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# IBM System z Technical University

Enabling the infrastructure for smarter computing

## System z Hardware Exploitation in z/VSE

zDG05

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## *Agenda*

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

## VSE Roadmap

Quality

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

- CICS Explorer, LFP in LPAR, database connector

Connectivity

### **z/VSE 5.1 GA 11/25/2011**

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

z/OS Affinity

### **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*

Capacity

### **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*

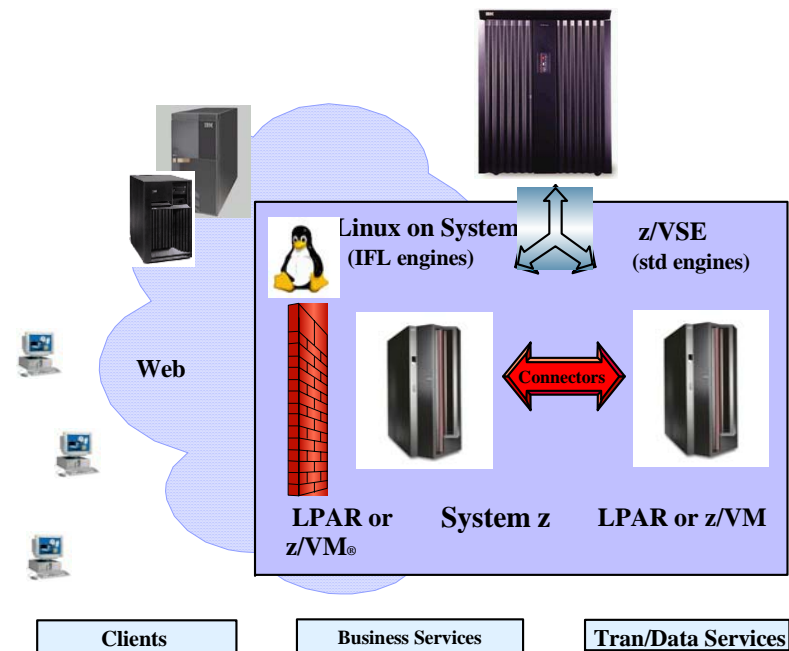
### **z/VSE 4.1 March 2007, *end of service 04/30/2011***

- 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 4.3

- Preview: 10/2009, GA: 11/26/2010
- z/VSE 4.3.1 GA: 08/12/2011
  
- Virtual storage constraint relief for 24 bit (CICS) programs
  
- 4 digit device addresses (cuus)
  
- IBM System z10 / z196 / z114 / zEC12
  - Dynamically add of CPUs
  - Large (1 megabyte) page support
  - FICON Express 8
  
- IBM System Storage support
  - DS8000 Remote Mirror and Copy (RMC) support through ICKDSF
  
- Basic Security Manager (BSM) will allow to protect MQ resources
  
- Monitoring agent based on SNMP (Simple Network Management Protocol)
  
- Pricing:
  - Sub-Capacity Reporting Tool (SCRT) – available on z9 / z10 / z196 / z114 / zEC12
  - Midrange Workload License Charges (MWLC) with sub-capacity option
  - z114: Advanced Entry Workload License Charge (AEWLC) pricing with sub-capacity option
  
- FSU from z/VSE 4.1 and 4.2



## z/VSE V5.1

- z/VSE 5.1: Preview 04/12/2011, Announcement 10/12/2011, 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 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 V5.1 ...

### ▪ System enhancements

- Language Environment enhancements
  - PL/I multitasking enhancements
  - C run-time socket API to include IPv6 related functions
  - Callable service sample for programs
  - Additions to system programmer C samples
  - Updated LE/C support for Librarian Members, and updates to the CEETRACE utility.
- E-business connector enhancements
  - VSE Script Connector to support LIBR access
- VSE/POWER
  - Token as new job attribute to address spooled output
- VTAPE enhancements
  - VTAPE Auto Close at EOJ dependent on new SCOPE keyword
  - SCOPE= SYSTEM or JOB
- TAPE UNLOAD at EOJ (TAPE UNL=EOJ)

### ▪ CICS - Statement of general direction (SOD):

- IBM intends to provide CICS Explorer capabilities for CICS TS for VSE/ESA, to deliver additional value.

All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice.

