



IBM eServer zSeries

# IBM z/VSE 3.1 and SCSI Performance Considerations

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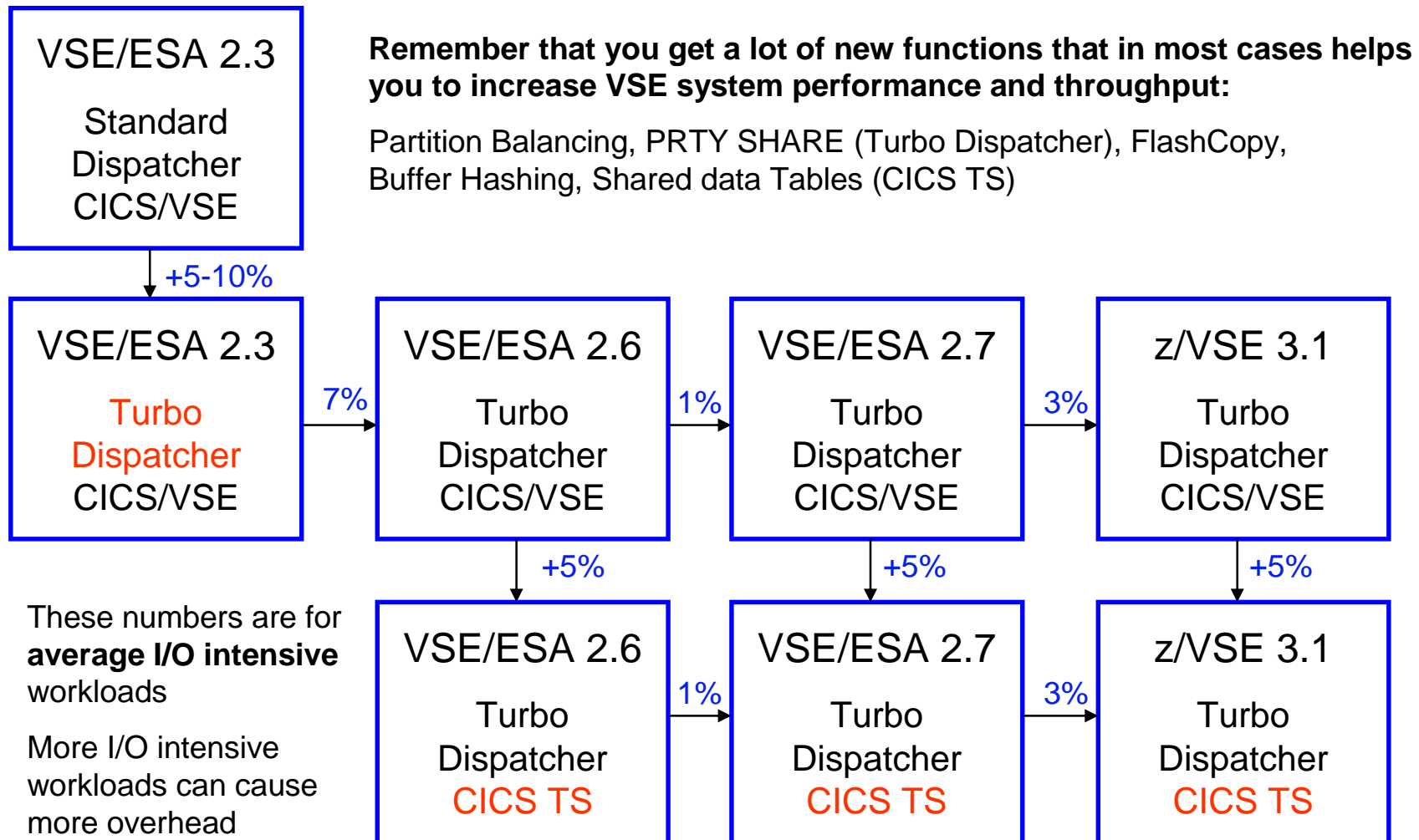
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# Overhead Deltas for VSE Releases



## Hardware and software requirements for SCSI

§ **IBM eServer zSeries 800, 900, 890 or 990**

§ **IBM zSeries FCP Adapter**

– Microcode Level:

- z800 und z900: J11233.015 or higher
- z890 und z990: J13471.004 or higher

§ **FCP Switch (e.g. IBM 2109)**

§ **IBM TotalStorage Enterprise Storage Server (ESS)**

– Microcode Level: 2.3.1 or higher

§ **IBM TotalStorage DS6000 or DS8000**

§ **z/VSE Version 3 Release 1**

§ **z/VM 4.4. or higher (only if VSE runs under VM)**

## Hardware and software requirements for SCSI (2)

### § IPL from SCSI

- CPU Feature Code 9904
- z800 and z900:
  - Microcode Level EC-Number J12811 or higher
- z890 and z990:
  - Microcode Level EC-Number J12221 or higher

### § IPL from SCSI under z/VM 4.4

- z/VM Service Level:
  - UM31181 (English)
  - UM31180 (German)
  - UM31179 (Kanji)

### § Emulated FBA Disks:

- z/VM 5.1

## SCSI disk characteristics

### § Size of a SCSI Disk

- Minimum 8 MB
- Maximum about. 24 GB
- 4 MB are used internally from z/VSE
- Usable size = size – 4 MB
- VSAM can only use the first 16 GB

