z/VSE Performance Update

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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.

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Overhead Deltas for VSE Releases

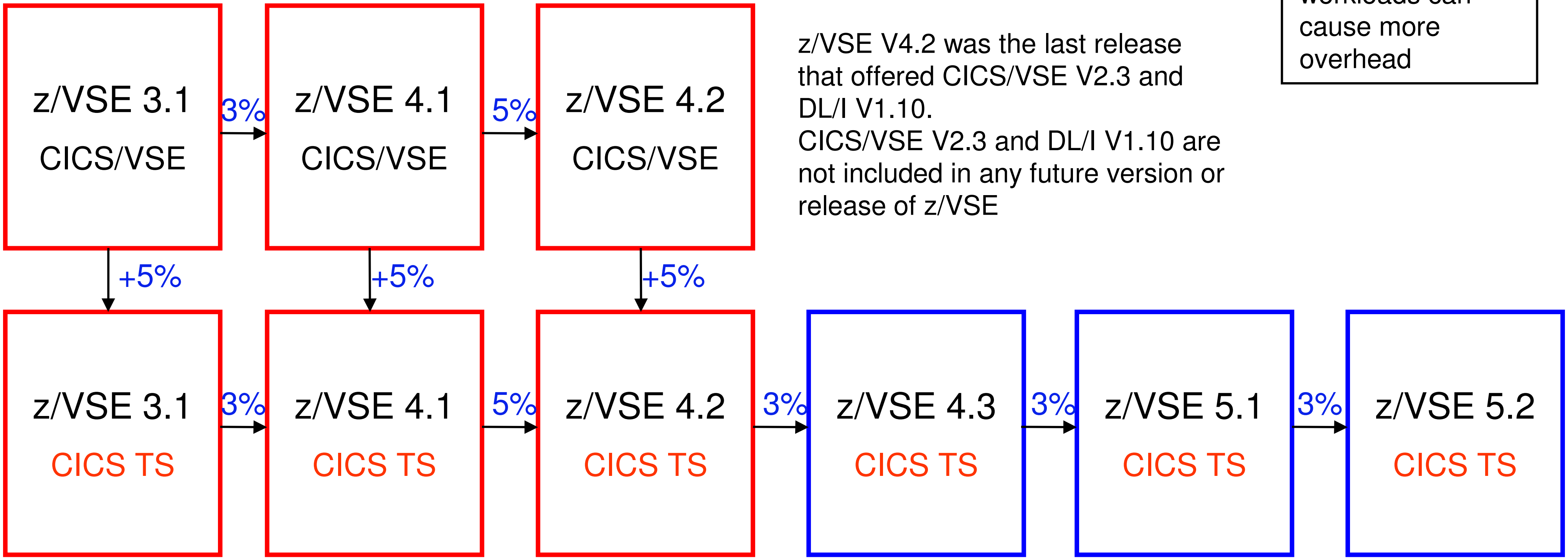
Remember that you get a lot of new functions that in most cases helps you to increase VSE system performance and throughput:

Partition Balancing, PRTY SHARE (Turbo Dispatcher), FlashCopy,
Buffer Hashing, Shared data Tables (CICS TS), NOPDS with larger VSIZE

These numbers are for **a specific average I/O intensive** workload (PACEX16)

More I/O intensive workloads can cause more overhead

No longer supported ← | → Supported releases



z/VSE 3.1 CICS/VSE → 3% → z/VSE 4.1 CICS/VSE → 5% → z/VSE 4.2 CICS/VSE

+5% ↓ +5% ↓ +5% ↓

z/VSE 3.1 CICS TS → 3% → z/VSE 4.1 CICS TS → 5% → z/VSE 4.2 CICS TS → 3% → z/VSE 4.3 CICS TS → 3% → z/VSE 5.1 CICS TS → 3% → z/VSE 5.2 CICS TS

z/VSE V4.2 was the last release that offered CICS/VSE V2.3 and DL/I V1.10.
CICS/VSE V2.3 and DL/I V1.10 are not included in any future version or release of z/VSE

You can also use the zSoftCap tool to determine release migration overhead:
http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS268

New: zSoftCap Tool

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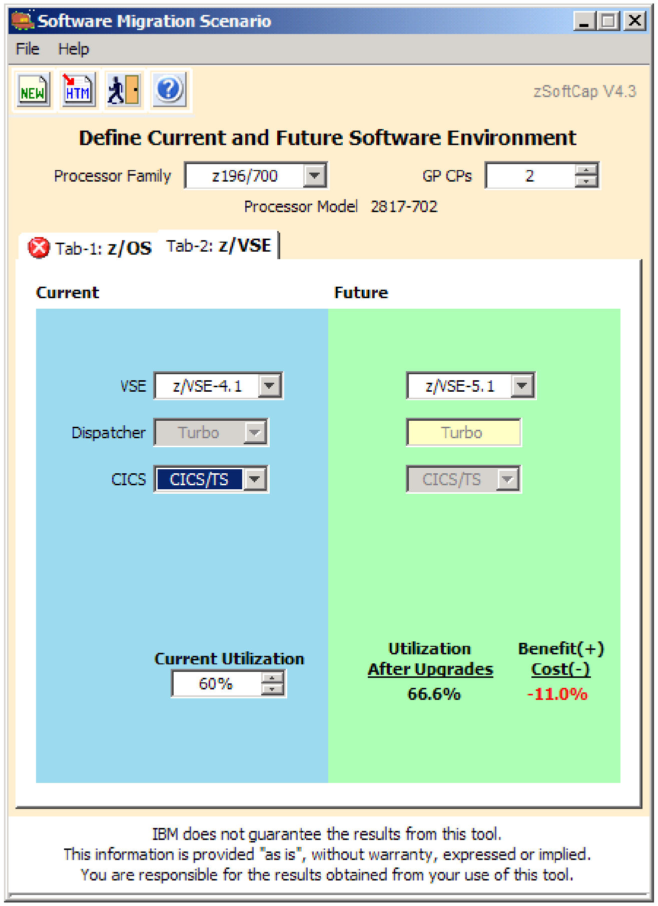
http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS268

zSoftCap is a PC-based productivity tool
designed to assess the effect on capacity
for IBM System z processors,
when migrating to more current releases
of the operating system or major subsystems.
zSoftCap assumes that hardware remains
constant while software releases change.