## *z/VSE 5.1 Announcement (04/03/2012)*

- IBM z/VSE V5.1 - Additional enhancements available
- Announcement content for
  - GA on June 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)
    - z/VSE database connector
    - VSE/POWER enhancement to ease job output handling
    - IBM System Storage Tape Controller 3592 Model C07
  - (new symbolic parameter IJBVMID containing the z/VM userid if running on z/VM)
  - Later PTFs (after June 15, 2012)
    - 64-bit input/output (I/O) processing for applications
    - IPv6/VSE V1.1 enhancements

## *Supported System z Environments*

- z/VSE 4.2 and 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 4.2, 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
- Virtual address/data space size remains at max. 2 GB
- 64 bit virtual addressing not supported
- 64 bit addressing mode not supported for applications or ISVs
- 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

- 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
  - Not supported in z/VM guests
  
- Dynamic add of logical CPUs (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
  - Not supported in z/VM guests

```

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 NP/TOT: 0.606 SPIN/(SPIN+TOT): 0.000
AR 0015 OVERALL UTILIZATION: 0% NP UTILIZATION: 0%
AR 0015 CPU BALANCING: NOT ACTIVATED
AR 0015 ELAPSED TIME SINCE LAST RESET: 4026069
AR 0015 11401 READY

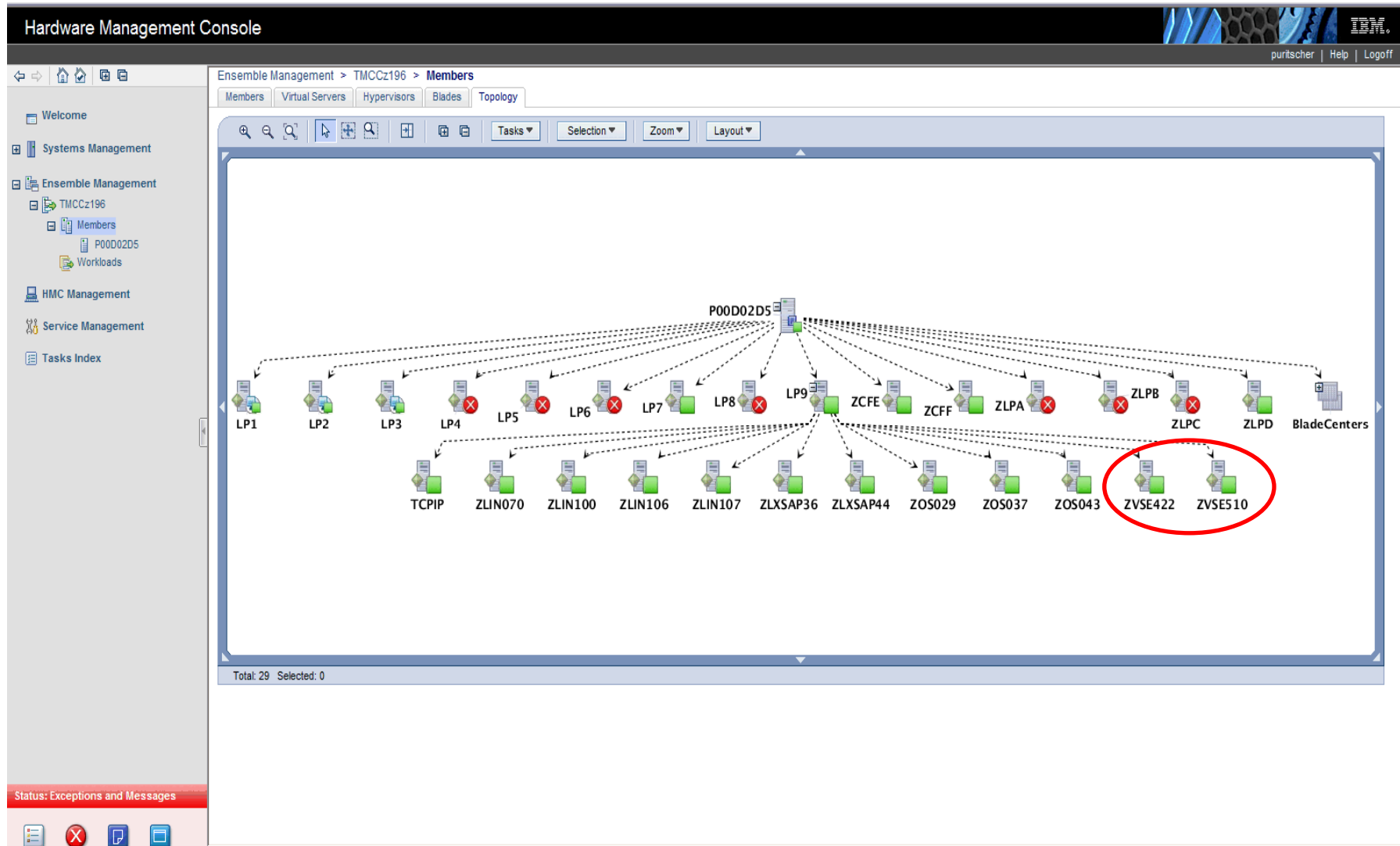
```



## *IBM zEnterprise exploitation ...*

- Linux Fast Path (LFP) in z/VM mode LPAR (z10, zEnterprise)
- 4096-bit RSA key support with configurable Crypto Express3 (z10, zEnterprise)
- Crypto Express4S support (z/VSE 5.1 + PTF)
- 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