### § Model

- SCSI Disks are defined as FBA Devices
  - 9336 Model 20

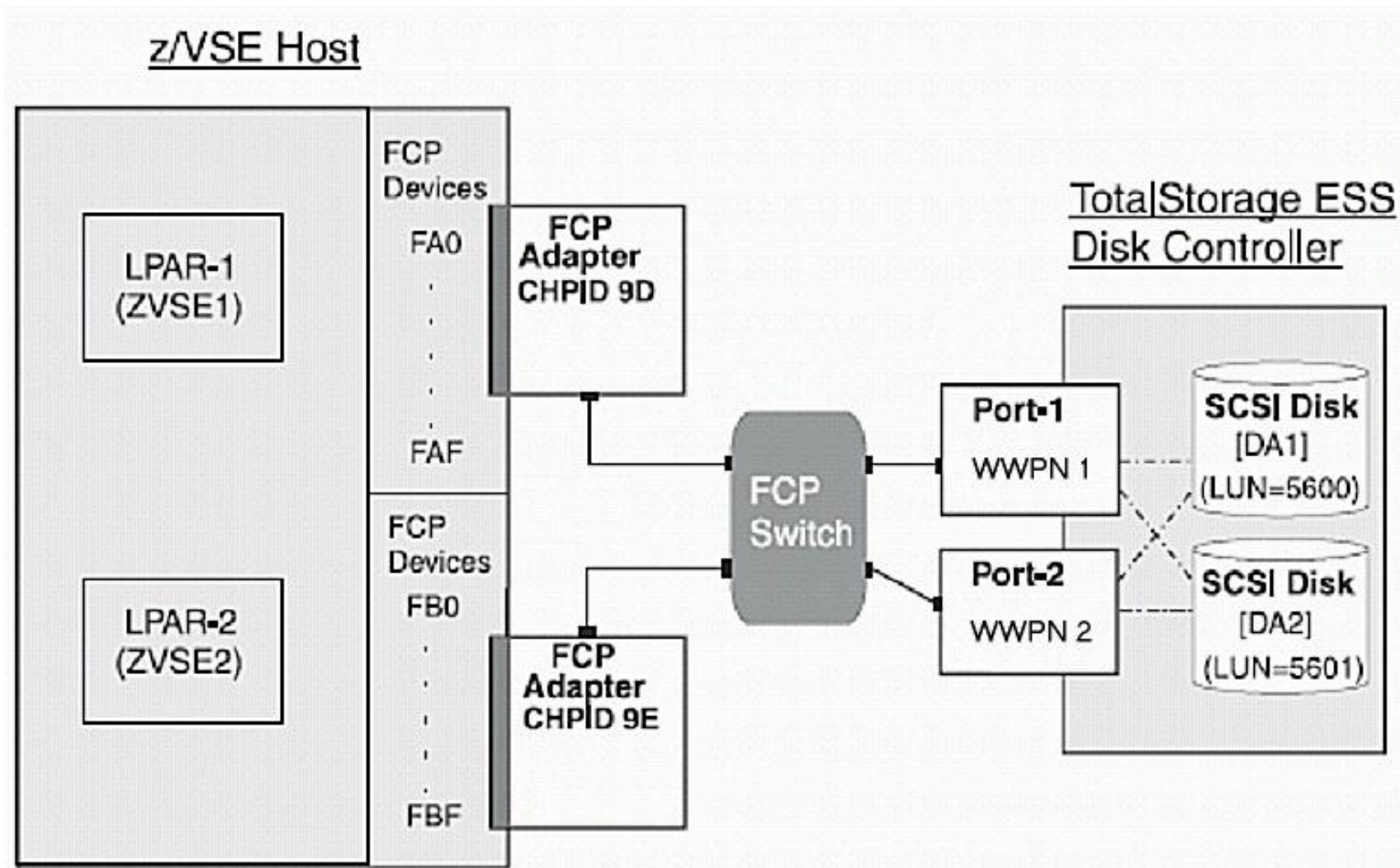
### § Block sizes

- z/VSE supports only SCSI Disks with a block size of 512 Bytes

### § Standards

- SCSI Disks must support ANSI SCSI Version 3

# SCSI components



## SCSI setup for z/VSE

### § FCP Devices:

- ADD 4A7:4A9,FCP

### § FBA Devices:

- ADD 608:61B,FBA

### § Define SCSI:

- DEF SCSI,FBA=608,FCP=4A7,WWPN=5005076300CA9A76,LUN=5710
- DEF SCSI,FBA=609,FCP=4A7,WWPN=5005076300CA9A76,LUN=5711
- ...
- DEF SCSI,FBA=60D,FCP=4A8,WWPN=5005076300CA9A76,LUN=5715
- DEF SCSI,FBA=60E,FCP=4A8,WWPN=5005076300CA9A76,LUN=5716
- ...

