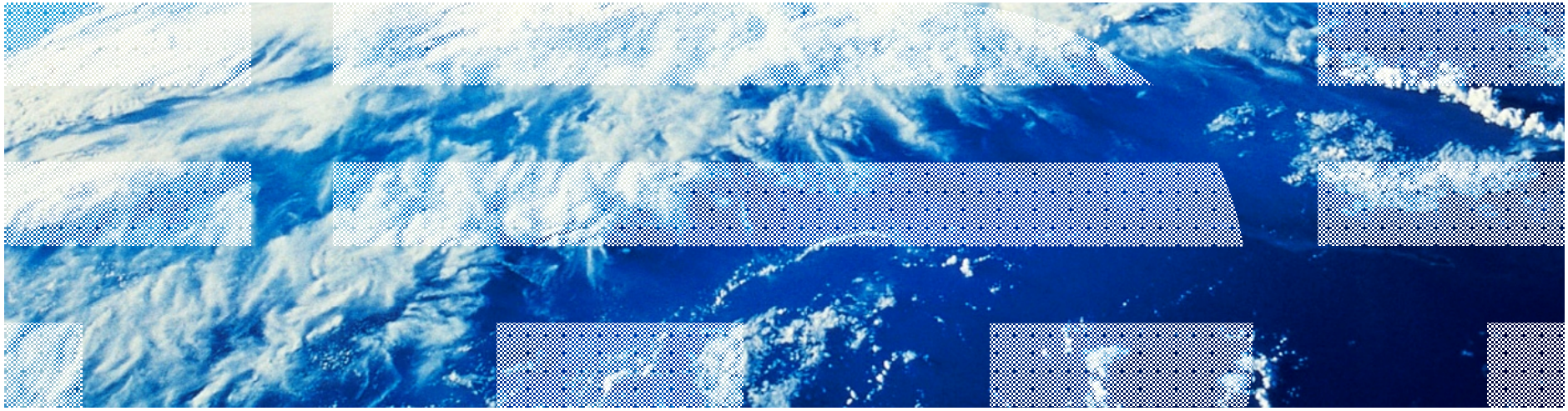
z/VSE Performance Update

Ingo Franzki, IBM



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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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Agenda

- **General Considerations**
- **z/VSE V4.3 Performance Considerations**
  - GETVIS constraint relief
  - Dynamic start/stop of CPUs
  - Queue-I/O Assist (QIOASSIST)
  - Crypto Express3 and AP queue interrupt support
- **z/VSE V5.1 Performance Considerations**
  - 64 bit virtual
  - Standalone Dump
- **Sizing a System for z/VSE**
- **z/VM and Linux considerations**
- **Performance Measurement Tools**

Supported VSE Releases

VSE Release	Available	End of Marketing	End of Service
z/VSE 5.1	11/25/2011		
z/VSE 4.3	11/26/2010	06/25/2012	
z/VSE 4.2	10/17/2008	11/26/2010	10/31/2012
z/VSE 4.1	03/16/2007	10/17/2008	4/30/2011 ut of service)
z/VSE 3.1	03/04	05/31/2008	7/31/2009 ut of service)
VSE/ESA 2.7	03/14/2003		2/28/2007 service)
VSE/ESA 2.6	12/14/2001		2006 service)
VSE/ESA 2.5	09/29/2000		2003 service)
VSE/ESA 2.4	06/25/1999		2002 service)
VSE/ESA 2.3	07/12/1997	06/30/2000	12/31/2001 (out of service)

Attention:
Order it now, if you still need it!