zSoftCap V4.3

Define Current and Future Software Environment

Processor Family z196/700 GP CPs 2
Processor Model 2817-702

Tab-1: z/OS Tab-2: z/VSE

	Current	Future
VSE	z/VSE-4.1	z/VSE-5.1
Dispatcher	Turbo	Turbo
CICS	CICS/TS	CICS/TS

Current Utilization	Utilization After Upgrades	Benefit(+) Cost(-)
60%	66.6%	-11.0%

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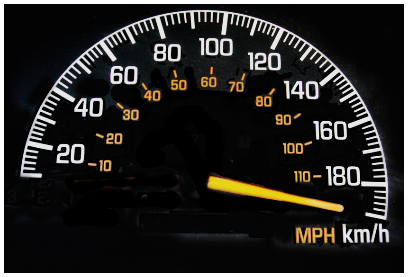
What is Performance ?

→ **Performance is about:**

- **How fast does it run**
  - Job Duration
  - CPU seconds
  - Throughput
  - Response times
- **How much resources does it use**
  - Memory
  - I/Os
- **Why doesn‘t it run faster?**
  - Where is the bottleneck ?

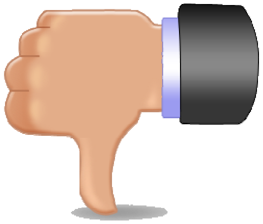


Performance is all about comparing

- **Absolute values do not tell you much**

  Examples:
  - Job A runs 4 minutes and 10 seconds
  - Program B requires 5 MB of memory

  → Is that good? Is that bad ?



- **Comparison tells you if its good or bad**

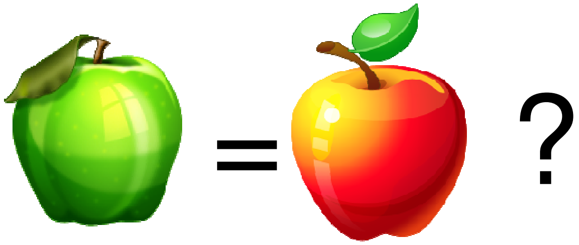
  Examples:
  - After migrating to z/VSE X.Y to z/VSE X.Z, job A now runs 4:10 versus 3:40

    → 13% increase
  - On version X Program B now needs 5 MB, on version Y it did only need 4 MB

    → 25 % increase

Performance is all about comparing (continued)

- **When comparing, make sure you compare apples to apples**



- **Comparing A to B is only valid if**
  - Environment is the same
    - Storage layout, Sizes, Priorities, ...
  - Workload is the same
    - Same amount of data processed, same number of requests, …

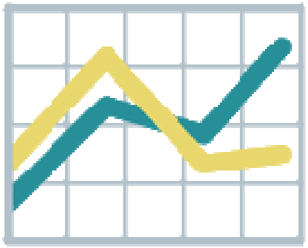
- **Little changes can cause big differences !**

- **True performance comparisons can only be done in a strictly isolated (clinic) environment**
  - Measurements in a production environment may not produce usable results
  - Results may be influenced by many different things
    - Concurrent users
    - Other work running in parallel (batch jobs)
    - Other work running on shared processors in other LPAR or z/VM guest

Performance Monitoring

- **Performance Monitor Tools**
  - Periodically gather values of certain counters (sampling)
  - Gather values of certain counters at special events (e.g. Job Accounting - At end of Job Step)

- **Data to be monitored:**
  - CPU usage (percent, CPU seconds)
  - I/O times and rate
  - Memory usage
  - Transaction rate
  - …



- **Real time monitoring**
  - Displays how the counters are NOW
  - Does not help you much to solve a problem if you are not looking at the screen at the time the problem occurs

- **History data**
  - Allows you to look at the samples over time
  - You can find out what happened when the problem occurred by looking back in history
  - You can draw charts to analyze the data

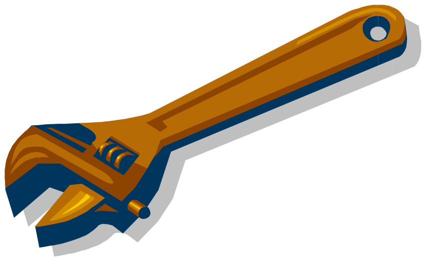
Performance Monitor tools

Commercial products provided by ISVs:
- TMON (ASG)
- Explore (CA)

- **Built into z/VSE**
  - Display System Activity Dialog (361/362)
  - QUERY TD
  - SIR SMF, SIR MON
  - Job Accounting
  - SNMP Monitoring Agent
  - CICS Statistics

- **Free tools**
  - CPUMON Tool

- **z/VM & LPAR**
  - z/VM Performance Toolkit
  - HMC provides very basic monitoring capabilities



QUERY TD command

- Usage:
  - SYSDEF TD,RES eset the counters
  - // run the workloa
  - QUERY TD,INTE displa

SPIN_TIME
spin CPU time waiting for a resource occupied by another CPU, not contained in TOTAL_TIME

NP_TIME
non-parallel CPU time, contained in TOTAL_TIME

TOTAL_TIME
total CPU time

```
AR 0015   CPU    STATUS      SPIN_TIME     NP_TIME  TOTAL_TIME  NP/TOT   DISP_ENTR
AR 0015    00    ACTIVE              0       76670      121778   0.629    13163221
AR 0015                    ----------------------------------------------------------
AR 0015 TOTAL                        0       76670      121778   0.629    13163221
AR 0015
AR 0015                    NP/TOT:  0.629       SPIN/(SPIN+TOT):  0.000
AR 0015   OVERALL UTILIZATION:      %            NP UTILIZATION:    0%
AR 0015
AR 0015   ELAPSED TIME SINCE L      SET:      166387830
AR 0015   NUMBER OF SVC
AR 0015 1I40I   READY
```

Non-Parallel-Share (NPS) = NP / TOT

Maximum number or exploitable CPUs can be calculated as follows:
Max expl. CPUs = 0.8 / NPS

S

▪

QUEUED:
Average time that an I/O request was queued in z/VSE (I/O supervisor).