### § IPL from SCSI (VM)

- Minimum 32M Memory
- SET LOADDEV PORT 50050763 00CE9A76 LUN 57350000 00000000
- IPL 4B8 (IPL from FCP device)



## SCSI commands

### §SCSI definitions during IPL:

```
DEF SCSI ,FBA=cuu ,FCP=cuu ,WWPN=nnnnnnnnnnnnnnnnnnnn ,LUN=nnnn
```

### §SCSI definitions online:

```
SYSDEF SCSI ,FBA=cuu ,FCP=cuu ,WWPN=nnnnnnnnnnnnnnnnnnnn ,LUN=nnnn
```

- FBA Device and FCP Device must have been already defined during IPL

### §Delete SCSI definitions:

```
SYSDEF SCSI ,DELETE ,FBA=cuu ,FCP=cuu ,WWPN=nnnnnnnnnnnnnnnnnnnn ,LUN=nnnn
```

### §Display SCSI definitions:

```
QUERY SCSI
```

AR	FBA-CUU	FCP-CUU	WORLDWIDE PORTNAME	LOGICAL UNIT NUMBER
AR 0015	608	4A7	5005076300CA9A76	5710000000000000
AR 0015	609	4A7	5005076300CA9A76	5711000000000000
AR 0015	60A	4A7	5005076300CA9A76	5712000000000000
AR 0015	60B	4A7	5005076300CA9A76	5713000000000000
AR 0015	60C	4A7	5005076300CA9A76	5714000000000000
AR 0015	60D	4A8	5005076300CA9A76	5715000000000000

```
QUERY SCSI,608 (FBA Device)
```

AR	FBA-CUU	FCP-CUU	WORLDWIDE PORTNAME	LOGICAL UNIT NUMBER
AR 0015	608	4A7	5005076300CA9A76	5710000000000000

# Interactive Interface Dialog

```

ADM$DSK2                HARDWARE CONFIGURATION: DISK LIST

Options: 2 = Alter device type code/mode                    5 = Delete a disk
         3 = Specify Shared and/or Device Down by an 'X' in the appr. column
         8 = Specify DEF SCSI command

   OPT      ADDR  DEVICE  DEVICE-TYPE  DEVICE SPEC  SHARED  DEVICE
           ADDR  ADDR     CODE          MODE         DOWN
           -----

   8       DA1   FBA-SCSI  FBA
   -
   -
   -
   -
   -
   -
   -
   -
   -
   -
   -

PF1=HELP      2=REDISPLAY  3=END                    5=PROCESS
    
```



## Interactive Interface Dialog

```
TAS$ICME          HARDWARE CONFIGURATION AND IPL: DEF SCSI
Enter the required data and press ENTER.

FBA .....      DA1          cuu of the FBA-SCSI device
FCP .....      FA0          cuu of the FCP device
WWPN .....      5005076300CA9A76  World wide port name of the
                               remote controller
LUN .....      5600          Logical unit number of the SCSI

PF1=HELP      2=REDISPLAY  3=END
```

## Interactive Interface Dialog

```
TAS$ICMD          HARDWARE CONFIGURATION AND IPL: DEF SCSI

Enter the required data and press ENTER.

OPTIONS: 1 = ADD           2 = ALTER
         5 = DELETE

  OPT   FBA      FCP      WWPN          LUN
  ---   ---     ---     ---            ---
  -     233     C01     5005076300C693CB  5176
  -     DA1     FA0     5005076300CA9A76  5600
  -
  -
  -
  -
  -
  -
  -
  -
  -
  -
  -

PF1=HELP          2=REDISPLAY  3=END                5=PROCESS
```

## SCSI messages

- § **AR 0033 0S45I SCSI DEVICE 618 CONSISTS OF 03906304 BLOCKS, 03897432 BLOCKS ARE AVAILABLE, 680 BLOCKS ARE UNUSED**
  - Multiple of 777 Blocks
    - Internal Model: 1 „Cylinder“ = 777 Blocks
- § **AR 0033 0S40I SCSI PROCESSING EVENT: REASON=0060  
FUNCTION=INIT-SCSI FBA=609 FCP=4A7 WWPN=5005076300CA9A76  
LUN=5711000000000000**
  - Message description shows the reason based on the Reason Codes
  - SCSI I/O errors are mapped in S/390 I/O errors for user programs (e.g. Unit check)
  - In addition, message 0S40I message is issued, to inform about the exact reason

## SCSI multipathing

### § One or more alternative paths to the same SCSI Disk

- Increases the availability
- NOT: Workload-Balancing

### § Each path must be defined over a different PCF adapter

- One FCP card can contain multiple FCP adapters (CHPID)
- To increase availability, you should use different FCP adapters on different physical FCP cards

### § As best, even over different switches and/or ports

### § Example:

```
DEF SCSI , FBA=DA1 , FCP=FA0 , WWPN=5005076300CA9A76 , LUN=5600
DEF SCSI , FBA=DA1 , FCP=FB0 , WWPN=5005076300C29A76 , LUN=5600
```

### § QUERY SCSI

```
AR 0015 FBA-CUU FCP-CUU WORLDWIDE PORTNAME LOGICAL UNIT NUMBER
AR 0015 DA1      FA0      5005076300CA9A76 5600000000000000
AR 0015 DA1      FB0      5005076300C29A76 5600000000000000
```

- The first path is currently used to access the SCSI disk

## Base installation on SCSI disks

### § Only base installation possible

- FSU from ECKD- to SCSI-Disks not possible

### § Automatic installation

- IPL from Tape

```
BG 0000 SI70D IF YOU WANT TO USE SCSI DEVICES SPECIFY YES, ELSE NO
```

```
0 YES
```

```
BG 0000 SI75I ENTER SCSI COMMAND FOR DOSRES
```

```
BG 0000 SA80D SCSI,FBA=CUU,FCP=CUU,WWPN=PORTNAME,LUN=LUN
```

```
0 SCSI,FBA=608,FCP=C00,WWPN=5005076300C69A76,LUN=5745
```

```
AR 0033 0S45I SCSI DEVICE 608 CONSISTS OF 09765632 AVAILABLE, 651 BLOCKS ARE UNUSED
```

```
BG 0000 SA76I ENTER SCSI COMMAND FOR SYSWK1
```

```
BG 0000 SA80D SCSI,FBA=CUU,FCP=CUU,WWPN=PORTNAME,LUN=LUN
```

```
0 SCSI,FBA=609,FCP=D00,WWPN=5005076300C29A76,LUN=5746
```

```
AR 0033 0S45I SCSI DEVICE 609 CONSISTS OF 09765632 AVAILABLE, 651 BLOCKS ARE UNUSED
```

```
BG 0000 SI08I DOSRES IS 608, DEVICE TYPE FBA
```

```
BG 0000 SI09I SYSWK1 IS 609, DEVICE TYPE FBA
```