Hardware Management Console

Ensemble Management > TMCCz196 > Members

Members Virtual Servers Hypervisors Blades Topology

Select	Name	Member	Status	Processors	Memory (MB)	Type	Auto Start	Shutdown Timeout
<input type="checkbox"/>	P00D02D5		Operating			PR/SM		
<input type="checkbox"/>	LP9	P00D02D5	Operating			z/VM	--	300
<input type="checkbox"/>	TCP/IP	P00D02D5	Operating	1	128	z/VM		
<input type="checkbox"/>	ZLIN070	P00D02D5	Operating	2	3,072	z/VM		
<input type="checkbox"/>	ZLIN100	P00D02D5	Operating	2	1,024	z/VM		
<input type="checkbox"/>	ZLIN106	P00D02D5	Operating	4	6,144	z/VM		
<input type="checkbox"/>	ZLIN107	P00D02D5	Operating	1	1,024	z/VM		
<input type="checkbox"/>	ZLXSAP36	P00D02D5	Operating	2	6,144	z/VM		
<input type="checkbox"/>	ZLXSAP44	P00D02D5	Operating	2	6,144	z/VM		
<input type="checkbox"/>	ZOS029	P00D02D5	Operating	4	2,048	z/VM		
<input type="checkbox"/>	ZOS037	P00D02D5	Operating	4	16,384	z/VM		
<input type="checkbox"/>	ZOS043	P00D02D5	Operating	4	16,384	z/VM		
<input checked="" type="checkbox"/>	ZVSE422	P00D02D5	Operating	2	1,024	z/VM		
<input type="checkbox"/>	ZVSE510	P00D02D5	Operating	3	2,048	z/VM		
<input type="checkbox"/>	ZLPA	P00D02D5	Operating			z/VM	--	300

Virtual Server Details  
 Toggle Lock  
 Daily  
 Configuration  
 Monitor

Page Size: 500 Total: 19 Filtered: 19 Selected: 1

Tasks: ZVSE422

Virtual Server Details  
 Toggle Lock

Daily  
 Activate  
 Deactivate  
 Grouping

Configuration  
 Delete Virtual Server  
 New Virtual Server Based On

Monitor  
 Monitor System Events

Status: Exceptions and Messages

*zEnterprise zManager (HMC) and z/VSE*

Virtual Server Details - ZVSE422 [P00D02D5:LP9:TMCC40]