If the PENDING time is not given explicitly then the QUEUED time does also include the time the request was PENDING in the Channel Subsystem.

An I/O request is queued in z/VSE from the time the I/O request is enqueued up to the point where the Start I/O operation (SSCH) has successfully been initiated. Starting with the successful initiation of the SSCH instruction, the time will be counted as PENDING in Channel Subsystem. A request would be held pending in the Channel Subsystem if e.g. a channel or a Control Unit (CU) is currently busy.

TOTAL
Average time of a complete I/O operation and is actually the sum of QUEUED (+PENDING), CONNECT and DISCONN (+DEV.BUSY).

An excessive value in this field could be the indication of a device problem.

– SIR SMF =OFF ... ic SMF

```
AR 0015 DEVICE   I/O-CNT        QUEUED      CONNECT      DISCONN      TOTAL
AR 0015                       msec/SSCH    msec/SSCH    msec/SSCH    msec/SSCH
AR 0015
AR 0015  150          107         0.2           0.406          705        1.349
AR 0015  151          136                 3     0.327          01         0.792
AR 0015  152                                    0.3
AR 0015 1I40
```

CONNECT:
Average time that a device is logically connected to a channel for purposes of transferring information between it and the Channel Subsystem.

– SIR SMF ... Queue

```
AR 0015 TIMING VALUES FOR 200 BASED ON      20
AR 0015 MAXIMUM I/O QUEUE   2
AR 0015
AR 0015   QUEUED      PENDING      CONNECT
AR 0015  msec/SSCH   msec/SSCH    msec/SSCH    m                        CH
AR 0015      0.001       0.000        0.604        0.000        0.000        0.606
```

DISCONN
Average time that a device is logically disconnected from the Channel Subsystem while the device is still busy and has not yet presented primary interrupt (Channel End) status.

In case a DEV.BUSY time is not outlined explicitly, then the DISCONN time does also include the DEV.BUSY time
which is the time between the primary status (CE) and the secondary device-end status (DE).

SIR MON command

- Usage:
  - SIR MON=ON ← enable MON
  - SYSDEF TD,RESETCNT ← reset the counters
  - // run the workload
  - SIR MON ← display the counters
  - SIR MON=OFF ← disable MON

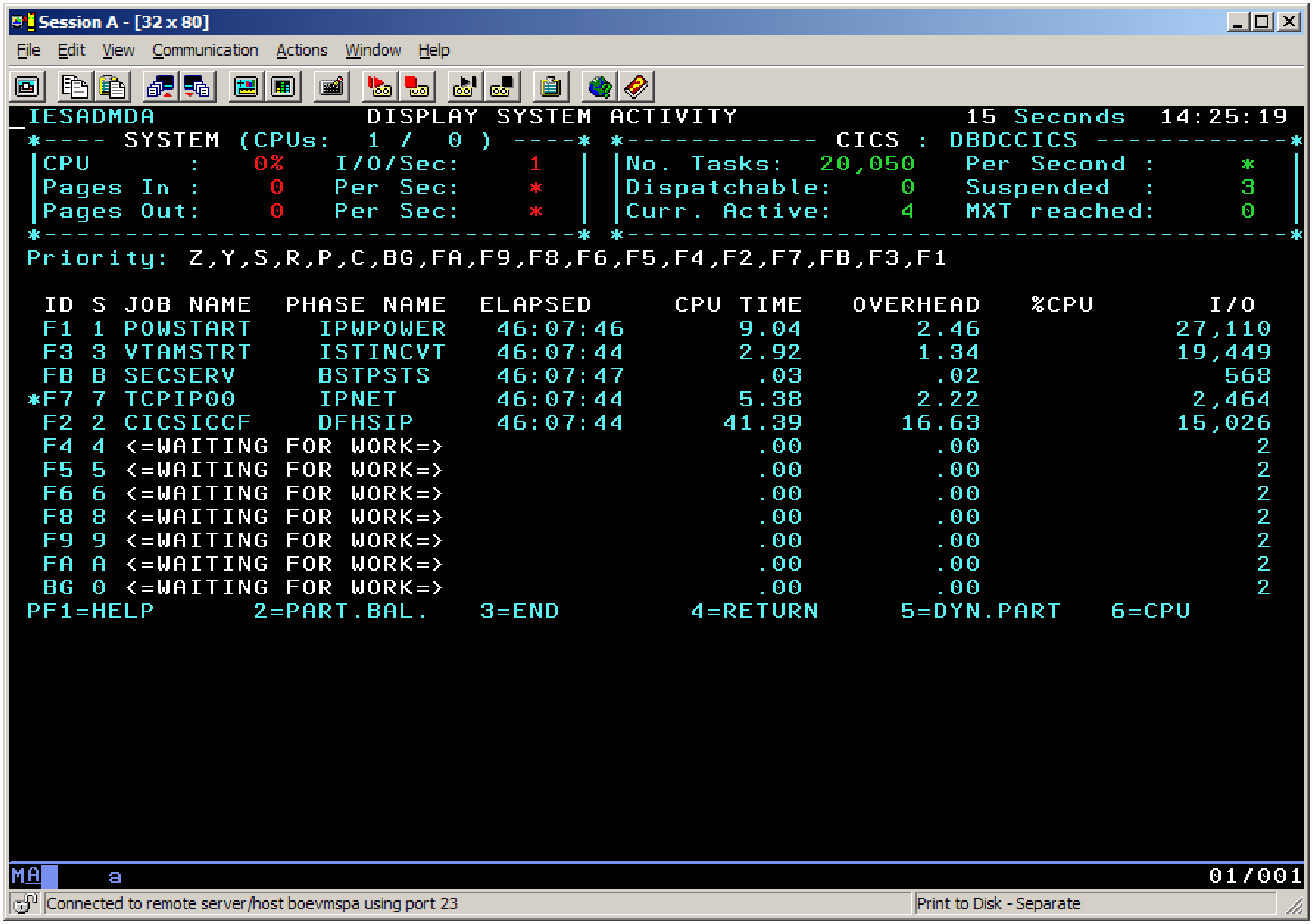
```
AR 0015                       MONITORING REPORT
AR 0015               (BASED ON A 0000:00:13.338 INTERVAL)
AR 0015                       SVC SUMMARY REPORT
AR 0015 EXCP     =        195  FCH-$$B  =         14  SVC-03   =          1
AR 0015 LOAD     =        138  WAIT     =        405  SETIME   =         22
AR 0015 SVC-0B   =          5  SVC-0C   =        231  SVC-0D   =        236
AR 0015 EOJ      =          2  SYSIO    =        118  EXIT IT  =         28
AR 0015 SETIME   =         15  SVC-1A   =          4  WAITM    =         25
AR 0015 COMREG   =       1125  GETIME   =         25  FREE     =          1
AR 0015 POST     =        122  DYNCLASS =          2  SVC-31   =         53
AR 0015 HIPROG   =          1  TTIMER   =          3  SVC-35   =        487
AR 0015 INVPART  =          2  GETVIS   =        708  FREEVIS  =        626
AR 0015 CDLOAD   =         11  RUNMODE  =          1  REALAD   =          1
AR 0015 SECTVAL  =        137  SETLIMIT =          5  SVC-5B   =          1
AR 0015 XECBTAB  =          1  EXTRACT  =          7  GETVCE   =         30
AR 0015 EXTENT   =          2  SUBSID   =          1  FASTSVC  =       2992
…
```