### § Hardware Configuration Dialog

- Press PF5 to catalog the IPLPROC
  - Otherwise the next IPL will fail because it does not find SYSWK1

## IPL from SCSI

### § Uses the „Machine Loader“

- Platform independent Hardware-Tool

### § Native or LPAR

- Perform a Load using Hardware Management Console (HMC)
  - Load Address = FCP Device
  - WWPN
  - LUN number

### § Under z/VM

- SET LOADDEV PORTNAME 50050763 00C29A76 LUN 56010000 00000000
- IPL cuu (FCP Device)



## Migration from ECKD to SCSI

### § FSU from ECKD to SCSI not possible

- Only base installation

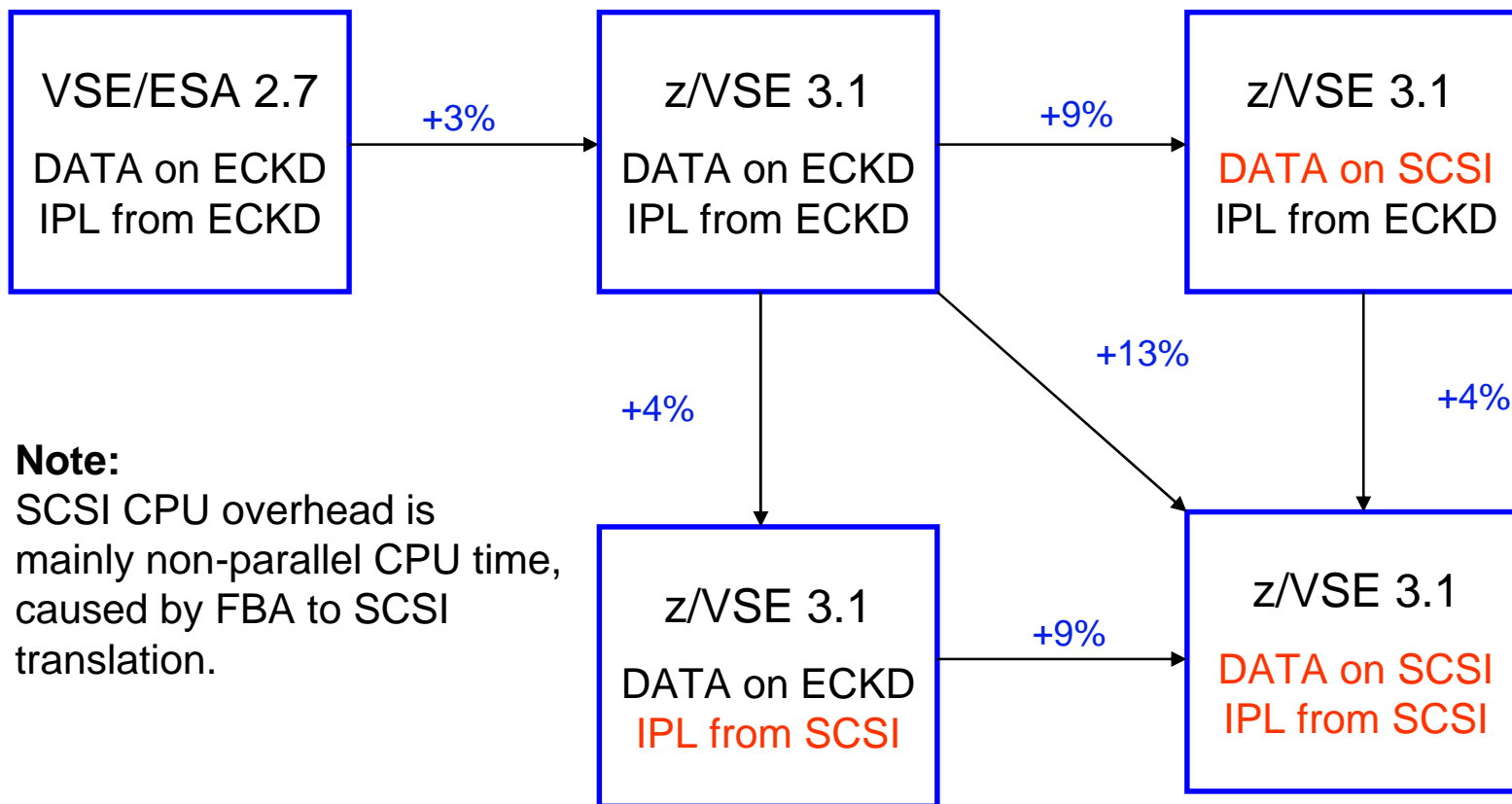
### § File allocations must be adapted

- Tracks/Cylinder into Blocks (for 3390):
  - 1 Track = about 112 Blocks
  - 1 Cylinder = about 1680 Blocks
- VSAM Space
  - Hint: Specify cluster sizes in RECORDS, not Tracks
- Sequential files
- VSE Libraries
  - Hint: 1 LIBR Block = 1024 Bytes = 2 SCSI Blocks