Name Status **Processors** Memory Network Storage Options Workloads Performance

Initial virtual processors: \* 2

Maximum virtual processors: \* 2

Share limit: None

Initial share mode: Relative

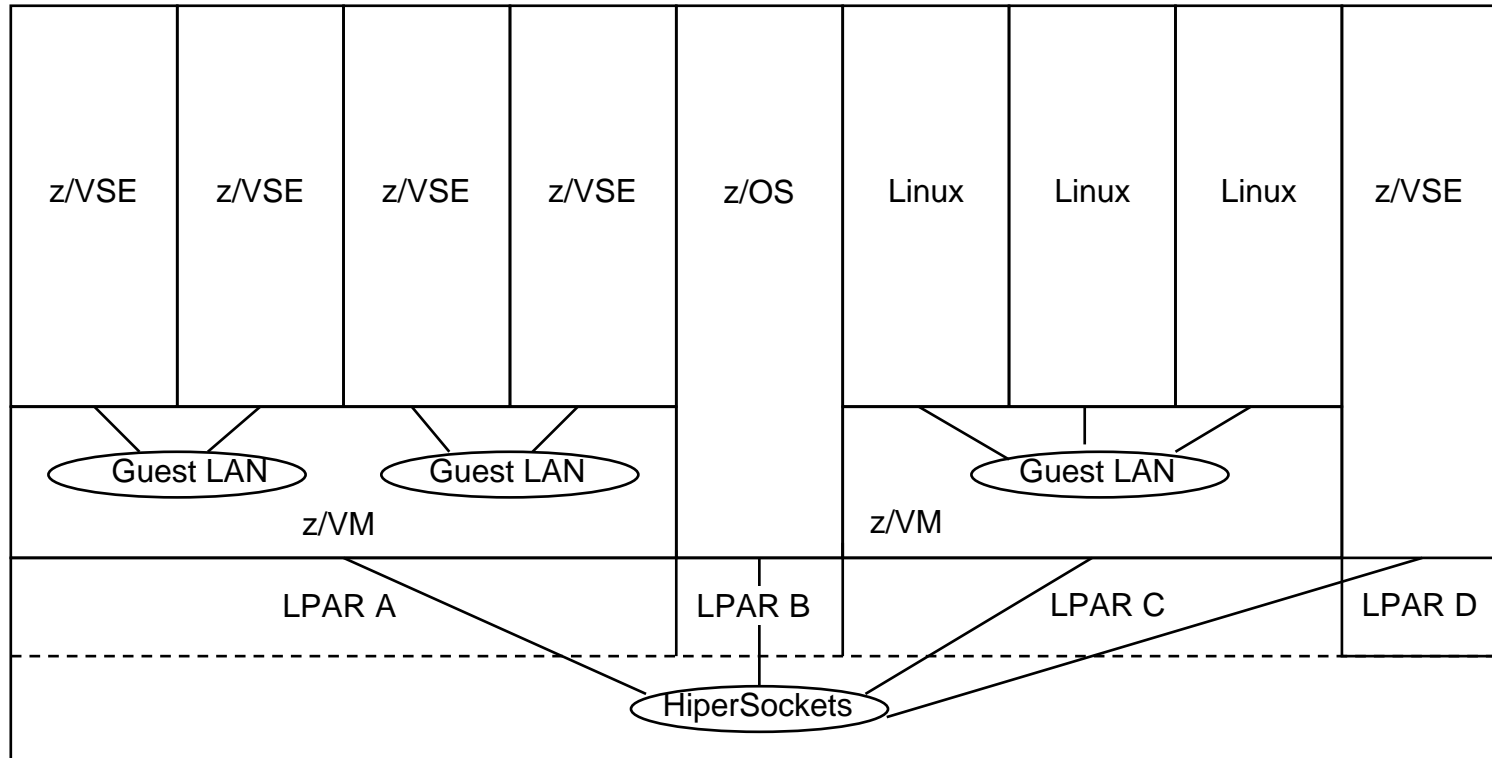
Initial relative shares: \* 2000

OK Apply Cancel Help

## 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

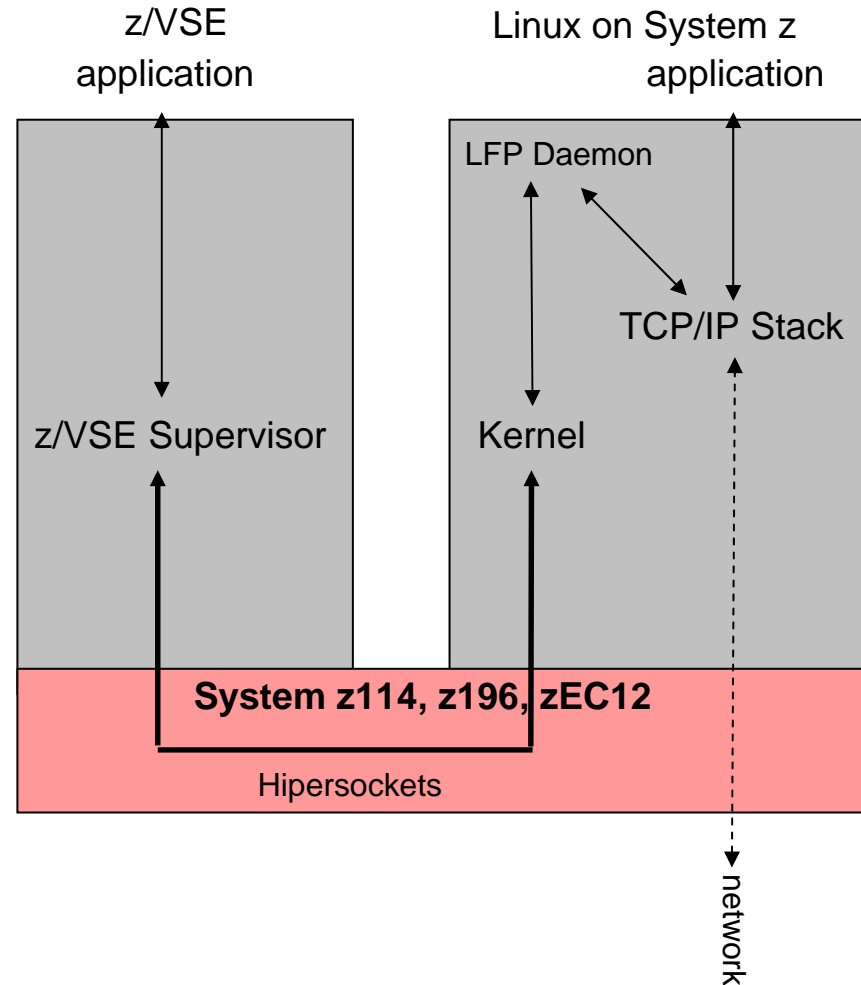
## HiperSockets Example





## 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 Express3 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 for VSE/ESA's transparently
  - Encryption Facility for z/VSE (CPACF)
- Transparent for "TCP/IP for VSE/ESA" applications
  - VSE connector server, CWS, 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



## *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

## *Exploitation of IBM System Storage Products ... Large Volume (64K cylinder) support*

- IBM System Storage DS8000/DS6000 64K cylinder support
  - Supported by BAM and VSE/VSAM
  - Allows consolidation of smaller disks volumes
  
- 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

## Parallel Access Volume (PAV) ...

- Multiple z/VSE jobs can transfer data to or from the same physical volume in parallel
  - A VSE task can only process one I/O at a time
  