Job Accounting

- Use skeleton SKJOBACC in ICCF Library 59
  to assemble Job Accounting routine $JOBACCT
- Prints info about CPU usage and I/Os after every job step

```
JOBNAME   = PRINTLOG  USER INFO = PR       EXEC NAME = PRINTLOG
DATE      = 11/05/99  PART ID   = BG
START     = 10:56:23  STOP      = 10:56:28 DURATION  = 5.560 SEC
CPU       =     0.060 SEC      PAGEIN SINCE IPL   = 0
OVERHEAD  =     0.017 SEC      PAGEOUT SINCE IPL  = 0
TOTAL CPU =     0.077 SEC
UNIT = E15      UNIT = FEC      UNIT = 01F     UNIT = E16
SIO  = 26       SIO  = 5        SIO  = 5       SIO  = 105
UNIT = FEE
SIO  = 4083
```

Display System Activity Dialog (361)



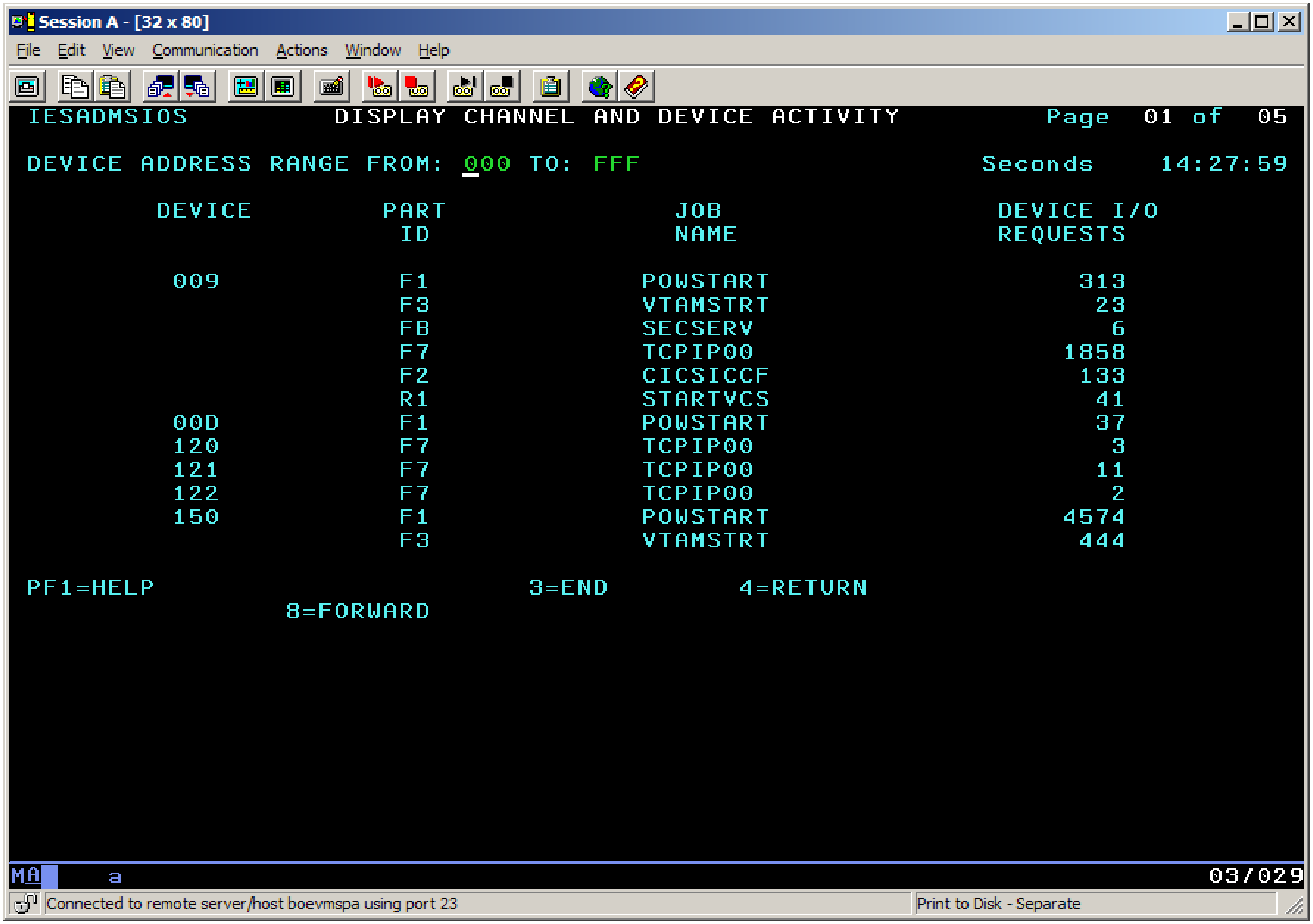
```
 IESADMDA             DISPLAY SYSTEM ACTIVITY              15 Seconds  14:25:19
 *---- SYSTEM (CPUs:  1 /  0 ) ----* *------------ CICS : DBDCCICS ------------*
 |CPU      :   0%   I/O/Sec:    1  | |No. Tasks:  20,050   Per Second :     *  |
 |Pages In :    0   Per Sec:    *  | |Dispatchable:    0   Suspended  :     3  |
 |Pages Out:    0   Per Sec:    *  | |Curr. Active:    4   MXT reached:     0  |
 *---------------------------------* *-----------------------------------------*
 Priority: Z,Y,S,R,P,C,BG,FA,F9,F8,F6,F5,F4,F2,F7,FB,F3,F1

  ID S JOB NAME  PHASE NAME  ELAPSED     CPU TIME   OVERHEAD   %CPU       I/O
  F1 1 POWSTART    IPWPOWER   46:07:46       9.04       2.46            27,110
  F3 3 VTAMSTRT    ISTINCVT   46:07:44       2.92       1.34            19,449
  FB B SECSERV     BSTPSTS    46:07:47        .03        .02               568
 *F7 7 TCPIP00     IPNET      46:07:44       5.38       2.22             2,464
  F2 2 CICSICCF    DFHSIP     46:07:44      41.39      16.63            15,026
  F4 4 <=WAITING FOR WORK=>                   .00        .00                 2
  F5 5 <=WAITING FOR WORK=>                   .00        .00                 2
  F6 6 <=WAITING FOR WORK=>                   .00        .00                 2
  F8 8 <=WAITING FOR WORK=>                   .00        .00                 2
  F9 9 <=WAITING FOR WORK=>                   .00        .00                 2
  FA A <=WAITING FOR WORK=>                   .00        .00                 2
  BG 0 <=WAITING FOR WORK=>                   .00        .00                 2
 PF1=HELP      2=PART.BAL.   3=END        4=RETURN     5=DYN.PART   6=CPU
```

```
MA     a                                                                 01/001
```

