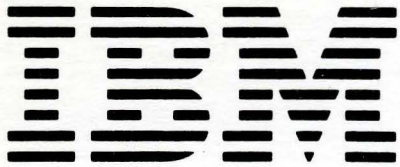

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IBM System/34
System Measurement Facility
Reference Manual

Program Number 5726-SS1

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IBM System/34
System Measurement Facility
Reference Manual

Program Number 5726-SS1

Fourth Edition (January 1981)

This is a major revision of, and obsoletes, SC21-7828-2. Changes were made to support reporting of new execution priorities by SMF and reporting of additional disk capabilities on System/34. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change or addition.

This edition applies to release 7, modification 0 of the IBM System/34 Support Program Product (Program 5726-SS1) and to all subsequent releases and modifications until otherwise indicated in new editions or technical newsletters.

Changes are periodically made to the information herein; these changes will be reported in technical newsletters or in new editions of this publication.

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The reference information in this manual is intended for programmers and systems analysts using the System/34. Interpretation of SMF output requires an understanding of System/34. The publications listed as prerequisite publications provide information about System/34 concepts. SMF should be more useful as you gain knowledge of your system and more experience interpreting SMF reports.

The responsibility for the installation of the System/34 System Measurement Facility (SMF), a component of the System Support Program, and the interpretation of the results, rests solely with the user. IBM assumes no responsibility for the interpretation of the results; any benefits to be gained from the use of this program must be assessed by the individual user.

Many of the statements in this publication are necessarily general and might not apply in every case. Many factors that affect system performance are cited. When you are trying to identify causes of performance problems, look at all of these factors and try to decide which of them might be contributing to the problems. If you have any suggestions that you feel will make this publication more useful, please use the Reader's Comment Form at the back of the publication.

System performance degradation caused by SMF varies with the SMF options selected and the number of active tasks. See Appendix B, *Performance Considerations when Using SMF.*

SMF collects statistical data about interactive and batch programs, the spooling function, the main storage processor, disk utilization, and the communications lines. SMF collects data for communications lines that are configured under multiline communications adaptor (MLCA) support as well as lines that do not use the MLCA device. Methods used by SMF for determining usage are approximate, and the user should be aware that the utilization figures presented are not exact. They should be used only as indicators of approximate relative usage.

SMF consists of three components: the data collection program collects data while user applications are executing and writes that data to a disk file; the SMF-MLCA communications data collection routine collects data about line utilization for MLCA communications and passes this information to the data collection program; the report writer program prints a summary of the data that is collected by SMF. This publication addresses each of the components separately. Chapter 2 describes the data collection program, and the SMF-MLCA data collection routine. Chapter 3 describes the report writer program and the reports that it generates.

You are cautioned against drawing any conclusions from only one run of the data collection program. The data gathered in one run, although statistically accurate, might not be representative of your total work load.

Prerequisite Publications

Before you use SMF and analyze the reports it generates, *you must be familiar with System/34.* If you require more information, refer to the following publications:

- *IBM System/34 Introduction,* GC21-5153
- *IBM System/34 Planning Guide,* GC21-5154
- *IBM System/34 System Support Reference Manual,* SC21-5155
- *IBM System/34 Concepts and Design Guide,* SC21-7742
- *IBM System/34 Installation and Modification Reference Manual: Program Products and Physical Setup,* SC21-7689
- *IBM System/34 System Data Areas and Diagnostic Aids Manual,* LY21-0049
- *IBM System/34 Data Communications Reference Manual,* SC21-7703
- *IBM System/34 Screen Design Aid Programmer's Guide and Reference Manual,* SC21-7716
- *IBM System/34 Interactive Communications Feature Reference Manual,* SC21-7751

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Contents

Chapter 1. Introduction

System/34 allows you to process data interactively as well as in batch mode. In this type of environment, inefficient use of system resources can affect the performance of your applications. If the performance of your applications does not meet your requirements, you might need to allocate system resources differently and/or redesign your applications. To do this, you will have to evaluate how efficiently you are using system resources.

The System/34 System Measurement Facility (SMF) provides you with access to statistical samplings (snapshots) of system resource usage while applications are running. These samples provide you with a tool for evaluating the use of system resources. The data collected by SMF can:

- Show the effect of various application mixes on system resources and help you to determine more efficient loading and scheduling
- Show the effect of applications on system resources and identify performance problems
- Provide information that will help you evaluate the effect of newly added applications on system resources

DESCRIPTION OF SMF

SMF consists of three components: a data collection program, the SMF-MLCA communications data collection routine (for those users with MLCA support), and the report writer program.

The data collection program has an additional task that can be selected. This task measures the time the main storage processor (MSP) is waiting for work. The data collection program records configuration data, takes snapshots of system activity, records the number of attached work stations for each task, and records the contents of system event counters and I/O counters. These counters contain counts of system activities such as the number of swap ins, swap outs, and disk I/O operations. The data collection program also retrieves MLCA line utilization information from the SMF-MLCA communications data collection routine. All data is collected at an interval that is specified on the SMFSTART procedure display. The data collection program records the data in a disk file specified by the user. If the user does not specify a disk file for the data, the data is recorded in a file labeled SMF.LOG.

The SMF-MLCA communications data collection routine keeps SMF counters and provides utilization figures for each of the four lines associated with MLCA. Line information is collected for binary synchronous communications (BSC) or synchronous data link control (SDLC) types of communication. These line information counters are made available to the data collection program. The SMF-MLCA communications data collection routine is activated whenever the user selects the communications utilization option from the SMFSTART procedure display. The SMF-MLCA communications data collection routine is only available to users with MLCA support.

The report writer program processes and prints the collected data directly from the SMF data collection file. The report writer program can be run after one or more data collection intervals. The program lists:

- Configuration data at the time of the last IPL.
- Snapshots of system activity.
- The contents of various system counters.
- Communications line data if data communications is active. This listing will be for either MLCA or non-MLCA lines.
- A summary of the system activity.
- A summary of the collected system counters.

Figure 1-1 summarizes the functions performed by the SMF programs.

Note: No communications line data is collected for autocall lines.

SMF STORAGE REQUIREMENTS

The data collection program and the report writer program have the following control storage, main storage, and disk space requirements.

Control Storage Requirements

The resident control storage section of the data collection program uses the control storage area that is also used by the SSP concurrent maintenance function.

