IBM VSE/ESA Hints for Performance Activities

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Notes

All information contained in this document has been collected and is presented based on the current status. It is intended and required to update the performance information in this document.

It is the responsibility of any user of this VSE/ESA document

- to use the latest update of this document
- to use this performance data appropriately

This document is unclassified and intended for VSE customers.

This document is available from the Internet via the VSE/ESA home page

http://www.ibm.com/servers/eserver/zseries/os/vse

(http://www.ibm.com/s390/vse/ former URL)

The following documents are also available via Internet, in Adobe Reader format (.PDF):

'IBM VSE/ESA 1.3/1.4 Performance Considerations'
'IBM VSE/ESA V2 Performance Considerations'
'IBM VSE/ESA Turbo Dispatcher Performance'
'IBM VSE/ESA I/O Subsystem Perf. Considerations'
'IBM VSE/ESA VM Guest Performance Considerations'
'IBM VSE/ESA Hints for Performance Activities' (this doc)
'IBM VSE/ESA TCP/IP Performance Considerations'
'IBM DFSORT/VSE Performance Considerations'
'IBM VSE/ESA CICS Transaction Server Performance'
'IBM VSE/ESA V2.5 Performance Considerations'
'IBM VSE/ESA Performance on xSeries (NUMA-Q) Enabled for S/390'

The files are
VE13PERF.PDF, VE21PERF.PDF, VE21TDP.PDF, VEIOPERF.PDF, VEVMPERF.PDF, VEPERACT.PDF, VETCPPER.PDF, VESORTP.PDF, VECICSTS.PDF, VE25PERF.PDF, VEXEFSP.PDF

Starting with VSE/ESA 2.4, these documents are also available on the VSE/ESA CD-ROM kit SK2T-0060.

Disclaimer

This document has not been subjected to any formal review or testing procedures and has not been checked in all details for technical accuracy. Results must be individually evaluated for applicability to a particular installation.

Any performance data contained in this publication was obtained in a controlled environment based on the use of specific data and is presented only to illustrate techniques and procedures to assist to understand IBM products better.

The results which may be obtained in other operating environments may vary significantly. Users of this document should verify the applicability of this data in their specific environment.

The above disclaimer is required since not all dependencies can be described in this type of document.

Acknowledgements

Thanks to all who contributed directly or indirectly, be it by measurements, suggestions or in other ways.
Specific thanks is due to Joachim Ebert, IBM Munich, Germany.

All mistakes and inaccuracies in this document are owned by me.

Please, as in the past, contact us if you have

- suggestions or questions regarding this document
- questions on VSE/ESA performance, not covered in any of the performance documents

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Base Documents

This document essentially tries to assist in performance trouble shooting (solving unexpected, individual performance problems).

It applies to all VSE/ESA releases, some aspects are only valid if
e.g. - running with the Turbo-Dispatcher on an n-way
- running as a guest under VM or in a shared PR/SM LPAR

The VSE/ESA performance documents (see a previous foil) are also available to any IBM person, as part of the VE12PERF/VE13PERF/VE21PERF PACKAGEs on the same IBMVSE TOOLS disk. Contact your IBM representative to retrieve a copy for you by entering the following CMS command:

TOOLS SENDTO BOEVM3 VMTOOLS IBMVSE GET VExxPERF PACKAGE

These documents contain references to further VSE performance documents.

Trademarks

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BIM VIO	Ben I. Moyle Corporation
OPTI-CACHE	Barnard Systems Incorporated
StorageTek, Iceberg, SnapShot	Storage Technology Corporation

What has been added/changed?

Deltas as compared to earlier versions

Editorial changes are done throughout the document without special notice.

Updates as of 97-08-08:

- This is the first time that different existing trouble shoot hints and sizing charts are collected in this new document.

  Later on, some of the few charts taken over from the other performance documents will be removed there to avoid duplication.

Updates for 97-12-05:

- VSE/POWER Statistics recommendations
- More SIR commands
- New Multiprise 200 models in processor ITR table

Updates as of 98-10-10:

- More info to CICS/VSE SOS
- Added VSE/ESA 2.3 to the release migration table
- Added chart 'To MIPS or not to MIPS?'
- Added G5 CMOS processors to the LSPR ITR Ratio tables

Updates after 98-10-10:

- Added 9672 G6 CMOS processors
- Updated VSEQMS program hints
- 'Exported' and extended VSE JA charts to new V2.5 document

Glossary

There is no separate glossary for this document.
Refer to the base documents, should it be necessary.

References

Further References

The following are few references for the subjects discussed here in the context of VSE/ESA Performance Activities.

All details and 'education' is contained in the already mentioned 5 VSE/ESA performance documents.

They also contain many references.

'VSE/ESA and VM/VSE/ESA System Sizing, Performance, and Capacity Planning', Dan Janda, IBM System Center Endicott, VSE/ESA Tech Conf Atlanta, 05/95

'VSE Sizing using the NWAY (VSEQMS) Tool
Dan Janda, IBM System Center Endicott, Success '97, San Francisco, Session #290

'Hints and Tips for VSE/ESA' brochure.
3rd editon, 11/97 (236 pages), IBM Boeblingen, Germany
4rth editon, 04/00 (2xx pages), IBM Boeblingen, Germany
As VSEHINTS PACKAGE on the IBMVSE tools disk

'How much does a Hen Weigh? -Sizing VSE/ESA Systems-'
Dan Janda, IBM System Center Endicott, VM/VSE Tech Conf Kansas City, MO, 05/97 Session 33I

'Sizing S/390 CMOS Processors for VSE/ESA Customers'
Dan Janda, IBM System Center Endicott, VM/VSE Tech Conf Reno, Nevada, 05/98 Session 32E

Introduction and Overview

PART A.

Introduction and Overview

Overall System Performance

Overall System Performance depends on ...

- **H/W Configuration**
  - **Processor speed/capacity, number of processors**
  - **Real storage**
  - **I/O subsystem type and configuration**
  - **...**
- **S/W Configuration**
  - **Operating system and product levels**
  - **Type of program products**
  - **Startup options and parameters**
  - **VM/VSE setups and guest definitions**
  - **...**
- **Workload characteristics**
  - **Type of applications**
  - **CPU and I/O heaviness of application**
  - **Type/access pattern/frequency of file or data base accesses**
  - **...**
- **Tuning status**
  - **ESA exploitation**
  - **...**

Types of Performance Problems

- **Overall System Performance splits into**
  - **CPU/processor component**
  - **I/O component**
  - **Other resources**
- **'System Performance' components**
  - A) Elapsed times and/or Response times
  - B) Batch and/or online throughput
  - C) Balancing of partial loads (e.g. Online vs Batch)

More details:

Types of Performance Problems (Summary)

- **A) Batch Elapsed time or Online Response time**
  - **CPU-component**
    - **Wait for CPU**
    - **CPU-time for processing**
  - **I/O-component**
    - **Number of I/Os**
    - **Wait in VSE channel Queue (IOSQ)**
    - **I/O Service time(s)**
  - **Other resource delays**
    - **Paging**
    - **Operator, ...**

Í **All ETs and RTs are composed of these parts**

Types of Performance Problems ...

Types of Performance Problems (cont'd)

- **B) System Throughput problems**
  - **Batch Throughput (jobs per minute, hour...)**
  - **On-line Throughput (Transactions per minute...)**
    Number of active terminals is too vague
- **Depends on**
  - **ETs/RTs (previous chart)**
  - **Concurrency achieved**
- **Actual System Throughput also depends on available resources AND the available work**
- **C) Balancing problems**
  Making trade-offs among different partial loads

Types of Performance Activities

Types of Performance Activities

- **Trouble Shooting**
  Analyzing and solving a suddenly emerging performance problem.
  (sporadic, time critical problem)
- **Performance Tuning**
  Improving the performance of total loads, partial loads or jobs, usually planned and thus less urgent
  (medium term, as wanted or required)
- **Standard Performance Monitoring**
  The base for any performance related activity, mandatory for any bigger VSE installation.
  (should be a permanent part of large installations)
- **Capacity Planning**
  Observation and planning of load and resources (growth).
  (long term)
- **Migration Planning**
  Migration Planning could be considered as specific subtasks of Capacity Planning. It must be done by IBM personel together with the customer, in order to assure a smooth transition.
  - **Processor Migration**
    Sizing for processor migration usually is straightforward, provided no other major changes are done at the same time.
  - **Major S/W Migration and/or Setup Changes**
    Migration of VSE releases usually is also straightforward, but may be more challenging if other major changes are done concurrently.

What is This Document For?

What is This Document For?

Provide hints to do performance related activities more effectively:

- **General**
  - **Identify what performance relevant values are to be examined**
  - **State which tools or commands can be used and how to use them**
  - **Better enable customers and IBM personel**
    - to determine causes of a performance problem
    - to remove or circumvent a new bottleneck should it appear
    (slowly emerging due to load changes or suddenly appearing)
  - **Make customers aware of the risk or costs of not having useful information on their current system's performance**

Cont'd ...

What is This Document For? ...

What is This Document For? (cont'd)

- **Trouble Shooting**
  - **Give hints how to proceed for performance Trouble Shooting**
  - **Assist in determining the global type of performance problem**
  - **Provide further directions when problem type has been determined**
  - **Reduce the time from detection to solution of a performance problem**
- **Performance Tuning**
  - **Provide Checklists to suggest areas of potential improvements**
- **Migrations**
  - **Provide checklists for key technical points of H/W and S/W migrations**
- **Tell customers how they can help us to help them**
- **Different parts of this doc are related to each other but from different view-point**

Not discussed in this document

Not discussed in this document

„ **VSE/ESA system tuning itself, i.e. details on ...**

- **Potential system bottlenecks**
- **VSCR Exploitation and Virtual Storage Tuning**
- **Data In Memory Exploitation**
- **VSAM Tuning**
- **CICS Tuning**
- **Tuning of other components (VSAM, TCP/IP)**
- **Sizing/tuning of I/O subsystems**

The base documents contain
- a lot of tuning hints, not repeated here
- many further references for tuning

Í **No technical background education here**

This is contained in the official VSE literature with form numbers and in the base documents

„ **Listings of VSE/ESA performance related PTFs**

They are contained in the base documents, and updated information is available in IBM RETAIN

Most Challenging Case for Trouble Shoot

Most Challenging Case for Trouble Shooting

The following is the worst case for a performance problem for anyone who must solve it and for any customer:

Ù **Customer has performance problems and**

1. **No information about what was changed**
2. **No idea where the problem may be**
   'Just bad performance'
3. **No idea and no measurement data from 'before'**
   Even w/o a performance monitor, the key data can be collected
4. **No idea how the load evolved or changed, or what users do**
5. **No idea how the load varies across days, etc.**
6. **Hard- and Software, and setup changed at the same time**
7. **No fallback alternative is available**

BUT: He wants the problem immediately to be solved

Be assured:

IBM will help to do whatever can be done technically

Migration Planning Remarks

Migration Planning Remarks

„ **Sizing for Processor Migration**

This is an area which must be done by IBM personel together with the customer.

If possible and reasonable, changing the processor should be separated from any changes in software releases, but often processor and software releases and setup are changed together.

Sizing of processors without software change is done with the IBM LSPR tool, not just via some anonymous 'public MIPS chart'.

Refer to the separate part of this document 'VSE/ESA Sizing Checklist'.

„ **Migration between major software releases**

Migration between VSE releases is 'business-as-usual'.

Specific attention is required if

- several VSE relases are skipped
- migration is from Standard to Turbo Dispatcher
- software setup is significantly changed
- ESA-mode is used for the first time and no DIM is exploited
- hardware was changed and Latent Demand existed

VSE/ESA Quick Migration Sizer

Sizing of VSE migrations (mostly together with processor and setup changes) is done with the IBM tool VSEQMS (Quick Migration Sizer).

It
- now includes also the Turbo Dispatcher on n-ways
- is part of the VE21PERF package on the IBMVSE tools disk
- is available to IBM personnel to assist in sizing customer systems

Refer to the explanations to this tool in the separate part 'VSE/ESA Quick Migration Sizer'

Some More Words on Trouble Shooting

Some More Words on Performance Trouble Shooting

Ù **The solution of performance problems cannot be readily automated**

Too many individual situations / tools / varying aspects ...

Ù **But any means to come closer to a solution should be exploited.**

The actual sequence of actions is as important as using a systematic approach to the problem.

(The sequence may be controlled by factors like machine availability for test runs, ...),

Ù **Often good and systematic questions help a lot to come to a solution**

Í **This document contains a lot of questions for this purpose**

Trouble Shooting

Trouble Shooting, Principal Possible Steps (Part 1/2)

The following are useful and often required steps.
Their sequence is not a must, but often logically required

1. Have Base Results before the problem occurs

Refer to Charts B2 to B5

2. Check for available Performance PTFs

Refer to 'Perf. PTF and EC level Checklist' (Chart D2)

3. Compare Perf. Data 'after' to 'before'

This step depends on availability and applicability of available data.

4. Determine Global Type of problem

Refer to - 'High Level Item Checklist' (chart D3) and to
- Part C 'Global Types of Performance problems'

5. Check which Changes may cause the problem

This is customers responsibility. Many changes at the same time may be OK, if a fallback option is available.

Trouble Shooting ...

Trouble Shooting, Principal Possible Steps (Part 2/2)

6. Determine Conditions for the problem

Refer to 'Narrow Down Checklist' (Chart D4/5)

7. Do More Detailed Analysis

Activity is very case dependent. Usually involves IBM

8. Proceed with Performance Tuning, if wanted

You may have found other items which promise to improve performance.

Refer to 'VSE Tuning Checklist' and others.

Performance Tuning

Guidelines for Performance Tuning

- **Be aware of/Find the resource which limits the performance**
- **Remember the Law of Diminishing Returns**

  Potential improvements get smaller the more you already have changed
- **Change only one parameter at a time**

  Even if changes are definitly positive, you cannot evaluate the individual contributions
- **Understand the problem cause before you upgrade H/W**

  Spend your money for things that you benefit from.
- **Put fallback procedures in place before you start tuning**

Performance Tuning ...