Connected to remote server/host boevmspa using port 23

Print to Disk - Separate

Display Channel and Device Activity (362)



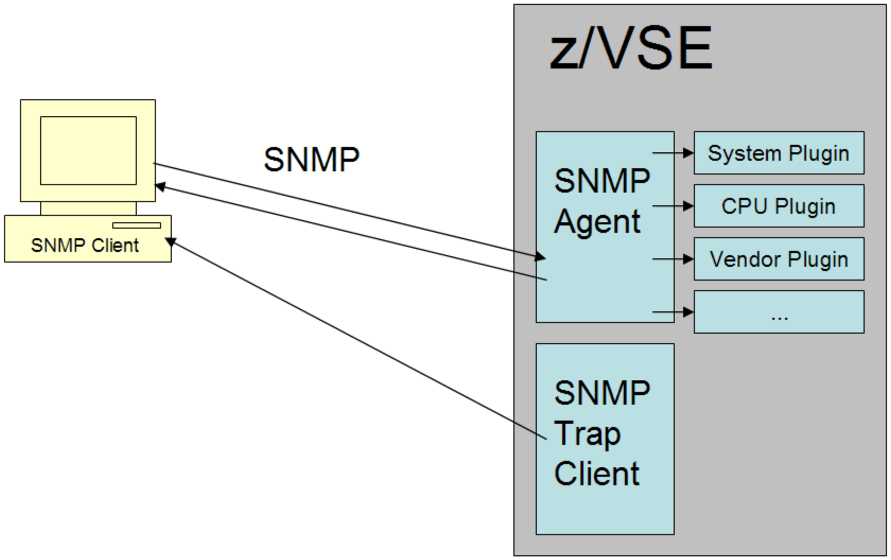
```
IESADMSIOS          DISPLAY CHANNEL AND DEVICE ACTIVITY          Page  01 of  05

DEVICE ADDRESS RANGE FROM: 000 TO: FFF                        Seconds   14:27:59

         DEVICE        PART              JOB                 DEVICE I/O
                        ID               NAME                REQUESTS

          009           F1             POWSTART                   313
                        F3             VTAMSTRT                    23
                        FB             SECSERV                      6
                        F7             TCPIP00                   1858
                        F2             CICSICCF                   133
                        R1             STARTVCS                    41
          00D           F1             POWSTART                    37
          120           F7             TCPIP00                      3
          121           F7             TCPIP00                     11
          122           F7             TCPIP00                      2
          150           F1             POWSTART                  4574
                        F3             VTAMSTRT                   444

PF1=HELP                       3=END        4=RETURN
                8=FORWARD
```

```
MA     a                                                                03/029
```

z/VSE SNMP Monitoring Agent support

- **z/VSE Monitoring Agent enables customers to monitor z/VSE systems using standard monitoring interfaces (SNMP V1)**
  - Available since z/VSE V4.3
  - It also includes an open interface, which enables customers or vendors to use own programs (plugins) to collect additional data

- **Data collected by the IBM provided plugins contains**
  - Information about the environment (e.g. Processor, LPAR and z/VM information)
  - Number of partitions (static, dynamic, total, maximum)
  - Partition priorities
  - Number of CPUs (active, stopped, quiced)
  - Paging (page ins, page outs)
  - Performance counters overall and per CPU
  - CPU address and status
  - CPU time, NP time, spin time, allbound time
  - Number of SVCs and dispatcher cycles



z/VSE CPU Monitor Tool (CPUMON)

- **Intended to help customers to measure the CPU utilization of their VSE system over a period of time.**