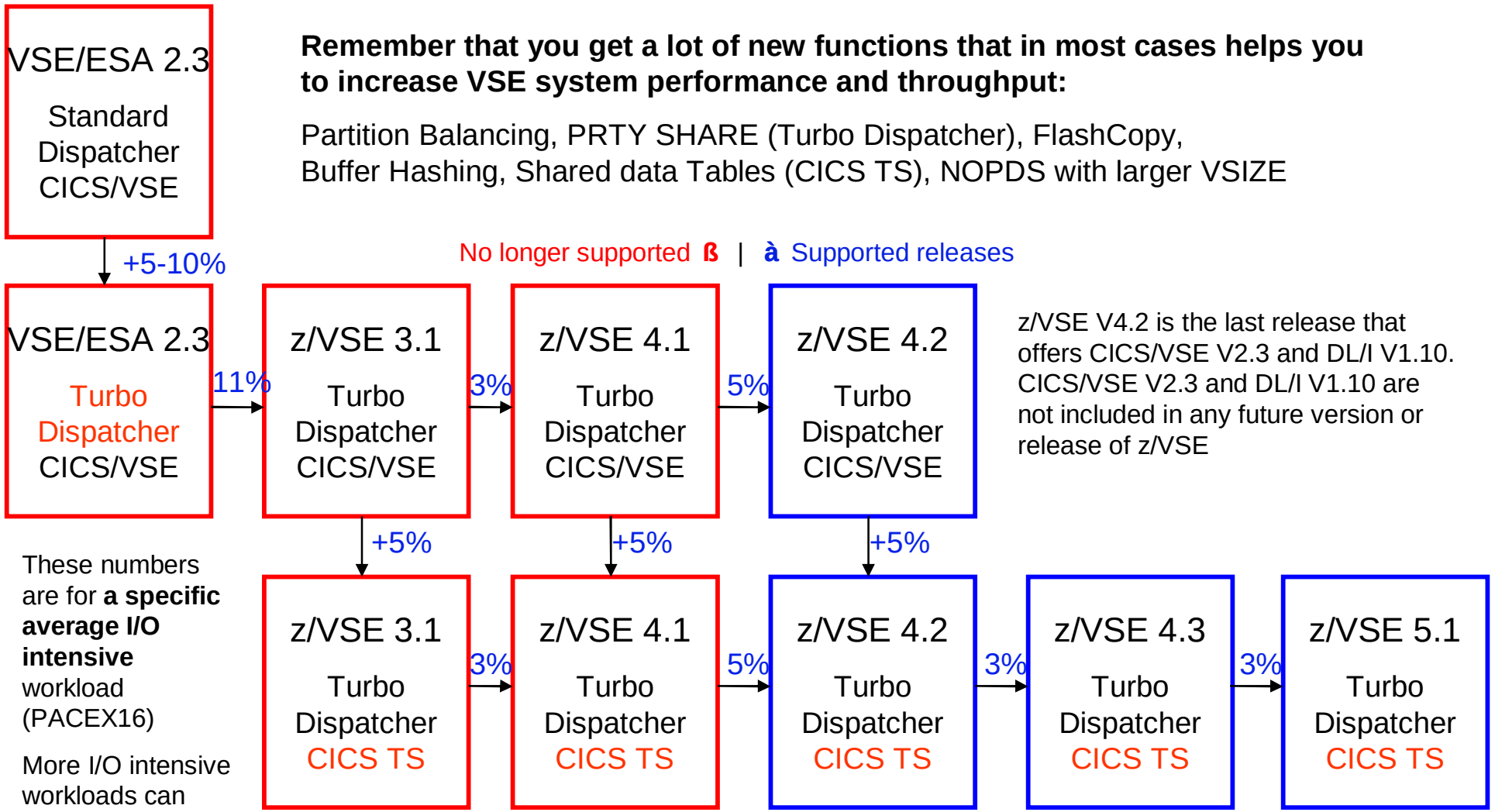
Attention:
z/VSE V4.2, CICS/VSE V2.3, DL/I V1.10 and DL/I V1.11 will be withdrawn from service effective at 10/31/2012.
z/VSE V4.2 is the last release that offers CICS/VSE V2.3 and DL/I V1.10.
CICS/VSE V2.3 and DL/I V1.10 are not included in any future version or release of z/VSE.

http://www.ibm.com/systems/z/os/zvse/about/status.html

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



z/VSE V4.2 is the last release that offers 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

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

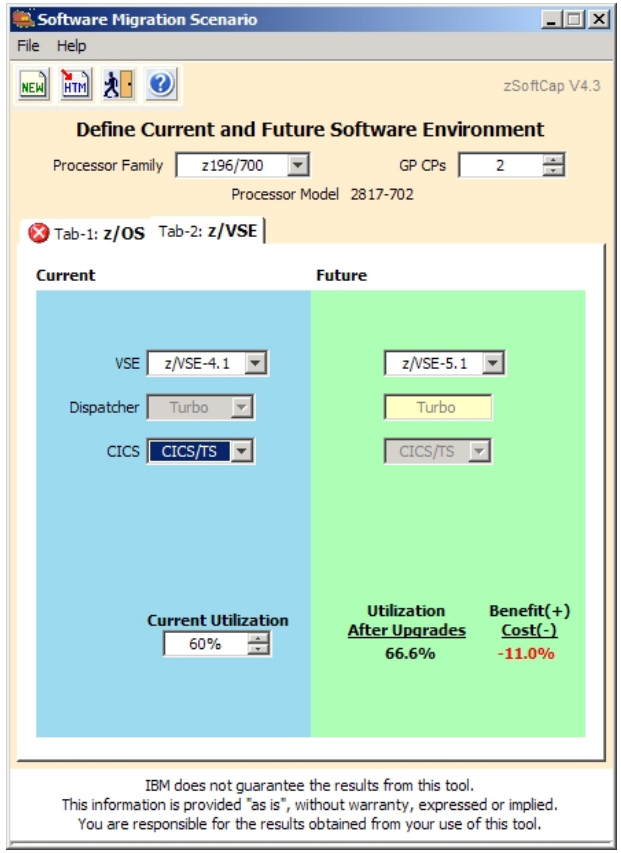
More I/O intensive workloads can cause more overhead

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

You can use the zSoftCap tool to determine release migration overhead:
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.



z/VSE V4.3 – GETVIS constraint relief

§ I/O Constraint Relief:

- The z/VSE I/O supervisor routines will run in AMODE(31)
- Depending on the IODEV statement, the control blocks will be allocated either in 24-bit area or in 31-bit area:
  - Specifying IODEV=1023 will result in an allocation of the control blocks below the line (24-bit area)
  - Specifying IODEV=1024 will result in an allocation of the control blocks above the line (31-bit area)

à *Note: in either way the z/VSE limit of 1024 devices does apply and is as well maintained !*

