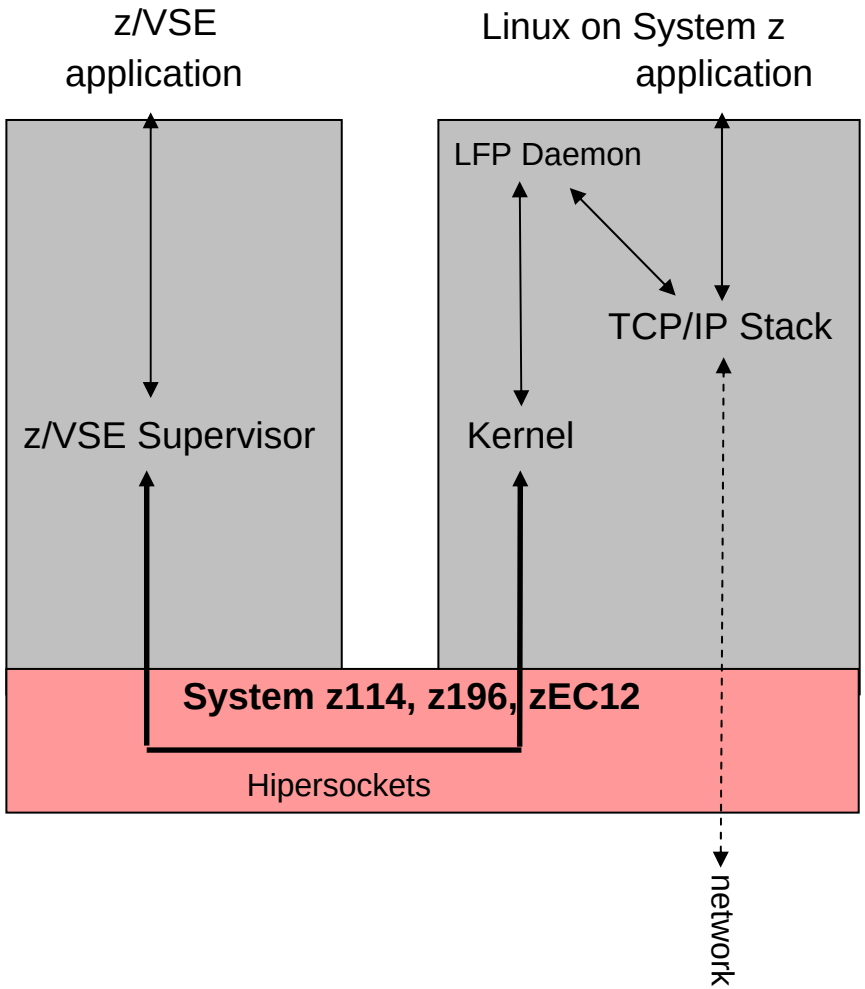
LFP - z/VSE z/VM IP Assist (VIA)



- VIA runs in a z/VM guest
- Acts as a router for z/VSE
- No TCP/IP stack required on z/VSE
- Requires IBM zEnterprise system driver level 86 or later
  - z/VM 6.1
  - z/VSE 5.1

Linux Fast Path (LFP) – Linux Fast Path in LPAR

- No TCP/IP stack required on z/VSE
- System requirements
  - Supported on zEnterprise
    - Exploits HiperSockets completion queue
  - Linux on System z distribution (RHEL, SLES)
  - z/VSE 5.1.1 (z/VSE 5.1 + PTF)



System z Exploitation

- FICON Express8 - Higher I/O bandwidth

- Adapter interruptions (performance improvements)
  - OSA-Express3 / OSA-Express4S (QDIO mode), FICON Express8 (FCP)

- OSA-Express features
  - 10 Gigabit Ethernet, Gigabit Ethernet
  - 1000BASE-T Ethernet (4 modes of operation)
    - ICC (Integrated Console Controller)
    - QDIO (Queued Direct I/O) for TCP/IP traffic
    - Non-QDIO for TCP/IP and SNA traffic
    - OSN (Open System Adapter for NCP) works with
      IBM Communication Controller for Linux on System z