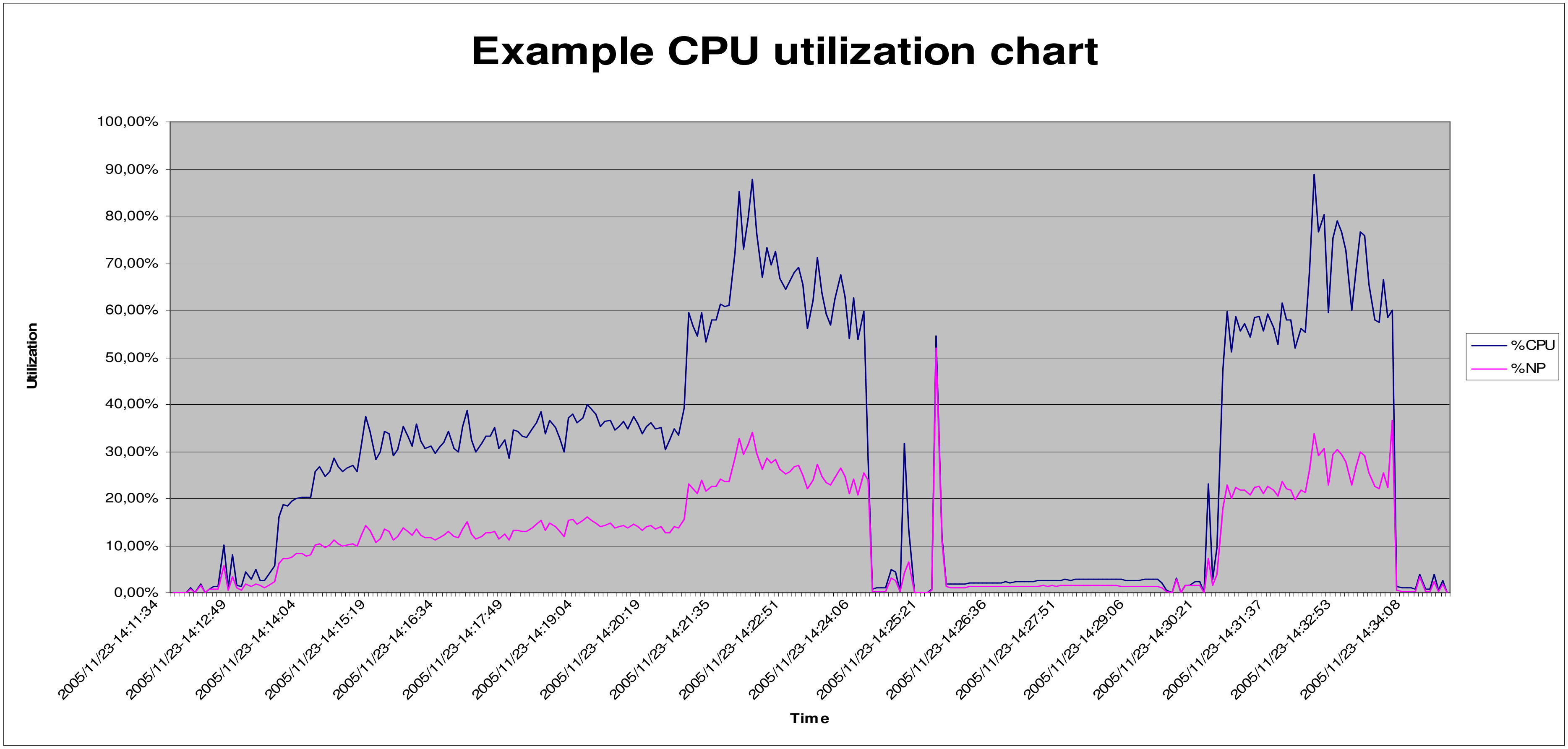
- **The VSE CPU Monitor Tool is not intended to replace any existing monitoring product provided by partners.**
  - It provides only very basic monitoring capabilities on an overall VSE system level (same data as QUERY TD)
  - No details about CPU usage of certain applications are provided

- **Download**
  - http://www.ibm.com/systems/z/os/zvse/downloads/tools.html
  - ‘As is’, no official support, e-mail to zvse@de.ibm.com

- **CPUMON supports 2 different output data formats**
  - CSV Format (Comma Separated Values)
    - Good for importing into spreadsheet
    - This is the default
  - XML Format
    - Used for zCP3000 Capacity Planning tool
    - Specify XML in PARM on EXEC card

  - Conversion from one format to the other one is possible (manually)

z/VSE CPU Monitor Tool

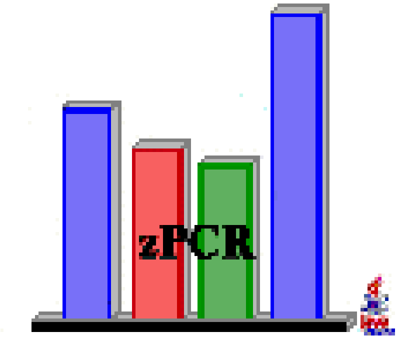


Sizing a system for z/VSE

- Sizing a system for z/VSE is different from sizing a system for z/OS
  - Although z/VSE supports multiprocessing, z/VSE does not scale as good as z/OS does
    - Do not use more than 3 active processors per z/VSE LPAR or z/VM Guest
- In general, a faster single CPU is better than multiple smaller CPUs
  - One partition can only exploit the power of one CPU
    - The largest partition (e.g. CICS) must fit into one single CPU
  - Dependent on nonparallel share (NPS) value
- Additional CPUs can be useful when multiple LPARs or z/VM Guests are used
  - Define only up to 3 CPUs per LPAR or z/VM Guest, even if more than 3 CPUs are available on the CEC
- Do **not** use MIPS tables for capacity planning purposes
  - Use zPCR Tool instead with the z/VSE workloads Batch, Online or Mixed
  - Use free of charge Capacity Planning Services from IBM

IBM Processor Capacity Reference for zSeries (zPCR)

- The zPCR tool was released for customer use on October 25, 2005
  - http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1381
  - ‘As is’, no official support, e-mail to zpcr@us.ibm.com
- PC-based productivity tool under Windows
- It is designed to provide capacity planning insight for IBM System z processors running various workload environments