– *Example:*

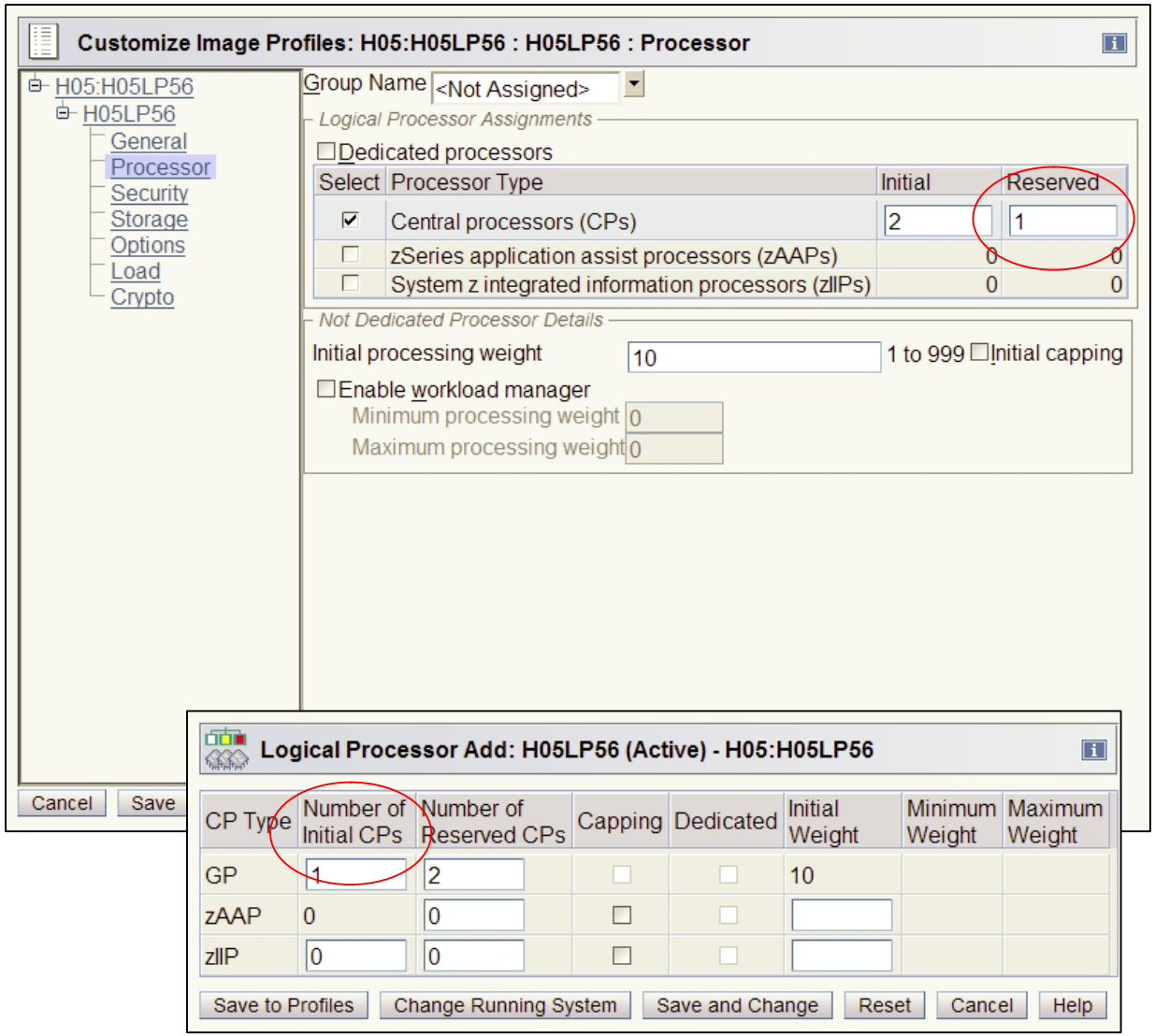
```
…
BG 0000 $$A$SUPI,VSIZE=264M,VIO=512K,VPOOL=64K,LOG,IODEV=1024
…
```

- The z/VSE 4.3/5.1 system is shipped with IODEV=1024
- If you FSU to z/VSE 4.3/5.1, the value remains IODEV=1023

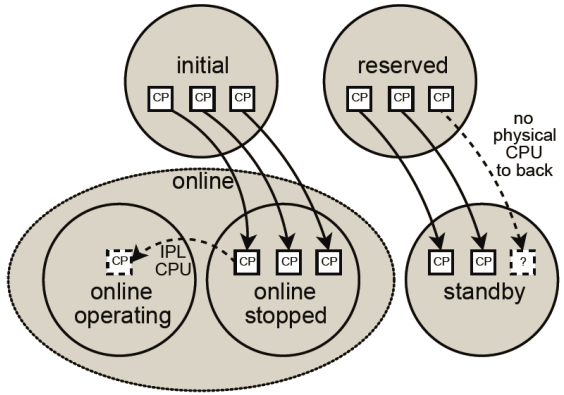
z/VSE V4.3 – Dynamic Starting/Stopping of CPUs

- **z/VSE allows you to start CPUs that were not online at IPL**
- **These can be either:**
  - CPUs that were in a "standby" state at IPL
  - CPUs that were added to the z/VSE LPAR profile after IPL
- **Using the HMC/SE "Logical Processor Add" task, you can add CPUs to an LPAR after IPL. This feature is available on IBM z10 and zEnterprise platforms**.
  - When CPUs are added to an LPAR, z/VSE automatically updates its CPU configuration.
- **You can then use the:**
  - SYSDEF TD,STARTSBY=cpuaddr command to set CPUs that are in a "standby" state to an "online" state and start these CPUs
  - SYSDEF TD,STOPSBY=cpuaddr command to change the CPU state from "online" to "standby".
- **These functions allow you to exploit z10 and z196 technology and update the CPU configuration depending on workload needs**
- Note: "Standby" CPUs do not consume any CPU share of their LPAR