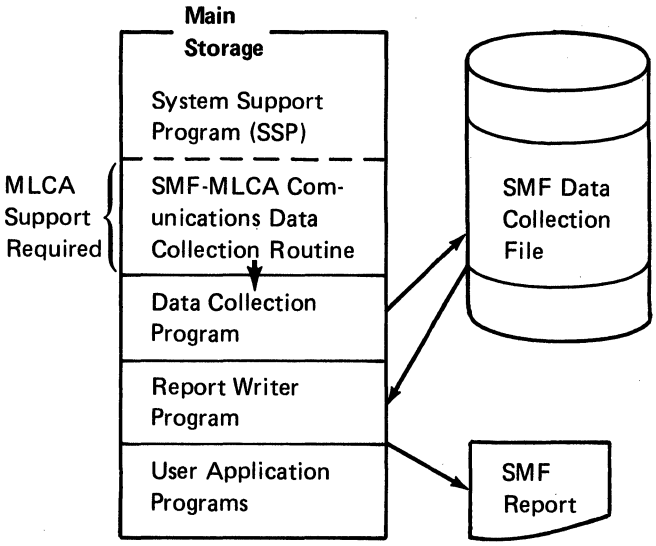


Figure 1-1. Functions Performed by the SMF Programs

Main Storage Requirements

Data Collection Program

If you do not have communications support configured, the SMF data collection program will execute on a 32 K byte system. If communications support is configured on the system, 48 K bytes are required for executing the SMF data collection program.

After finishing the 14 K byte initiation phase, the data collection program is a swappable program that uses 2 K bytes of main storage. If you desire communications utilization information and have a non-MLCA system, 4 K bytes of swappable main storage are used. If you desire communications utilization information and have a MLCA system, 4 K bytes of swappable main storage are used along with an additional resident 2 K page of user area while SMF is active. The data collection program always requires at least 314 bytes of assign/free area. In addition, the data collection program may require the following assign/free area:

- 128 bytes of main storage, if main storage processor utilization statistics are collected.
- From 75 bytes to 150 bytes for various system counters. This area is used to save the SIO and SEC counter information.

Report Writer Program

The report writer program is a swappable program that requires 24 K bytes of main storage to execute. The assign/free area requirements are the same as those for any application program that has allocated two disk data files and the printer. Because the report writer program requires a 24 K region, the storage size of your system must be at least 48 K bytes to print the report.

SMF-MLCA Communications Data Collection Routine

The SMF-MLCA communications data collection routine will keep SMF counters for all MLCA communications lines. This line information will be for both BSC (binary synchronous communications) and SDLC (synchronous data link control) communications. The SMF-MLCA communications data collection routine requires a resident 2 K page of user area while SMF is active.

Disk Space Requirements

System Library

SMF support, if it is selected during system configuration, requires an additional 30 blocks, which includes two directory sectors, in the system library (#LIBRARY).

SMF Data Collection File

The size of the SMF data collection file is specified by the user of the data collection program. The size can be from 1 block (10 sectors) to 65 535 blocks. The first record written for a sample is always the first record in a sector. The first sector of the log file holds system data and the status of one task. Each additional sector holds information for six additional tasks. For example, assume that:

- Not more than 15 tasks, including system tasks, will be active at one time (this is not the system limit).
- SMF is to be collecting data for 4 hours using a sampling rate of once per minute. This results in 240 samples being recorded.

In this case, each sample will require up to four sectors. (If fewer than 15 tasks are active during a sample, three or fewer sectors will be required for that sample.) Therefore, a maximum of 96 blocks will be used to record the 240 samples.

SMF Work File

This is a one block file created by the SMF report writer as a scratch file to hold temporary information (such as disk utilization counts) while the report is being printed.

Local Data Area Requirements

Locations 220 through 256 of the local data area are used by the SMFSTART and SMFPRINT procedures. These locations are used to pass information such as file name, time interval, and data file label from the SMF procedures to the SMF data collection programs and the SMF report writer program.

SMF PROCEDURES

The following procedures are used to request SMF functions:

- SMFSTART starts the data collection program.
- SMFSTOP stops the data collection program.
- SMFPRINT starts the report writer program.

These procedures and the data collection program and report writer program are described in Chapters 2 and 3.

A procedure called SMF is also available. When you enter the command statement, SMF, the following display will appear:

```
                SYSTEM/34 MEASUREMENT FACILITY PROCEDURES

0 -             Exit From SMF Processing
1 - SMFSTART    Start SMF Data Collection Program
2 - SMFSTOP     Stop SMF Data Collection Program
3 - SMFPRINT    Print Collected SMF Data

ENTER NUMBER OF OPTION DESIRED -->
```

From this display, you enter the number that identifies the SMF function you want to run.

Note: You can also start the SMF data collection program from your own set of procedures or by using a menu item.

This chapter describes the procedures used to start and to stop the data collection program.

Because the SMF data collection program and the concurrent maintenance function share a common control storage area, the SMF data collection program cannot be started if the concurrent maintenance function is being used on another display station. If concurrent maintenance is active when you attempt to start the data collection program, the system will display a message indicating that the control storage required for SMF is not available. SMF can be used only in a multiprogramming mode on System/34.

STARTING THE DATA COLLECTION PROGRAM

You can start the data collection program by:

- Invoking the SMF procedure and selecting option 1 to the prompt screen display
- Entering the SMFSTART command statement with no parameters and then responding to prompts on the next display screen
- Selecting a menu item that contains the SMFSTART command statement
- Entering the SMFSTART command statement with parameters
- Creating your own procedure that involves the SMF data collection program

If you enter the SMFSTART procedure command with no parameters or the SMF procedure command, and select the 1 option, the following prompt appears on the screen:

```
                        SMFSTART PROCEDURE
                   Start SMF Data Collection Program
Data Collection Time Interval In Minutes & Seconds (0:10-5:00)....1 : 00
Data File Size In Blocks ..........................................100
Collect Main Storage Processor Utilization Data (Y/N).............Y
Collect Communications Utilization Data (Y/N).....................N
Data File Label...................................................SMF.LOG
```

If you enter a Y for Collect Communications Utilization Data, the following information will appear on your screen.

```
Line 1 Speed (In Bits Per Second).....
Line 2 Speed.....
Line 3 Speed.....
Line 4 Speed.....
```