Performance Tuning, Principal Steps (Part 1)

The following are useful and often required steps.
Their sequence is not mandatory, but often flows logically

1. Have Base Results ('before')

Refer to Charts B2 to B5

2. Check for available Performance PTFs

Refer to 'Perf. PTF and EC level Checklist' (Chart D2)

3. Select specific loads/jobs/partitions to improve

This is customer specific. For example, the time for night batch represents a critical constraint, or the peak CPU utilization or response times of key on-line transactions is important

4. Determine the utilizations of your system resources

Refer to the 'VSE Bottleneck Checklist'.
If any of those resources is not a bottleneck, proceed with the next resource.

Performance Tuning ...

Performance Tuning, Principal Steps (Part 2)

5. Remove, reduce or circumvent biggest bottleneck

Be aware that when you remove your biggest bottleneck, you will still have 'a biggest bottleneck', but at higher throughput.

Bottlenecks usually limit overall or partial throughput, but the resources behind these potential bottlenecks may cause significant delays even before the resource is heavily utilized.

6. Tune VSE as for Standard Dispatcher

Refer to 'VSE Tuning Checklist'

7. Make workload setup more N-way friendly

Refer to the 'TD Performance Checklist' in this document, and to the 'IBM VSE/ESA Turbo Dispatcher Performance' base document.

8. Improve/Correct VM/VSE guest setup

Optimal VM/VSE guest setup is discussed (with overviews) in 'IBM VSE/ESA VM Guest Performance Considerations'.

Turbo Dispatcher related VM/VSE aspects are contained in 'IBM VSE/ESA Turbo Dispatcher Performance'.

When may problems usually appear?

When may problems usually appear?

Please note that the reasons below are listed just for completeness and do NOT imply any assessment of importance or frequency.

Real life tells us that performance problems always may occur in such a widely and diversely used commercial operating system.

Be sure that if potential performance problems or pitfalls are known (e.g. at a release migration), they will be documented as early as possible.

1. Hardware related:

- „ At a processor migration
- „ After migration to a new I/O subsystem

2. Software related:

- „ At a VSE release migration
- „ At first use of Turbo Dispatcher
- „ At a setup/parameter change in VSE
- „ At a change of an optional product
- „ At a change of an vendor product, or because a vendor product was NOT updated to new VSE interfaces
- „ At any change in VM for the VSE guest
- „ After functional PTFs were applied, or because performance PTFs were NOT applied

Cont'd

When may problems usually appear? ...

When may problems usually appear? (cont'd)

3. Others:

- „ After customer load has increased
- „ Suddenly, w/o any obvious reason (hard to believe, but we are told...)
  We haven't changed anything, but now...
- „ At introduction of a new application or change of an existing one

Í A good application design is always worthwhile

Test new applications performance-wise
before putting them into production

Do not consider application design changes as a NONO

Let application programmers

- trace their applications
- discuss results with system people
- discuss design of planned applications with system people

Why only tune after the fact?

Performance Data become Information

Performance Data become Information

Ù Need BEFORE and AFTER data

- „ to get performance change information

Ù Need BEFORE and AFTER data

- „ to evaluate change benefits

Ù Need BEFORE and AFTER data

- „ to wisely exploit new system features
  - CICS Data Tables
  - Virtual Disks
  - More VSAM LSR Buffer pools
  - ...

Ù Collect performance data in a sensible way

- „ Measure always same day of week
- „ Consider the amount of work regarding your business cycle
- „ Track principal values in simple charts
- „ Retain printed reports for at least 1 year
- „ Keep monitoring tapes for later re-evaluation

Performance Activities in General

PART B.

Performance Activities in General

Common Aspects to

- **Trouble Shooting**
- **Performance Monitoring**
- **Capacity Planning and Migrations**

Mandatory Actions (in any case)

Mandatory Actions (in any case)

(not only required before migrations, but also highly beneficial for sudden problems)

- **Know your VSE environment and workload**
  - **Usage of files, startup, compile options ...**
- **Measure VSE system with a VSE system monitor**
  - **for several typical weeks and peak hours**
- **Measure VSE Online activities**
  - **for several typical weeks and peak hours**
  - **Keep CICS statistics**
- **Select batch jobs and online transactions that are**
  - **typical for your type of work**
  - **important for you regarding performance**
  - **easily reproducible**

    (either doing the same or an easily specified workload)

  Measure such key activities
- **In case of VM/VSE**
  - **Use a VM system monitor in addition to VSE measurements**
  - **At least, have actual T/V ratios available (with variations)**

Customer Specific Information Required

Customer Specific Information Required

- **Variation of load (CPU utilization, I/O rate, Throughput) across e.g.**
  - **a typical day**
  - **a week**
  - **a month**
  - **at a quarter end**
  - **at year end**
- **Batch total run-time variation**
  - **Night batch window, depending on**
    amount of work
    amount of work already done by day
- **Of highest interest:**

  CPU utilization(s) and throughput at a peak hour plus pertinent I/O rates
- **Performance relevant setup parameters**

Basic Performance Metrics

Basic Performance Metrics

A) System related values

'How the system feels'

- **CPU utilization**

  (Total, Online total, Batch total, and per partition)

  Online total is sum of all partitions equal or higher in priority to the lowest production online partition.
- **DASD I/O rate, DASD response times**

  (Total, Online, Batch)

  Changes in DASD I/O rate(s) may be a measure/indication for throughput changes, but only if the DIM setup (I/O buffering) and workload mix has not changed.

  If total throughput has not changed, changes in DASD I/O rates may indicate workload mix changes or different amount of DASD data required.
- **Throughput**

  (tx/sec, batch jobs/hr ...)
- **VSE page-IO rate (Real Storage use)**
- **Virtual Storage use**

  - Total amount of space available
  - Maximum amount of space used

  ... for key areas, e.g.
  - SVA-24
  - GETVIS-24 for CICSs

Basic Performance Metrics ...

Basic Performance Metrics (cont'd)

B) Related to individual or average jobs or txns:
'What the user sees'

Ù **Response times and Batch run-times**

For all (average) jobs, and specific critical examples

Ù **CPU-time per (average) batch job**

Ù **CPU-time per (average) transaction**

E.g. #txns per CPU-sec
= Internal Throughput Rate (ITR)

Ù **Number of DASD I/Os per job or txn**

All performance values depend on

„ **Software release, PTF status**
„ **Software setup parameters**
„ **Workload mix (tx type and heaviness, also batch)**
„ **Concurrency of other activities in the system**

Some More Metrics

Some More Metrics

Ù **Absolute Performance**

Internal Throughput Rate ITR

```
        Units of work (e.g. #txn)
ITR = ---------------------------
              CPU-time
```

External Throughput Rate ETR

```
        Units of work (e.g. #txn)
ETR = ---------------------------
            Elapsed-time
```

Ù **Relative Performance**

ITR Ratio (ITRR) for Processors

```
        ITR(processor_2)
ITRR = ------------------      with same workload
        ITR(processor_1)
```

This is THE value for pure Processor Migration, no anonymous 'MIPS'.

ITR Ratio (ITRR) for S/W

```
          ITR(S/W_2)
ITRR = ----------------      on same processor
          ITR(S/W_1)
```

S/W_2 may be a different S/W setup, or product release.

If S/W_2 is VM/VSE and S/W_1 is VSE native,
this ratio is called Guest/Native ratio

ITR Ratio (ITRR) for Migrations

```
        ITR(processor_2,S/W_2)
ITRR = ----------------------
        ITR(processor_1,S/W_1)
```


Tools for Performance Measurements

Tools for Performance Measurements

The following tools are required/highly beneficial

Ù **VSE System monitor**

E.g.	CA-EXPLORE for VSE	from Computer Associates
	TMON/VSE	from Landmark
	Minimon	from The Minimon People

Ù **VSE Online (CICS) monitor**

E.g.	CA-EXPLORE for CICS	from Computer Associates
	TMON/CICS	from Landmark
	TMON for CICS/TS	from Landmark
	OMEGAMON	from Candle Corporation

Ù **Other (specialized) monitors**

E.g.	CA-EXPLORE for VTAM	from Computer Associates

Ù **VM System monitor (VM/VSE)**

RTM/ESA, VMPRF	from IBM
FCON/ESA	from IBM Switzerland

VSE/ESA Performance Reporter

This is some system-monitor-like tool, for IBM personel only.
It is available in the VSEPERF PACKAGE on the IBMVSE tools disk

Hint:
You better understand the validity of monitor data if you know how data were collected:

„ **Via 'event counting'**
Such data are 'precise' even for short measurement intervals (e.g. for single job steps)

„ **Via sampling**
Only with enough samples the data gathered are statistically relevant

Tools for Performance Measurements ...

Tools for Performance Measurements (cont'd)

The following tools/means are available in any VSE

All items are descibed later in more detail

Ù **VSE Job Accounting**

„ **for data of individual job steps**
Info on SYSLST

„ **for POWER Job Accounting**

„ **for Display Activity IUI screens**
On a total partition basis

Ù **Automated Collection of Display Activity data**

REXX VSE CPU Monitor

Ù **Many VSE commands**

Refer to 'Useful VSE/ESA Commands'

VSE Job Accounting (JA)

VSE Job Accounting (JA)

All charts on VSE JA and Display Activity have been extended and moved as an Appendix to the new VSE/ESA 2.5 document.

Exploitation of Display Activity Data

Exploitation of Display Activity Data

Ù **DA screen data are analyzed via user exits for**

„ **Collection of Display Activity data**

„ **REXX CPU Monitoring**

• Any other user written program/purpose

Ù **Functions are selected, started and controlled via the CICS txn IEXM, which**

- starts and controls capturing of data:
  - when (from/to = measurement interval)
  - what (DSA and/or DCDA data)
  - 'sampling interval', default=15 sec
- writes each sample temporarily into the DSA or DCDA TS queue

Collection of Display Activity data

„ **Function**

Collect DA data in CICS TS for later analysis

Especially for long term monitoring.

Í **No replacement of any performance monitor**

„ **Selection**

Specify user exit IESDALOG (default) in IEXM master transaction.

IESDALOG
- is compiled with the skeleton SKEXITDA in ICCF lib 59
- collects all data in a single new TS queue
- Evaluation is user responsibility, no program provided

• Function was provided as a 'late line item' to VSE/ESA 2.1, now documented in 'VSE/ESA Enhancements, Version 2.2', SC33-6629-00

Exploitation of Display Activity Data ...

REXX/VSE CPU Monitor

„ **Function**

Checks for critical partition values

- CPU-time and CPU utilization
- Elapsed Time
- Total number of I/Os and I/O rate

The user sets these limits via the REXX function SYSDEF

Creates console messages when limits exceeded

„ **Selection**

The REXX procedure REXXCPUM (in a batch partition)
- invokes the IEXM master transaction
- calls the user exit ARXITCPU.

ARXITCPU
- is based on Display System Activity (DSA)
- analyzes samples/snapshots on the fly
- issues console messages, when limits exceeded

• For free and standard in VSE/ESA 2.2

For more info refer to

- 'REXX/VSE Reference', SC33-6642-05

VSE/JA Data under VM or PR/SM

VSE/JA uses:

TOD clock to determine Elapsed times

CPU-timer to determine CPU-times

Validity of Results

„ **Elapsed Times (based on TOD clock): valid**

„ **CPU Times/Utilizations: valid**

If a VSE guest under VM is not active, the VSE CPU-timer is stopped until VSE is being re-dispatched by VM.
The same holds for VSE as PR/SM LPAR guest.

The VSE JA time under VM corresponds about to VTIME, which is somewhat bigger than the corresponding native JA time.

„ **I/O Counts (event recorded) : valid**

VSE Monitor Data under VM

Validity of Results

„ **Generally, all event recorded results are still valid,**

sampling results in general distorted, but relative values usable.

(Degree of distortion increases with decreasing VM dispatch priority, due to dependencies of the monitors on the timer facilities).

„ **Valid:**

IO counts
SVC statistics
Queue lengths (total, average)
Reserve Release counts
DASD Activity Reports

- Such type of reports lose a lot of value for simulated devices
- For real (non-simulated) devices, e.g. SEEK analysis do not show/include SEEKs by other guests to other areas of a disk

Exception Report counters
Paging rates (refer to VSE paging only)

„ **Not valid/distorted:**

CPU utilization(s) and breakdowns from sampling
CPU, Channels and Device overlap tables
Channel activities

VSE Monitor Data under PR/SM

Validity of Results

„ **Very similar to VSE monitors under VM** (Refer to last foil)

„ **PR/SM specific aspects**

CPU utilizations by sampling

- valid (dedicated LPARs)
- distorted (shared LPARs)
  (distortion depends on LPAR dispatch priority. Additional distortion, if capping was in effect on top: i.e. more CPU could have been used than specified in the (relative) CPU WEIGHT value)

NOTE

- Monitored CPU utilization(s) under PR/SM represent the utilization of a LOGICAL processor.

Channel utilizations by sampling

- same as CPU utilizations by sampling

Useful VSE/ESA Commands

Virtual Storage Related VSE Commands

„ **GETVIS**

GETVIS SVA	to determine any SVA-24 shortage
GETVIS Fx	for 'important' partitions, including F1 POWER, F3 VTAM, Fn CICSs

The 'Largest free area' might be used as some indication for the degree of fragmentation.

The 'Max ever used' is a high water mark and relevant for tunung.

Subtract '24' from 'ANY' to obtain the 'above-the-line' values.

With APAR DY44471 new parameters are provided:

,ALL	gives a summary report on all subpools (KB used)
,DETAIL	gives additional info

„ **MAP**

There are various flavors of this command:

MAP VIRTUAL	displays virtual sizes (VIRTUAL is default)
MAP REAL	displays PFIX actuals and limits and 'available real size' ('TOTAL')
MAP Fx or CLASS=	displays partition/class specifics
MAP SVA	displays SVA specifics

„ **Display Storage Layout panels of IUI**

IUI '363-panels'	display detail info on shared areas

„ **QUERY DSPACE**

QUERY DSPACE,ALL	displays summary info on all data spaces

For data space related commands, refer to the VTAM 4.2 commands on the next foil.

Useful VSE/ESA Commands ...