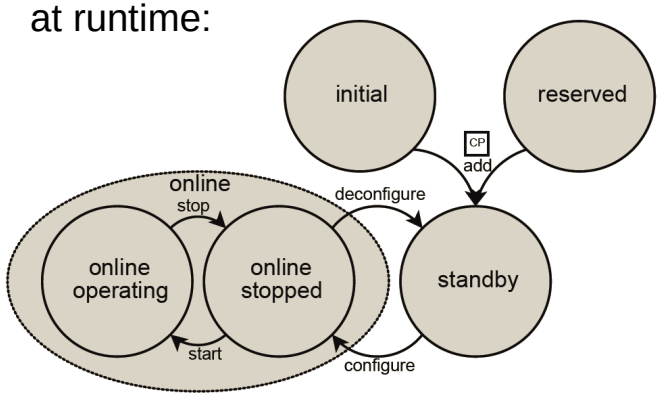
z/VSE V4.3 – Dynamic Starting/Stopping of CPUs



LPAR CPU state transitions during LPAR activation and IPL:



LPAR CPU state transitions at runtime:



z/VSE V4.3 – Dynamic Starting/Stopping of CPUs

```
query td
AR 0015 CPU STATUS SPIN_TIME NP_TIME TOTAL_TIME NP/TOT
AR 0015 00  ACTIVE 0         43      23070      0.001
[…]

AR 0030 0W03I 00002 STANDBY CPUS HAVE BEEN ADDED TO THE CONFIGURATION

query td
AR 0015 CPU STATUS SPIN_TIME NP_TIME TOTAL_TIME NP/TOT
AR 0015 00  ACTIVE 0         65      23095      0.002
AR 0015 01  STANDBY
AR 0015 02  STANDBY
[…]

sysdef td,startsby=01
AR 0015 1YH7I NUMBER OF CPU(S) - ACTIVE: 1 - QUIESCED: 0 - INACTIVE: 0 -
              STANDBY: 1
AR 0015 1I40I READY
```

z/VSE V4.3 – Queue-I/O Assist (QIOASSIST)

- **The z/VM function queue-I/O assist (QIOASSIST) provides performance improvements for V=V guests using real adapters and real networking devices that use the Queued Direct I/O (QDIO) facility**

- **z/VSE exploits the queue-I/O assist function for:**
  - OSA Express devices (CHPID type OSD)
  - HiperSockets devices (CHPID type IQD)

- **To use the queue-I/O assist (QIOASSIST) function in z/VSE, use the z/VM CP command:**
  - SET QIOASSIST ON

- **After you have enabled the queue-I/O assist function, each z/VSE DEFINE LINK,TYPE=OSAX command will then automatically exploit the queue-I/O assist function**

- **If you do not wish to use the queue-I/O assist (QIOASSIST) function in z/VSE, disable it using this z/VM CP command:**
  - SET QIOASSIST OFF

z/VSE V4.3 – Crypto Express 3 and AP queue interrupt support

§ **Support for AP-interrupts is a new function of IBM System z10 and IBM zEnterprise**

§ **A hardware interrupt is issued when a response is ready for de-queuing from a card.**
- Removes the need for the formerly used polling mechanism
- User can switch between polling and interrupts (default: polling)
- Using interrupts increase throughput for certain workloads without increasing CPU load

§ **Only available in LPAR mode, not available under z/VM!**

§ **Supported cards are:**
- Crypto Express 2
- Crypto Express 3

§ **The VSE crypto device driver provides new commands:**
- APEAI, enable AP interrupts for all APs
- APDAI, disable AP interrupts for all APs

z/VSE V5.1 – Enhancements

- **64 bit virtual addressing**
  - Support for (64-bit) Memory Objects in 64-bit Address Spaces
- **Exploitation of IBM System Storage Tape Technology**
  - TS7700 Copy Export Feature
  - TS7700 Multi-Cluster Grids
- **Exploitation of IBM System Storage Disk Technology (supported by z/VSE V4.2 or later)**
  - IBM Storwize V7000
  - IBM XIV Storage System
- **Security/Encryption Enhancements**
  - Improved Cryto Commands
  - New AP Crypto Command
  - 4096-Bit Key Lengths
- **e-business Connectors Enhancements**
- **System Management Enhancements**
  - Enhancements of SNMP Trap client
  - GDPS Support

z/VSE V5.1 – Enhancements

- **VSE/POWER Enhancements**
  - Support for the TKN Attribute
- **TCP/IP and Networking Enhancements**
  - Layer 2 Support
  - Virtual LAN (VLAN) Support
  - Support for Intra-Ensemble Data Network (IEDN) using OSA Express for zBX
  - z/VSE z/VM IP Assist (z/VSE VIA)
  - IPv6/VSE
  - Support for IPv6 in Fast Path to Linux on System z
- **Dump Handling Enhancements**
  - Support for Memory Objects
  - Support for 64-Bit Address Space
- **Available via PTFs (see announcement letter)**
  - CICS Explorer
  - Database connector
  - 64-bit I/O

z/VSE V5.1 – 64 bit Virtual Performance Considerations

à 64 bit virtual does not make the system run faster or slower (*)

