

VM Performance - Getting started using SAS
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This report describes how to do first level analysis of CP monitor data collected with VM/SP, and variables that can be used to report graphically the performance of the system.
Before going any further, let us review some VM characteristics.

VM is a time-sharing system used for interactive program development, problem solving and personal computing. The control program (CP) manages the sharing of the resources - CPU, STORAGE, I/O. The tasks generally entered from a terminal are first assumed to be interactive, requiring fast response while making slight demands on resources. If proven otherwise i.e. if a task does not terminate before consuming a certain amount of CPU, it loses its interactive status. Such tasks are commonly called Q1 (interactive), Q2 (non-interactive) and Q3 by extension of Q2. While in-Q a task requires system resources - STORAGE, I/O, CPU. Storage requirements are met dynamically through a demand paging mechanism. The rates at which these resources are used, the resource contention, as well as the response time to interactive tasks provide good first level performance measures.

The following graphical reports can be produced and will show the relation between the performance and the system load.

- Active and Logged users
- CPU utilisation (users, CP)
- I/O rates
- Storage utilisation
- Q utilisation
- Resource wait
- Distribution of active users
- Distribution of CPU usage
- Paging rate
- Response time

It will as well show the average utilisation and contention for the major resources - Key performance factors.

It will permit to see if the CPU is well utilised, where the peaks are, what kind of work demands are placed onto the system, what is the response time, if the system is overloaded, and if service is consistent.

This method can very easily be implemented and does not request the presence of full time performance analyst which many VM installations do not have.

VM monitor data collection can be controlled from the SYSMON macro in DMKSYS or more flexibly from a privileged user with the CP MONITOR command. The MONITOR command can be included in the VMUTIL virtual machine. The monitor data is then spooled to a chosen virtual machine (e.g. SASPERF) which can then be autologged, preferably at night, to analyse VM performance data. A customized PROFILE EXEC can be used to control the flow of program execution. A summary will then be produced and will display header records, descriptive statistics for each variable, resource utilisation by userid, I/O activity and line graphs showing user load, CPU utilisation...

Files will also be created:

1) SAS Datasets on a R/W A minidisk:

MONAVGED	Dmmdh	(Where 'mmdhh' represents: month-day-hour)
MONDATA	Dmmdh	
MONIO	Dmmdh	
MONUSER	Dmmdh	

and

MAXIMA	MONTREND
MEANS	MONTREND
MINIMA	MONTREND

2) A SAS Dataset on a R/W D minidisk that could be used for detailed analysis by a performance analyst.

USER	TEMP
PRIVOPS	TEMP
SEEKS	TEMP
IODEVICE	TEMP
IOCHAN	TEMP
CHANIO	TEMP

Graphics can then be produced on a variety of graphics devices with SAS-GRAPH to give a load profile of the VM system, showing what the demand on resources are, and how well the system meets those demands and the reponse expectation of the users.

Appendix A

Example of programs:

```
-----
&TRACE OFF
***** This is an exec that is called from
***** the profile exec of the monitor data reduction machine
***** when that machine is autologged (automatically at 18:00).
***** It will reduce all class M monitor files
***** in the reader, and change their class to P (processed).
CP CH RDR ALL HOLD
CP SP RDR CL M CONT HOLD
CP CH RDR CL M NOH
FI MONTAPE READER (PERM
*
* perform the actual data reduction and analysis.
*
* temp is for some temporary files we might want to play with later
FILEDEF TEMP DISK D TEMP D (PERM
*
* the following ddnames are written to the 'A' disk for archiving:
*   CURR      - data for the current set of files
*              (renamed to data stamp later)
*   MONTREND  - daily maxima, minima and means of 'MONDATA'
*
* these filedefs can be left out for SAS 82.2
FILEDEF MONVLST DISK MONVLST SAS * ( PERM
FILEDEF MONVLABL DISK MONVLABL SAS * ( PERM
SAS MONANAL ( SASLIB MNFORMAT NODATE NOSPOOL CMDMSG
&SRC = &RC
CP CH RDR CL M CL P
PRINT MONANAL LISTING
&STACK CP LOGOUT
&EXIT &SRC
```

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PLOT THE NUMBER OF USERS (ACTIVE AND LOGGED) VS. TOD

```
DATA FRED (GEN=0 KEEP= TIME USERS NUMBER ) ;
SET _DMMDDHH . MONAVGED END=DONE;
LENGTH USERS $10 ;
IF _N_ = 1 THEN DO ;
    TIME = '8:00'T - .1 ;
    USERS = 'ACTIVE' ; NUMBER = 0 ; OUTPUT ;
    USERS = 'LOGGED ON' ; NUMBER = 0 ; OUTPUT ;
END ;
TIME = TOD ;
USERS = 'ACTIVE' ; NUMBER = ACTIVE ;
OUTPUT ;
USERS = 'LOGGED ON' ; NUMBER = LOGGED ;
OUTPUT ;
IF DONE THEN DO ;
    TIME = '18:00'T + .1 ;
    USERS = 'ACTIVE' ; NUMBER = 0 ; OUTPUT ;
    USERS = 'LOGGED ON' ; NUMBER = 0 ; OUTPUT ;
END ;

PROC GPLOT ;
PLOT NUMBER * TIME = USERS / OVERLAY VZERO AREAS = 2 CTEXT=WHITE
CAXIS=WHITE
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE CMS USER LOAD THROUGHOUT THE DAY ;
TITLE2 .A=90 .H=1 ;
TITLE3 .A=90 .C=WHITE NUMBER OF USERS ;
FOOTNOTE DATA COLLECTED _MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL NUMBER = 'OO'X ;
SYMBOL1 I=SPLINE C=CYAN V=NONE ;
SYMBOL2 I=SPLINE C=YELLOW V=NONE ;
PATTERN1 C=CYAN V=S ;
PATTERN2 C=YELLOW V=S ;
FORMAT TIME TIMES. ;
```