You can also enter the SMFSTART command statement with parameters. The format of the SMFSTART command is:

| SMFSTART [time / 100], [blocks in data file / 100],

[collect main storage utilization data (Y/N)],

[collect communications utilization data (Y/N)],

[data file label (SMF.LOG)],

[line 1 speed, line 2 speed, line 3 speed, line 4 speed]

Notes:

1. All three digits must be specified in the time parameter.
2. If you specify N for collect communications utilization data, you do not have to enter line speeds.
3. If you specify Y for collect communications utilization data and do not enter a line speed for a particular line, SMF will not collect communications utilization information for that line.
4. Line speed information need only be entered for a line or lines that are active or will be active.
5. Entering the wrong line speed for a particular line causes inaccurate utilization information to be reported by SMF.
6. Each MLCA communications line operates independently up to 9600 bps (bits per second) with the other MLCA lines. One line may operate at a speed greater than 9600 bps independent of the other three MLCA lines. However, the aggregate rate of the remaining lines must not exceed 9600 bps and the aggregate rate of all four lines must not exceed 65 600 bps.
7. Autocall lines are not supported by SMF.

You can also invoke the SMFSTART command by using a user-defined procedure command or by selecting an item from a menu. If any of the first five parameters are entered for the SMFSTART procedure, the default values for the rest of the parameters are assumed. If this data is omitted, the SMFSTART screen is displayed when you execute your procedure. The line speed information is optional for both MLCA and non-MLCA lines, and the standard default of not collecting communications line utilization data is in effect if you do not enter line speeds for your communications lines.

For more information on creating your own procedures to start SMF, refer to *Using Procedure Commands to Invoke SMFSTART* in this chapter.

You can run SMFSTART by selecting an item from a menu. The user selects an item number and the system executes the statement that corresponds to the item number. The menu items and the statements corresponding to the menu items are defined by the programmer when the menu is created.

For more information on using a menu item to start SMF, refer to *Using a Menu to Invoke SMFSTART* in this chapter.

SMFSTART Prompts and Parameters

The following paragraphs describe the SMFSTART screen prompts and command statement parameters. If one or more parameters are entered, the data collection program is initiated; default values are used for any parameters not specified on the display or command statement.

Data Collection Time Interval in Minutes and Seconds (0:10-5:00)

Your response to this prompt specifies the sampling interval for the data collection program. System and task status data collected by SMF is collected at the specified time interval. Data collection records are written to the SMF data collection file after each sampling interval. You specify the sampling interval in minutes and seconds: the first (leftmost) digit specifies minutes; the second two digits specify seconds. The minutes field and the seconds field are separate fields. You may use either the Field Advance key or the Field Exit key to move from one field to the other. The minimum time interval you can specify is 10 seconds (010); the maximum interval is 5 minutes (500). The default value for the sampling interval is 1 minute.

Data File Size in Blocks

Your response to this prompt specifies the size of the file that is used to hold SMF output data. If the output file already exists, five asterisks (*****) are displayed following the prompt. You can enter new data over the asterisks if you specify a new data file label. If data from a previous data collection run is already in the file, the data collected from the current run immediately follows the previously collected data. The amount of data that can be written into the file depends upon the sampling interval, the number of jobs running, and the size of the file allocated.

The following guidelines will help you determine an appropriate data file size:

- Each sampling interval requires at least 1 sector of the data file. This sector holds the system and task data information.
- Each additional sector holds information for at least six additional tasks.
- System tasks are included in the task count information.

For example, if you specify an SMF sampling interval of 1 minute and you have between two and seven tasks that are active during the specified time interval, then a 12-block file would be filled with data in 1 hour.

If the data collection file becomes full while SMF is running, a message is issued informing you of this fact and the data collection program is terminated. If the data collection file is full from a previous run of SMF, you can restart SMF and collect data in a new output data collection file by specifying a new file name on the SMFSTART procedure.

Collect Main Storage Processor Utilization Data (Y/N)

Your response to this prompt specifies whether or not you want to collect data about main storage processor utilization. If you enter Y, an additional SMF task is started by the data collection program. This task keeps track of the time that the main storage processor (MSP) is waiting for work to do. An additional 128 bytes of assign/free space are required for the additional SMF task. The default value for this prompt is Y.

Notes:

1. If you specify Y for this prompt, the number of task dispatches and task switches shown in the SMF report can be up to twice as high as when main storage utilization information is not collected. The increased number of dispatches and switches occurs because the wait task is dispatched each time the main storage processor would have entered a wait state.
2. This wait task will not appear on the SMF reports or on the System/34 status displays.

Collect Communications Utilization Data (Y/N)

Your response to this prompt specifies whether or not you want to collect data about your communications environment. If you have MLCA support on your system, SMF collects line utilization information for each of the four lines associated with the MLCA device for which you want information. If you do not have MLCA support on your system, line utilization information is collected for only two lines and pertains to bytes sent and received, but does not include line turnaround time or any error time.

If you choose to collect communications utilization data, be sure to enter the line speed information. If you do not enter the line speed information, no communications utilization data is collected by SMF, even if you specify Y.

Data File Label (SMF.LOG)

Enter the label of the file to which you wish SMF to write system and task data. If you do not specify a file name, the data is written to the SMF.LOG file. This data is input to the report writer program. The data file label can be up to eight characters in length.

You do not have to create the file prior to running the SMFSTART procedure. SMF creates the file for you with the number of blocks you specified for the size.

Line Speed Information

Enter the line speed in bits per second for communications lines that are configured and active, so SMF can collect communications line utilization statistics. If you do not want communications utilization data for a particular line, do not enter a value for that line. SMF will not collect communications utilization data for that line. If you enter the wrong line speed for a particular line(s), you will get inaccurate and misleading percentages on the SMF output reports. Appendix D contains labels on which you can write the correct line speed information. If you cut these labels out and affix them to your workstation, your line speeds will be available at the workstation(s).

The line speed information is a five-digit field and commas (,) are not allowed in the field. Leading zeros are not required.

The line speed information can be contained in user-defined procedures that invoke the SMFSTART procedure. If you create your own procedure to invoke SMFSTART use the same rules.