(*) Besides the general release overhead

§ But it allows an application to keep more data in memory

– Memory Objects above the 2 GB bar

§ Examples:

– Extended caching for database type of applications

– Large TCP windows support of IPv6/VSE product

à Exploitation requires changes in application or vendor code

§ You may have to increase the VSIZE of your system to utilize 64 bit memory objects

– Check the real storage, to avoid paging

Standalone Dumps of large systems

§ **Dumping huge amounts of data may take a considerable long time**
- – Large VSIZE
- – Huge partitions (up to 2GB)
- – 64 bit Memory Objects (above or below the 2 GB bar)

§ **Be prepared for taking a Stand-Alone Dump in case of a hardwait**
- – Check the SADUMP options
  - • Dump only what is really needed
- – Have an updated Stand-Alone Disk/Tape available
  - • The creation of the standalone dump program on disk can take a long time to complete
    - **à** Every data record on IJSYSDU is initialized
    - **à** This job can run in background and should not affect other workload
- – Have enough space available

§ **In general, it is recommended to use standalone dump on disk**
- – Only if the size of the system is > 50GB, then use standalone dump on tape
- – Advantage of disk:
  - • It is faster
  - • IJSYSDU file can be easily transferred via FTP

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

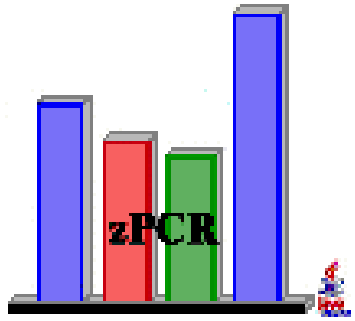
Sizing a system for z/VSE

The fastest uni-processor is (almost always *) the best processor

(*) from a single VSE-image point o view

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: http://www.ibm.com/systems/z/advantages/management/lspr/
- For VSE use z/VSE workloads Batch, Online or Mixed