PLOT THE CPU UTILISATION (CP, TOTAL AND CPUQ) VERS TOD

```

DATA FRED (GEN=0 KEEP = TIME CPU USAGE) ;
SET _DMDDHH . MONAVGED END= DONE;
LENGTH CPU $8 ;
IF _N_ = 1 THEN DO ;
    TIME = '8:00'T - . 1 ;
    CPU = 'CP' ; USAGE = 0 ; OUTPUT ;
    CPU = 'TOTAL' ; USAGE = 0 ; OUTPUT ;
    CPU = 'WAITING' ; USAGE = 0 ; OUTPUT ;
END ;
TIME = TOD ;
CPU = 'CP' ; USAGE = CPCPU ;
OUTPUT ;
CPU = 'TOTAL' ; USAGE = TOTCPU ;
OUTPUT ;
CPU = 'WAITING' ; USAGE = CPUQ ;
OUTPUT ;
IF DONE THEN DO ;
    TIME = '18:00'T + . 1 ;
    CPU = 'CP' ; USAGE = 0 ; OUTPUT ;
    CPU = 'TOTAL' ; USAGE = 0 ; OUTPUT ;
    CPU = 'WAITING' ; USAGE = 0 ; OUTPUT ;
END ;

PROC GPLOT ;
PLOT USAGE * TIME = CPU / OVERLAY VZERO AREAS = 3
VAXIS = 0 TO 100 BY 10 CAXIS = WHITE CTEXT = WHITE
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE VM CPU UTILISATION ;
TITLE2 .A=90 .H=2 ;
TITLE3 .A=90 .C=WHITE CPU UTILISATION ;
FOOTNOTE DATA COLLECTED _MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL USAGE = 'OO'X ;
SYMBOL1 I=SPLINE C=RED V=NONE ;
SYMBOL2 I=SPLINE C=YELLOW V=NONE ;
SYMBOL3 I=SPLINE C=CYAN V=NONE ;
PATTERN1 C=RED V=S ;
PATTERN2 C=YELLOW V=S ;
PATTERN3 C=CYAN V=S ;
FORMAT TIME TIMES. ;

```

PLOT THE RESOURCE AVAILABILITY INDEX (RAI) VS. TOD

```
DATA FRED (GEN=0 KEEP= TIME INDEX NUMBER ) ;
SET DMDDHH . MONAVGED END= DONE;
LENGTH USERS $10 ;
IF N = 1 THEN DO ;
    TIME = '8:00'T - .1 ;
    INDEX = 'R.A.I.' ; NUMBER = 0 ; OUTPUT ;
END ;
TIME = TOD ;
INDEX = 'R.A.I.' ; NUMBER = RAI ;
OUTPUT ;
IF DONE THEN DO ;
    TIME = '18:00'T + .1 ;
    INDEX = 'R.A.I.' ; NUMBER = 0 ; OUTPUT ;
END ;

PROC Gplot ;
PLOT NUMBER * TIME = INDEX / VZERO AREAS = 1 CTEXT=WHITE
CAXIS=WHITE
VAXIS = .50 TO 1.00 BY .05
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE CMS RESOURCE AVAILABILITY INDEX ;
TITLE2 .A=90 .H=1 ;
TITLE3 .A=90 .C=WHITE RES. AVAIL. INDEX ;
FOOTNOTE DATA COLLECTED MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL NUMBER = '00'X ;
SYMBOL1 I=SPLINE C=CYAN V=NONE ;
PATTERN1 C=YELLOW V=S ;
FORMAT TIME TIMES. ;
```

PLOT THE INTERACTIVE RESPONSE TIME (Q1SEC) VS. TOD

```
DATA FRED (GEN=C KEEP= TIME RESP NUMBER ) ;
SET DMDDHH . MONAVGED END= DONE;
LENGTH USERS $10 ;
IF N = 1 THEN DO ;
    TIME = '8:00'T - .1 ;
    RESP = 'RESPONSE TIME' ; NUMBER = 0 ; OUTPUT ;
END ;
TIME = TOD ;
RESP = 'RESPONSE TIME' ; NUMBER = Q1SEC ;
OUTPUT ;
IF DONE THEN DO ;
    TIME = '18:00'T + .1 ;
    RESP = 'RESPONSE TIME' ; NUMBER = 0 ; OUTPUT ;
END ;

PROC GPLOT ;
PLOT NUMBER * TIME = RESP / VZECO AREAS = 1 CTEXT=WHITE
CAXIS=WHITE
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE CMS INTERACTIVE RESPONSE TIME ;
TITLE2 .A=90 .H=1 ;
TITLE3 .A=90 .C=WHITE RESPONSE TIME ;
FOOTNOTE DATA COLLECTED MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL NUMBER = '00'X ;
SYMBOL1 I=SPLINE C=CYAN V=NONE ;
PATTERN1 C=CYAN V=S ;
FORMAT TIME TIMES. ;
```