Using a Menu to Invoke SMFSTART

You can use a menu to invoke the SMFSTART procedure. You select the specific menu item and the procedure command associated with that menu item is executed. The necessary parameters to execute the procedure are defined by the user. The following figure illustrates a menu in which item 8 invokes the SMFSTART procedure.

```
COMMAND                                                          Y2
                                MENU  DAILYX
 1. START COMMUNICATIONS            13.
 2. START TIME CARD VERIFICATION    14.
 3. EDIT SALES RECEIPTS             15.
 4. PRODUCE ACCOUNTING REPORT       16.
 5. PRODUCE DAILY MASTER FILE       17.
 6. PRODUCE ACCOUNT EXCEPTIONS      18.
 7. PRODUCE DAILY SALES REPORT      19.
 8. START SMF RUN                   20.
 9.                                 21.
10.                                 22.
11.                                 23.
12.                                 24.




ENTER NUMBER, COMMAND, OR OCL.
 8                                                    <- READY
```

For more information about creating a menu, refer to the BLDMENU procedure in the *IBM System/34 System Support Reference Manual* or to the *IBM System/34 Screen Design Aid Programmer's Guide and Reference Manual.*

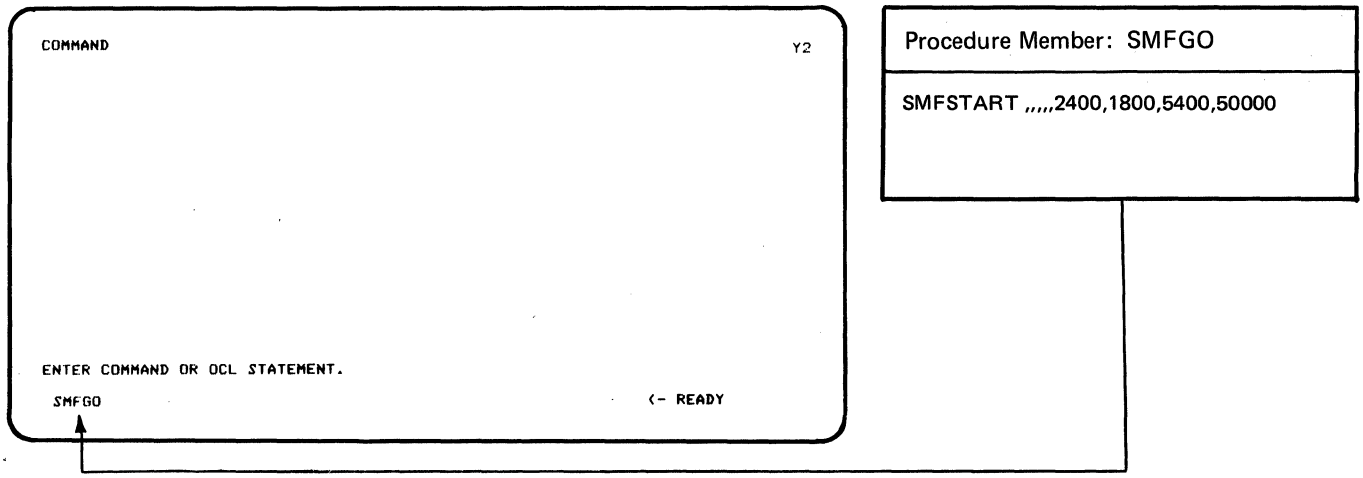
Using Procedure Commands to Invoke SMFSTART

A procedure command tells the SSP to execute a procedure, for example, the SMFSTART procedure. To execute the SMFSTART procedure by using a user-defined procedure member, you must enter all data necessary to run the SMFSTART procedure into a procedure member in a library. You can do this by using source entry utility (SEU) or $MAINT. The procedure member in the library should have an identifying name other than SMFSTART.

To execute the procedure, enter the name of the procedure member in the specified library on the display screen.

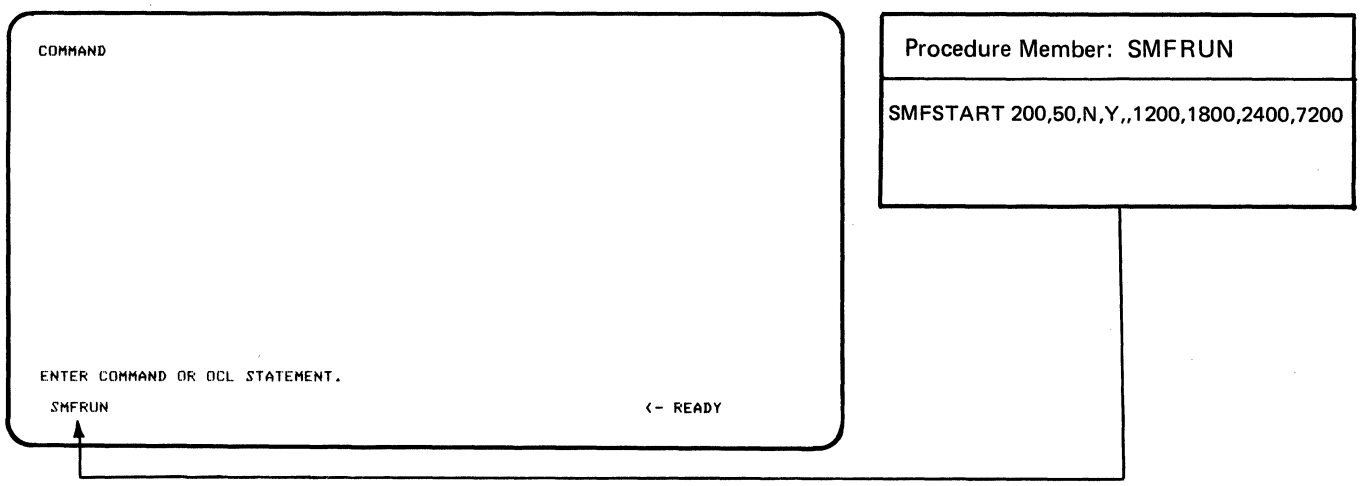
The following examples illustrate the use of procedures to invoke SMFSTART.

Example 1



Example 1 is an illustration of a procedure member labeled SMFGO that was coded to invoke the SMFSTART screen every time it is executed. The procedure is executed when the name of the procedure member (SMFGO) is entered on the display screen. None of the first five parameters have data. Parameters six through nine are the desired line speed values in bits per second. If none of the first five parameters of the procedure member contain information, the SMFSTART screen is displayed. You then enter the information to run the SMFSTART procedure. You do not have to reenter the line speed information. The line speeds in the procedure member are displayed if you enter a Y to collect communications utilization data. You can change the original line speeds that were coded in the procedure member by entering the new line speeds on the SMFSTART screen.