### § Programs must be able to work with FBA disks

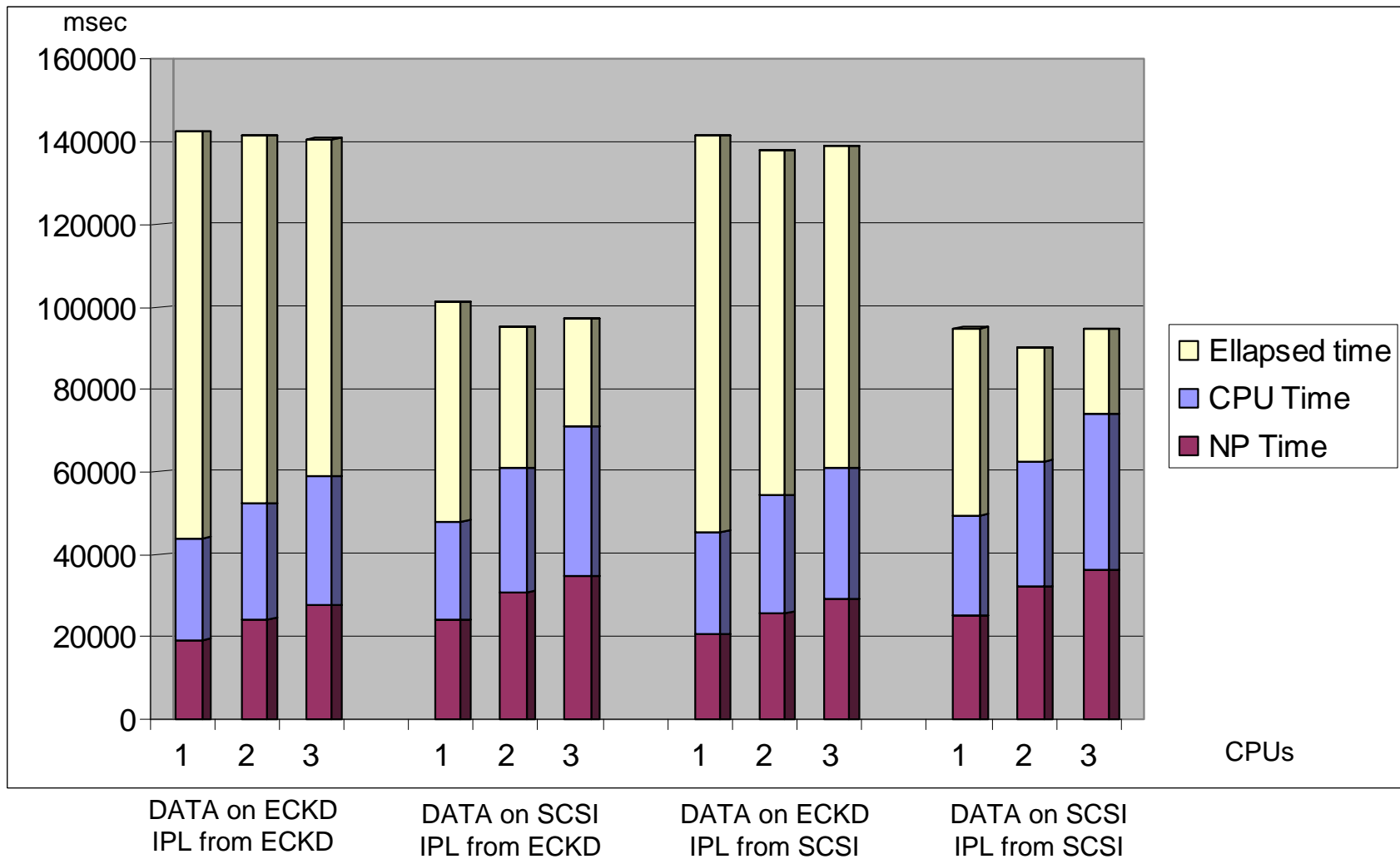
- As best, implement it device independent

# Overhead Deltas for SCSI



**Note:**  
SCSI CPU overhead is mainly non-parallel CPU time, caused by FBA to SCSI translation.

# SCSI Overhead



## SCSI I/O count considerations

### § For PACEX16 workload

- ECKD:
  - 18000 ECKD I/Os per disk
- SCSI:
  - 20000 FBA I/Os per disk
- ECKD → FBA:
  - 11% increased I/O counts

### § In general 1 FBA I/O is translated into 1 SCSI I/O

### § Except for

- Long CCW chains
- Overlapping addresses (e.g. PHASE loading)

## Comparison ESCON – FICON/FCP

	<b>ESCON</b>	<b>FICON/FCP</b>
<b>Max # of channels</b>	256	4 x 256
<b>Max # device addresses per link</b>	4096	65536
<b>Max # logical CU-paths per port</b>	64	256
<b>Device addresses per channel</b>	1024	16384
<b>Link rate</b>	20 MB/sec	200 MB/sec
<b>Max achievable transfer rate</b>	17 MB/sec	170 MB/sec
<b>Full duplex</b>	No	Yes
<b>Concurrent I/O operations</b>	1	Up to 32
<b>CCW execution</b>	Synchrony	Asynchrony (FICON)

## When should I (not) use SCSI?

### § When should I use SCSI?

- When enough CPU power is available to handle the additional SCSI overhead.
  - SCSI overhead is mostly non-parallel code.