- z/VM queue-I/O assist for real networking devices
  - OSA Express adapters (CHIPID type OSD)
  - Hipersockets (CHIPID type IQD)

OSA Express Support

- OSA-Express for high-speed communication
  - OSA-Express3 on z10, z196, z114, zEC12
  - OSA-Express4S on z114, z196 and zEC12
- OSA-Express for non-QDIO environments (CHPID type OSE)
  - SNA and passthru traffic require configuration via OSA/SF
- z/VSE supports the Gigabit Ethernet (GbE) and 10 Gigabit Ethernet (10 GbE) features
  - To be configured in IOCDS as CHPID type OSD (other CHPID types not supported)
  - Exploited by TCP/IP via DEFINE LINK,TYPE=OSAX command
  - OSA Express3 10 GbE (2 ports), GbE (4 ports)
- Port specification for TCP/IP
  - OSA-Express 10 GbE features: one port per CHPID to connect to the network
  - OSA-Express GbE: two ports per CHPID – port 0 and port 1
    - To use port 0, no port specification is necessary
    - To use port 1, the port needs to be specified, e.g.:
      - DEFINE LINK,TYPE=OSAX,DEV=D00,DATAPATH=D02,OSAPORT=1

System z hardware cryptographic support

- Enhances Internet security
- Encryption support via crypto cards or on the processor itself (CPACF)
- Cryptographic assists
  - Exploited by the SSL support of TCP/IP transparently
  - Encryption Facility for z/VSE (CPACF)
- Transparent for “TCP/IP for VSE/ESA” applications
  - VSE connector server, CICS Web Support, VSE/Power PNET
- No definition necessary

System z hardware cryptographic support …

- CPACF – for symmetric encryption
  - AES for 128-bit keys (z9 EC, z9 BC), AES for 256 keys (z10 EC or higher)
- Crypto Express2 / Express3 / Express4S – for asymmetric encryption
  - Encryption hardware assist for increased SSL throughput
    - Supports SSL handshaking only for applications that use the SSL crypto API
  - Crypto Express4S support (zEC 12, z/VSE 5.1 + PTF)
  - 2048-bit RSA key with Crypto Express2
  - 4096-bit RSA key support with configurable Crypto Express3 (z/VSE 4.3 or higher)
  - Configurable Crypto Express
    - Dynamically configurable in coprocessor or accelerator mode
  - Dynamic change of cryptographic processors
    - Add/remove cryptographic processor of z10 LPAR or higher
  - AP (adjunct processor)-queue adapter-interruption facility
    - May accelerate the SSL throughput

Signal Quiesce (Signal Shutdown) Support

- If e.g. an IML or IPL is performed via the HMC / SE or z/VM SIGNAL SHUTDOWN , a signal-quiesce event is generated.

- Need to be enabled via IPL SYS QUIESCE=YES | NO

- If QUIESCE=YES a message is generated:

```
0W01D DO YOU WANT TO CONTINUE SYSTEM SHUTDOWN (WILL BE FORCED AFTER TIMEOUT)?
REPLY 'YES' TO ENTER HARD WAIT STATE OR 'NO'
```

- If the operator reply is **yes**,
  - The system will enter the disabled wait state
- If the operator reply is **no** or does not reply, the system will wait for a predefined time interval
  - Console automation can initiate a controlled system shutdown

- z/VSE does not provide controlled shutdown processing

4 digit CUUs

- Ease of use and infrastructure simplification
  - In mixed environments running z/VSE together with z/VM, Linux on system z or z/OS
  - Removes the requirement for a z/VSE specific IOCDS configuration
  - Provides more flexibility

- 4 digit CUUs transparent to applications and most system programs
  - Implemented via mapping to 3 digit CUUs during IPL
  - z/VSE will only use 3 digit CUUs after IPL complete