Example 2



Example 2 invokes the SMFSTART procedure bypassing the SMFSTART screen display. The first four parameters have data and the fifth parameter (file name) has the default value of SMF.LOG. Parameters six through nine supply the desired line speed information.

These two examples illustrate a method that can be used to start the SMF data collection program via the SMFSTART procedure without requiring that the work station operator know the line speeds for the communications lines. In the event that you want line speed information readily accessible at your work station, there are labels in Appendix D on which you can write your line speeds. You can then cut them out and affix them to your work station.

Note: If you enter data for at least one of the first five parameters, the SMFSTART screen is not displayed and default values are assumed for the parameters for which you have entered data. If you do not enter data for line speeds, their default values are assumed.

STOPPING THE DATA COLLECTION PROGRAM

Normally, the SMFSTOP procedure command or the SMF procedure command with option 2 is entered to stop the data collection program. The data collection program then stops immediately. Therefore, the last reported time interval might be shorter than the specified sampling interval. The reported utilization statistics are still accurate because they are based on the actual interval.

The system operator can also cancel the data collection program by:

- Entering the CANCEL control command and specifying the job name of the data collection program (the job name can be obtained from the STATUS USERS display).

- Entering the STOP SYSTEM control command. If the system operator enters the CANCEL or the STOP SYSTEM control command, the data collection program does not immediately go to end-of-job processing. Instead, the program waits for the next sampling interval to elapse before going to end-of-job processing.

This chapter describes the report writer program, the reports it generates, and the SMFPRINT procedure, which initiates the report writer program. The report writer program lists data that was recorded by the data collection program. The report writer program can be run while the data collection program is still active (the data is printed as it is made available in the SMF.LOG or user-specified file) or after it has terminated. Data can be processed, by the program, directly from the SMF.LOG file or from the user-specified file.

STARTING THE REPORT WRITER PROGRAM

You can start the report writer program by:

- Invoking the SMF procedure and selecting option 3 to the prompt screen display
- Entering the SMFPRINT command statement with no parameters and then responding to prompts on the display screen
- Entering the SMFPRINT command statement with parameters

If you entered the SMFPRINT procedure command with no parameters, or the SMF procedure command with the 3 option, the following prompts appear on the screen:

```
                          SMFPRINT PROCEDURE                    OPTIONAL-(O)
                       Print Collected SMF Data
Print Option (SUMMARY/DETAIL/ALL) ..... DETAIL
Delete Data File After Printing (Y/N) ..... N
Printer - ID ..... SYSTEM
Disk Data File Name ..... SMF.LOG
Printing Interval 'From' Limit (HHMMSS) .....          (O)
Printing Interval 'To' Limit (HHMMSS) .....            (O)
Place On Input Job Queue (Y/N) ..... N
```

You can also enter the SMFPRINT command statement with parameters. The format of the SMFPRINT command is:

```
SMFPRINT [SUMMARY ], [delete file after printing (Y/N)],
         [DETAIL  ]
         [ALL     ]

         [ws-id  ], [file label ],
         [SYSTEM ]  [SMF.LOG   ]

         ['from' limit , 'to' limit],

         [run from input job queue (Y/N)]
```

SMFPRINT Prompts and Parameters

The following paragraphs describe the SMFPRINT screen prompts and parameters. If one or more parameters are entered, the report writer program is initiated, and default values are used for any parameters not specified in the command statement or on the screen display.

Print Option (SUMMARY/DETAIL/ALL)

This parameter specifies the type of listing to be generated by the report writer program. Three types of reports can be generated: SUMMARY, DETAIL, and ALL. Figure 3-1 shows the types of information that are listed on each report. *SMF Reports and Their Interpretation* gives a detailed description of the data listed in the reports. DETAIL is the default for this prompt.

Delete Data File After Printing (Y/N)

This parameter specifies whether or not the input file should be deleted from the disk after the report writer program ends. Y indicates the file should be deleted; N indicates the file should not be deleted. N is the default value for this parameter.

SUMMARY	DETAIL	ALL
• IPL configuration information	• IPL configuration information	• IPL configuration information
	• Communications configuration data (only if communications is active and selected)	• Communications configuration data (only if communications is active and selected)
	• Statistics for each sample interval: – Task status	• Statistics for each sample interval: – System status – Task status – System event counter and I/O statistics – Communications line data (only if communications is active and selected)
• SMF summary data (includes a summary of system event counter statistics)	• SMF summary data (includes a summary of system event counter statistics)	• SMF summary data (includes a summary of system event counter statistics)

Figure 3-1. Listing Options for SMF Reports

Printer ID

This parameter specifies the printer to be used by the report writer program. Possible entries are:

SYSTEM	The report writer program will use the system printer. SYSTEM is the default value for this parameter.
ws-id	The report writer program will use the printer identified by the 2-character work station printer ID.

If the printer that you selected is being spooled, the report writer output will be placed in the spool file.

Disk Data File Name

This parameter specifies the label of the disk file to be used as input for the report writer program. SMF.LOG is the default value for this parameter. The file name you specify is printed on each page of the SMF output report.

Printing Interval 'From' Limit (HHMMSS)

This parameter specifies a beginning time in hours, minutes, and seconds (HHMMSS) for the report writer program. Only samples recorded at or after the first occurrence of the specified time are processed by the report writer program. Any valid time from 000001 through 235959 may be entered. All six digits must be entered. Invalid times (for example, 264545) are diagnosed by the report writer program, and an error message is displayed. The default value for this parameter is blank or 000000, which is interpreted as meaning that the printing of data should begin with the first record in the data collection file.

Printing Interval 'To' Limit (HHMMSS)

This parameter specifies an ending time in hours, minutes, and seconds (HHMMSS) for the report writer program. After the program begins printing data, it will print until the specified 'to' time is encountered. Any valid time from 000001 through 235959 may be entered. All six digits must be entered. Invalid times are diagnosed by the report writer program, and an error message is displayed. The default value for this parameter is blank or 000000, which is interpreted as meaning that the printing of data should end with the last record in the data collection file. To print samples that were recorded between 10:30 p.m. and 2:00 a.m., for example, you would enter the 'from' limit as 223000 and the 'to' limit as 020000. If the SMF data file contains more than 24 hours of information, you might have to print the entire file to get information recorded after the first 24 hours.