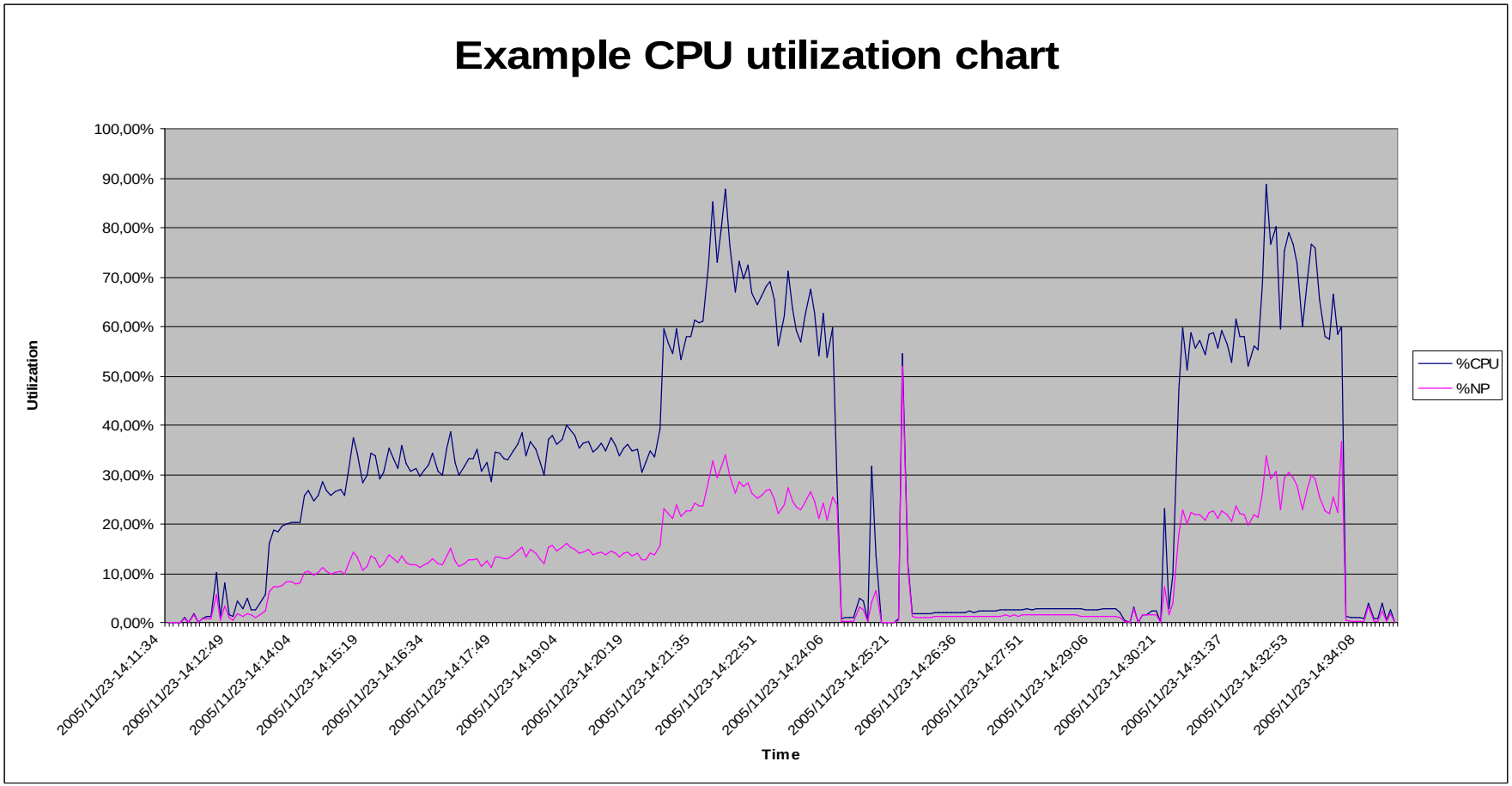
z/VSE CPU Monitor Tool

- Intended to help customers to measure the CPU utilization of their VSE system over a period of time.
- When you plan for a processor upgrade it is very important to know the CPU utilization of your VSE system over a day or a week.
  - Helps you to estimate the size of the new processor.

- 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.
- No details about CPU usage of certain applications are provided
- New version available (XML Output) for z/VSE Capacity Planning

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

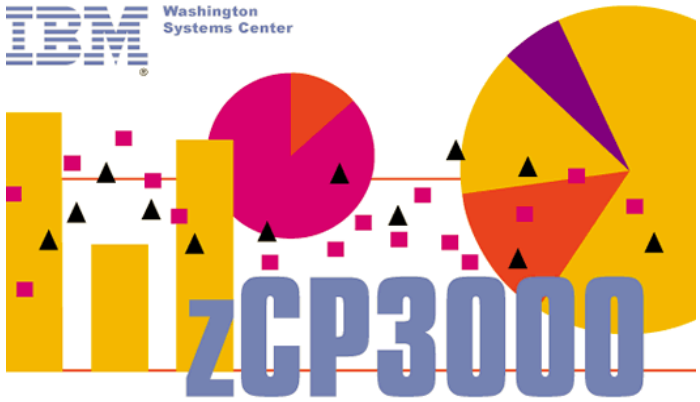
z/VSE CPU Monitor Tool



z/VSE Capacity Planning Offering

- **A new z/VSE Capacity Planning Offering is now available**
  - Available for Business Partners
  - and Customers
- **Performance data collection is based on a new version of the CPUMON Tool**
- **Analysis is done using zCP3000**

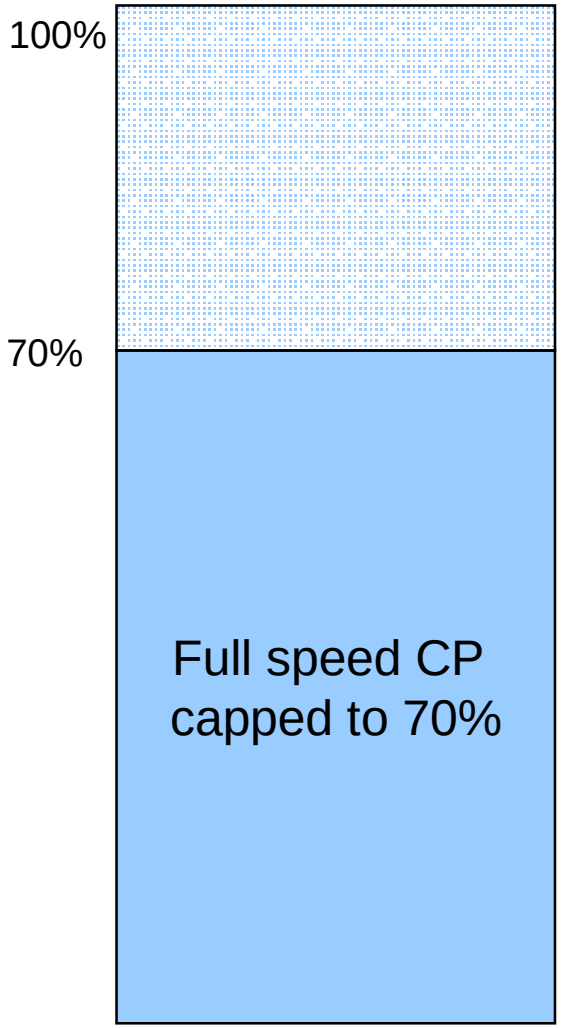
- **Contact techline@us.ibm.com**
  and ask for z/VSE Capacity Planning Support



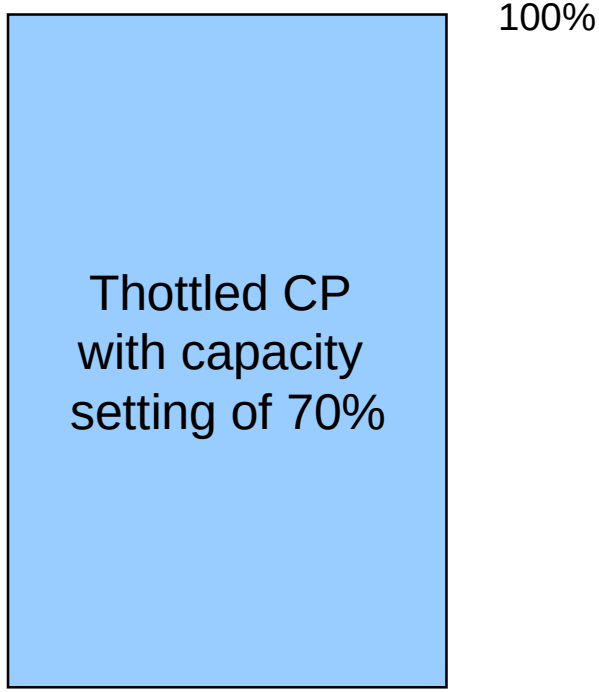
Capping versus Capacity Settings

Attention: Do not use Capping to simulate Capacity Settings !