- PAV processing can be dynamically
  - Activated via the AR/JCL command `SYSDEF PAV=START`
    - PAV devices will be sensed during START processing

**sysdef system,pav=Start**

```
AR 0028 1K01I ALIAS DEVICE 778 FOR BASE 777 ESTABLISHED
AR 0028 1K01I ALIAS DEVICE 77E FOR BASE 777 ESTABLISHED
AR 0028 1K01I ALIAS DEVICE 779 FOR BASE 777 ESTABLISHED
AR 0028 1K01I ALIAS DEVICE 77A FOR BASE 777 ESTABLISHED
AR 0028 1K01I ALIAS DEVICE 77B FOR BASE 777 ESTABLISHED
AR 0015 1I40I READY
```
  - Deactivated via the AR/JCL command `SYSDEF PAV=STOP`
    - All I/Os on alias devices need to complete, delays possible.
  
- `QUERY SYSTEM` and `SIR AR` commands show, if PAV is active
  - E.g. `QUERY SYSTEM: AR 0015 PARALLEL ACCESS VOLUME (PAV): ACTIVE / INACTIVE`

## Parallel Access Volume (PAV) ...

- VOLUME AR command indicates a base volume via a “\*B” in the CODE column:

### VOLUME

```
AR 0015 CUU CODE DEV.-TYP VOLID  USAGE  SHARED STATUS CAPACITY
....
....
AR 0015 261 6E    2107-900  VIS001 UNUSED          20 CYL
AR 0015 262 6E    2107-900  VIS002 UNUSED          20 CYL
AR 0015 777 6E*B 2105-000  FRA740 UNUSED        10017 CYL
AR 0015 1I40I READY
```

- VOLUME AR command, DETAIL parameter

### VOLUME 777,DETAIL

```
AR 0015 CUU CODE DEV.-TYP VOLID  USAGE  SHARED STATUS CAPACITY
AR 0015 777 6E*B 2105-000  FRA740 UNUSED        10017 CYL
AR 0015          BASE TO 778,77E,779,77A,77B
AR 0015 1I40I READY
```

## *Parallel Access Volume (PAV) ...*

- Alias device cuus can not be added at IPL
  - ADD statement with an alias cuu will be ignored.
- 3 digit cuu limitation apply to base and alias devices
- Planning information:
  - Alias devices make use of copy blocks, channel queue entries and other I/O resources



## Parallel Access Volume (PAV) ...

- Subsystem Monitoring Facility (SMF) shows I/O distribution to base and alias devices
  - Documentation available on [ibm.com/vse](http://ibm.com/vse)
    - Hints and Tips for z/VSE
    - PAV White Paper (available with PAV PTF)

### **SIR SMF,VSE,777**

```

AR 0015 TIMINGS FOR 777 BASED ON          2368 I/O INSTRUCTION
AR 0015 BASE 777                          0 I/O INSTRUCTION
AR 0015 ALIAS 778                          0 I/O INSTRUCTION
AR 0015 ALIAS 77E                          208 I/O INSTRUCTION
AR 0015 ALIAS 779                          310 I/O INSTRUCTION
AR 0015 ALIAS 77A                          832 I/O INSTRUCTION
AR 0015 ALIAS 77B                         1018 I/O INSTRUCTION
AR 0015
AR 0015 QUEUED    PENDING  CONNECT  DISCONN  DEV.BUSY  TOTAL
AR 0015 msec/SSCH msec/SSCH msec/SSCH msec/SSCH msec/SSCH msec/SSCH
AR 0015 0.000    0.000    0.812    0.000    0.000    0.812
AR 0015 1I40I READY
    
```

## 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
  - Exception: z/VM DIAG instruction use 4 digit CUUs

## *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
  - Persistent 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*