Place on Input Job Queue (Y/N)

This parameter specifies whether or not the report writer program should be run from the input job queue. If you run the report writer program from the input job queue, any error messages generated by the report writer program are displayed at the system console. Y indicates that the job should be run from the input job queue; N indicates that the job should not be run from the queue. N is the default value for this parameter.

Chapter 4. SMF Reports and Their Interpretation

The information printed on SMF reports is divided into the following sections:

- IPL configuration information, which is printed on all SMF reports
- Communications configuration data, which is printed on all SMF reports if communications is active and was selected
- Utilization rate information, which is printed for each sample if the print option is DETAIL or ALL
- Task status information, which is printed for each sample if the print option is DETAIL or ALL
- Detailed system information, which is printed for each sample if the print option is ALL
- Communications line data, which is printed for each sample if communications is active and was selected, and if the print option is ALL
- SMF summary information, which is printed on all SMF reports

Descriptions of the information printed in each of the report sections follow. Along with the descriptions of the printed information, information that will help you interpret the report is provided.

IPL CONFIGURATION INFORMATION

The first page of an SMF report describes the system configuration and the communications configuration at the time of the most recent IPL. Communications configuration information will be printed whenever a communications line is activated. The system configuration information shown in this section shows your chosen buffer sizes and data management options. The storage available for user programs and system functions will be determined by the options selected. Trade-offs can be made to obtain the optimum performance levels. Figure 4-1 shows the system and communications configuration section of an SMF report. Most of the information listed in the configuration section is explained in the *System/34 Planning Guide* and is not explained here. The following paragraphs describe only those items that require additional explanation.

1 *SMF File–XXXXXXXX:* This is the name of the file that was specified in the SMFPRINT procedure. The file contains the necessary input information for the report writer program to generate SMF output reports.

2 *System Assign/Free Size (A/F):* The system assign/free area of main storage contains system and task control information for all system activity and for each job that is active. You specify the size of the assign/free space during system configuration and can override it during IPL. When all available assign/free space is assigned, the system dynamically increases the size of the assign/free area so that processing can continue. When the assign/free area is expanded, the amount of main storage available for your jobs (the user area) is decreased. Therefore, an increase in the size of assign/free space can cause additional swapping to occur and, in the case of very large programs, could decrease the user area to the point where the programs cannot be run. When the additional assign/free space is no longer needed, the system attempts to reduce the size of the assign/free area to its original value.

3 *Work Station Buffer Size (WSB):* The work station buffer space is an area of main storage that is used to transmit display screen formats and data to and from display stations. The size, which is selected during system configuration and can be overridden during IPL, depends upon the number of work stations configured and their types. Support for remote work stations requires an additional 2 K (4 HK) bytes of work station buffer. The work station buffer space contains both the display screen format and the data to be transmitted. For output to a display station, part of the user program might be temporarily written to disk and the freed space used for work station buffer space. This happens if the work station buffer is not large enough to contain both the format and the data. The number of work station buffer retries indicates the number of times work station buffer space was not available. Refer also to *WSB Retries, WSB Read Retries*, and *WSB Write Retries* described later in this chapter for additional information about work station buffer space.

4 *Trace Buffer Size:* The trace buffer is an area of main storage reserved for logged information that is helpful in diagnosing software problems. The trace buffer size is specified during system configuration and can be overridden during IPL. Every 16 entries in the trace buffer require 256 bytes of user storage. Increasing the size of the trace buffer can decrease the size of the user area.

5 *Spool Intercept Buffer Size:* The spool intercept buffer is an area of main storage that contains printer data that is being written to the spool file. The spool intercept buffer size is specified during system configuration and can be overridden during IPL. If more than one task is spooling printer output, the buffer space may be split into segments, one segment for each task. (The buffer will not be divided into segments smaller than 256 bytes.) If sufficient buffer space is not available, the system uses assign/free area for additional buffer space. Allocating 512 bytes of spool intercept buffer for each printer in a task ensures that a minimum amount of disk activity will be required to place a given amount of information into the spool file. However, increasing the size of the spool intercept buffer can decrease the size of the user area.

6 *Spool Writer Buffer Size:* The spool writer buffer is an area of main storage that contains compressed data to be printed on the line printer by a spool writer program. When the size of the spool writer buffer is increased, there will be less dispatching if the task is non-swappable. If the task is swappable, there will be reduced swapping activity. However, increasing the size of the spool writer buffer can decrease the size of the user area.

7 *Task Work Area Size:* The task work area is an area on disk that contains control information and work areas, including the program swap area, related to a specific task. You can change the size of the available system task work area during a reload of the system. If a task requires more task work area space than is available, the task work area is dynamically expanded if possible. Expanding the task work area reduces the amount of disk space available to the user. The added space will not again be available until the COMPRESS function is run or an IPL is performed. If there is not enough space available in the first 16 megabytes of disk to extend the task work area, the task must wait until the required amount of task work area is available (for example, when another task terminates). For information about determining the size of the task work file, see Appendix B of the *Installation and Modification Reference Manual.*

Figure 4-1. System Configuration Information

```
REPORT DATE  7/29/80  1 SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                PAGE      1

------------------------------------------ I P L  C O N F I G U R A T I O N ------------------------------------------

  CONTROL STORAGE SIZE.................  16.00 K          IPL DATE.............................. 80/07/29
  MAIN STORAGE SIZE.................... 256.00 K          RELEASE/MODIFICATION LEVEL.........    07/00
  NUCLEUS SIZE.........................  40.00 K        8 WORKSTATION DATA MANAGEMENT.........  RES/TRN
  USER AREA SIZE....................... 216.00 K        9 SPOOL SUPPORTED.....................       Y
2 SYSTEM ASSIGN/FREE SIZE (A/F).......   8.00 K         10 HIGH PRIORITY SPOOL WRITER.........       N
3 WORK STATION BUFFER SIZE (WSB)......   6.00 K         11 RESIDENT SPOOL WRITER..............       N
4 TRACE BUFFER SIZE...................   8.00 K            NUMBER OF PRINTERS..................       1
5 SPOOL INTERCEPT BUFFER SIZE.........   0.50 K            LINE PRINTER SUPPORTED..............       Y
6 SPOOL WRITER BUFFER SIZE............   0.50 K            REMOTE WORKSTATIONS SUPPORTED.......       Y
7 TASK WORK AREA SIZE.................   1203 BLKS         NUMBER OF WORKSTATIONS..............       4
  DISK CAPACITY.......................  257.4 MB        12 COMMUNICATION LINES SUPPORTED.......   1,2,3,4
                                                        13 AUTO CALL LINES SUPPORTED...........    NONE
                                                        14 MLCA SUPPORTED......................       Y

---------------------- C O M M U N I C A T I O N  C O N F I G U R A T I O N ----------------------

15 LINE NUMBER.................      1             2             3
16 LINE USER...................   SDLC-P        SDLC-P        SDLC-P
17 LINE PRIORITY...............     HIGH           LOW           LOW
18 LINE TYPE...................  PT-TO-PT      PT-TO-PT      PT-TO-PT
19 LINE RATE...................     FULL          FULL          FULL
20 SDLC POLLING INTERVAL(SEC)..     .020          .020          .020
21 LINE RATE (BITS/SEC)........     9600          9600          4800
```