Useful Commands for VTAM 4.2

„ **GETVIS F3**
shows usage of 24/31-bit GETVIS in VTAM partition F3

„ **MAP F3**
shows allocation information about VTAM partition F3

„ **QUERY DSPACE,ALL**
shows detailed information on all dataspaces (incl. VTAM)

„ **D NET,BFRUSE**
shows information about all buffers and usage of 24/31-bit System GETVIS (optionally use ',BUFFER=SHORT')

„ **D NET,VTAMOPTS**
shows information about all startup options

„ **D NET,STATS,TYPE=VTAM**
shows information about the VTAM network

„ **D NET,STORUSE,DSPNAME=***
shows information about all dataspaces accessed by VTAM

„ **D NET,STORUSE,APPL=appl-name**
shows information about the dataspace accessed by VTAM for the specific application 'appl-name'

„ **D NET,STORUSE**
shows usage information about all VTAM storage pools

„ **D NET,SESSIONS**
displays session status information

Useful VSE/ESA Commands ...

Dispatch Related VSE Commands

„ **PRTY**

PRTY	displays the priority sequence of all partitions and all classes (highest priority for rightmost partition)

„ **PRTYIO**

PRTYIO	displays the priority sequence of all partitions and the (single) value for all dynamic classes (highest priority for leftmost partition)

The I/O priority for requests in the VSE channel queue should be used to priorize I/Os. e.g. CICS over batch. This will help if more than 1 partition accesses the same logical volume concurrently. If PRTYIO is not used (not set), the I/Os in the channel queue are searched in FIFO (fist-in first-out) order, and thus are independent of the partition PRTY. (Some system tasks such as paging are treated with 'headqueue' priority).

„ **PRTY SHARE**

PRTY SHARE,part-ID	allows setting relative VSE SHARE values for any member of the balanced group

This function is only available for the TD, starting with VSE/ESA 2.2.

„ **MSECS**

MSECS	displays current setting of the 'inspection interval'
MSECS n	changes value to n msecs

- used by the Turbo Dispatcher for processor balancing
- used in order to dynamically set the (internal) priorities within the partition-balanced group

The default is 976, i.e. 1 sec, a good value. Lower values increase the overhead and only would bring benefits in exceptional (error) cases.

Useful VSE/ESA Commands ...

Overall VSE Related Commands

Note to SIR commands:
SIR means System Information Report and is a command that has been developped for internal use, but has been found very useful to system operators also. It is NOT a COMITTED interface of any kind and is subject to change as need arises.
Any comments/concerns may be sent to AXEL@VNET.IBM.COM (Internet).

„ **STATUS**

STATUS	displays the status of all partitions/tasks
STATUS part-ID	displays the status of a partition and its subtasks
STATUS SYS	displays the status of system tasks

Status may be any waiting for a resource or a completion:
e.g. for I/O on device cuu
for Page I/O completion
for Program Fetch
for ...
This command just is suited for snapshots, not for statistics

„ **SIR**

For individual items, but not replacing a system monitor

SIR	displays various info (PTF level, TD level, CHANQ, BUFSIZE, Paging, LOCKs...)
SIR ?|HELP	provides help-info for SIR sub-commands
SIR RESET	resets specific SIR counters (APAR DY44277 V2, DY44358 V1)
SIR VENDOR	displays info on vendor programs

„ **LOCK**

This command was setup in order to allow a faster diagnosis in deadlock situations. In specific cases it might also be used to 'snapshot' locking situations and for performance reasons.

LOCK SHOW	shows all currently held locks in VSE
LOCK SHOW=part-ID	shows currently held locks of a partition

Useful VSE/ESA Commands ...

Overall VSE Related Commands (cont'd)

„ **QUERY STDOPT**

QUERY STDOPT	displays current setting of all std options

„ **SIR MON (SVC and bound condition stats)**

This is associated with some overhead, naturally:

Using the very supervisor intensive PACEX batch workload, the SIR MON overhead was up to about 8% more CPU-time (only).

This overhead is smaller than SVC counting by any performance monitor.
It is for Turbo Dispatcher only.

SIR MON=ON	starts the measurement interval
SYSDEF TD,RESETCNT	resets all counters (SVCs and others)
///////////	measured activity
QUERY TD,INTERNAL	displays TD counters
SIR MON=OFF	ends all SIR MON measurement activity (w/o resetting counters)
SIR MON	displays SVC counters + bound conditions

„ **QUERY TD,INTERNAL (TD CPU-times and stats)**

There is no overhead included during the measurement interval.
It is for Turbo Dispatcher only

SYSDEF TD,RESETCNT	resets all TD counters
///////////	measured activity
QUERY TD,INTERNAL	displays all TD/SVC/other counters

Note: The total SVC count from QUERY TD,INTERNAL is higher than the sum of the individual counts, since the individuals are only counted if dispatcher is involved.

The output of QUERY TD has been enhanced in VSE/ESA 2.3.

Useful VSE/ESA Commands ...

I/O Related VSE Commands

„ **SIR SMF (get msec/IO data)**

Applies to SD and TD.

SIR SMF	displays status of Subsystem Measurement Facility (default is INACTIVE)
SIR SMF=ON	starts SMF measurement interval, if OFF
///////////	measured activity
SIR SMF(=cuu)	displays SMF counters (for device cuu)
SIR SMF=OFF	ends SMF activity

Recently, an extension of this command has been made available via APAR DY44841, in order to allow to get msec/IO values seen and directly measured by VSE itself:

```
SIR SMF,VSE
```

These results are independent of SMF counters in the I/O subsystem, but, naturally would include e.g. any time in VM or other intercepting programs.

For more info on SIR SMF, refer e.g. to

- the VSE/ESA I/O Subsystem Performance document
- 'Hints and Tips for VSE/ESA' brochure
- the SIR documentation on the Internet, via

http://www.s390.ibm.com/products/vse/vsehtmls/hintshp.htm

Useful VSE/ESA Commands ...

I/O Related VSE Commands (cont'd)

- **CACHE ...,STATUS**

```
CACHE UNIT=cuu,STATUS    For caching status info for device cuu
CACHE SUBSYS=cuu,STATUS                  ... for the subsystem
```

- **CACHE ...,REPORT**

```
CACHE UNIT=cuu,REPORT    Provides caching statistics
                         for device cuu
CACHE SUBSYS=cuu,REPORT  Provides caching statistics
                         for an I/O subsystem
```

The I/O counters shown are provided from the I/O Subsystem and reset at Control Unit IML.

Different cache hit ratios can be determined.

For CACHE command related info, refer also to
'VSE/ESA I/O Subsystem Performance Considerations'

- **VOLUME cuu**

```
VOLUME cuu   Provides also the device type
             (6C=CKD, 6E=ECKD) for a disk
```

This function was introduced with VSE/ESA V2.

For any newer subsystem the device type must be ECKD (6E) for performance reasons

Miscellaneous VSE Trace Functions

Miscellaneous VSE Trace Functions

Tracing functions usually are required for analyzing functional problems. But often, the sequence of events allows detection of reasons for performance problems.

- **DEBUG**

All VSE supervisors are capable of tracing basic events, without using the flexible but less detailed SDAID.

In case of functional problems, you may be asked by IBM to temporarily switch DEBUG on.

```
DEBUG                 to display DEBUG status (must be OFF)
                      (default status is OFF, except at IPL)

DEBUG ON (,nnnK)      to switch it on

DEBUG OFF             to switch it off

DEBUG SHOW(,CUU=cuu)  to display current buffer contents
                      (PSHOW = previous, NSHOW = next buffer)
                      (3x16K dynamically in SVA-31)

DEBUG END             to end DEBUG and free all buffers
```

Refer also to

- 'DEBUG Overhead' in the VSE/ESA V2 base document (from 10% to 25% of CPU-time)
- DEBUG description in 'Hints and Tips for VSE/ESA' brochure

DEBUG ON should NEVER be used on a permanent basis

- **DEBUG CPU-time overhead is only acceptable in debugging situations, and only then**

Miscellaneous VSE Trace Functions ...

Miscellaneous VSE Trace Functions (cont'd)

- **SDAID**

This trace is so powerful (and has also such significant overhead) that only partial loads can usually be traced yielding performance relevant data.

It is the only way
- to determine sequence of events (often)
- to find out details on channel programs

When using SDAID to determine details on channel programs used, do not forget to specify OUTPUT=CCWD in the TRACE IO statement in order to get (besides TOD and CCW-type) also info on the CCW-data.

The following examples generate both an SSCH and an I/O interrupt trace for device cuu on tape:

```
// JOB SDAID
// EXEC SDAID
OUTDEV T=cuu       (specify tape address)
TRACE SSCH AREA=ALL UNIT=cuu OUTP=CCW
TRACE IO AREA=ALL UNIT=cuu OUTP=(CCWD=40)
READY
/*
/&
```

You also can use the shipped procedure SDIO:

```
// EXEC PROC=SDIO,UNIT=cuu,TAPE=cuu
```

Use STRTSD to start, STOPSD to stop and ENDSD to end SDAID tracing.
Use EXEC DOSVSDMP to print the contents of the SDAID trace tape.

Refer e.g. to the brochure 'Hints and Tips for VSE/ESA'

Miscellaneous VSE Trace Functions ...

Miscellaneous VSE Trace Functions (cont'd)

- **CICS Auxiliary Trace**

This CICS function is very similar to the CICS Internal Trace, but does no wrap around in buffers, it goe sto disk instead.
It is a very powerful tool to analyze performance problems for CICS based workloads. (It requires that the CICS Internal Trace is also active).

```
CEMT SET TRACE ON        starts the CICS Internal Trace
                         (if not yet active)
CEMT SET AUXtrace ON     starts the AUX trace
 ///////////////            activity to be measured
CEMT SET AUX OFF CLOse   closes and ends Auxiliary trace
CEMT SET TRACE OFF       stops CICS Int. Trace (if wanted)
```

Usually a trace of only 5 seconds from a production system is a lot of data and can be helpful to the expert.

It's always better if it can be done in a test system and with individual test transactions.

To print the trace on SYSLST, you can use the member DFHAUXPR in ICCF library 59.

- **Partition Trace (PTRACE) for tracing VSE usercode**

- Tracing overhead much smaller than SDAID trace
  (PER/370 only in effect if traced partition dispatched)
  - by tracing only individual partitions
  - by tracing only user code

This function applies to VSE/ESA 2.2 and above

- **LIBR Trace for an individual partition**

via a new TEST TRACE operand 'PARtition'

- Tracing overhead much smaller

This function applies to VSE/ESA 2.2 and above

Which Values from which Tool?

Which Values from which Tool?

VSE/ESA native, under VM, and in PR/SM LPAR

The following is a very concise summary

	VSE std	VSE Syst.Mon.	CICS Mon.
Total CPU util interval	QUERY TD DSA	X	-
snapshot	DSA	x	-
Partition utils interval	(DSA)	X	-
snapshot	DSA	x	-
Total I/O rate	DSA	X	-
Partition I/O rate	DSA	X	-
Device I/O rate	DCDA	X	-
Paging	DSA (SIR)	X	-
CPU-time/tx	-	-	X
CPU-time/job	JA	X	-
#IOs per tx	(DSA)	-	X
#IOs per job	JA	X	-
Online throughput	-	-	X
Batch throughput	x	X	-
Online RTs	-	-	X
Batch run-times	X	X	-
msec/IO (Disk Serv.Time)	SIR SMF	X	x
IO cache hit ratios	CACHE REPORT	X	-
TD only environments:			
Non Parallel Share NPS	QUERY TD	x	-
NP-utilization	QUERY TD	x	-
SVC stats	SIR MON	x	-

X = best choice
x = possible choice
JA = VSE Job Accounting
DSA = Display System Activity screen of IUI

In case of VM/VSE you need a VM monitor on top for
- total VSE values and
- VM related values

Useful VSE/ESA Listings and Info

Useful VSE/ESA Listings and Info

- **VSE System Related**
  - „ **IPLPROC**
  - „ **LIBR LD SDL**
  - „ **Console log**
  - „ **POWER Statistics**
    At POWER shutdown, or via D STATUS
- **CICS Related**
  - „ **Listing of CICS startup**
  - „ **CICS Shutdown Statistics**
  - „ **DFHSIT and DFHFCT listings**
- **VSAM Related**
  - „ **VSAM LISTCAT of selected catalogs, clusters**
    EXCP (I/O) counts (before OPEN, after CLOSE)
- **VTAM Related**
  - „ **D NET,BFRUSE**
  - „ **D NET,VTAMOPTS**

  Refer also to separate foil
- **LE Related**
  - „ **LESTG stats**
    In CICS statistics or via CSTT
  - „ **RPSTG option in LE**
    Use only temporarily

VSE Display Activity (DA) Modification

VSE Display Activity (DA) Modification

The following part is a brief description in case you want to change the time interval of the Display System Activity function, such that the refresh of the screen is done upon ENTER.

Note that for VSE/ESA the DASD utilizations by default are already refreshed upon ENTER.

To this end, a new user WOLF is defined, having

- an initial selection panel called WKLADM
- a new application profile WKLA and WKLA.

All other users will remain as provided by VSE/ESA.

Perform the following steps:

- **STEP 1: Select 'Maintain Application Profiles' (path 213)**
  - Go to IESLA
  - Specify 1 (ADD) in line for IESLA
  - Specify, for example, NAME = WKLA as a new application name, and DATA = 00 as a new value
  - Hit PF5 (-> Application profile WKLA added)

VSE Display Activity (DA) Modification ...

- **STEP 2: Select 'Maintain Selection Panels' (path 212)**
  - Add 1 to, for example, the IESEADM line to obtain the next screen as a skeleton. Change this screen to:

```
selection panel name = WKLADM (for example)

1 IESEADM   2 Normal Menu
2 WKLA      1 System Utilizations
3 IESDS     1 DASD Utilizations
```

  - Erase the residual lines by inserting blanks
  - 1 stands for Application Profile, 2 for Selection Panel
  - Hit ENTER to review your changes
  - Hit PF5
    (-> selection panel WKLADM added. HELP text not found.)
  - Hit PF3 (END)
- **STEP 3: Select 'Maintain User Profiles' (path 211)**
  - Specify '1' (ADD) in the line for SYSA
  - Specify

```
UID           WOLF    (new user-id)
USER TYPE     1
PASSWORD      WOLF
DAYS          000
INITIAL NAME  WKLADM  (first selection panel)
NAMETYPE      2
```

  - Hit PF5
  - Hit ENTER to accept proposed primary library
    (-> User profile information has been updated)
  - Hit PF3 (END)

Global Types of Performance Problems

PART C.

Global Types of Performance Problems

Overall System Performance

„ **Overall System Performance depends on**

CPU-time component
I/O-time component
Other resources (locks on user/system res.)