Exploitation of IBM System Storage Products

- IBM System Storage TS1130 / TS1120 Tape Drive
- IBM System Storage TS7700 / TS7720 Virtualization Engine
  - Copy Export function of TS7700 Virtualization Engine for disaster recovery (z/VSE 5.1)
  - Multi-Cluster Grid support of the TS7700 Virtualization Engine Series (z/VSE 5.1)
- IBM System Storage TS3400 autoloader Tape Library
- IBM System Storage TS3500 Tape Library
- IBM TS7680 ProtecTIER Deduplication Gateway for System z
  - Disk-only virtual tape solution
- zVSE supports the S/390 channel command interface via
  - Perform Subsystem Function (PSF)
  - Perform Library Function (PLF) commands

Tape Data Encryption

- IBM TS1120 / TS1130 Tape Drive with encryption feature
  - Supports data encryption within the drive itself
  - Using Systems Managed Encryption with the TS1120 / TS1130
  - z/VSE support will require the **Encryption Key Manager** component running on another operating system other than z/VSE using an out-of-band connection.
    - Generation and communication of encryption keys for tape drive
    - TCP/IP connection between EKM and the tape controller
  - Data encryption is transparent to z/VSE applications
  - Data encryption
    - Data will be encrypted and compressed, when specified
    - Default: encryption disabled
  - Encryption re-keying support to encrypt data key of encrypted tape cartridge

Data Encryption …

- Encryption Key Manager (EKM)
  - EKM is a Java application, used to generate and protect AES keys
  - On request EKM generates AES (256 bit) data keys and protects those keys
  - Key encryption key label (KEKL) identifies the encryption keys
  - The KEKL or the hash value of the public key can be stored on the cardridge.
  - You may download EKM from the internet

- In z/VSE jobs must have an ASSGN statement and KEKL statement to access or write encrypted data

- ASSGN statement
  - ASSGN SYSnnn,cuu,mode
    - cuu = device address
    - mode =
      - 03 encryption wirte mode
      - 0B encryption and IDRC write mode
      - 23 encryption and unbuffered (compression) write mode
      - 2B encryption and IDRC and unbuffered write mode

- KEKL statement
  - // KEKL UNIT=cuu,KEKL1=key_label_1,KEM={L|H}
    - KEM = key encoding mechanism
      - L = label, H = public key hash

Exploitation of IBM System Storage Products …

IBM System Storage DS8000/DS6000 64K cylinder support:

- Allows consolidation of smaller disks volumes
- Supported by BAM and VSE/VSAM
- VSAM supports more than 1,500 clusters per catalog
- VSAM FAT-BIG DASD support
  - **Small DASD** (normal): smaller than 64k tracks per volume
    - 3390 in LISTCAT
  - Large DASD with two subtypes:
    - **Big DASD**: more than 64k tracks per volume
      - BIG-3390 in LISTCAT
      - Support of up to 10017 cylinders
    - **Fat DASD**: up to 64k cylinders
      - FAT-3390 in LISTCAT
      - New type of volume

Parallel Access Volume (PAV)

- Optional licensed feature of DS8000, DS6000, ESS series

- Enables z/VSE to simultaneous process multiple I/O operations to the same volume
  - Can provide enhanced throughput
  - Can help to consolidate small volumes to large volumes

- Multiple logical addresses to the same physical device
  = Base and alias volumes for concurrent processing of I/O operations
  - Configuration in DASD, IOCDS and z/VSE
  - Base device: physical device to be added during IPL
  - Alias device(s) are associated to the base device.
  - z/VSE supports up to 7 alias devices

- Multiple z/VSE jobs can transfer data to or from the same physical volume in parallel

- All z/VSE references to I/O devices (e.g. in JCL) relate to the base device

- In z/VSE PAV processing can be dynamically activated or deactivated via the AR/JCL command SYSDEF PAV=START or STOP

- Max. 1023 I/O devices can be added, if PAV to be activated

FlashCopy Support

- Available on DS8000, DS6000 and ESS
- Source and copied data almost available immediately
- NOCOPY option
  - Direct copy to backup device
- Dataset Copy
  - Source and target volumes may have different sizes
  - Should not be used for VSAM files
- Elimination of Logical Subsystems
  - Source and target volume can span LSS
- Multiple relationship FlashCopy
  - Up to 12 volumes from one source in a single FlashCopy operation