- Capacity results are based on IBM's LSPR data supporting all IBM System z processors
  - Large System Performance Reference: https://www-304.ibm.com/servers/resourcelink/lib03060.nsf/pages/lsprindex
- For z/VSE use z/VSE workloads Batch, Online or Mixed

z/VSE Capacity Planning Offering

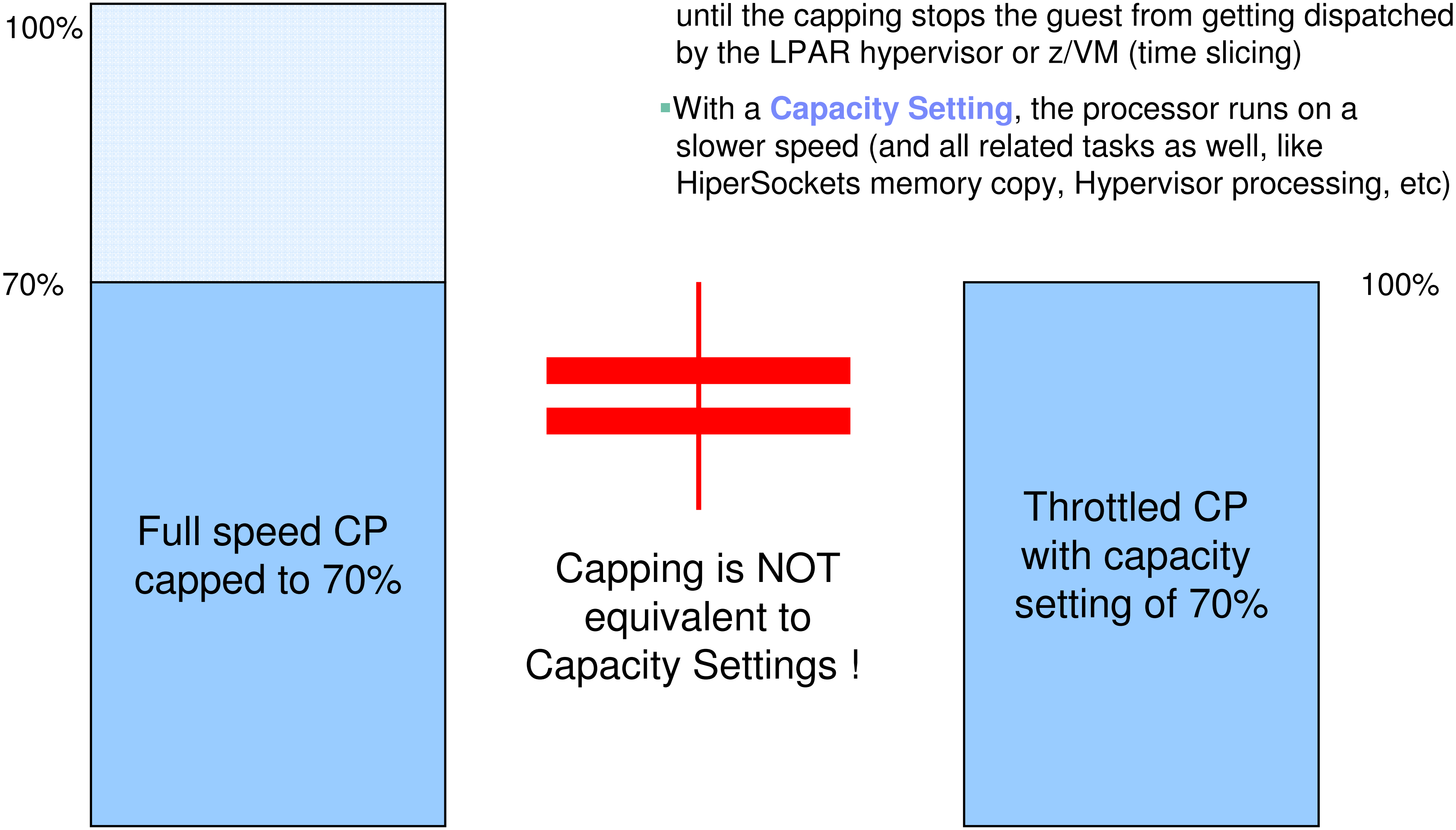
- A z/VSE Capacity Planning Offering is available
  - for Business Partners
  - and Customers
- Performance data collection is based on the XML data produced by the CPUMON Tool
- Analysis is done using zCP3000

- Contact techline@us.ibm.com
and ask for z/VSE Capacity Planning Support

Capping versus Capacity Settings

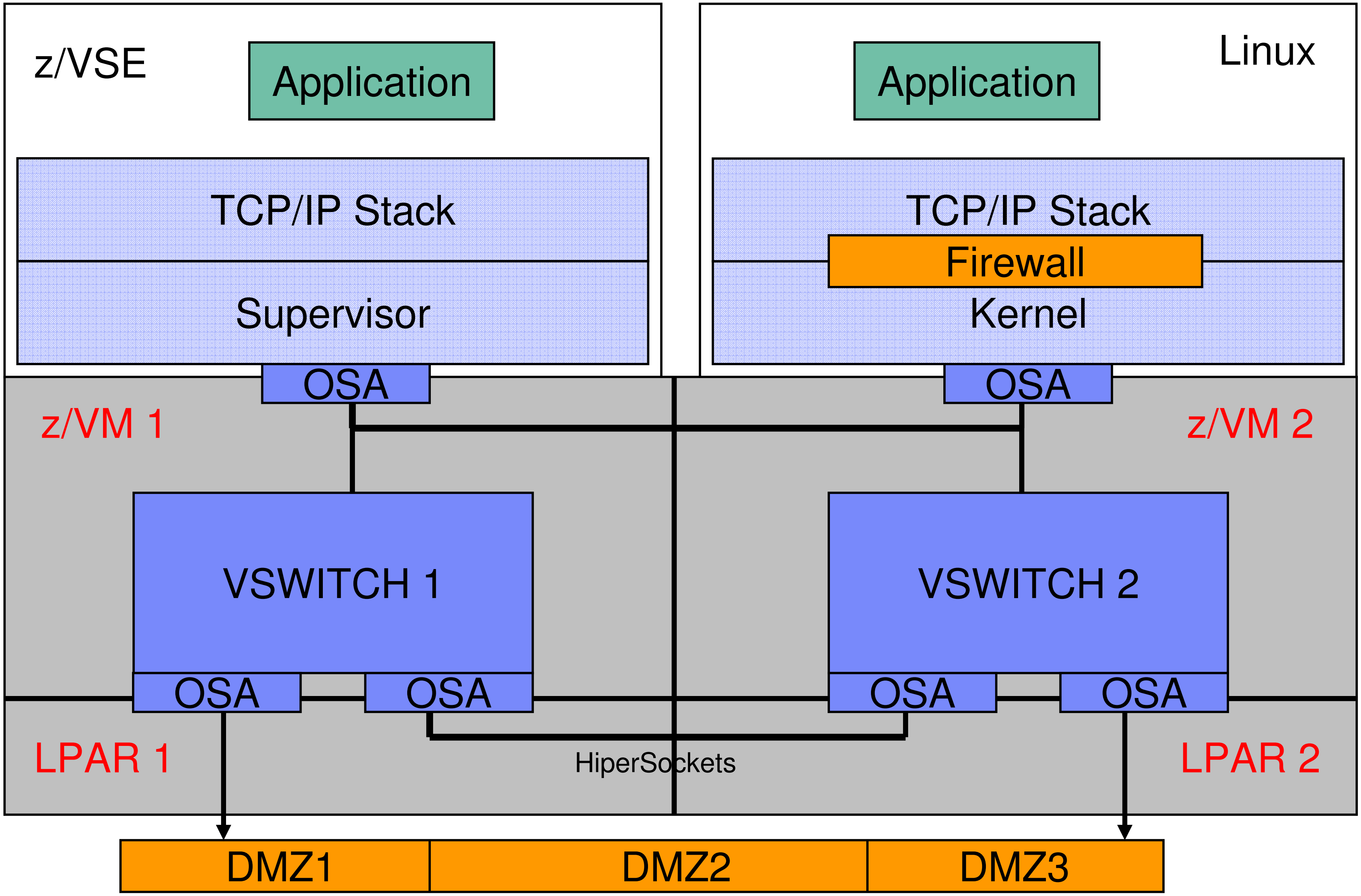
Attention: Do not use Capping to simulate Capacity Settings !