„ **Batch Elapsed (ET) or Txn Response Time (RT)**

```
Batch job  Elapsed Time (ET) or  Online Tx Response Time (RT):

  CPU    CPU        Other       Total I/O-time
  wait   time       delays      (#IOs x IORT)
 |.....|----------|........|=====|====================|
                                IOSQ        DST

 'Other delays' may be caused by
  - waiting for a locked resource
    (e.g. LTA, I/O translation buffers, ...)
  - VSE paging
  - VM, not dispatching the VSE guest

 'CPU-wait' also impacted by
  - VSE, not dispatching this partition/job
  - CICS, not dispatching this transaction
```

```
                  Overall Runtime
    (Batch Elapsed Time ET or Tx Response Time RT)

                            |
     ---------------------------------------------
    |                       |                     |
 CPU-time              Total I/O-time          Other delays
                            |
                  -------------------
                 |                   |
              #I/Os          Msec/IO or IORT
```

Í **ETs and RTs are composed of these 3 parts**

Overall System Performance ...

„ **System Throughput**

```
System throughput:

      Batch  throughput   (jobs/minute)
      Online throughput   (tx/minute)

Depends on:
      - all values shown above,
        which determine ET/RTs
 plus
      - amount of actual concurrency
        (#concurrent partitions, #active users)
```

Í **System Thoughput is determined by available resources AND the available work**

„ **Balancing**

```
Balancing:

  Making Trade-offs between different (partial) loads
  (e.g. Online vs Batch)
```

In general, if there is a too high performance degradation of an 'Add-on load' on the considered 'base load', it has to be distinguished, where the Add-on load resides:

- in another VSE under the same VM or same PR/SM
- in another partition of the same VSE
- in the same VSE partition

VSE/ESA Workload Balancing is discussed in detail in

'VSE/ESA 1.3/1.4 Performance Considerations'
Part I, charts I1-I15

(Global) Types of Performance Problem

Global Types of Performance Problem

On a very high level, the following global type of 'performance problems' exist:

1. **Response or Elapsed Time**
2. **Throughput or System Capacity**
3. **Balancing ... problem**

Types of Performance Problem

From the last foil, it is clear what types of performance problems may cause the above global types:

Ù **For RT or ET (global) problem**

a) CPU-time
b) I/O-time
c) Other delay ... problem

Ù **For Thruput or System Capacity (global) problem**

a) CPU-utilization
b) I/O-subsystem utilization
c) Other resource utilization ... problem

Ù **For Balancing (global) problem**

a) CPU-contention
b) I/O-contention
c) Other resource contention ... problem

Naturally, in practice, more than 1 type of problem may exist.
E.g. when System Capacity is limited by a bottleneck, the closer you approach it, the higher will be RT or ETs for a given load.

CPU Related Performance Problems

CPU Related Performance Problems

In case of CPU-time, utilization or contention problems,

- **High(er) CPU may be caused by:**

  1 or more of the following reasons may apply

  - **Different processor**
    E.g. a single engine of an n-way
  - **Different VSE or vendor product(s) release**
  - **Different Software setup or options used**
    E.g. more costly options, traces
  - **Any Software PTF**
    This should not happen, just for completeness
  - **Different Environment**
  - **More work done per job or transaction**
    Same number of orders, but more items per order?
  - **Higher transaction rate**
    E.g. more CICS program compressions,
    more VTAM buffer extensions,
    longer GETVIS searches...
  - **Higher VM CP overhead**
  - **Other reasons**

A motherhood statement:

Any CPU utilization without a statement on the related throughput is useless to assess CPU-time per job or txn

CPU Related Information

CPU Related Information

- **System Monitor**

  To determine CPU-times and utilizations, a VSE system monitor is mostly appropriate, e.g.

EXPLORE/VSE	from Computer Associates
TMON/VSE	from Landmark
TMON for CICS/TS	from Landmark
OMEGAMON/VSE	from Candle

- **VSE Job Accounting**

  VSE Job Accounting (JA) is done always on job-step basis and distinguishes between 'CPU-time' and 'Overhead-time'.

  In case of JA=YES (standard for Turbo Dispatcher) at each job step end the phase $JOBACCT is being called. There is a skeleton job provided in ICCF library 59 to create a routine which displays the job-step related data in the SYSLST output.

- **VSE IUI Display System Activity**

  The VSE Display System activity displays CPU-times only for job steps which are still active.

- **CICS Monitor**

  This is the only way to determine CPU-times for individual transactions in a production environment, e.g.

EXPLORE/CICS	from Computer Associates
TMON/CICS	from Landmark
OMEGAMON/CICS	from Candle

CPU Related Information ...

CPU Related Information

- **CPU-wait Estimates**

  The total time for waiting for a processor is roughly:

0	in case of single thread (job/txn)
$\frac{u}{1-u} \times$ CPU_time	in multithread (on a uni-processor), with u being the sum of the CPU Util. of all higher priority work in VSE

- **More SVCs**

  More CPU-time may be associated with more SVCs, so any SVC statistics (from a VSE system monitor or VSE SIR MON) may give more insight, especially if data from before and after the change is available.

- **VM/VSE**

  More (total) CPU-time in case of a VM guest may stem from VM overhead in CP:

  Total_CPU_time = CP-time + VTIME

  T/V_ratio = Total_CPU_time / VTIME

  Total_CPU_time ('TTIME') and the virtual time ('VTIME') can be obtained from any VM performance monitor or via the IND USER command.

  Important in any case is the T/V ratio, ranging from 1.10 to 1.25, in well tuned VM/VSE systems, but a higher range is possible, depending on the type and setup of guest and the VSE load.

  Often for ITR calculations the inverse of T/V, the Guest/Native ratio G/N is used.

  Refer also to the VM/VSE Performance Checklist and to the document 'IBM VSE/ESA VM Guest Performance Considerations'

I/O Related Performance Problems

I/O Related Performance Problems

In case of I/O performance problems,

- **High(er) ET/RT may be caused by high(er) total time spending in the I/O subsystem:**

  One or both of the following reasons may apply

  - **More I/Os**
  - **Slower I/Os**
    (higher device service time)

In any case, reducing the number of I/Os via DIM (Data In Memory) is the most effective way:

'The Fastest I/O is NO I/O'

- **More I/Os may be caused by:**

  One or more of the following reasons may apply

  - **Smaller I/O blocking (KB/IO)**
  - **More data required per job or txn**
  - **Different VSE, VM or H/W caching setup**
    Changes can affect both number of physical I/O operations and I/O service times as well.

I/O Related Performance Problems ...

Í **Slower I/Os may be caused by:**

1 or more of the following reasons may apply

Different I/O subsystem
or different u-code (EC) level

Different I/O concurreny
e.g. more IO/sec which affect the considered load

Different I/O priority

Different file locations

Different cache hit ratios

Different I/O setup in VSE
Device accessed as CKD, not as ECKD. Device shared (',S')

Higher I/O blocking (more KB/IO)

I/O Related Information

I/O Count Information

Ù **VSE System Monitors**

Ù **VSE Job Accounting**

Ù **VSE IUI Display System Activity**

I/O Response Time Information

Ù **VSE System Monitors**
To determine I/O response times (and its components), a VSE system monitor can be used.

Ù **VSE SIR SMF command**
For trouble shooting only, VSE/ESA 2.1.x. and up.
Before VSE/ESA 2.3, I/O counts wrapped at 64K, which reduced ease of usage, then.

Refer to VSE/ESA Hints and Tips brochure, or to the SIR SMF description in 'VSE/ESA I/O Subsystem Performance Considerations'.

Ù **Estimates**
In very specific cases (i.e. single thread txn or batch job) the average I/O reponse time can be estimated (e.g. in single thread, neglecting IO/compute overlap):

$$\text{Msec/IO} = \frac{\text{ET - CPU\_time}}{\text{\# IOs}}$$

I/O Response Time in a Nutshell

IORT (at a single glance)

```
IORT      =  Wait_in_VSE_channel_queue
           + Wait_in_Channel_Subsystem
(Uncached) + Device_seek + Rot.delay  + RPS_miss_time
           + Device_Channel_transfer_time
(Cached)   + %Cache-miss x Cache_miss_resolution_time
           + Channel_transfer_time
```

All components of the IORT are being discussed in detail in section 'I/O Response Time Component Analysis'in 'VSE/ESA I/O Subsystem Perf. Considerations'.

What are unacceptable I/O Response Times?

„ **User Definition**

'Any value that is worse than my expectation'
'Any value that is worse than what I had before'

„ **Technical Definition**

'Any value, be it average or individual, that is technically not explainable with the real potential of the I/O attachment with optimal channel programs'
'Any value that simply is caused by a too high I/O-rate to a device or by a too high path utilization'

Usually achievable I/O response times and their components is contained in the VSE/ESA I/O Subsystem Performance document

Refer to the I/O Response Time Checklist

Other Delay Related Perf. Problems

Other Delay Related Information

In case of 'Other Delay Related' perf. problems, the following principal type of reasons may exist

„ **Over-utilization (or exhaustion) of a VSE Software resource**

„ **Not enough H/W resources available for VSE**

A) Over-utilization (exhaustion) of a VSE S/W resource

-> A 'VSE-internal bottleneck'

One or more of the following reasons may apply:

BUFSIZE

CHANQ

Virtual storage problems

SVA-24 GETVIS

Non-Parallel Utilization (NPU, for n-ways)

VSAM Wait-on-Strings

LTA

Any LOCKs

Refer also to the 'VSE Bottleneck Checklist'

Other Delay Related Perf. Problems ...

Other Delays (cont'd)

B) Not enough H/W resources available to VSE

-> A 'VSE-external bottleneck'

CPU-power (VSE native)
(High CPU-wait time, already discussed)

CPU-power granted by VM (via VM SHAREs)

Real storage (native, or simulated by VM)
Paging I/Os in VSE and/or VM

I/O resources
High msec/IO times, already discussed

Others

It is obvious how to solve such type of 'problems'.

Other Delay Related Information

Other Delay Related Information

- **Performance Monitors**
  Other delays can be seen with performance monitors, be it system or CICS monitors.

- **VSE**
  The following table shows which tools can be used in order to determine delays or bottlenecks in VSE S/W resources

Checks for VSE S/W resource usage	
To check	Recommended tool (besides System Mon.)
Gen. Status (Partition bound state snapshot)	STATUS
LTA	-
BUFSIZE	SIR
CHANQ	SIR
Virt. Storage	GETVIS
Non-Parallel state/util	QUERY TD
Paging	DSA
VSAM strings	CICS stats

- Performance monitors, naturally, are likewise suited to get such information
- Specific VSE messages, naturally, also indicate resource shortages

VSE Performance Checklists

PART D.

VSE Performance Checklists

These are some checklists which may be beneficial in any case of performance problems.

They also apply to the Turbo Dispatcher on N-ways

Checklist Overview

Checklist Overview

- **Perf. PTF and EC-level ..**
- **High Level Item ..**
- **Narrow Down ..**
- **VSE Tuning ..**
- **CICS Statistics ..**
- **CICS DL/1 Statistics ..**
- **POWER Statistics ..**
- **TD Performance ..**
- **I/O Response Time ..**
- **VSE Bottleneck ..**
- **VM/VSE Performance ..**

Perf. PTF and EC Level Checklist

Check for Available Performance PTFs

Check those listed in the Base documents,
in addition let RETAIN be checked.

Entitled customers may search the APAR database via the URL
http://service.software.ibm.com/390launch.html

General VSE/ESA V2 performance PTFs

TD PTFs and level

PTF to reduce ICCF impact on dispatch intensity

31-bit COBOL PTFs for VSAM usage

VSAM Hardware compression PTFs

LE/VSE related PTFs

Any PTFs for vendor programs
Contact your vendors

...

Check for latest H/W EC-levels (performance related)

Contact your IBM CE

High Level Item Checklist

Suited to assist in
'Determining the global type of problem'

- **CPU-time per tx or job**
  (higher CPU util. often by higher throughput)
- **I/O problem (number of I/Os or msec/IO)**
- **Batch Elapsed or Txn Response times**
- **Batch window problem**
- **How has batch and online throughput changed?**
- **Any other delays in tx or batch jobs?**
- **Any problem caused by virtual storage sizes**
- **Higher CP overhead (T/V ratio) than before**

The next items are for TD only:

- **Not enough CPU power on 1 engine?**
- **Non-parallel share/utilization**
- **Share of spin time**
- **...**

Narrow Down Checklist 1/2

Very important e.g. for 'Trouble Shooting'
Determine the Conditions/Environment/Spectrum of a Performance Problem

The better this can be done, the better/faster problem can be localized

Does the problem occur ...

- **In single thread or only at full load?**
- **For Batch only or CICS only or for both?**
- **With Standard Dispatcher only?**
- **On a uniprocessor (with Turbo Dispatcher)?**
- **Only on an N-way?**
- **Only when certain actions run concurrently e.g. Batch concurrently to Online?**
- **Only when a specific vendor product is being used or installed?**
- **Only for specific parameter options?**

Cont'd

Narrow Down Checklist 2/2

Does the problem occur ...

- **Only for VSAM processing, for example?**
- **If VSE runs native or under VM,**

  or without competing with other VM tasks?
- **Does problem already exist or existed**
  - **in a 'simpler' environment or txn or job?**
  - **on former software or hardware?**

í **Use creativity to narrow problem further down ...**

Document what has been changed that

- **could have caused the problem,**
- **could have caused the problem to become visible**

VSE Tuning Checklist

VSE Tuning Checklist

Check Chances to Tune Workload as on Unis

Refer to the base documents:

'IBM VSE/ESA 1.3/1.4 Performance Considerations'
'IBM VSE/ESA V2 Performance Considerations'

„ **Do a Virtual Storage Tuning**

Exploit 31-bit for applications,
Maximize private space below the line
Optimally exploit private space below the line

Refer to the base documents, especially the V2 document Appendix A: 'Space Optimization'.

„ **Do a standard VSAM tuning**

Described in many documents by Dan Janda:
'VSE/VSAM Performance and Tuning'
WAVV Conference 10/96, Green Bay, Wisconsin, 70 pages
VM/VSE Tech Conf 05/97, Kansas City, Sessions 33F-G
VM/VSE Tech Conf 06/97, Mainz, Germany, Sessions 53F-G

„ **Check chance to exploit (more) Data In Memory**

Reduce number of I/Os, save CPU-cycles, improve response times

Data in memory exploitation is described in the base documents.