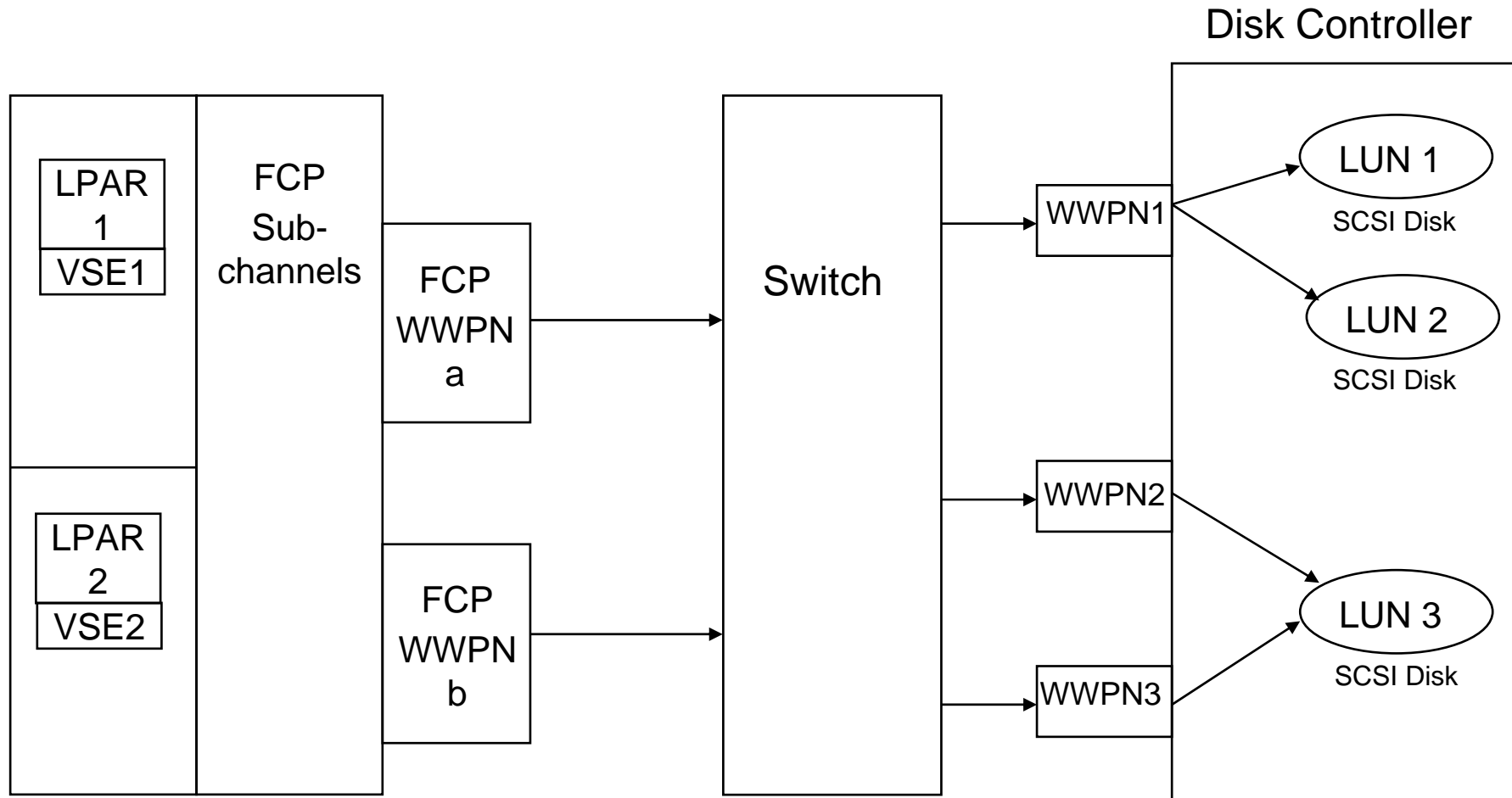
- New IPL / JCL commands and dialog to define and query a SCSI device
- Required steps to get a SCSI device known to z/VSE
  - Device configuration
  - Switch configuration
    - In case of point to point connections (System z9 or higher) not necessary
  - FCP Adapter to be configured in IOCDS (CHIPID 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 Configuration in z/VSE (Example)