### § When should I not use SCSI?

- When you are already CPU constraint.
  - If you are today running at 80% CPU utilization, SCSI would fill up your CPU up to 100 %

## z/VSE 3.1 Hardware support

### § z/VSE 3.1 and VSE/ESA 2.7 runs on the following machines

- zSeries: z800, z900, z990, z890
- 9672 Parallel Enterprise Server (G5/G6)
- Multiprice 3000 (7060)
- equivalent emulators (Flex-ES)

### § z/VSE 3.1 and VSE/ESA 2.7 is based on the hardware instruction set described in the manual 'ESA/390 Principles of Operation' (SA22-7201).

- It is assumed that all the ESA/390 instructions and facilities described in that manual can be used.

## z/VSE 3.1 Hardware support - continuation

### § z/VSE 3.1 is designed to support:

- IBM eServer zSeries 890 and 990
- SCSI disks attached to zSeries FCP channels
- OSA-Express2 and FICON Express2 adapters
- Crypto Express2 and CP Assist for Cryptographic Function (CPACF)
- IBM TotalStorage 3494 Virtual Tape Server
- improved support for IBM 3494 Tape Library
- IBM TotalStorage DS8000 and DS6000 series Storage Servers
- IBM TotalStorage Enterprise Storage Server (ESS)



## Supported VSE Releases

VSE Release	Available	End of Marketing	End of Service
z/VSE 3.1	03/04/2005		
VSE/ESA 2.7	03/14/2003	planned 3Q2005	
VSE/ESA 2.6	12/14/2001	03/14/2003 (no longer orderable)	03/31/2006
VSE/ESA 2.5	09/29/2000	12/14/2001	12/31/2003 (out of service)
VSE/ESA 2.4	06/25/1999	09/29/2000	06/30/2002 (out of service)
VSE/ESA 2.3	07/12/1997	06/30/2000	12/31/2001 (out of service)

## VSE Server Support

IBM zSeries eServer	z/VSE 3.1	VSE/ESA 2.7	VSE/ESA 2.6	VSE/ESA 2.5	VSE/ESA 2.4/2.3
zSeries 890, 990	Yes	Yes	Yes (PTF required)	Yes (PTF required)	No
zSeries 800, 900	Yes	Yes	Yes	Yes	Yes
S/390 Parallel Enterprise Server G5/G6	Yes	Yes	Yes	Yes	Yes
S/390 Multiprise 3000	Yes	Yes	Yes	Yes	Yes
S/390 Parallel Enterprise Server G3/G4	No	No	Yes	Yes	Yes
S/390 Multiprise 2000	No	No	Yes	Yes	Yes
S/390 Integrated Server	No	No	Yes	Yes	Yes
S/390 Parallel Enterprise Server G2 / G1 (out of Service)	No	No	Yes	Yes	Yes
ES/9000 – 9221, 9121, 9021 (out of Service)	No	No	Yes	Yes	Yes
P/390 and R/390 (out of Service)	No	No	Yes	Yes	Yes

## VSE Hardware Support

VSE Release	HiperSockets	OSA Express (QDIO mode)	Hardware Crypto
z/VSE 3.1	Yes	Yes	Yes (PCICA, CEX2C, CPACF)
VSE/ESA 2.7	Yes	Yes	Yes (PCICA, CPACF)
VSE/ESA 2.6	No	Yes	No
VSE/ESA 2.5	No	No	No
VSE/ESA 2.4	No	No	No
VSE/ESA 2.3	No	No	No

PCICA: PCI Cryptographic Accelerator

CEX2C: Crypto Express2

CPACF: CP Assist for Cryptographic Function

available on z800, z900, z890, z990

available on z890, z990

available on z890, z990

## zSeries Remarks

- § **Prior to zSeries there is one cache for data and instructions**
- § **zSeries has spitted data and instruction cache**
- § **Performance implications:**
  - If **program variables** and **code that updates** these program variables are **in the same cache line** (256 byte)
    - Update of program variable invalidates instruction cache
    - Performance decrease if update is done in a loop
  - See APAR PQ66981 for FORTRAN compiler

## zSeries Remarks - example

### Not causing a problem:

```

LA    R1,PHASNAME    POINT AT PHASE NAME
CDDELETE (1)
+*   SUPERVISOR - CDDELETE - 5686-032-06
+    CNOP  0,4
+    BAL   15,*+8
+    DC    A(B'00010010')
+    L     15,0(,15)
+    SVC   65          ISSUE SVC FOR CDDELETE
+    DS    0H

```

CDDELETE uses an inline flag byte,  
but does not modify it

### Can cause a problem:

```

WTO TEXT=DATA
+    CNOP  0,
+    BAL   1,IHB0003A  BRANCH AROUND MESSAGE
+    DC    AL2(8)      TEXT LENGTH
+    DC    B'0000000000010000'  MCSFLAGS
+    DC    AL4(0)      MESSAGE TEXT ADDR
...
+IHB0003A DS    0H
+    LR    14,1        FIRST BYTE OF PARM LIST
+    SR    15,15       CLEAR REGISTER 15
+    AH    15,0(1,0)   ADD LENGTH OF TEXT + 4
+    AR    14,15       FIRST BYTE AFTER TEXT
+    LA    15,DATA     LOAD TEXT VALUE
+    ST    15,4(0,1)   STORE ADDR INTO PLIST
+*   SUPERVISOR - SIMSVC - 5686-032
...
+    SVC   35          ISSUE SVC 35
@GE00016 DS    0H