„ **For other tuning, refer also to the checklists provided:**

- CICS Shutdown Statistics
- CICS DL/1 Statistics
- VSE/POWER Statistics

„ **Set CICS Internal Trace off, if system stable**

„ **...**

Business as usual

CICS/VSE Statistics Checklist

CICS/VSE Statistics Checklist 1/2

Check the following performance relevant counters

CICS Statistics Output	
Value Considered	**Recommendation**
TASK CONTROL STATISTICS	
PEAK NUMBER OF TASKS	Should be smaller than MXT
NUMBER OF TIMES AT MAX TASK	Should be always 0
MAX.NO.ACTIVE TASKS REACHED	Should be smaller than AMXT
STORAGE STATISTICS	
NUMBER OF STORAGE ACQUISIT.	Use to calc. #GETMAINs/txn
- " - RELEASES	Use to calc. #FREEMAINs/txn
ACQUISITIONS ABOVE 16M LINE	#VSE GETVISs above
MAXIMUM USED LESTG (KB)	Should be < max. usable LESTG
UNSUCCESSFUL LESTG GETMAINS	Should be 0
NUMBER OF STORAGE VIOLATIONS	Should be always 0
- " - CUSHION RELEASES	#SOS conditions should be 0
PROGRAM STATISTICS	
TIMES PROGRAM USED	Use to calc. #uses/txn
- " - FETCHED	Any figure should be <10/hour **
DUMP STATISTICS	
NUMBER OF STORAGE DUMPS	Should be close to 0
VTAM STATISTICS	
MAX. NUMBER OF RPLS POSTED	Should be <RAPOOL in DFHSIT
NUMBER OF TIMES REACHED MAX	Should be 0 (line not shown)
VTAM SHORT ON STORAGE COUNT	Should be 0

** Number of program compressions not directly shown.
Locate program with highest number of FETCHes, which is not defined with RELOAD=YES

CICS/VSE Statistics Checklist ...

CICS/VSE Statistics Checklist 2/2

CICS Statistics Output	
Value Considered	**Recommendation**
FILE STATISTICS	
VSAM EXCP REQUESTS DATA	Should be much less than the total #of logical requests
- " - INDEX	Should be much less than the total #DATA EXCP
WAIT-ON-STRING	Should be 0
VSAM SHARED RESOURCE STATISTICS	
HIGHEST #REQUESTS WAITED FOR STRING	Should be 0
TOTAL #REQUESTS WAITED -"-	Should be 0
MAX.NO.CONCUR.ACT.FILE CONT. STRINGS	Should be < total #strings for all subpools together
NUMBER OF BUFFERS	Should not exceed 200 per sub-pool (use up to 15 subpools)
NUMBER OF SUCCESSFULL LOOK--ASIDES	Should be much higher than #BUFFER READS (the LSR buffer hit ratio should be high)
TEMPORARY STORAGE STATISTICS	
#TIMES AUX STORAGE EXHAUSTED	Should be 0
#TIMES BUFFER WAIT OCCURRED	Should be <1000 per day
#BUFFER WRITES	Should be much less than #PUT/PUTQ requests for TS AUX
#BUFFER READS	Should be much less than #GET/GETQ requests for TS AUX
#TIMES STRING WAIT OCCURRED	Should be 0
DL/I DATA BASE- AND SUBPOOL-STATISTICS	
#RECORDS SPILLED BY DTB	Should be <3% of RECORDS LOGGED

CICS/VSE Statistics -Remarks-

CICS/VSE Statistics -More Remarks-

Ù Task Control Statistics

MXT (Max Task) Value — Max number of initiated(=attached) tasks: Active + Suspended. Use the max. value of 999

AMXT (ActiveMax Task) — Max number of active tasks. Controls CICS load. Use a number well above MAX NO.ACT.TASKS

```
                                        AMXT            MXT
Limits:
          |-----------------------------|---------------|

Snapshot: |<--- Active ---->|<----- Suspended----->
```

In conversational environments, the number of suspended tasks may be very high (AMXT then is the better means for control).

Too low values for MXT and AMXT reduce throughput and response times, too high values may create SOS conditions in the DSA, or VSE paging (those days should be gone).

Ù Program Statistics

If a program is FETCHed more than 10/hour, this program should be made resident via ALT or PPT.

CICS/VSE Statistics -Remarks- ...

Ù **Storage Statistics**

„ **Background info**

Before issuing SOS messages on the console, CICS

- first tries to compress programs in the DSA (this costs a lot of CPU-time)
- then releases (=uses) the storage cushion (a number of reserved CICS 'pages', not necessarily contiguous).

„ **Before CICS virtual storage tuning, check the usage/size of the shared storage below the line**

Refer to the VSE/ESA V2 base document to optimize (Appendix A: Space Optimization)

„ **Increase the DSA by**

- increasing the SIZE= value
- increasing the CICS partition size (if not already crossing the 16M line)

„ **Offload the DSA by**

- using more 31-bit applications
- making less 24-bit programs resident (only if really required)

„ **Maybe, make often loaded bigger programs resident**

in order to reduce the impact of fragmentation (but only if loaded frequently)

Cont'd

CICS/VSE Statistics -Remarks- ...

Storage Statistics (cont'd)

„ **Check SIT Cushion Size**

In order to increase the probability that a program can be loaded into the cushion, select SIT SCS=50K, instead of its 16K default.

„ **Check other CICS definitions**

- define SPURGE =YES in the PCT and
- use a value of ICVS=1000 (msec)

Ù **VTAM Statistics**

MAX. NUMBER OF RPLS POSTED:

CICS maintains a VTAM RECEIVE ANY for a number n of Request Parameter Lists:

n = min (RAPOOL, MXT-#currently_active_tasks)

RAPOOL should be high enough that all incoming requests can be directly satisfied by CICS (and thus VTAM queuing overhead can be avoided).
A too high RAPOOL value (max is 999) costs virtual storage.

NUMBER OF TIMES REACHED MAX:

This line is only shown when >0.

VTAM SHORT ON STORAGE COUNT:

This is the number of time VTAM had to expand the VTAM buffers. Monitor that via D NET,BFRUSE.

CICS DL/I Statistics Checklist

CICS DL/I Statistics Checklist

At CICS shutdown, if configured correctly via PCT and PPT, the DL/1 statistics (DLZSTTL) is being added
(It also can be viewed via the CSDE transaction)

DL/I Statistics Output	
Value Considered	Recommendation
DL/I DATA BASE- AND SUBPOOL-STATISTICS (Application view, across all data bases)	
# individual DL/I calls #BUFFER HANDLER REQUESTS #REQUESTS SATISF. FROM POOL #BUFFER READ REQUESTS #BUFFER WRITE REQUESTS	total requests hits misses (READ EXCPs) WRITE EXCPs
DL/I COMMON SUBPOOL AND DATA BASE INFORMATION (For individual subpools/data bases)	
NUMBER OF DMBS REQ.SATISFD FROM POOL NUMBER OF READ REQUSTS NUMBER OF WRITES ISSUD	Use 1 database per subpool Should be >70% of #BH REQUESTS Buffer read misses, must be low Write EXCPs, is a function of checkpoints
- Consider the following DL/1 call ==> segment(=buffer) request(s) ==> buffer hits or miss (EXCP) - No Batch DL/I data included	

Make sure APAR PN83042 (PTF UN93565) as of 02/96 is applied for better output interpretation.

For more info refer to

- DL/I 1.10 Performance Enhancements in 'IBM VSE/ESA V2 Performance Considerations'
- DL/I 1.10 Release Guide SC33-6211-04

POWER Statistics Checklist

POWER Statistics Checklist

At POWER shutdown, the POWER STATUS (Statistics) is being displayed on the console and its log.
(It also can be viewed anytime via the pDisplay STATUS command).

POWER Statistics Output	
Value Considered	Recommendation
TURBO-DISP	Use parallel POWER (-PA) if OK with vendor products
DATA FILE	
DATA BLOCK GROUP SIZE DATA BLOCK SIZE	DBLKGP | * see below DBLK |
DATA FILE DBLK GROUP TRACING	ENABLED means active (let it be active, except system stable since months)
ACCOUNT FILE	
NO ACCOUNT SUPPORT AVAILABLE	Means ACCOUNT=NO (but Accounting normally used)
GENERAL STORAGE/TASK STATISTICS	
#TIMES TASKS WAITING FOR PREFIXED STORAGE VIRTUAL STORAGE	 Should be 0 Should be 0
DYNAMIC PARTITION SCHEDULING STATISTICS	
UNSUCCESSFUL DYN.PART. ALLOC	Should be 0
* The smallest allocation on DASD is DBLK x DBLKGP. DBLK should be reasonably large, theoretically could be up to tracksize. The product of both should be big enough - to even reduce the small DBLKGP trace overhead - but not to consume too much POWER GETVIS-24 storage - POWER virtual storage tuning is discussed in detail in 'POWER Administr. and Operation' SC33-6633-01 (p29ff) - More specific tuning hints are given in the POWER Performance Enhancements part of the VSE/ESA V2 document	

TD Performance Checklist 1/2

Make Workload Setup more N-way Friendly

„ **Reduce Non-Parallel Share and/or dispatch intensiveness**

Any program which increases NPS by running key-0 only?

Newest vendor program performance PTFs applied?

Performance related PTFs are a sign of strength and vitality and available e.g. from CA, SAG and others.

Refer to the foils for CA and SAG in the TD base document.

More DIM (again)

Just as a rough check:
- Divide the total CPU-time spent for any partition or partial load by the number of its I/Os:
  --> xx msec CPU-time/IO
- Multiply xx with the rough value of 'MIPS' to obtain a rough value for the avg number of (avg) instructions between I/Os (in K).

The following classification could be assumed for VSE/ESA:
<8 KI/IO 'extreme' I/O intensive
14 KI/IO 'heavy' I/O intensive
20 KI/IO 'average' I/O intensive
40 KI/IO 'lower' I/O intensive

Avoid options which cause additional SVCs and/or dispatcher entries

Use 3800 dummy printers at spool time or vendor "Fast Print"

TD Performance Checklist 2/2

„ **Check #processors Defined/Used for VSE**

Define never more than the required number

Refer to 'VSE/ESA Turbo Dispatcher Performance Considerations'

„ **Split workload across more VSE partitions**

Time of starting certain jobs

Different setup of batch jobs

Split of CICS or SQL/DS partition(s)

Automate job scheduling for batch window

Refer to the base document:

'IBM VSE/ESA Turbo Dispatcher Performance'

I/O Response Time Checklist

Refer to the base document:

'IBM VSE/ESA I/O Subsystem Performance Considerations'

Checklist predominantly is for trouble-shooting, not so much for standard I/O performance tuning

Spectrum and Sequence of Checks

	DASD Attachment	
To check	Cached	Uncached
Problem in Single or Multi-thread:		
1. VSE device type (VOLUME cuu)	X	X
2. Actual cache settings (VM+VSE)	X	-
3. Cache hit ratio(s)	X	-
4. VM settings of I/O relevance	X	X
5. S/W and H/W levels (PTFs...)	X	X
6. ECKD channel programs	X	X
7. Cache bits/Mask byte in DX CCWs	X	-
8. EREP incidents	X	X
9. IOCDS definitions	X	X
10. Sector value settings	X	X
Problem in Multi-thread only:		
11. Device utilizations (logical/physical HDD)	X	X
12. Channel/path utilizations	X	X
13. Cache sizes and hit ratios	X	-

- Sequence of checks is suggested, not mandatory
- Sector value settings is really last, done only if lost revolutions are the only chance

VSE Bottleneck Checklist 1/2

In cases of any throughput or capacity problem, (when enough work is available for being dispatched but processor power is still not all used)...

Check Presence of a VSE internal Software Bottleneck:

(May occur on a fast UNI-processor also)

Logical Transient Area (LTA)
May be misused for serialization purposes

BUFSIZE (copy blocks for CCW translation)

Channel Queue length (CHANQ)

Virtual storage problems
Mostly private space for CICS, below the 16M line (SOS conditions and Program Compressions)

Not enough space for VTAM buffers
Too many VTAM buffer extensions/compressions. This means increased CPU-time, but is nevertheless cited here, too.

SVA-24 GETVIS
Avoid in any case that SVA-24 space is exhausted

CICS Journaling

Any VSE LOCKs of a S/W resource (if excessive/misused)

VSE Bottleneck Checklist ...

VSE Bottleneck Checklist 2/2

Any excessive LOCKs for a VSE S/W resource

Non-Parallel Utilization (NPU, for n-ways)

In case of native VSE, it holds

NPU = Total sum of utilizations x NPS (over all processors)

Where NPS is the so-called Non-Parallel Share.
VSE/ESA 2.3 directly has NPU being displayed upon 'QUERY TD'

In case of VM/VSE, do not forget to multiply the VSE determined NPS-value with the T/V ratio.