PLOT CHAN1, CHAN2 CHAN5 VERS TOD

```

DATA FRED (GEN=0 KEEP= TIME CHAN USAGE ) ;
SET _DMDDHH . MONAVGED END= DONE;
LENGTH CHAN $8 ;
IF _N_ = 1 THEN DO ;
    TIME = '8:00'T - .1 ;
    CHAN = 'CHAN1' ; USAGE = 0 ; OUTPUT ;
    CHAN = 'CHAN2' ; USAGE = 0 ; OUTPUT ;
    CHAN = 'CHAN5' ; USAGE = 0 ; OUTPUT ;
END ;
TIME = TOD ;
CHAN= 'CHAN1' ; USAGE = CHAN1 ;
OUTPUT ;
CHAN= 'CHAN2' ; USAGE = CHAN2 ;
OUTPUT ;
CHAN= 'CHAN5' ; USAGE = CHAN5 ;
OUTPUT ;
IF DONE THEN DO ;
    TIME = '18:00'T + .1 ;
    CHAN= 'CHAN1' ; USAGE = 0 ; OUTPUT ;
    CHAN= 'CHAN2' ; USAGE = 0 ; OUTPUT ;
    CHAN= 'CHAN5' ; USAGE = 0 ; OUTPUT ;
END ;

PRCC GPLOT ;
PLOT USAGE * TIME = CHAN / OVERLAY VZERC AREAS = 3
VAXIS = 0 TO 50 BY 5 CAXIS = WHITE CTEXT = WHITE
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE CHANNEL UTILISATION ;
TITLE2 .A=90 .H=2 ;
TITLE3 .A=90 .C=WHITE I/C RATE PER SEC. ;
FOOTNOTE DATA COLLECTED _MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL USAGE = 'OO'X ;
SYMBOL1 I=SPLINE C=RED V=NONE ;
SYMBOL2 I=SPLINE C=YELLOW V=NONE ;
SYMBOL3 I=SPLINE C=CYAN V=NONE ;
PATTERN1 V=S ;
PATTERN2 V=S ;
PATTERN3 V=S ;
FORMAT TIME TIMES. ;

```


PLOT THE QUEUE UTILIZATION (Q1, Q2, Q3) VERS TOD

```

DATA FRED (GEN=0 KEEP= TIME QQQ USAGE ) ;
SET DMDDHH . MONAVGED END= DONE;
LENGTH QQQ $8 ;
IF N = 1 THEN DO ;
    TIME = '8:00'T - .1 ;
    QQQ = 'Q1' ; USAGE = 0 ; OUTPUT ;
    QQQ = 'Q2' ; USAGE = 0 ; OUTPUT ;
    QQQ = 'Q3' ; USAGE = 0 ; OUTPUT ;
END ;
TIME = TOD ;
QQQ = 'Q1' ; USAGE = Q1 ;
OUTPUT ;
QQQ = 'Q2' ; USAGE = Q2 ;
OUTPUT ;
QQQ = 'Q3' ; USAGE = Q3 ;
OUTPUT ;
IF DONE THEN DO
    TIME = '18:00'T + .1 ;
    QQQ = 'Q1' ; USAGE = 0 ; OUTPUT ;
    QQQ = 'Q2' ; USAGE = 0 ; OUTPUT ;
    QQQ = 'Q3' ; USAGE = 0 ; OUTPUT ;
END ;

PRCC G PLOT ;
PLOT USAGE * TIME = QQQ / OVERLAY VZERO
VAXIS = 0 TO 7 BY .5 CAXIS = WHITE CTEXT = WHITE
HAXIS = '8:00'T TO '18:00'T BY '2:00'T ;
TITLE .H=2 .F=TRIPLEX .C=WHITE VM QUEUE UTILISATION ;
TITLE2 .A=90 .H=2 ;
TITLE3 .A=90 .C=WHITE IN QUEUE USERS ;
FOOTNOTE DATA COLLECTED MMDD ;
LABEL TIME = 'TIME OF DAY' ;
LABEL USAGE = 'OO'X ;
SYMBOL1 I=SPLINE C=RED V=NONE ;
SYMBOL2 I=SPLINE C=YELLOW V=NONE ;
SYMBOL3 I=SPLINE C=CYAN V=NONE ;
FORMAT TIME TIMES. ;

```

Appendix B

References:

IBM VM/SP system programmer's guide.

IBM VM/SP operator's guide.

Evaluating the performance of VM/SP systems with SAS (Peter L. Jobusch).