```

WTO uses an inline parameter list,  
but modifies the parameter list

**Note:** WTO can be coded with an external  
parameter list: WTO ...,MF=(E,addr)

## z890 and z990 Considerations

### § The z890 and z990 are LPAR-only machines

- No basic mode any more
- Even if you run just one VSE system, it now runs in an LPAR
- Running VSE systems under z/VM means
  - running VSE in z/VM in an LPAR
- No I/O Assist in LPARs
  - Only available if z/VM runs in basic mode, but no basic mode available on z890, z990

## z/VM 5.1 considerations

### § z/VM 5.1 no longer supports V=R and V=F guests

### § z/VM 5.1 no longer support I/O Assist

- If you currently run with preferred guests, you will need to estimate and plan for a likely increase in processor requirements as those preferred guests become V=V guests as part of the migration.
- Refer to Preferred Guest Migration Considerations at <http://www.vm.ibm.com/perf/tips/z890.html> for assistance and background information

### § How to size the impact (on your current system)

- **Loss of I/O Assist:** Run your workload with CP SET IOASSIST OFF and measure the increase
- **Loss of V=R/F:** Run your workload with V=V and use the CP Monitor to watch for increased CPU consumption

### § How to tune

- **Dedicated processors:** CP SET SHARE ABSOLUTE
- **Dedicated memory:** CP SET RESERVED
- **I/O Assist:** Use minidisks, turn minidisk caching on (MDC)

## Possible performance problem with PPRC

### § Problem occurs if

- PPRC is used
- VSE runs in native or in LPAR
- Not all devices that are defined in IOCP are also defined in VSE ADD statements

### § In case there is an PPRC state change, interrupts are sent to all LPARs where the related device are defined in IOCP.

- If the device is defined in VSE ADD, no problem occurs: VSE will process the interrupt correctly.
- If the device is NOT defined in VSE ADD, the interrupt is ignored by VSE and the interrupt is resent very quickly to that LPAR
  - Results in very high channel activity (up to 100%)

### § Solution:

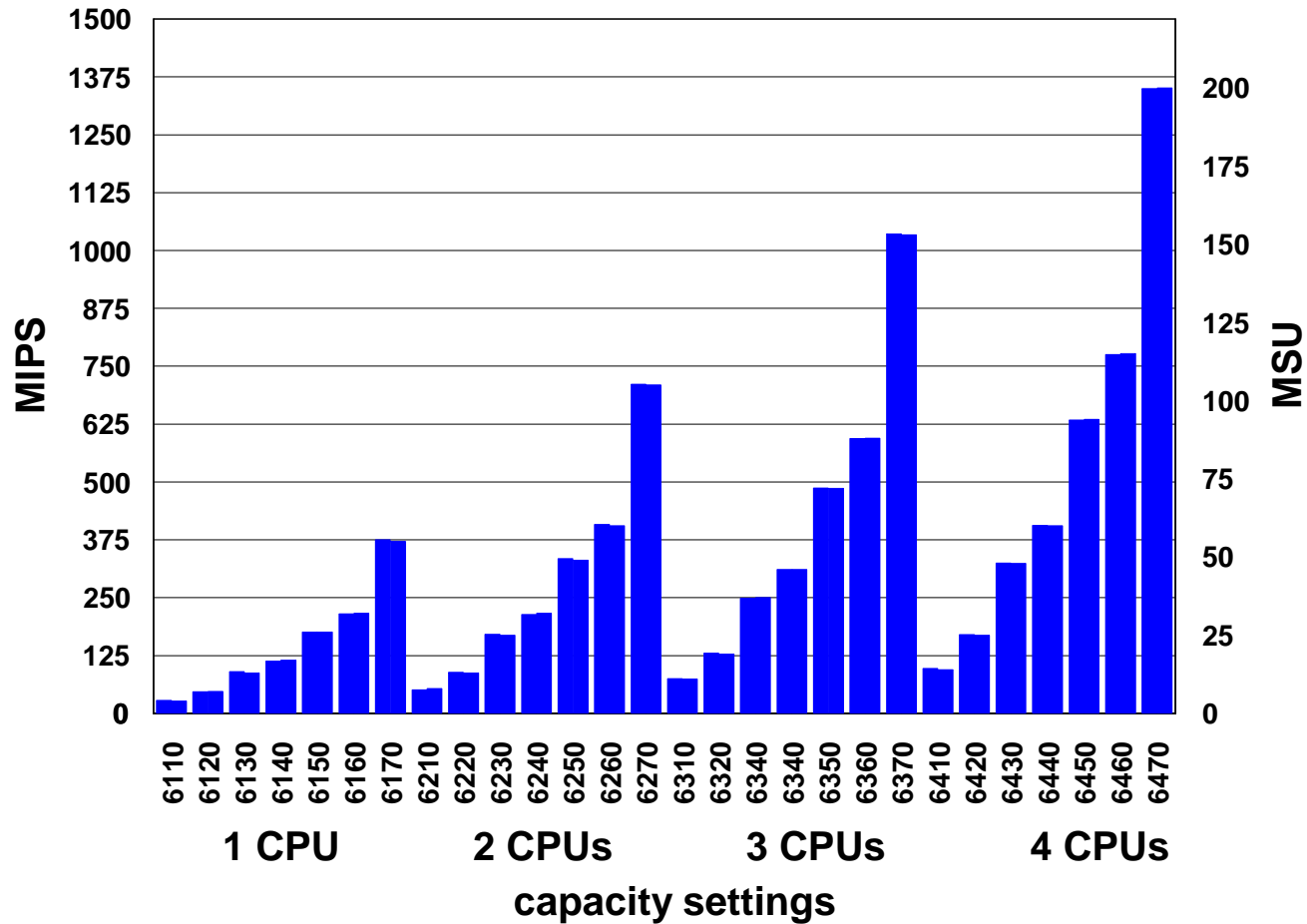
- Define ALL devices in VSE ADD that are defined in IOCP