VSAM Wait-on-Strings

Low VSAM LSR Buffer read hit ratio

Check Presence of a VSE H/W related bottleneck:

Paging

I/O contention (msec/IO)

Plus

Not enough dispatchable partitions active

Set up more concurrently active partitions

VM/VSE Performance Checklist

VM/VSE Performance Checklist

Check Potential for Improving Guest Setup

Refer to the base document:

'IBM VSE/ESA VM Guest Performance Considerations'

- **T/V ratios as compared to former results**
- **Usage of V=R/F with DEDicated devices**
- **Are SIE assist really active?**
- **Any other chance to tune for VM/VSE?**
- **Have VM absolute and/or relative shares been increased to favor TD guest vs other VM tasks?**

Refer to the next 2 foils, excerpted from
'IBM VSE/ESA VM Guest Performance Considerations'

VM/VSE Guest Setup Performance Settings

VM/VSE Guest Setup Performance Settings

- **Optimally set guest performance parameters in CP**

CP Command	Performance function for guest(s)	Note	Guest
SET IOASSIST ON	Enables I/O passthru (SIE assist)	a C	R F -
SET CCWTRAN OFF	Disable VM CCW translation	a C	R - -
SET PAGEX ON	Enable pseudo-page-fault facility	a DS	- - V
SET QUICKDSP	Bypass eligible list for key server machines	a D	R F V
SET SHARE	Sets priority weights (ABSolute, RELative, LIMITSoft, LIMITHard)	b D	R F V
SET RESERVED	Reserves real page frames for key V=V QUICKDSP machines	b S	- - V
LOCK	Fixes specified guest pages (Better: use RESERVE command)	b S	- - V
SET SRM STORBUF	Defines usage (%) of page pool DPA	b S	- - V
LDUBUF	Defines usage (%) of paging devices	b	- - V
DSPBUF	Limits #guests in dispatch list (Do not use in general)	b D	R F V
DSPSLICE	Size of dispatch time slice (Do not use in general)	b D	R F V
MAXWSS	(")	b S	- - V
DEDICATE	Dedicate a real processor to a virtual processor of a guest	b CD	R F V

Notes
- a Option may be beneficial in any case and for any number of VSE guests
- b Option only allows to prefer a specific VSE guest at cost of other VM tasks (VSE guests, CMS users)

The following are primary performance effects:
- C Impact on CP CPU-time (VM overhead)
- D Impact on dispatching/balancing
- S Impact on storage/paging

VM/VSE Querying Commands

- **Query guest performance parameters in CP**

CP Command	Display of
QUERY SET	Status of many SET command functions e.g. PAGEX, NOTRAN, CCWTRAN, IOASSIST
QUERY IOASSIST	SIE Assist status for V=R/F guests
QUERY SRM	Current scheduler parameters (SRM)
QUERY SHARE uid	Type and value of SHARE for guest
QUERY FRames	Current status of real storage
QUERY MDC MDIsk cuu	Minidisk Cache setting for device cuu
INDicate LOAD	Total operating load on the host (smoothed values), e.g. - processor utilizations - MDC overall data - total VM paging rate
INDicate USER	Currently used resources of a virt. mach. e.g. - type of guest - TTIME, VTIME -> T/V ratio
INDicate PAGing	All virt. machines in VM page wait status
INDicate Queues	Current members of dispatch and eligible list (in priority order)

- I/O related VM commands are contained in the document 'IBM VSE/ESA I/O Subsystem Perf. Considerations'

Overview on DASD and Guest Types

Overview on DASD and Guest Types

This summary shows for VSE guests which type of I/O handling is in general possible for each individual type of DASD

Machine Type	SET IOASSIST	SET CCWTRAN	Device Type DED	FPM	PPM	MDCWrite FPM/PPM
V=R	ON	OFF	IOASS	NONE	NORMAL	NONE/NORMAL
V=R	ON	ON	FAST	FAST	FAST	FAST
V=R	OFF	ON	FAST	FAST	FAST	FAST
V=R	OFF	OFF	NONE	NONE	NORMAL	NONE/NORMAL
V=F	ON	-	IOASS	FAST		FAST
V=F	OFF	-	NONE	FAST		FAST
V=V	-	-	FAST	FAST		FAST

MDC VM Minidisk Caching for guests (WRITE-through)

IOASS I/O assist is active for that DEDicated device, no CP interrupt occurs and no VM CCW translation is needed. If I/O assist is not present on the processor, a CP interrupt is generated.

NONE VM CCW translation is not required

FAST VM CCW translation can try the Fast Path (CFP)

NORMAL VM CCW translation is done via the normal path

- IOASSIST OFF is the only case for all processors NOT having VM/ESA I/O assist (e.g. all ES/9000s do)
- I/O Assist is lost when CCWTRAN is set ON for a V=R guest
- For V=F machines CCWTRAN can not be set off, so that switch doesn't apply
- Fast CCW Translation may provide a benefit if the device happens to be out of I/O Assist at the time of the SIOF/SSCH
- For V=V guests CCWTRAN ON is always effective, and IOASSIST OFF
- Fast CCW Translation is slightly slower for V=R (vs V=F) due to requirements for V=R recoverability
- Be aware of all the specific cases and all additional conditions for I/O Assist and Fast CCW Translation

Pure Processor Migration Aspects

PART E.

Pure Processor Migration Aspects

This part discusses the case where at (basicly) same S/W release and setup the processor is migrated

Aims of This Part

Aims of This Part

For Migration of Processors ...

Ù **Describe (mostly reliably) Predictable Values**

to solidly describe IBM promises (avoid MIPS rating nit-picking)

Í **to technically assess performance correctly**

Í **to help understand performance differences and/or required setup changes**

Í **to get a clear understanding and verification of performance descriptions and guarantees**

Í **to see which type of guarantees or expectations are or would be useless or unrealistic**

(In General) Reliably Predictable Values

(In General) Reliably Predictable Values

Refer to the chart 'To MIPS or not to MIPS?'.

Ù **Internal Throughput Rate - Ratio (ITRR)**

„ **is the reciprocal of the CPU-time ratio for a given total load (#jobs, #txns)**

„ **is directly measurable (if environment comparable)**

„ **gives the potential throughput ratio for the new processor,**
- **IF no other, new bottleneck is created**
- **IF enough Online and/or Batch work is being offered**

„ **still slightly depends on type of workload**

For example, scientific floating point vs. commercial decimal work

„ **is the only reasonably guaranteeable measure IBM can give in case of a processor migration**

„ **means that you have ITRR times the effective 'MIPS' of what you had before**

(Whatever 'MIPS' value a customer thinks he currently has, he is always right)

To 'MIPS' or not to 'MIPS'?

For the more interested reader it may be of interest how many millions of instructions are being processed per second on a processor.

MIPS = IER = Instruction Execution Rate

This, though impressive, is in general a dangerous and dependent item if not used properly, since

- **it heavily depends on the architecture**
  If an instruction set is less powerful, more instructions are needed to complete the same work, and thus a higher IER is not a reasonable measure for processor speed.
- **it heavily depends on the job mix or instruction mix**
  For commercial programs many I/O instructions in general are included, thus slowing down the IER of the processor.
  If only short instructions are executed, the IER is higher than with more complex or heavy instructions.
  Commercial and engineering/scientific may differ significantly in their IER rate.
- **it also depends on the processor utilization**
- **it does not reflect the speed benefits gained by replacing simple and recurring instruction sequences by so-called microcode-assists.**
  (if you use them you get lower CPU-time, but at the same time also lower IER!)

> Any use of an IER is only useful thus within the same architecture and for well specified environments and instruction mixes.
>
> Only then, there is a certain chance that IER ratios coincide with (reciprocal) CPU-time values and thus processor speeds and capacities.
>
> The only comparable measure of (internal) processor power is the total CPU-time needed for a certain job/task/transaction.

Some Motherhood Statements

Some Motherhood Statements

- **Any CPU utilization can only be assessed, if the pertinent throughput is known**
  Transaction rate, number of concurrently active batch partitions (or better: completed batch jobs per minute)
- **Twice the CPU or processor power cannot give twice the actual throughput, since**
  - **New bottlenecks may arise**
    - I/O bottleneck
    - not enough partitions active
      e.g. restricted by application design or operational reasons
    - locking problems
  - **There is not so much work to do**
    - users may get better response times, but this only slightly makes them work faster
  - **Due to better response times and new CPU capacity**
    - users may issue 'heavier' txns (= more work/txn)
- **Faster turnarounds of compiles and tests yields more turnarounds of compiles and tests**

Which CPU Utilization?

Which CPU Utilization?

- **Note of Caution:**

  It is very important to adequately select and determine relevant and meaningful CPU utilizations

- **You must strictly distinguish between**

  - avg CPU utilization (as a 1 hour average)

  - peak CPU utilizations (as 15 min, 5 or even 1 min averages)

  For systems where immediate responses is key (transactions must be processed when need arises i.e. cannot be somehow shifted over the day) and which are VERY response time critical ...

  5 min average values must be looked at (in extreme cases, even a 1 min interval may be required).

- **It is very hard to predict, how 'latent demand' will impact actual throughput (and thus CPU utilization) on a faster processor:**
  - **Latent demand always exists, if the total Online CPU utilization reaches values close to 100% e.g. as 15 min averages**

    Naturally, some 'rules-of-thumb' exist.

General Migration Rules

General Rules, always good to be followed

- **Never change hardware and software at the same time unless absolutely required**
  - **This may complicate trouble shooting very much**
    especially when only few results are available before migration
- **If target H/W configuration needs S/W changes,**
  - **apply, if possible, these changes (S/W release, PTFs, ..) first in the old H/W environment (before H/W migration)**
  - **you may apply them in the target environment, if system can run without these changes during migration**
    'First day performance'
- **Refer to S/W documentation for S/W deltas**

  IBM LSPR ITR-ratios for processors do NOT and CANNOT contain any S/W release or setup deltas

- **If you also want to migrate the I/O subsystem, think of doing it in a separate controlled step, if possible**
- **Keep, if possible, the old H/W for a short time as a fallback solution**
  (of special importance if only few measurement results are available BEFORE migration)

Mandatory Activities AFTER

Mandatory Activities AFTER Migration

- Measure the very same instances you measured before migration
- Measure items not understood or which appear worse even more carefully
- Aspects
  - Carefully check whether and to what extent results are comparable
  - Be aware that individual txn or load deltas may or may not be the cause of a problem
  - If a problem should arise, it is of benefit if this problem occurs with a single job or transaction

Concurrent I/O Subsystem Migration

Concurrent I/O Subsystem Migration

The following should be observed, if at the same time also the I/O subsystem is being migrated.

All technical details to that are contained in the 'IBM VSE I/O Subsystem Performance Considerations' document.

- Understand I/O performance dependencies
- Have I/O related measurement data available BEFORE I/O subsystem migration is done (# of I/Os, msec/IO, hit ratios...)
- Have a realistic idea of the achievable I/O performance with the new subsystem
  - The only realistic and directly measurable value is msec/IO

    It is assumed that for first day I/O performance no changes are made in the I/O setup (same buffering, Data in memory use), so at same throughput the number of I/Os remain same
  - The impact on your overall throughput depends on other parameters (relative I/O intensiveness, CPU utilization, ...)
- Follow the performance hints for new subsystems given in the separate document
- Measure AFTER migration

  If measurement data is available, it should be no problem to separate I/O related problems from others, should they occur

VSE Sizing Checklists

PART F.

VSE Sizing Checklists

VSE Sizing Checklists (Summary)

VSE Sizing Checklist (Summary)

These are checklists for Performance Sizing, BEFORE Migration

- to a major new VSE release
- to a new processor (concurrently)
- to an N-way

You likewise can use them for the standard dispatcher (SD) and for the Turbo Dispatcher (TD) on Uni-processors, just skip the N-way specific lists and items.

1. Performance Capabilities of TD
2. Measurement Data of Source Environment
3. Correct Performance Sizing
4. Customer Specific Performance-Critical Req'ts
5. Can concurrent hardware and software Migration be avoided?
6. Dependencies from Vendor Programs
7. Correct Customer Expectations and IBM Promises

All items of the checklist are required for correct sizing

Refer also to

- the part 'LSPR Results for Turbo Dispatcher' in the 'IBM VSE/ESA Turbo Dispatcher Performance' document
- the part 'VSE/ESA Quick Migration Sizer'

VSE Performance Sizing Checklist 1/4

1. Performance Capabilities of TD

- 1 partition only exploits power of 1 engine
- Non-parallel Share limits number of fully exploitable processors
- Enough partitions must be active to exploit aggregate CPU power

2. Measurement Data of Source Environment

- Type of data
  VSE JA (incl. DSA) is good,
  VSE monitor (EXPLORE or equiv.) is better,
  CICS monitor in addition is best
  - Concurrency of active partitions
  - Variation of load (season/day/hour) in volume and mix
  - CPU consumption and throughput of individual VSE partitions
  - VSE JA (or equiv.) data of key txns or batch jobs
  - Non-Parallel Share with variations
  - T/V (or guest/native) ratios for VM/VSE
- Utmost care is required if 100% CPU was achieved for intervals > 15 min:
  LATENT DEMAND cannot be assessed reasonably in practice.
  Largest effect is on lower priority partitions

VSE Performance Sizing Checklist 2/4

3. Correct Performance Sizing

- Processor ITR ratios applied from IBM LSPR?
  They are based on measurements
  - Uni-processor ratios for VSE or VM/VSE
    (MVS or VM figures, or 'CRIPS' is NOT applicable, Gardner is non-IBM and MVS only)
    Refer e.g. to Part K 'LSPR Results' in 'VSE/ESA Turbo Dispatcher Performance'
- VSE release migration deltas factored in?
- TD overhead on Uni and VSE MP factors applied?
- Number of processors not higher than the expected NPS allows?
- Customer growth requirements considered?

4. Customer Specific Performance-Critical Req'ts

- 'MIPS per engine' really sufficient for biggest partition?
  Mostly a production-CICS
- Any critical job in batch window with high CPU utilization?

VSE Performance Sizing Checklist 3/4

5. Can concurrent Hardware and Software Migration be avoided?

- Best, if applicable:
  a. Migrate to VSE/ESA V2 on 'old Uni'
  b. Use TD to get info on NPS and vendor programs
  c. If OK, roll in CMOS n-way (e.g. with RAMACs)
  Never change hardware and software in one step unless necessary

6. Dependencies from Vendor Programs

- Test vendor program functions
- Find out any major 'key-0-only' program
  Key-0 programs still might run in Non-parallel state,
  thus potentially increasing the TDs Non-Parallel Share
- Contact vendors and also VSE Development

VSE Performance Sizing Checklist 4/4

7. Correct Customer Expectations and IBM Promises

- Be aware of TD capabilities and limitations
- Do not expect or promise MVS MP factors for VSE
- Do not expect or promise or argue about 'MIPS'
  Use ITR-ratios to customers source processor.
  New 'MIPS' = ITR-ratio x 'MIPS'_source_proc.
  (whoever and how uses/defines 'MIPS')
- Make sure, performance basics are understood, e.g.
  - 2x processor power does not give 1/2 of RT or ET
  - Any CPU-utilization can be only assessed together with the actual throughput
    (transactions/sec or batch jobs/hr...)
  - Actual processor ITR ratios are workload dependent

VSE Sizing Documentation/Tools

Sizing for Single VSEs

Sizing for SINGLE VSE ... (VSE on different processor)	What to use ...
Deltas in - Release - Setup - Dispatcher use (TD vs SD) (also even on same processor)	Use VSE (Base, VM/VSE, TD-) documents. S/W deltas are not included in LSPR (VSEQMS considers all)
VSE Native	
VSE native on N-WAY	Use LSPR for equiv. UNI, and MP-factors from TD doc. (VSEQMS considers all)
(Single) VSE Uni-Guest (Refer to next foil for more info on multiple VSE guests)	
Single VSE Uni-guest on UNI '1-1-1'	Use LSPR, if guest setup does not change (VSEQMS considers all)
(Single) VSE N-way-Guest	
Single VSE n-way guest on UNI '1-n-1'	NOT RECOMMENDED, low G/N ratio, not in LSPR (not included in VSEQMS)
Single VSE n-way guest on N-WAY '1-n-n'	Use TD document, not in LSPR (VSEQMS considers all)
- Terminology used here for VM guests: '#VSE_guests - #processors_per_guest - #processors' - VSEQMS is the VSE/ESA Quick Migration Sizer tool	

VSE Sizing Documentation/Tools ...