FlashCopy Support …

- IBM System Storage DS8000 FlashCopy SE (Space Efficient)
  - Allocates storage on target volume only “as-needed”, if copied tracks from source volume
- FlashCopy Consistency Group
  - Allows to create a consistent point-in-time copy across multiple volumes
- Supported by ICKDSF only
  - DS8000 Remote Mirror and Copy (RMC)
  - Peer-to Peer Remote Copy (PPRC)
    - Allows remote data replication
- z/VSE does not support:
  - Incremental FlashCopy
  - Persisent FlashCopy relationship
  - Inband Commands over Remote Mirror link

SCSI Support in z/VSE

- SCSI disks as emulated FBA disks on z/VM
  - z/VSE supports a max. size of 2 GB
- Direct attached SCSI disks
  - z/VSE supports up to 24 GB (VSAM: 16 GB)
  - z/VSE supports SCSI disk devices only
  - Impact on applications
    - Transparent to all VSE applications and subsystems,
    - Reasons for transparency:
      - z/VSE's SCSI implementation is based on FBA support
      - applications can not exploit SCSI commands directly
      - FBA to SCSI emulation on low level I/O interface
- SAN Volume Controller (SVC)
  - To access FCP-SCSI disks in DS8000, DS6000, DS4000 and ESS series as well as disk subsystems from other manufacturers supported by SVC
- IBM XIV Storage System
- IBM Storwize V7000 Midrange Disk System

SCSI Support in z/VSE

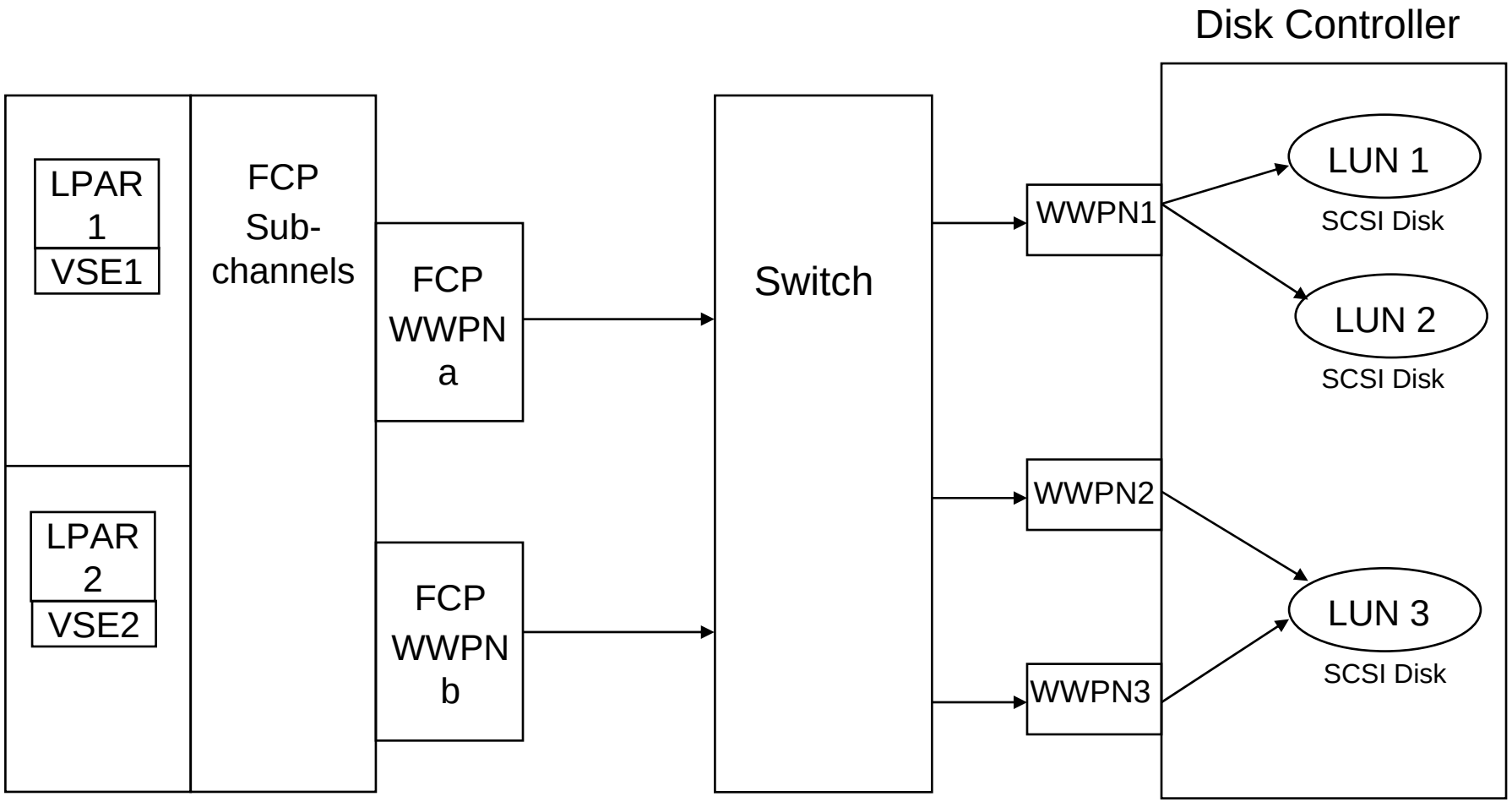
- Access SCSI devices through Fibre Channel Protocol (FCP)
- z/VSE's SCSI support includes:
  - SCSI for system and data device (SCSI only system)
  - Multipathing for fail-over
- SCSI support transparent to existing (I/O) APIs
- SCSI disk devices utilize fixed block sectors
  - Block size restricted to 512 bytes,
    even if the SCSI device can be configured with larger block sizes
- FSU from SCSI to SCSI device only