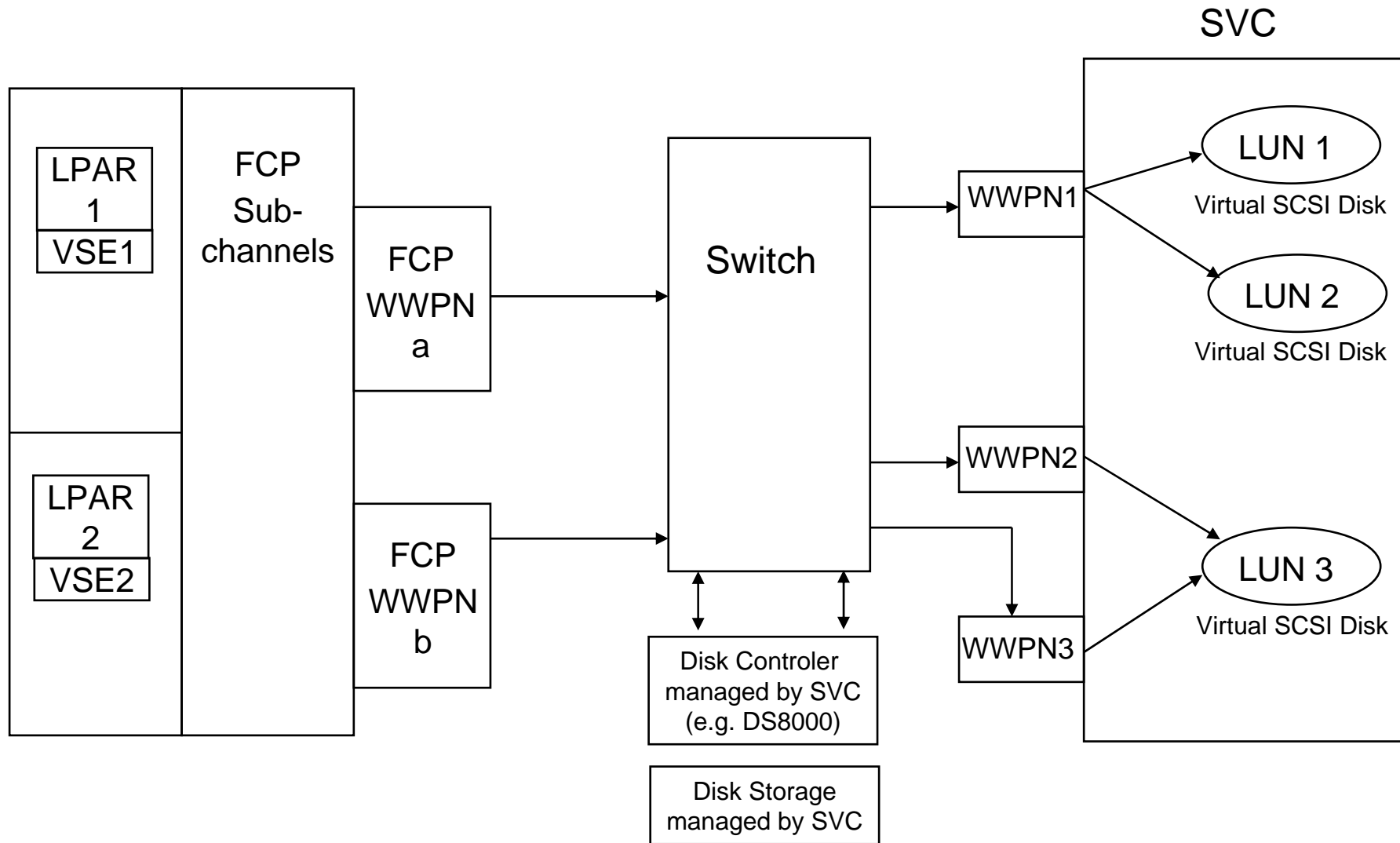
- Define FCP Devices, SCSI Disks and Connection Paths to z/VSE
  - FCP Devices
    - ADD C00,FCP (ADD C00:C0F,FCP)
    - ADD D00,FCP (ADD D00:D0F,FCP)
  - FBA Devices:
    - ADD 700:701,FBA
    - Note: these devices must not exist in the IOCP or under VM
  - Define a Connection Path (IPL)
    - DEF SCSI,FBA=700,FCP=C00,WWPN=5005076300CA9A76,LUN=5600
    - DEF SCSI,FBA=701,FCP=C00,WWPN=5005076300CA9A76,LUN=5601
    - Only one FCP cuu required to access the LUNs
  - Define a Connection Path (after IPL)
    - SYSDEF SCSI,FBA=702,FCP=C00,WWPN=5005076300CA9A76,LUN=5602
    - Note: The FBA and FCP devices added during IPL.
  - IUI Dialogs are available to configure SCSI Devices

## SCSI Support – Disk Controller Configuration



Point to point connection  
with z9/z10 possible

## SCSI Support – SVC Configuration



## SCSI Support

- N\_Port ID Virtualization (NPIV) for (CHPID type) FCP channels (z9 or higher)
  - Multiple virtual FCP channels can be defined each with its own unique Fibre Channel port name and FC N\_Port ID
  - NPIV allows sharing the Lock file on SCSI between multiple z/VSE systems using the same physical FCP adapter (CHPID)
    - DEF SCSI,FBA=600,FCP=C00,WWPN=5005076300CA9A76,LUN=5750 (VSE1)
    - DEF SCSI,FBA=600,FCP=C01,WWPN=5005076300CA9A76,LUN=5750 (VSE2)

600 is the lock file disk. With NPIV, C00 and C01 can be on same FCP CHPID
  - To use NPIV, the Fibre Channel switch must support NPIV
  - Without NPIV,
    - Each FCP channel(device) has the portname of the FCP CHPID
    - Each z/VSE needs its own physical FCP adapter to access the lock file
- FCP point-to-point attachments (z9 or higher)
  - FCP feature can directly attach to storage devices. No switch required.