- With **Capping**, the processor runs on its full speed, until the capping stops the guest from getting dispatched by the LPAR hypervisor or z/VM (time slicing)
- With a **Capacity Setting**, the processor runs on a slower speed (and all related tasks as well, like HiperSockets memory copy, Hypervisor processing, etc)


100%
70%
Full speed CP capped to 70%
100%
Throttled CP with capacity setting of 70%

Capping is NOT equivalent to Capacity Settings !

TCP/IP Tuning: A simple picture might not be that simple in reality



Shared OSA Adapter versus HiperSockets

To connect a z/VSE system with a Linux on System z you have 2 options:

1. Using a shared OSA Adapter

- All traffic is passed through the OSA Adapter
- The OSA Adapter has its own processor
  - Processing occurs asynchronous
  - Processing in OSA Adapter does not affect host processors

2. Using HiperSockets

- Direct memory copy from one LPAR/Guest to the other
- Memory copy is handled by the host processors
  - Processing occur synchronous
  - Consider mixed speed processors (full speed IFLs and throttled CPs)

    → Memory copy performed by throttled CP is slower than memory copy performed by full speed IFL

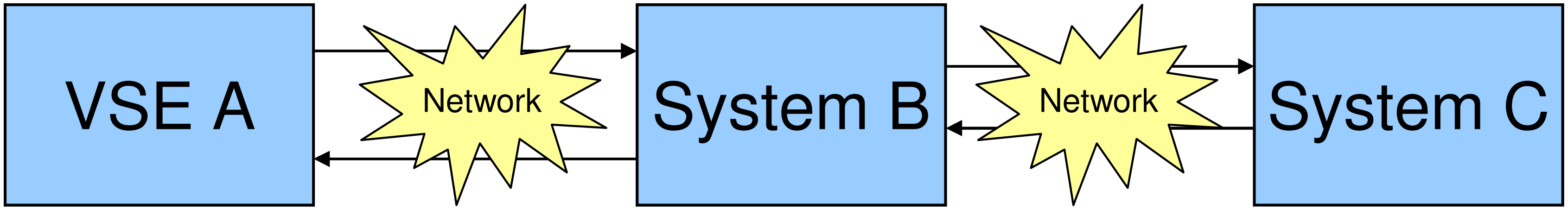
TCP/IP Tuning: Performance tuning for HiperSockets

- **When using HiperSockets to communicate between z/VSE and Linux, you may run into a "Target Buffer Full" condition**
  - This happens when z/VSE sends faster/more than Linux can receive
  - Per default Linux has 16 inbound buffers (64K per buffer = 1M per link)
  - To increase the number of buffers on Linux, use QETH option "buffer_count=128"
    - Use YAST to configure, or sysconfig scripts
    - Maximum of 128 buffers require 8MB of storage per link
- **When TCP/IP for VSE encounters this situation (BUSY), it waits 500 msec until it retries to send the packet**
  - Any additional packets to be sent are queued up
  - Problem can become dramatic, if more than 16 packets are queued up to be sent after BUSY situation
    - The resend will immediately flood the Linux buffers again, leading to the next BUSY situation, and so on....
- **You can check via QUERY STATS,LINKID=xxxx [,RESET] if you have ever run into the BUSY situation** (RESET resets the counters)

```
C1 0065 0004: IPL615I  Busy mode............................0  ← see here
C1 0065 0004: IPL615I  Busy mode, longest...................0
```

- **You can configure a shorter BUSY wait time via DEFINE LINK command**
  - BUSY=nnn (shortest possible wait time is 100 msec)

Performance tuning in a distributed environment



- **Performance of a function in VSE may be dependent on other systems**
  - Where is the bottleneck ?
    - Is it on VSE A, or on System B or System C
    - Is it in the network ?
  - Tuning the VSE system will not help if the bottleneck is outside of VSE
  - Simple tasks on VSE may produce very time consuming tasks on other systems
- **You need to understand the whole environment**
  - With all affected systems and their dependencies

Summary

- **There is no ‘standard’ path to solve a performance problem**
  - Every customer environment is different
  - Every workload is different

- **Very seldom, a performance problem is caused by a bug in the code**
  - E.g. loops, unnecessary waits, etc

- **Mostly it is about monitoring and then suggesting tuning options**
  - Tune configuration settings
  - Find and remove bottlenecks

- **Sometimes a performance problem is because of unrealistic expectations**
  - Customer ‘thinks’ or ‘wishes’ that it should run faster
  - Customer underestimates resource/CPU requirements of a new function/workload
  - Someone ‘promised’ good performance to get a deal closed

Questions ?

?

http://www.ibm.com/zVSE