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SYSTEM ACTIVITY MONITOR
(S 80, S/90)

ABSTRACT

This bulletin provides general Ease of Use guidelines for using the System Activity Monitor (SAM) with System 80 and Series 90.

COMPANY CONFIDENTIAL 'C'

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1. INTRODUCTION

The System Activity Monitor (SAM) is a performance measurement tool. It can be ordered as a software program product from Software Order Services. Since June, 1982 it is included in the normal OS/3 shipments. There is a User Guide/Programmer Reference Manual (UP8812) available, which describes SAM in detail.

The objective of this Bulletin is to provide a 'Starter Kit' for SAM Usage. A Systems Analyst would be able to use this Bulletin to start the monitor, collect performance data and analyze it for the system's monitored period. The System Activity Monitor manual should be referred to for further details.

SAM has been successfully used in analyzing performance problems in the field, in the Marketing Center and in the Development Center. The more one uses SAM, the better one will understand the system's performance. The System Activity Monitor should be used during a normal workload period. This will provide the System Activity Statistics during that period. These Statistics can be used as a baseline for future comparisons. Should a performance problem occur, the SAM data during the problem period can be compared against the baseline for comparison.

SAM runs as a Symbiont (JL\$SSA00). Once generated in the supervisor and ICAM, it can be turned 'ON' and 'OFF' from the system console.

The SAM overhead involved depends upon the activity in the System and the frequency of Sampling (approximately 10% to 20%). The performance data collected by SAM can be saved in disk file and the reports can be generated at any time by running SAMRPT, preferably during slow system activity periods. SAM data can be partially displayed on the System Console during the monitoring session. In this Bulletin, SAM for OS/3 Rel. 7.1 will be discussed. It has been enhanced in OS/3 Release 8.0. The enhancement includes TRACE. The TRACE facility provides the reports on the file reference pattern by device and the I/O requests by device with command code.

2. OPERATIONAL CONSIDERATIONS

The first step is to ensure that the software product (SAM) is installed in the Operating System. The System Activity Monitor needs to establish some links with your Supervisor. In addition, if the communication activity is to be monitored with SAM, some links need to be established with your ICAM. The linking can be achieved by specifying keyword SAM=YES in SUPGEN (Supervisor Generation) and FEATURES=(MONITOR) in ICAM Generation. After these steps are completed, SAM can be controlled from the Systems Console.

The Main Storage requirement for SAM Symbiont is 11,776 bytes (Rel 7.1). SAMRPT, the report utility, is 70K bytes. A file needs to be allocated for collecting the SAM data on disc. This can be allocated by the 'ALLOCATE' command or by an "EXT" in a JCL stream.

ALLOCATE COMMAND:

```
AL ST, FIL=XXXXXX,VSN=YYYYYY,SIZE=Z
where,
XXXXXX=NAME(e.g. SAMDAT)
YYYYYY=WORK01
```

Z is number of cylinders. Table 1 shows the guidelines for selecting this number.

For 'EXT' please refer to UP8812 manual.

If SAM is to be used for problem analysis, the following steps must be taken.

- 1) Identify the nature of the performance problem (slow terminal/workstation response, slow batch turnaround.) Take timings with this problem for future comparisons. For slow batch turnaround use the following classes in SAM session,

CPU
DSK
I/O
MEM

If SVCR in CPU class is high compared to the normal workload, replace I/O with SVC in the next SAM session. For slow terminal response use following classes in SAM session,

CPU
DSK
COM
MEM

If SVCR shows high, replace COM with SVC in next SAM session. In OS/3 Release 8 one can turn SAM 'ON' with ALL classes (CPU, I/O, SVC, COM, MEM, DSK).

- 2) Identify the duration of the performance problem. If the slow period lasts for 10 minutes, the SAM session must start before and stop after the slow period. Also, SAM should collect performance data at a smaller interval (e.g. every 10 seconds, I=S10) for finer granularity.

If the slow period lasts for half shift (4 hours) then the monitoring interval should be larger (e.g. 4 minutes I=4).