8 *Workstation Data Management:* This item indicates whether work station data management (WSDM) is transient (TRN), partially resident (RES/TRN), or fully resident except for minor functions (RES). This function is specified during system configuration and can be overridden during IPL. If work station data management is transient, it is called into main storage only when it is needed. In this case, no additional nucleus storage is required. Making work station data mangement transient might be a good choice if interactive performance is not a primary concern. A partially resident or fully resident work station data management increases the size of the nucleus and reduces the disk activity required to control work station processing. A partially resident or fully resident work station data management can decrease the user area.

Note: If remote work stations are supported, an additional 0.75 K bytes of user area are required. There is no transient version of work station data management for remote work stations.

9 *Spool Supported:* If spooling is supported (if it is currently active on your system), an additional 2 K bytes of main storage nucleus are required for the spool intercept routine, intercept buffer, and disk buffer. The additional 2 K bytes are taken from the user area. The spooling function is specified during system configuration and can be overridden during IPL.

10 *High Priority Spool Writer:* If the spool writer programs have been assigned priority, they are given the chance to execute before interactive or batch priority programs. Assigning priority to the spool writer programs might help improve printer performance. High priority for the spool writer is specified during system configuration and can be overriden during IPL.

11 *Resident Spool Writer:* If the spool writer program for the line printer has been assigned as resident, that program is nonswappable while it is printing information. The program occupies 8 K bytes of main storage whenever it has information to print. Assigning the spool writer program for the line printer as resident can decrease the amount of user area. This option is specified during system configuration and can be overridden during IPL.

12 *Communication Lines Supported:* This item identifies by line number the communications lines that you have configured on your system.

13 *Auto Call Lines Supported:* This item identifies by line number which of the four MLCA lines are to be used as autocall communications lines. You can have up to two lines as autocall lines. If you do not have autocall lines, *none* will show up on the report.

14 *MLCA Supported:* This item identifies whether or not you have MLCA communications on your system. Y means that you have MLCA communications support and N means that you do not have MLCA communications support.

15 *Line Number:* This item identifies, by line number, those communications lines that are active and were selected for communications utilization data. If you have MLCA communications, up to four lines can show on the report.

COMMUNICATIONS CONFIGURATION INFORMATION

The communications configuration consists of the following:

16 *Line User:* This item identifies what the line is being used for at the time it is brought up.

- BSC-B: Batch binary synchronous data communications (RPG II or Assembler)
- BSC-I: Interactive BSC
- BSC-EM: BSC 3270 emulation
- MRJE: BSC multi-leaving remote job entry
- SDLC-P: SDLC primary (remote work station or PEER or SNA finance)
- SDLC-S: SDLC secondary (SNA upline facility or PEER or SNA 3270 emulation or SNA remote job entry)

17 *Line Priority:* This item identifies the priority of the communications line as either high or low if more than one line is configured. The line priority is assigned during hardware configuration. High priority should be associated with the line that has the higher speed.

18 *Line Type:* This item identifies the type of line for which the system is configured.

- Point to point (PT-TO-PT)
- Multipoint (MULTI-PT)
- Switched (SWITCHED)
- Switched backup (SW-BKUP)

19 *Line Rate:* This item indicates whether the line is being used at its full rated speed or half of its rated speed.

20 *SDLC Polling Interval (Sec):* This item specifies how long the system should wait after processing the polling list once if no productive data transmissions have occurred. The interval polling is automatically determined by the system, and is shown on your report.

21 *Line Rate (Bits/Sec):* This item identifies the bits per second (bps) line speed as specified by the operator on the SMFSTART procedure for each particular line. This bit per second rate is used to calculate communications line utilization statistics.

SMF uses the listed bits per second rate to calculate line utilization statistics. If you specify an incorrect bits per second rate, the line utilization information reported by SMF will be incorrect. The following examples illustrate the effects of entering the wrong bits per second rate for communications lines that are both non-MLCA and MLCA.

- SDLC: If, for example, you are using a 4800 bps modem for an SDLC communications line and you specify a 9600 bps rate on the SMFSTART procedure, you should multiply any line utilization percentages shown on the SMF output reports by 2.
- BSC: If, for example, you are using a 4800 bps modem for a BSC communications line and you specify a 19 200 bps rate on the SMFSTART procedure and the SMF report indicates a byte count value of 1000 bytes transmitted during one time interval, you should divide the byte count shown on the report by four because your actual bits per second rate is one-fourth the given bits per second rate. The actual byte count should have been 250 bytes.
- MLCA lines: If you specify an incorrect bits per second rate for an MLCA line, all utilization figures for that line will be incorrect. Make sure to enter correct line speed for MLCA lines.

TASK STATUS INFORMATION

The task status information is printed for each sampling interval when the DETAIL or ALL print option is selected. The task status information defines the status of the active user tasks at the time of the sample. Figure 4-2 shows the task status section of a page from an ALL report. The following paragraphs describe the task status information.

1 *Procedure:* The name of the procedure that called the task if the task was called from a procedure.

2 *Program:* The name of the task or program being executed. If a program is in the process of initiation or termination, the name SCHEDULR might appear. This name is blank for certain system tasks such as SDLC or SNA.

3 *Prog Size:* The actual amount of user storage used by the task in K bytes. If the task is nonswappable, an asterisk will follow the number of K bytes. This indicates that the space occupied by the task has been temporarily removed from the currently available user storage.