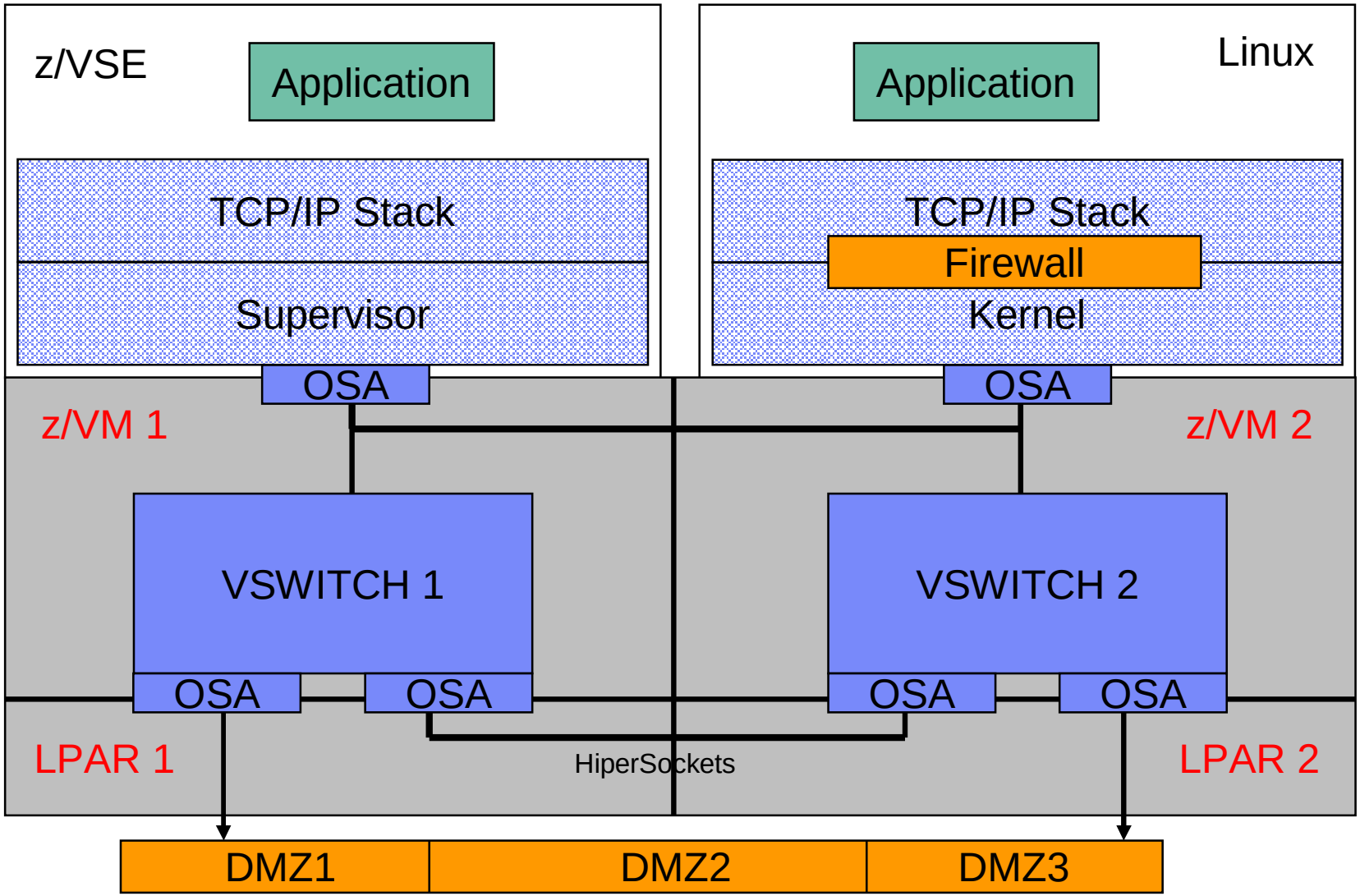
- With **Capping**, the processor runs on its full speed, until the capping stops the guest from getting dispatched by the LPAR hipervisor or z/VM (timeslicing)
- With a **Capacity Setting**, the processor runs on a slower speed (and all related tasks as well, like HiperSockets memory copy, Hipervisor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



Capping is NOT equivialent 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)
    - **à** 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   ß 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)

Best practice activities for monitoring and tuning

Any performance improvement process includes the following fundamental steps:

1. Define the performance objectives.
2. Establish performance indicators for the major constraints in the system.
3. Develop and execute a performance monitoring plan.
4. Continually analyze monitoring results to determine which resources require tuning.
5. Make one adjustment at a time.

If an application or a set of applications does not run as fast as expected, you must become familiar with the affected systems and components.

- A distributed environment, such as z/VSE connected to a DB2 database server running on Linux on System z, requires a look at the entire picture rather than at each site or component separately.

The data and requests flow through several different software layers and services on its way from the z/VSE application to the server on Linux on System z and back.