Sizing for Multiple VM/VSE Guests

- No VSE MP-factors apply for Turbo Dispatcher, just VM MP-factors
- VM/VSE ITR ratios for multiple VSE guests are not contained in LSPR

Sizing for MULTIPLE VSEs ... (VSE on different processor)	What to use ...
Multiple VSE UNI guests on UNI	
Mult. VSE Uni-guests on UNI 'n-1-1'	Use LSPR. You may refine the ITR ratio by multiplication e.g. with .97 (2 guests)
Running 2 VSE uni-guests under VM/ESA on unis (using the VSE LSPR CICS online workload) showed: 2 guests vs 1 guest = 0.97 ITR ratio (on same uni, same total processor utilization). This small degradation is because VM has now to dispatch 2 different guests (but each less often)	
Multiple VSE UNI guests on N-WAY	
Mult. VSE Uni-guests on N-WAY 'n-1-n'	Use LSPR for equiv. UNI, for N-WAY multiply ITRR e.g. with 1.83-1.86 for 2-way (see special case below)
VM MP-factor (2-way) = 1.83...1.86 = about 1.85 (2 VSE uni-guests on 2-way vs equivalent 1-way) These factors were observed on 9221 CMOS processors and represent a first guess for newer processors, too. VM MP-factor (3-way) = about 2.55	
Mult. VSE n-way guests on N-WAY 'n-n-n'	Use VSEQMS for each individual guest. Contact us

LSPR Results for VSE/ESA

PART G.

LSPR Results for VSE/ESA

For official LSPR results and more info, refer to

- LSPR/PC package for use on a PC
  Available to your IBM representative from MKTTOOLS
- LSPR description, SC281187 package on MKTTOOLS, or SC28-1187
- LSPR in the Internet

  http://www.s390.ibm.com/lspr/

Turbo Dispatcher Results for LSPR

Large System Performance Reference (LSPR)

„ **Background**

LSPR:

UNI-Processor ITR-ratios for VSE/ESA

Native and as VM V=R guest, no change in S/W or setup

The following results were obtained with the VSE/ESA 2.1 Turbo Dispatcher (DY43757 and also DY44052), plus VSE/ESA 2.2/2.3. They were included in the official LSPR tables.

„ **Workload**

In all cases, RTXA for VSE was used in to simulate the terminals. Usually, for VSE/S/W regression puposes, TPNS is used via an NCP connection on a second processor.

Usually, for an n-way processor n+1 CICSs are being used.

In all cases, CICS monitoring was active, in order to get the number of transactions and the response times from CICSPARS.

Also in all cases, EXPLORE/CICS was active.

All guest runs were done under VM/ESA 1.2.2 with dedicated VSE DASDs and V=R. It was made sure that IO-assists were active.

LSPR ITR-Ratio Results

1. Processor ITR-ratios for Turbo Dispatcher on Unis

are very close to those LSPR data that were shown for VSE/ESA 1.3/1.4 (i.e. Standard Dispatcher).

Current VSE/ESA LSPR values are shown for VSE/ESA 2.3.2 with TD, but also hold for other VSE/ESA releases.

Turbo Dispatcher Results for LSPR ...

LSPR ITR-Ratio Results (cont'd)

2. VSE TD Guest/Native Ratios and 2-way MP-factors

Processor	G/N Ratio (V=R, DED DASDs)	MP-factor native / VM/VSE
9221-211	0.911	1.71 / 1.58
-421	0.843	
9121-320	0.916	1.71 / 1.62
-480	0.866	
9672-R11	0.885	1.75 / 1.69
-R21	0.843	
9672-R12	0.909	1.75 / 1.67
-R22	0.866	
9672-R1x/RAx (x=4,5)	0.920	1.75e / 1.67e
R2x	0.876e	
2003-116	0.920	1.75e / 1.67e
-126	0.876e	
9672-RA6/R16	0.920	1.75+e/ 1.67+e
-RB6/R26	0.876e	
9672-X17/Z17	0.920	1.75+e/ 1.67+e
-X27/Z27	0.876e	

- VSE/ESA V2 Turbo Dispatcher at 90% CPU utilization
- LSPR/CICS workload
- More I/O intensive loads show lower values
- G/N Ratios for Uni-processors also apply to SD
- Same figures were obtained for the newer CMOS models including the new Multiprise 200 models

„ **do not forget to consider**

- Release and setup deltas
- TD overhead on Uni
- Resulting throughput deltas (mix)

VSE LSPR ITR Ratios (Excerpt)

LSPR ITR Ratios (Excerpt)

„ **Numbers from LSPR/PC**

- Refer to LSPR for mandatory explanations.
- All capacity numbers here are relative to the IBM 9121-320
- VSE TD MP-factors (N-WAY to technology-wise equiv. UNI), see the TD document or on next foils

*a The 9221-221 does not have an equivalent UNI, which would correspond to a 9221-211 with only 62% of speed

*b A 9672-RC4 3-way is NOT a 3-way equivalent of an -RA4. Use .91 x 9672-R34 instead, or .91x -R14 as equiv. UNI

*c A 2003-124 2-way does not have an 'equivalent 1-way'. Use 1.08x -107 as equiv. UNI

*d A 2003-1C5 3-way does not have an 'equivalent 1-way'. Use 1.38x -107 as equiv. UNI

*e Similar considerations apply to some 2- and 3-way models of the 2003-200 series

Processor (UNI)	ITRR VSE Native	ITRR VM/VSE V=R	Equiv. 2-WAY	Equiv. 3-WAY
9121-320	1.00	1.00	9121-480	-
4381-90E	0.17	0.16	-	-
4381-91E	0.22	0.19	4381-92E	-
9221-120	0.09	0.08	-	-
9221-130	0.17	0.15	-	-
9221-150	0.23	0.21	-	-
9221-170	0.30	0.27	9221-200	-
(.62x-211)	(0.48)	(0.45)	9221-221*a	-
9221-191	0.51	0.49	-	-
9221-201	0.64	0.60	-	-
9221-211	0.77	0.73	9221-421	-
9121-180	0.25	0.24	-	-
9121-190	0.37	0.35	-	-
9121-210	0.55	0.53	-	-
9121-260	0.75	0.75	9121-440	-

Table cont'd on next page

VSE LSPR ITR Ratios (Excerpt) ...

Processor (UNI)	ITRR VSE Native	ITRR VM/VSE V=R	Equiv. 2-WAY	Equiv. 3-WAY
9121-320	1.00	1.00	9121-480	-
3006	0.35*1	0.35*1	-	-
9121-311	0.99	0.99	-	-
9121-411	1.18	1.18	9121-521	-
9121-511	1.56	1.57	9121-621	9121-732
9672-R11	0.72	0.69	9672-R21	9672-R31
9672-RA2	0.72	0.69	-	-
9672-R12	1.04	0.98	9672-R22	9672-R32
9672-RA4	1.67	1.64	9672-RB4	-
(.91x-R14)	(2.16)	(2.13)	-	9672-RC4*b
9672-R14	2.38	2.34	9672-R24	9672-R34
9672-RA5	2.60	2.55	9672-RB5	9672-RC5
9672-R15	3.33	3.28	9672-R25	9672-R35
9672-RA6	4.55	4.58	9672-RB6	-
9672-R16	6.06	6.10	9672-R26	9672-RC6
9672-T16	6.51	6.56	9672-T26	9672-R36
9672-Y16	7.74	7.80	9672-Y26	9672-Y36
2003-102	0.19	0.18	-	-
2003-103	0.28	0.27	-	-
2003-104	0.47	0.46	-	-
2003-105	0.65	0.64	-	-
2003-106	0.84	0.82	-	-
2003-107	1.24	1.22	-	-
(1.08x107)	(1.34)	(1.32)	2003-124*c	-
2003-115	1.51	1.48	2003-125	2003-135
(1.38x107)	(1.71)	(1.68)	-	2003-1C5*d
2003-116	1.86	1.83	2003-126	2003-136
2003-202	0.19	0.18	-	-
2003-203	0.28	0.27	-	-
2003-204	0.47	0.46	-	-
2003-205	0.65	0.64	-	-
2003-206	0.84	0.82	-	-
2003-207	1.24	1.22	-	-
2003-215	1.51	1.48	-	-
(0.75x216)e	(1.40e)	(1.37e)	2003-224*e	
(0.92x216)e	(1.71e)	(1.68e)	-	2003-2C5*e
2003-216	1.86	1.83	2003-225	-
(1.14x216)e	(2.12e)	(2.08e)	2003-227*e	2003-237*e
9672-X17	8.77	8.83	9672-X27	9672-X37
9672-Z17	10.00	10.09	9672-Z27	9672-Z37

*1 Processor capacity exploitation heavily depends on the I/O intensiveness of load

VSE TD Sizing on n-way (Summary)

VSE TD Sizing on n-way (Summary)

VSEQMS tool is applicable.

„ **LSPR ITR ratios could be used from source UNI to equivalent target UNI**

Use a previous foil for processor correspondences and use the latest LSPR figures for VSE commercial workload

Factors vary with workload(s)

Be aware that e.g. VM/VSE figures may differ measurably from pure VM loads (not shown here). Apply a mixed calculation in such mixed cases

„ **Consider S/W deltas (release and setup)**

Done automatically in the VSEQMS tool

„ **Use VSE MP-factors from the VSE TD document**

Without workload specifics, use the following average MP-factors for a single VSE n-way with Turbo Dispatcher (values for multiple uni guests and MVS are shown for rough comparison only)

	VSE TD native	VM/VSE 1 n-way	VM/VSE Mult.unis	MVS native
2-way	1.7	1.65	1.85	1.9
3-way	2.3	2.2	2.55	2.7
4-way	(2.8)*	(2.65)*	3.2	3.4

- All values may vary with processor type etc...
- Heavy I/O loads may have smaller values
- Check Non-Parallel Shares: n-max = 0.9/NPS (native)
* 4-way sizing for single VSEs needs careful checks

All newer IBM processors (refer to table on previous foil) have very similar MP-factors.

The IBM Sizing tool VSEQMS considering these aspects is described next

VSE/ESA Quick Migration Sizer

PART H.

VSE/ESA Quick Migration Sizer

This part describes the rationale behind the VSE Quick Migration Sizer program, an IBM Internal tool. In any case the external description of the dependencies eases understanding of even complex migration scenarios, not only for IBM personel or IBM business partners using that program for your specific environment.

For IBM representatives, the program is available as part of the VE21PERF PACKAGE on the IBMVSE tools disk, or as a stand-alone package on the WSC CPSTOOLS disk:

TOOLS SENDTO WSCVM TOOLS CPSTOOLS GET VSEQMS PACKAGE

The output of that program is suited and intended to be given to customers.

The external description here may be partly obsolete, since V2 of VSEQMS was significantly restructured, BUT the main principles still apply.

Current version is VSEQMS 3.1.5, an enhanced version for Windows 9x/NT.

Intro to Quick Migration Sizer

Introduction to VSE/ESA Quick Migration Sizer

Ù **Internal Throughput Rate (ITR)**

ITR = Internal Throughput Rate
= (#jobs or #txns per CPU sec) x N

Depends on
- „ **H/W**
- „ **S/W and dispatcher used**
- „ **S/W setup,**
  incl. Data In Memory (DIM) exploitation
- „ **VM/VSE setup**
  (also dependent on processor type)

On an N-way,
- N CPU-seconds per sec are available, so the ITR is higher than on the equivalent 1-way
- the ITR available per engine is ITR/N.

(For single CICS production systems this is important)

Ù **Overall ITR Ratio (ITRR) is**

ITRR = ITR_target / ITR_source

ITRRs cannot consider capacity bottlenecks through a critical resource, e.g.
- real storage requirements,
- virtual storage and partition setup
- I/O configuration setup

Intro to Quick Migration Sizer ...

Ù **Source and target systems are characterized by:**

Source System		Target System
Processor model		Processor model
- generation/class		- generation/class
- #engines		- #engines
H/W-mode		H/W-mode
- /370 ...	Total ITR	- ESA
- ESA Basic Mode	============>	
VM release	Ratio ITRR	VM release
- VM/370, VM/ESA		- VM/ESA
VSE setup		VSE setup
- release		- release
- dispatcher		- dispatcher
Data in Memory		Data in Memory

The following is not (no more) included in the VSEQMS tool:
- VSE in a Shared LPAR, use preferred VM guest instead with dedicated devices.
- S/370 target modes

Ù **Gross values for expected overall ITR ratios for single VSE images**

For more precise figures, more input and differentiation would be required

„ **Only effective speed (ITR ratio) considered at the processor side**

Í **No environment specific and misleading MIPS values are used**

MIPS cited elsewhere
- are often obsolete planning MIPS for TSO
- do not reflect VM/VSE guest setup variations

„ **Any release delta assumed is based on values for average loads**

Intro to Quick Migration Sizer ...

Ù **The following source/target environments are considered:**

	/370	ESA
A) VSE native (no VM/LPAR)		
43xx	X	-
4381-9x	X	X
9370	X	-
9221	X	X
9121	-	X
9672	-	X
2003	-	X
B) VSE as VM/370 guest (source only)		
43xx	X	-
9370	X	-
9221	X	-
9121	-	-
C) VSE as VM/XA or VM/ESA ESA guest		
9221	-	X
9121	-	X
9672	-	X
2003	-	X
X: case considered nc: not considered -: not applicable		

- VM/SP with or w/o HPO, VM/ESA /370 are close and not distinguushed here
- VSE/ESA native on XA not included
- S/370 target mode is no more supported
- VM in LPAR not recommended for production

Ù **Intermediate Migration Steps may also be assessed by proper definition of the 'target' environment**

Intro to Quick Migration Sizer ...