- 3) SAM can now be started by keying in following command at the System Console,

```
SAM I=1,C=(CPU,DSK,I/O,MEM),0=D,AAA,XXXXXX,GO
```

where AAA = Address of the disk (e.g. 103) where SAM data is to be collected.

XXXXXX = File name allocated for SAM data. (e.g. SAMDAT)

- 4) The SAM Session can be terminated, after monitoring during the slow period, by keying in the following command at the system console.

```
00 SA EOJ
```

Informational messages are displayed, after start and stop of the SAM session, at the System console.

SAM SESSION DISK SPACE REQUIREMENT
(FOR OS/3 REL. 7.1)

<u>SELECTED INTERVAL</u>	<u>CYLINDERS ONE HOUR SESSION</u>		<u>CYLINDERS TEN HOUR SESSION</u>	
	8417	8419	8417	8419
	----	----	----	----
10 SECONDS	2.125	5.076	21.25	50.76
20 SECONDS	1.062	2.538	10.62	25.38
30 SECONDS	0.708	1.692	7.08	16.92
1 MINUTE			3.54	8.64
2 MINUTES			1.77	4.23

TABLE 1

3. SAM REPORT CONSIDERATIONS

Reports can be printed by executing 'SAMRPT' against the SAM data collected on disc. This is a batch job and it should preferably be run during off peak load hours. There is a canned job stream available to produce the reports (Section 3.2.1, UP8812). The format of this command is

```
RV SAMRPT,,V=YYYYYY,F=XXXXXX,SFL= ALL
```

(e.g. WORK01) (e.g. SAMDAT)

This command can be keyed in at the System Console to produce the Final Tabular Report of all subfiles. This is summary of each Subfile (each SAM session). This report gives the system profile for the session (monitored classes).

SAM reports can also be produced via your own Job Stream. Figure 1 shows an example of a Job Stream. Line 7 (SFL=LST) generates a Subfile directory listing. This listing shows Subfile Number, Creation date, Start time, Elapsed time, Recording Interval, Number of Blocks (256 bytes) used and 'CLASS's monitored.

```

1. // JOB RKJSAR1
2. // DVC 20 // LFD PRNTR
3. // DVC 50 // VOL OS3WRK
4. // LBL SAMDATA // LFD SAMIN
5. // EXEC SAMRPT
6. /$
7. SFL=LST
8. SLF=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
9. RPT=ALL
10. IVL=1,RPT
11. SLF=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
12. RPT=NO
13. HIS=NO
14. HIS=TCPU
15. HIS=SPVR
16. HIS=KEYS
17. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
18. HIS=NO
19. HIS=IDLE
20. HIS=WAIT
21. HIS=MEMS
22. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
23. HIS=NO
24. HIS=KEY0
25. HIS=INTR
26. HIS=SVCR
27. HIS=I/OR
28. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
29. HIS=NO
30. HIS=RATE,CH1
31. HIS=RATE,CH3
32. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
33. HIS=NO
34. HIS=DISK,100
35. HIS=CYLS,100
36. HIS=DISK,101
37. HIS=CYLS,101
38. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
39. HIS=NO
40. HIS=DISK,102
41. HIS=CYLS,102
42. HIS=DISK,103
43. HIS=CYLS,103
44. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
45. HIS=NO
46. HIS=DISK,104
47. HIS=CYLS,104
48. HIS=DISK,105
49. HIS=CYLS,105
50. SFL=1,MARKETING-BASIC SYSTEMS PERFORMANCE SUPPORT--R. JOSHI
51. HIS=NO
52. HIS=DISK,106
53. HIS=CYLS,106
54. /*
55. /&