## 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 cartridge.
  
  - 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 write 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

## Data Encryption ...

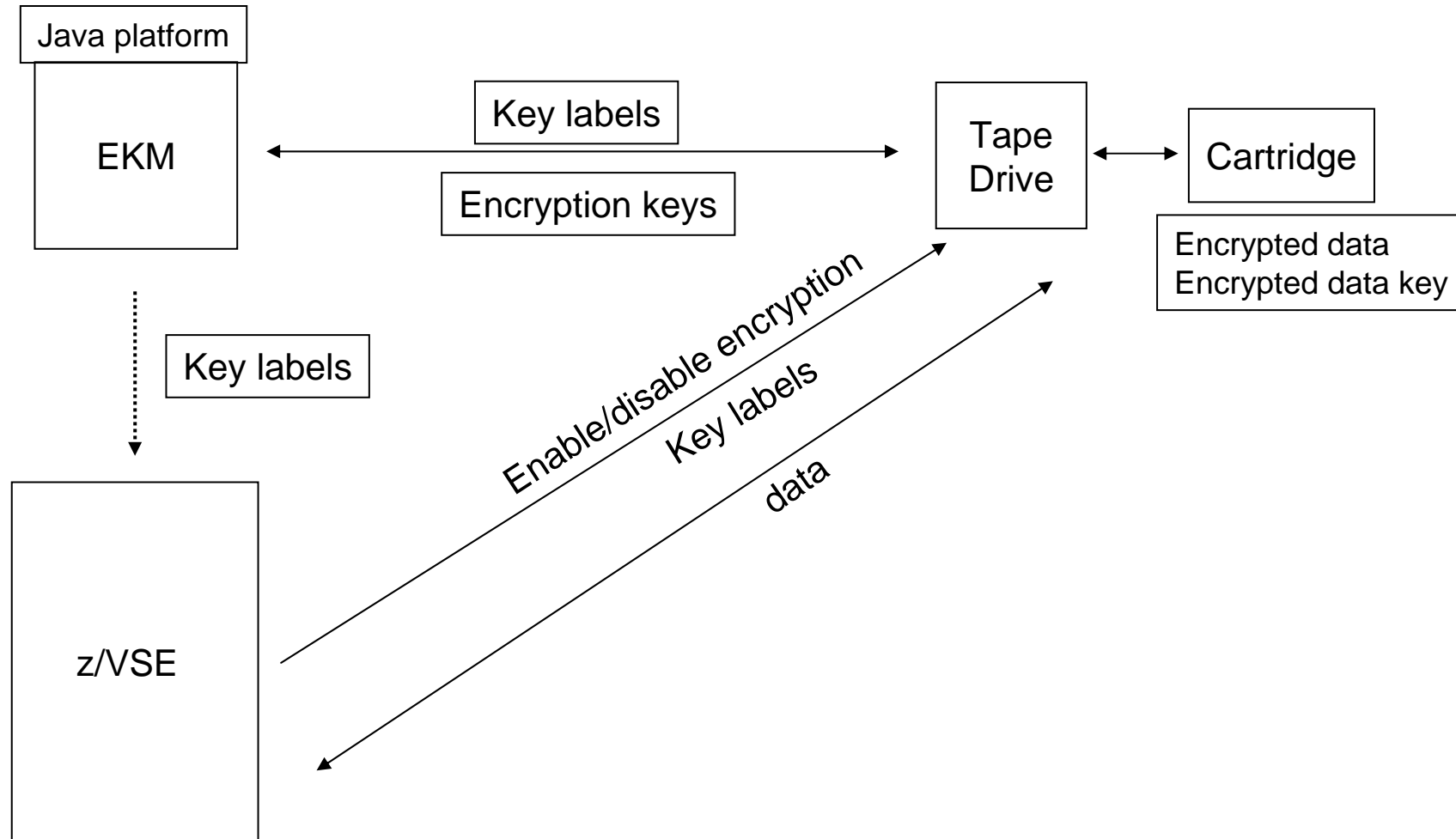
- Write encryption data example
  - // JOB ENCRYPT
  - // ASSGN SYS005,480,3
  - // KEKL UNIT=480, KEKL1=,ISAKEK1',KEM1=L
  - // EXEC LIBR
    - BACKUP LIB=PRD2 TAPE=SYS005
  - /\*
  - /&
  
- Read encrypted data
  - No need to specify the ASSGN mode or KEKL
  - The control unit recognizes the encrypted tape and tries a key exchange with the EKM and the KEKL saved in cartridge memory.

## *Data Encryption ...*

- Steps to encryption
  1. Load cartridge
  2. EKM to tape drive: specify encryption, provide key labels
  3. Tape drive requests data key from EKM
  4. EKM generates key and encrypts with public and session keys
  5. EKM to tape drive: Encrypted keys transmitted
  6. Tape drive writes encrypted data and stores encrypted data key on cartridge
  
- Implementation in z/VSE
  - VSE JCL enhancements
    - For encryption setting (via ASSGN)
    - Key Encryption Key Label (KEKL) may be specified
  - I/O Supervisor
    - retrieves encryption information, activates encryption and transfers KEKL



## Data Encryption ...



## *More Information*

... on VSE home page: <http://ibm.com/vse>

- **Hints and Tips for z/VSE 4.3:**
  - <ftp://public.dhe.ibm.com/eserver/zseries/zos/vse/pdf3/zvse43/hintbmm2.pdf>
- z/VSE Planning
- 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 – new update available**  
<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>