Calculation

Ù **Objective:**

Determine first guess for the Target CPU utilization

```
Target_CPU_util = (Source_CPU_util / ITRR) x Thruput_ratio
```

Thruput_ratio is >1 if e.g.

- 'Latent demand' exists on source processor (100% CPU util for >15 min periods)
- more work is done due to faster I/O subsystem
- future growth is to be concidered

If processor gets faster and thus response times improve, also more transactions per user may be requested in such a case per busy hour.

Ù **Acceptable Target Utilizations**

With exploitation of

- the Dynamic Channel Subsystem (ESA-mode)
- faster I/O subsystems
- more buffers for files (DIM)

the target utilization is allowed to be higher than before, if the same response time limits are set:

Í **Capacity ratio may be higher than ITR ratio**

Overall ITR Ratio

Overall ITR Ratio Formula

Total ITR Ratio = P x Mt/Ms x S1 x S2 x S3 x Gt/Gs

The formula contains all impacting factors, i.e.
- H/W
- S/W
- setup related items.

The VSEQMS tool assumes average statistical values for these items.

This total ITR ratio should not be lower than say 1.6, to

- allow future growth
- cope for "latent demand"
- have processor resources for parallel migration or test

Ù **P is a (Uni-)Processor ITR ratio**

P is the ITR ratio of the corresponding (technology-wise equivalent) uni-processors

$$P = \frac{\text{target (eq.uni)processor ITR ratio}}{\text{source (eq.uni)processor ITR ratio}}$$

For Uni-processors, directly the uni-processor is valid for the ITR.

For N-ways, P is the ITR value of the equivalent UNI
(An equivalent uni is that uni which is technology and cycle time wise identical, i.e. where 'usual' MP-factors apply).

This 'equivalent UNI' may even not exist, but is used anyhow for calculation purposes (transparently done by the tool).

Equivalent UNIs can be found in the VSE/ESA Turbo Dispatcher document, part K.

P also includes any change from S/370 to ESA-mode, if required

Overall ITR Ratio ...

Ù **Mt/Ms is a ratio of VSE MP-factors**

1/Ms performs the transition from a VSE n-way as SOURCE to its equivalent uni-processor.

Mt is the transition from the TARGET equivalent TARGET Uni to the actual TARGET n-way (using VSE MP-factors)

The factor Mt/Ms is important, when
- going from a UNI to an N-way (total ITRR for all engines together)
- the MP-factors change (this factor is 1.00 if you stay within IBM CMOS processors starting with the first 9672s, and use the same #engines)

Ù **S1xS3 is for VSE release deltas**

Besides pure release deltas (S1), the Turbo Dispatcher (TD) overhead on a UNI (here S3=0.9, i.e 10% overhead) is included in the following table.

From \ To	SP 2	SP 3	SP 4	ESA 1.1/ 1.2	ESA 1.3/ 1.4	ESA 2.1/ 2.2SD	ESA 2.1/ 2.2TD	ESA 2.3 SD	ESA 2.3 TD
SP 2	1.00	0.97	0.94	0.92	0.87	0.825	0.745	0.82	0.74
SP 3	-	1.00	0.97	0.95	0.90	0.855	0.765	0.85	0.76
SP 4	-	-	1.00	0.97	0.925	0.88	0.79	0.875	0.785
ESA 1.1/1.2	-	-	-	1.00	0.945	0.89	0.81	0.885	0.805
ESA 1.3/1.4	-	-	-	-	1.00	0.95	0.855	0.945	0.85
ESA 2.1/2.2SD	-	-	-	-	-	1.00	0.90	0.995	0.895
ESA 2.1/2.2TD	-	-	-	-	-	-	1.00	1.095	0.995
ESA 2.3 SD	-	-	-	-	-	-	-	1.00	0.90
ESA 2.3 TD	-	-	-	-	-	-	-	-	1.00

- Avg I/O intensive loads, native. Lower I/O intensive loads show figures closer to 1.
- Processor dependent deltas from /370 to ESA-mode contained in processor ITRs

Refer also to the chart 'Native ITR deltas for VSE Releases'.

Ù **S2 is for VSE setup deltas:**

No setup delta	1.00
Data In Memory (31-bit)	up to 1.20 (VSE/ESA 1.3 and up) (and more)

Overall ITR Ratio ...

Ù **Gt and Gs is for VSE as VM guest (Target and Source):**

If VSE is running native on the target and/or source processor:

Gt and/or Gs = 1.00 (native environment)

If VSE is running as VM guest
(either on source or target processor or on both):

Gt = target processor guest/native ratio

Gs = source processor guest/native ratio

The guest/native ratios reflect VM/VSE guest performance vs VSE native and their dependency of

- the type of processor and the implementation of
  - VM assists (VM/370)
  - SIE assists (VM/XA or VM/ESA ESA)
- the VM release and mode
- the guest mode

Ù **Do a rounding in your final result to 2 valid digits**

Overall ITR Ratio per Engine

Overall ITR Ratio per Engine

If your target processor is an N-way, consider in addition ...

Ù **N-way Power per engine**

ITRR_per_engine = Total_ITR_Ratio / n

(required for 'biggest' VSE partition, mostly CICS production)

Ù **Full N-way exploitation is limited to n_max processors**

even if enough dispatchable partitions are available

n_max = 0.9 / (NPS x TV_ratio)

Non-Parallel Share	NPS	native n-max	VM guest n-max
about .25	Online, CPU intens.	3.6	3.6 / TV_ratio
.35	Online, some DIM	2.6	2.6 / -"-
.50	Batch, no DIM	1.8	1.8 / -"-

... as described in the document
'IBM VSE/ESA Turbo Dispatcher Performance'

Overall Rationale

Rationale behind the Calculation Formula

To understand the individual steps of the calculation, and to avoid potential misinterpretations of the tables used, here some assistance.

Rewriting the formula (general case):

Total ITR Ratio = 1/Ms x 1/Gs x S1 x S3 x P x S2 x Gt x Mt

„ **Step 1: 1/Ms**
Go to an 'equivalent 1-way environment'
(Ms is the VSE MP-factor on the SOURCE n-way)

„ **Step 2: 1/Gs**
Go to a native source environment
(all VM'370' guests to /370 supervisor,
all VM'ESA' VSE/SP guests to /370 supervisor,
all VM'ESA' VSE/ESA guests to ESA supervisor)

„ **Step 3: S1xS3**
Change from source VSE to target VSE
(staying in same VSE-mode)
(plus transition to Turbo Dispatcher, if so)

„ **Step 4: P**
Go with target VSE in native environment to target processor and target VSE-mode

„ **Step 5: S2**
Change/tune setup for target VSE

„ **Step 6: Gt**
Go under target VM to target guest-mode

„ **Step 7: Mt**
Go from 'equivalent target 1-way' to target n-way

(Steps 3 to 5 could be conceptually imagined also in other orders)

Refer to the scheme on the next chart

Overall Rationale ...

VM-type	Guest-mode	VSE-rel.+ Dispatch.	VSE-mode	Processor type/mode model,	Tuning
VM/'370' SP,ESA 370 VM/'ESA' XA,ESA ESA	MODE=.. V=R,F,V	SP 2,3,4 ESA 1.x ESA 2.x	/370, ESA		...

Source N-way

Step 1 | 1/Ms | (If source on an N-way) V Go to 'Equivalent 1-way'

Source	Source	Source	Source	Source	Source

Step 2 | 1/Gs | (If Source VSE under VM)

-	-	Source	Source	Source	Source

Step 3 | S1 x S3 (If Release or Dispatcher change)

-	-	Target	Source	Source	Source

Step 4 (If different UNI, or mode) | P |

-	-	Target	Target	Target	Source

Step 5 (If more DIM exploitation) | S2

-	-	Target	Target	Target	Target

Step 6 | Gt | (If Target VSE under VM)

Target	Target	Target	Target	Target	Target

Step 7 | Mt | (If Target on an N-way) V Go to N-way

Target N-way

All intermediate steps refer to UNI or 'Equivalent UNI'.
Any factor for a non-required step is 1.0

VSEQMS Program

VSEQMS Program Highlights

- Before restructuring the program, it was a REXX program running under VM, OS/2 2.0, and VSE/ESA V2.
  Now user interface is full screen, using Visual Basic.
- Main logic of program is the treatment of different options/cases
- Sequence and scope of input specifications do not allow non-supported environments or redundant input
- Program has NOT been tested for 'backward migrations', e.g.
  VSE/ESA to VSE/SP, ESA-mode to /370-mode, ES/9000 to 43xx
- Output consists of
  - Summary of input specifications
  - ITR ratio results for some target environments
    (varying VSE guest modes, workload ...

Sequence of Input Specifications

The offered options of each input step depend on the input from potentially all former steps

Step a1) Processor Class
43x1, 9370, 4381, 9221, 9121, 9672, 2003

Step a2) Processor Model
Depending on processor class

Step b) VSE Release and Mode
VSE/SP 2 to 4, VSE/ESA /370, VSE/ESA ESA

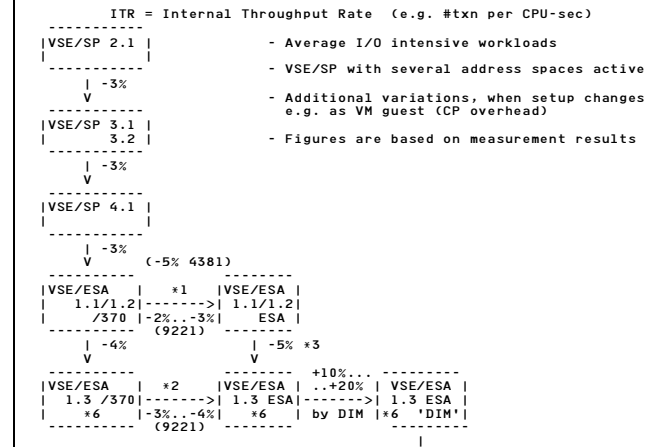
Step c) VM Type
None, VM/'370', VM/'ESA'

Step d) VM/VSE Guest Type (only for source)
MODE=... V=...

Step e) Hardware Mode (only if required)
/370 Basic, ESA Basic

Native ITR Deltas for VSE Releases

Approximate ITR Deltas for VSE Releases

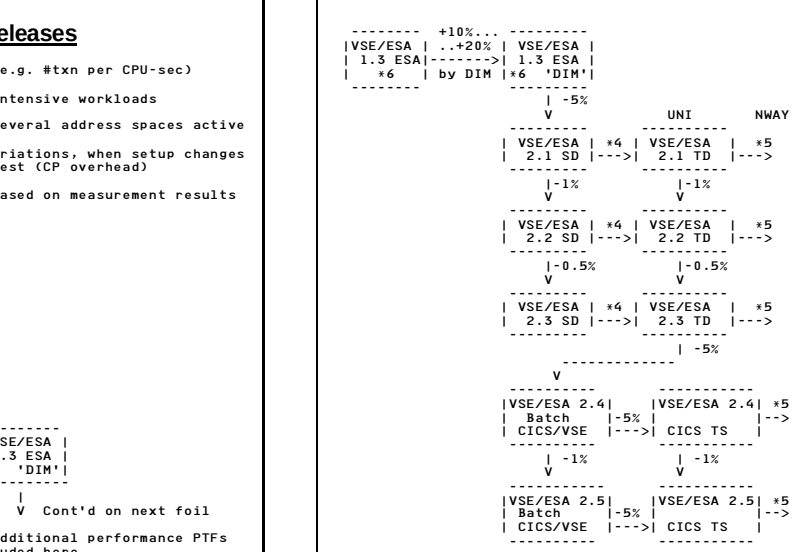


Notes:

- Any performance improvements by additional performance PTFs for a newer releases are NOT included here
- These figures for average I/O intensive workloads are TOTAL ITR ratios including CICS!
- Consider tuning potential in VSE/ESA by Data In Memory (DIM) for less I/Os (improves ITR and RTs)
- Consider functionality increase in VSE/ESA

*1 to *3: For non-ES/9000 processors the indicated deltas may be higher in case of a non-optimal ESA implementation.

Native ITR Deltas for VSE Releases ...



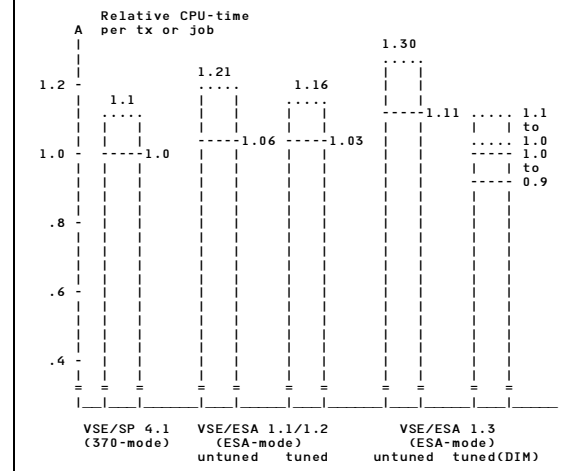
*4,*5: TD overhead on UNI (*4) and MP-factors (*5) as in the 'VSE/ESA Turbo Dispatcher Performance' document

*6: VSE/ESA 1.4 ITR is very close to VSE/ESA 1.3 (0% in batch, -1% in CICS workloads)

- For deltas due to LE/VSE refer to the VSE/ESA V2 Base document (-2% to -5% ITR)
- All ITR ratios apply to cases w/o exploiting new functions!

Native ITR Deltas for VSE Releases ...

Relative CPU-time for VSE/SP to VSE/ESA Migration



- Two (setup) types of commercial workloads

  _____ Average I/O intensive
  As measured and shown in previous chart

  ..... More I/O intensive or 'detuned' in VSE/SP 4.1
  Extrapolated scenario

- Tuning possibilities (Data In Memory, DIM) only with VSE/ESA 1.3, note: CPU-time reduction (i.e. I/O reduction) workload dependent

  > Tuned VSE/ESA 1.3 in general shows better CPU-time than VSE/SP 4.1

  > VSE/ESA 1.1/1.2 or VSE/ESA 1.3 w/o DIM cannot show ESA potential

EOD

EOD End Of Document

HAND Have A Nice Day