```

Line 8 (SFL=1,MARKETING-.....) specifies that Subfile 1 is to be processed and a report heading "MARKETING....." is to be printed on the reports. User can have a title up to 60 characters. Line 9 (RPT=ALL) specifies that a tabular report is to be generated and line 10 (IVL=1,RPT) specifies that an intermediate tabular report at every one minute is to be generated with a final tabular report. Line 12 specifies that for a parameter set starting at line 11, no tabular report is to be produced. If this is not specified, then this parameter is carried over to subsequent parameter sets. Line 14 (HIS=TCPU) specifies that a histogram of CPU activity is to be generated for each one minute of the session. This one minute is carried over from line 10 (IVL=1,RPT). There is a restriction of specifying a maximum of 5 'HIS=' parameters after each 'SFL=' parameter. Lines 15 and 16 specify two other histograms. Line 18 (HIS=NO) specifies that a new set of histograms is to be used. Line 21 specifies to generate a histogram of unused main storage, lines 26 and 27 specify to generate histograms of 'SVC' and 'I/O' rates. Line 30 and 31 specify the rate of 'I/O's on channel 1 (DISK CHANNEL on S80) and on Channel 3 (Tapes, Workstations, Paper Peripherals on S80). Line 34 specifies to generate a histogram of I/O rate on disk drive 100 and line 35 specifies to generate a histogram of "Average Cylinder Movement" on disk 100. The above two disk parameters are repeated for disk drives 101-106.

As a first step, SAM reports should be generated at a larger interval (e.g. 30 minutes) than monitored interval (e.g. 2 minutes) for SAM sessions lasting for a longer period of time (e.g. 8 hours). Then the peak periods should be expanded for closer analysis. The analysis of "SUMMARY" or "FINAL" report should be done first, then the histograms should be analyzed and then the intermediate tabular reports should be analyzed. This saves analysis time.

Sample tabular reports and histogram are in Appendix A.

4. REPORT ANALYSIS CONSIDERATIONS

SAM 'REPORTS' is only one set of system information which should be used in conjunction with other system information to understand your system's performance and reach a solution. SAM shows 'WHAT' is happening in the System. It does not tell 'WHO' is doing it.

The following system information should be available while analyzing SAM reports.

1. CONSOLE LOG (FOR EACH SESSION)
2. JOB ACCOUNTING (FOR EACH SESSION)
3. RECENT VTOC'S OF ALL DISK PACKS
4. TRNEQU (FOR SVC CLASS)

The Console log provides information about the active jobs, console operator commands, system informational messages and operator responses. Use this information to reason out system activity reported by SAM. The first page of Job Accounting (for each job) shows the files used by the job and device 'EXCP's. Use this information to justify device activities shown by SAM reports. The VTOC information can be used to find fragmented files (File Maintenance), location of the active files and to find the high 'SEEK' or 'AVERAGE CYLINDER MOVEMENT' on disk packs. Transient equate (TRNEQU) gives the functional description of the 'SVC's. Use this information to reason out their rate per second. The high rate of some 'SVC's may show a poor programming method used (e.g. too many 'OPEN's and 'CLOSE's). Transient Equates can be printed by keying in the following command at the System Console;

```
PRINT P$TRNEQU,$Y$MAC,RES,P .
```


During the analysis of SAM reports, the following points should be considered.

- A) CPU CLASS: The first parameter to look for is 'WAIT'. This indicates that there is a performance bottleneck somewhere in the system. Then see if 'IDLE' shows any data. This indicates an unused system or wait on communication terminals. See if any of the key activity (Key 1-14) is relatively high. If yes, check the console log for it's switching priority. Key 0 is high because it includes activity of SOA, TASK PROCESSING, WORK STATION MANAGER, SPOOL, SYMBIONT, ICAM, LOG and other system functions on behalf of the user. 'I/OR' indicates I/O rate. Check if the work load is I/O bound compared to the normal workload. 'SVCR' shows the SVC rate. If this is high, use 'SVC' class in next session to identify which 'SVC's are high.
- B) MEMORY CLASS: Use 'MEMS' item to generate a histogram of unused memory. This would indicate the Memory Utilization during the monitored session. You can also see if 'QUEUED' parameters in Transient request show any data. If it does, it means the transient areas generated in your Supervisor are insufficient for the workload.
- C) CHANNEL AND I/O: Look for an even workload distribution on channels and devices. This is not applicable to 'CHANNELS' on a S80 because there is only one disk BUSS (DMA). If the workload is unevenly distributed, set up a plan to balance the workload distribution. 'QUEUED' statistics indicate the bottleneck areas. This statistic is not supported on S80.
- D) DISC CLASS: In this class look for an uneven workload distribution and a combination of high I/O RATE, SEEK and AVERAGE CYLINDERS MOVED on a disc drive. This would indicate a serious performance bottleneck. Seek I/O is costly I/O when the CPU is waiting on it. It can take from 7 milliseconds to 70 milliseconds for Seek I/O on 8417's and 8419's. CPU wait on seek I/O, seriously degrades System performance. This could be reduced by even workload distribution on disc drives and placing active files in the middle of the pack and closer to each other.
- E) SVC CLASS: Analyze the SVC occurrence frequency for a workload being processed. Check programs for unnecessary 'SVC' calls. Use SVC call frequency for an abnormally high number for specific 'SVC's.
- F) COMMUNICATION CLASS: For OS/3 Release 7.1, apply COR=C075302 for S80 and C075301 for S90 for getting correct communication statistics. Use this data to find errors, no traffic responses on ports. Please refer to UP8812 for further information on communication class 'ITEMS' (CIMR,COMR,CNOT,CERR).