## VSE/POWER POFFLOAD Performance Problems

- § **Caused by incompatibility between VSE/POWER tape format and new tape drives**
- § **3490F empties cache for FSF used by POFFLOAD LOAD**
  - Install **DY46164/DY46245** for VSE/ESA 2.7/2.6
- § **3590 synchronizes cache with tape for each WTM**
  - Install microcode **FC0520** on A60 controller + VSE/AF **APAR DY45817** + AR command **TAPE WTM=NOSYNC**
  - Unfortunately controller A50 is too small to install FC0520

# IBM eServer zSeries 890



z890 consists of one Model (A04) and 28 capacity settings

## Enterprise Storage Server Model 750

- § **The ESS Model 750 is based on the same architecture as the ESS Model 800 to support functionality, stability, and reliability**
- § **up to 64 disk drives**
- § **4.6 terabytes (TB) of physical capacity**
- § **A two-way processor**
- § **8 GB of cache**
- § **2 GB of Non Volatile Storage (NVS)**
- § **up to 6 Fibre Channel/FICON or ESCON host adapters**
- § **Support for 72.8 GB and 145.6 GB 10,000 rpm drives**
- § **configured as RAID 5, RAID 10 (1+0), or a combination of both**
- § **See:**
  - <http://www-1.ibm.com/servers/storage/disk/ess/ess750/index.html>

## IBM TotalStorage DS6000

- § **Designed and priced to lower the total cost of ownership**
- § **For medium and large enterprises**
- § **Open systems and mainframe host attachment**
- § **Advanced copy services**
  - equivalent to and interoperable with DS8000 series and ESS 800 and 750 systems
- § **Includes the IBM TotalStorage DS Storage Manager**
  - GUI interface and Express Configuration wizards
- § **Using modular, 3U, 16 disk drive, rack-mountable enclosures**
- § **Up to 67.2TB physical storage**
- § **See:**
  - <http://www-1.ibm.com/servers/storage/disk/ds6000/index.html>

## IBM TotalStorage DS8000

- § **Robust, flexible and cost-effective disk storage for mission-critical workloads**
- § **IBM's first implementation of storage system logical partitions (LPARs) using IBM Virtualization Engine technology**
- § **Up to 192TB of physical storage**
- § **Supports extensive connectivity:**
  - Fibre Channel
  - FICON
  - ESCON
- § **Support storage sharing for a wide variety of servers**
  - zSeries
  - pSeries, eServer p5
  - iSeries, eServer i5
  - xSeries and other Intel based servers,
  - Sun and Hewlett-Packard
- § **See: <http://www-1.ibm.com/servers/storage/disk/ds8000/index.html>**

## 3494 Virtual Tape Server

- § **Can help reduce real tape mounts, because many mount requests are satisfied from the Tape Volume Cache (TVC)**
- § **Can reduce physical tape cartridges required because of higher utilization of cartridge capacity**
- § **Can help reduce operating costs such as power, maintenance, operations and support staff**
- § **Can help reduce floor space required to support the tape process, as a result of fewer physical resources**
- § **Can help to improve performance due to the elimination of most of the physical movement of tape**
- § **Can be upgraded to Peer-to-Peer configuration to support business continuance**
- § **See:**
  - <http://www.ibm.com/servers/storage/tape/3494vts/index.html>

## 3494 Tape Library

- § **Designed to provide reliable, scalable tape automation**
- § **Provides multiplatform connectivity**
- § **Supports 3592 rewritable and WORM cartridges**
- § **Supports multiple IBM tape drive models**
- § **Supports IBM Virtual Tape**
- § **By combining the various models of the 3494 Tape Library, you can create an automated tape library of up to 16 library frames that can contain over 6000 tape cartridges and up to 5.6PB of stored data.**
- § **See:**
  - <http://www.ibm.com/servers/storage/tape/3494/index.html>

## Documentation

### § **z/VSE homepage:**

- <http://www.ibm.com/servers/eserver/zseries/zvse/>

### § **VSE Performance:**

- <http://www.ibm.com/servers/eserver/zseries/zvse/documentation/performance.html>

### § **z/VM homepage:**

- <http://www.ibm.com/vm>

### § **z/VM 5.1 Preferred Guest Migration Considerations**

- <http://www.vm.ibm.com/perf/tips/z890.html>

### § **IBM eServer zSeries 890 and 990:**

- <http://www.ibm.com/servers/eserver/zseries/z890/>
- <http://www.ibm.com/servers/eserver/zseries/z990/>

### § **IBM TotalStorage DS8000 and DS 6000:**

- <http://www.ibm.com/servers/storage/disk/ds8000/index.html>
- <http://www.ibm.com/servers/storage/disk/ds6000/index.html>

### § **IBM TotalStorage 3494 Virtual Tape Server:**

- <http://www.ibm.com/servers/storage/tape/3494vts/index.html>

### § **IBM 3494 Tape Library:**

- <http://www.ibm.com/servers/storage/tape/3494/index.html>



# Questions ?