- Each layer adds a certain amount of overhead and processing time.
- To learn why such an application does not perform as expected, you might need to look at each layer, which includes the z/VSE application itself, the middleware running on z/VSE, the TCP/IP stack on both systems, the network, and middleware running on Linux on System z.
- In addition to the layers that are directly involved, you also must look at both operating systems, z/VSE and Linux on System z.

Best practice activities for monitoring and tuning

- **Remember the law of diminishing returns**
  - The greatest performance benefits usually come from your initial efforts.
- **Do not tune just for the sake of tuning**
  - Tune to relieve identified constraints.
  - If you tune resources that are not the primary cause of performance problems, you can make subsequent tuning work more difficult.
- **Consider the whole system**
  - You cannot tune one parameter or resource in isolation.
  - Before you make an adjustment, consider how the change will affect the system as a whole.
  - Performance tuning requires trade-offs among various system resources.
    - For example, you might increase buffer pool sizes to achieve improved I/O performance, but larger buffer pools require more memory, and that might degrade other aspects of performance.
- **Change one parameter at a time**
  - Do not change more than one factor at a time.
  - Even if you are sure that all the changes will be beneficial, you will have no way to assess the contribution of each change.

Best practice activities for monitoring and tuning

§ **Measure and configure by levels**
- – Tune one of the following levels of your system at a time:
  - Hardware
  - Operating system
  - Middleware components
  - Application programs

§ **Check for both hardware and software problems**
- – Some performance problems can be corrected by applying service to your hardware, your software, or both.
- – Do not spend excessive time monitoring and tuning your system before applying service to the hardware or software.

§ **Understand the problem before you upgrade your hardware**
- – Even if it seems as though additional storage or processor power might immediately improve performance, take the time to understand where the bottlenecks are.
- – You might spend money on additional disk storage, only to find that you do not have the processing power or the channels to exploit it.

§ **Put fallback procedures in place before you start tuning**
- – If tuning efforts result in unexpected performance degradation, reverse the changes that are made before you attempt an alternative approach. Save your original settings so that you can easily undo changes that you do not want to keep.

Best practice activities for monitoring and tuning

1. **Collect data:**
   - § The data collection step involves the usage of various performance monitor tools and optionally tracing tools on all components that are affected
   - § Part of this step proves that the monitoring and tracing tools work as expected and produce the kind of output that is needed for further analysis.

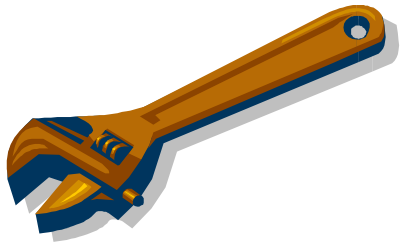
2. **Analyze the data:**
   - § The data analysis step uses the data that was collected in the previous step and analyzes it.
   - § Depending on the performance problem, concentrate on unusual behavior that catches your attention such as delays, high CPU utilization, long wait times, high water marks, and so on.

3. **Tune the systems:**
   - § Based on the results from analyzing the data, you tune the different parts of the environment.
   - § The goal is to change settings that influence the behavior when analyzing the data but in a positive way.

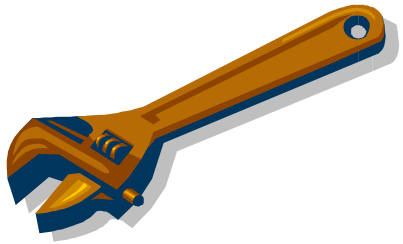
4. **Run the test case:**
   - § Re-run the test case to check whether the tuning has helped.
   - § Don’t forget to activate the performance monitor and tracing tools
   - § Make sure that the preconditions of the test case are the same on all test runs

z/VSE monitoring tools

- **System Activity Dialogs (SYS fast path 361 and 362)**
  - Displays real-time performance information about the System, CPU, partitions and I/O
- **QUERY TD command**
  - Displays information about CPU usage on the console
- **SIR SMF command**
  - Displays I/O related performance information on the console
- **Job Accounting Exit (SKJOBACC in ICCF library 59)**
  - Prints performance related information (CPU, I/O) to SYSLST after each job step
- **MAP and GETVIS commands**
  - Displays memory related information on the console
- **z/VSE CPUMON Tool**
  - Monitors overall system CPU usage and performance counters
- **CICS Statistics**
  - Prints CICS statistics
- **CICS built-in tools like CEMT INQUIRE**
  - Displays information about CICS ressources
- **A z/VSE performance monitor product for batch and CICS**
  - Like CA Explore, ASG TMON, etc.
- **z/VSE SNMP Agent**



Linux and z/VM monitoring tools



- **sysstat utilities**
  - A collection of performance monitoring tools for Linux
- **iostat utility**
  - Monitors disk utilization
- **top utility**
  - Prints system data for each process. It shows an overview of the currently running system processes.
- **oprofile utility**
  - profiles all running code on Linux systems, providing a variety of statistics
- **IBM Tivoli OMEGAMON XE on z/VM and Linux**
  - Displays data that is collected from multiple systems in one, flexible interface called the Tivoli Enterprise Portal
- **Performance Toolkit for z/VM**
  - Provides capabilities to monitor and report performance data for a z/VM system
- **3rd Party Performance Monitoring Tools**
  - e.g. Tools from Velocity Software, Inc

Questions ?