APPENDIX A

SPERRY+UNIVAC OS/3 SYSTEM ACTIVITY MONITOR
 DATA OBTAINED FROM S80 OS/3 - 071 0 ON 81/08/26 (SFL# 1)
 ++ INTERMEDIATE ++ REPORT PERIOD = 0.2 MIN. - FROM 17:41:55 TO 17:42: 8
 ++ RECORDED AT 0.2 MIN. INTERVALS ++

QUALIFICATION S/80--7.1 PERFORMANCE SUPPORT--JOSHI

----- CPU -----							
	PERCENT				INTERRUPT/SEC		
	REPORT PERIOD	INTERVAL MIN	INTERVAL MAX		REPORT PERIOD	INTERVAL MIN	INTERVAL MAX
WAIT	4.87	4.87	4.87	I/OR	35.54	35.50	35.50
IDLE	0.0	0.0	0.0	SVCR	168.25	168.20	168.20
SPVR	38.64	38.64	38.64	TMER	1.78	1.70	1.70
TCPU	95.11	95.11	95.11	OTHR	0.0	0.0	0.0
KEY 0	50.17	50.17	50.17	TOTL	205.57		
KEY 1	6.30	6.29	6.29				

----- MEM -----				
	REPORT PERIOD	INTERVAL MIN	INTERVAL MAX	
NO. JOBS STARTED	0.	0.	0.	
NO. ACTIVE JOBS	1.	1.	1.	
BYTES FREE MEM.	446208.	446208.	446208.	
TRANS REQ./SEC.	0.08	0.07	0.07	
PERCENT				
QUEUED	0.0	0.0	0.0	0.0
RUSECALL	0.0	0.0	0.0	0.0
REUSED	0.0	0.0	0.0	0.0
LOADED	100.00	0.08	0.07	0.07

----- SVC -----				
SVC#	SVC'S/SEC.	REPORT PERIOD	INTERVAL MIN	INTERVAL MAX
0	35.69	461	461	461

1	32.83	424	424	424
5	1.63	21	21	21
6	1.01	13	13	13
7	1.70	22	22	22
8	1.86	24	24	24
9	0.93	12	12	12
12	1.55	20	20	20
15	0.23	3	3	3
84	0.08	1	1	1
235	44.52	575	575	575
239	44.44	574	574	574
248	0.08	1	1	1
251	0.31	4	4	4
254	1.39	18	18	18

TOTAL 168.25 2173 SVC 0 TO VIRTUAL PUBS = 22

----- DSK -----

DISKID	I/O'S /SEC.	SEEK /SEC.	X I/O'S	NTIO X I/O'S	AVG.# CYLS MOVED
100	27.72	4.96	17.88	0.0	1.78
101	4.49	0.0	0.0	0.0	0.0
102	0.46	0.15	33.33	0.0	62.50
104	0.85	0.0	0.0	0.0	0.0

SPERRY+UNIVAC OS/3 SYSTEM ACTIVITY MONITOR
 DATA OBTAINED FROM S80 OS/3 - 071 0 ON 81/08/26 (SFL# 1)
 ++ FINAL ++ REPORT PERIOD = 10.4 MIN. - FROM 17:31:45 TO 17:42: 8
 ++ RECORDED AT 0.2 MIN. INTERVALS ++