SCSI Support - Configuration

- IPL / JCL commands and dialog to define and query a SCSI device

- Required steps to get a SCSI device known to z/VSE
  - Device configuration
  - Switch configuration
    - In case of point to point connections (System z9 or higher) not necessary
  - FCP Adapter to be configured in IOCDS (CHIPID type FCP)
  - FCP adapter and SCSI disk to be defined in VSE via
    - IPL ADD commands to define FCP and FBA device
    - IPL DEF or JCL SYSDEF command to define connection to LUN

SCSI Support – Disk Controller Configuration



Point to point connection possible (z9 or higher possible)

More Information

… on VSE home page: http://ibm.com/vse

- z/VSE Planning

- Hints and Tips for z/VSE 4.3:
  - ftp://public.dhe.ibm.com/eserver/zseries/zos/vse/pdf3/zvse43/hintbmm2.pdf

- 64 bit virtual information:
  - IBM z/VSE Extended Addressability, Version 5 Release 1
  - IBM z/VSE System Macro Reference, Version 5 Release 1

- CICS Explorer: http://www-01.ibm.com/software/htp/cics/explorer/

- IBM Redbooks:
  - Introduction to the New Mainframe: z/VSE Basics
    http://www.redbooks.ibm.com/abstracts/sg247436.html?Open
  - Security on IBM z/VSE – updated
  - http://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/sg247691.html?Open
  - z/VSE Using DB2 on Linux for System z
  - http://www.redbooks.ibm.com/abstracts/sg247690.html?Open

Спасибо
Russian

धन्यवाद
Hindi

Bedankt
Nederlands

شكراً
Arabic

Merci
French

Obrigado
Brazilian Portuguese

Thank You
English

Gracias!
Spanish

多谢
Simplified Chinese

Danke
German

多謝
Traditional Chinese

ありがとうございました
Japanese

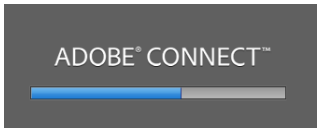
감사합니다

Thank You

Please forward your questions or remarks to

zvse@de.ibm.com
salm@de.ibm.com

z/VSE Live Virtual Classes



z/VSE @ http://www.ibm.com/zvse/education/

LINUX + z/VM + z/VSE @ http://www.vm.ibm.com/education/lvc/

Read about upcoming LVCs on @ http://twitter.com/IBMzVSE

Join the LVC distribution list by sending a short mail to alina.glodowski@de.ibm.com