QUALIFICATION S/80--7.1 PERFORMANCE SUPPORT--JOSHI

----- CPU -----

	REPORT PERIOD	PERCENT		REPORT PERIOD	INTERRUPT/SEC	
		MIN	MAX		MIN	MAX
WAIT	0.11	*****	*****	I/OR	10.66	***** *****
IDLE	0.0	*****	*****	SVCR	274.49	***** *****
SPVR	29.77	*****	*****	TMER	1.13	***** *****
TCPU	99.89	*****	*****	OTHR	0.0	***** *****
KEY 0	53.08	*****	*****	TOTL	286.29	
KEY 1	17.04	*****	*****			

----- MEM -----

	REPORT PERIOD	MIN	MAX
NO. JOBS STARTED	0.	*****	*****
NO. ACTIVE JOBS	1.	*****	*****
BYTES FREE MEM.	442541.	*****	*****
TRANS REQ./SEC.	0.16	*****	*****

PERCENT			
	REPORT PERIOD	MIN	MAX
QUEUED	0.0	0.0	***** *****
RUSECALL	29.70	0.05	***** *****
REUSED	21.78	0.04	***** *****
LOADED	78.22	0.13	***** *****

----- SVC -----

SVC#	SVC'S/SEC.	REPORT PERIOD	INTERVAL	
			MIN	MAX
0	10.93	6817	461	461

1	7.66	4777	424	424
4	0.11	68	0	0
5	0.44	276	21	21
6	0.24	148	13	13
7	0.49	305	22	22
8	0.47	293	24	24
9	0.91	566	12	12
12	0.64	399	20	20
15	0.21	130	3	3
20	0.00	3	0	0
23	0.01	5	0	0
24	0.03	18	0	0
33	0.00	2	0	0
37	0.00	3	0	0
38	0.02	10	0	0
39	0.01	5	0	0
46	0.01	6	0	0
48	0.01	6	0	0
66	0.00	2	0	0
70	0.02	10	0	0
80	0.02	11	0	0
82	0.00	1	0	0
84	0.00	1	1	1
98	0.00	1	0	0
117	0.01	6	0	0
139	0.00	2	0	0
143	0.01	9	0	0
231	0.07	42	0	0
235	125.86	78503	575	575
236	0.07	45	0	0
237	0.02	10	0	0
239	125.86	78503	574	574
248	0.00	1	1	1
251	0.07	41	4	4
252	0.05	30	0	0
254	0.24	147	18	18
TOTAL	274.48	171202	SVC 0 TO VIRTUAL PUBS =	429

----- DSK -----

DISKID	I/O'S /SEC.	SEEK /SEC.	% I/O'S	NTIO % I/O'S	AVG.# CYLS MOVED
100	5.82	2.45	42.14	0.0	26.40
101	0.72	0.0	0.0	0.0	0.0
102	0.27	0.11	40.96	0.0	103.03
103	0.14	0.02	12.79	0.0	10.18
104	2.73	0.06	2.23	0.0	21.68

17:38:25	30.57	.*****	28.16
17:38:35	27.90	.*****	28.22
17:38:45	27.90	.*****	28.21
17:38:55	27.07	.*****	28.20
17:39: 5	27.61	.*****	28.17
17:39:15	28.18	.*****	28.16
17:39:25	27.46	.*****	28.16
17:39:35	27.09	.*****	28.15
17:39:45	27.44	.*****	28.12
17:39:55	29.70	.*****	28.11
17:40: 5	27.33	.*****	28.14
17:40:15	27.64	.*****	28.13
17:40:25	27.74	.*****	28.12
17:40:35	27.32	.*****	28.11
17:40:45	45.22	.*****	28.09
17:40:55	44.69	.*****	28.41
17:41: 5	39.41	.*****	28.71
17:41:15	39.28	.*****	28.90
17:41:25	40.36	.*****	29.08
17:41:35	39.10	.*****	29.28
17:41:45	30.04	.*****	29.44
17:41:55	39.52	.*****	29.45
42: 5	49.91	.*****	29.62
			29.94