4 *Type:* The attribute associated with each program. User types:

- SRT: The program is a single requestor terminal program.
- MRT: The program is a multiple requestor terminal program.
- NRT: The program does not have an attached requestor.
- NEP-SRT: The program is a single requestor terminal program with never-ending program characteristics (long running).
- NEP-MRT: The program is a multiple requestor terminal program with never-ending program characteristics (long running).

System types:

- AUTO-CL: The task is the MLCA autocall function.
- SPOOL: The task is a spooling function.
- JOBQ: The task is being run from the input job queue.
- MRJE: The task is an MRJE function.
- BSC: The task is a BSC function.
- SDLC-P: The task is an SDLC primary function.
- SDLC-S: The task is an SDLC secondary function.
- SNA: The task is an SNA function.
- SRJE: The task is an SRJE function.
- SNUF: The task is a SNA upline facility.
- PEER: The task is the PEER subsystem.
- CCP: The task is the CCP subsystem.
- CICS: The task is the CICS subsystem.
- IMS: The task is the IMS subsystem.
- BSCEL: The task is the BSC equivalence link.
- INTRA: The task is the INTRA subsystem.
- SNA44: The task is a SNA44 function.
- BSC-I: The task is interactive BSC.
- BSC-EM: The task is the BSC interrupt handler for 3270 emulation.
- BSC3270: The task is the BSC3270 emulation subsystem.
- SNA3270: The task is the SNA3270 emulation subsystem.
- SNA-FIN: The task is the SNA finance subsystem.
- MLCA-ER: The task is the MLCA controller error task.
- GAIJI: The task is the ideographic character conversion and maintenance task.

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN       SYSTEM/34 MEASUREMENT FACILITY                            PAGE    62

    --------------------------------- T A S K   S T A T U S ------------------------------------
                          PROG                                         -*-- STATUS ---  SWAP   W/S   REQ
 1 PROCEDURE 2 PROGRAM  3 SIZE 4 TYPE   5 PRIORITY 6 USER ID 7 WSID 8 SWAP 9 WAIT 10 SCHD 11 INS 12 OPS 13 CNT
13.49.13.904
  UTILIZATION RATES -  MSP- 90%  CSP- 73%  TWA- 14%  CL1-  0%  CL2-  0%  CL3- 38%  CL4- **%
                       A/F- 62%  WSB-  0%  IOC- 35%   D1- 18%   D2-  0%   D3- 20%   D4- 16%
    SMFSTART    $SMFML      4 K  NRT       SYSTEM    RCB        W1   IN
                SYS TASK   12*K  SDLC-P    SYSTEM                    NSW
                SYS TASK    8 K  SNA       SYSTEM                    IN   EC
    COBOLP      #CBL00     10 K  SRT       INTER     AE         T1   IN   EC     INIT      1     30      1
    STATS       REPORT      8 K  SRT       BATCH     RRR        S1   IN                                  1
    BASICT      #BLSIC     56 K  SRT       LOW       MERK       R1   IN                                  1
      STORAGE:    USED -   86 K  AVAILABLE - 202 K  STORAGE COMMITMENT:  TOTAL -   42%  ACTUAL -    42%

      SYSTEM ASSIGN/FREE DATA -       TOTAL A/F SIZE....................  8192 BYTES
                                      TOTAL A/F AVAILABLE...............  3104 BYTES
                                      LARGEST AVAILABLE A/F SEGMENT.....  2464 BYTES
                                      NUMBER OF A/F SEGMENTS AVAILABLE.     16

      WORKSTATION BUFFER DATA -       TOTAL WSB SIZE....................  6144 BYTES
                                      TOTAL WSB AVAILABLE...............  6128 BYTES
                                      LARGEST AVAILABLE WSB SEGMENT.....  6128 BYTES
                                      NUMBER OF WSB SEGMENTS AVAILABLE.      1

      TASK WORK AREA DATA -           TOTAL TASK WORK AREA SIZE.........  1203 BLOCKS
                                      TOTAL TASK WORK AREA AVAILABLE....  1036 BLOCKS
                                      NUMBER OF TASK WORK AREA EXTENTS.      0

      SYSTEM EVENT COUNTERS -                                        I/O COUNTERS -

         INTER/BCH TIME/OUTS.     3   TRANSIENT CALLS.....   104      DISK 1 RD VERIFIES..    81  DISKETTE READS......      0
         GENERAL WAITS.......     0   TRANSIENT LOADS.....   135      DISK 1 WRITES.......    81  DISKETTE WRITES.....      0
         RESOURCE TIME/OUTS..   129   TRANSIENT PREEMPTS..     9      DISK 1 READS........   325  DISKETTE SEEKS......      0
         SPOOL BUFFER SPLITS.     0   TWA EXTENSIONS......     0      DISK 1 SEEKS........   240  72MD AUTO LOADER REQ      0
         SPOOL INDEX ENTRIES.     0   SECTOR ENQ RETRIES..     0      DISK 2 RD VERIFIES..     0  WORKSTATION OPS.....     32
         SPOOL EXTENTS.......     0   A/F ASSIGN RETRIES..     0      DISK 2 WRITES.......     0  LINE PRINTER OPS....      0
         SWAP INS............     1   WSB RETRIES.........     0      DISK 2 READS........     0  1255 MICR OPS.......      0
         SWAP OUTS...........     0   WSB READ RETRIES....     0      DISK 2 SEEKS........     0  SWAP-IN/MINUTE......      1
         SWAP OUTS, NET......     0   WSB WRITE RETRIES...     0      DISK 3 RD VERIFIES..     0
         SWAP OUTS, FORCED...     0   UNUSED..............     0      DISK 3 WRITES.......   109
         TASK DISPATCHES.....  2482   UNUSED..............     0      DISK 3 READS........     0
         TASK SWITCHES.......  2359   UNUSED..............     0      DISK 3 SEEKS........     0
                                                                      DISK 4 RD VERIFIES..     3
                                                                      DISK 4 WRITES.......     3
                                                                      DISK 4 READS........   356
                                                                      DISK 4 SEEKS........    23

      CHANNEL/SEEK UTILIZATION -

         ----- DATA CHANNEL -----      ----- SEEK DISTRIBUTION ------

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         DISK 1............ 10.6%     DISK 1 LT 1/3 DISK......100.0%
         DISK 2............   .0%     DISK 1 GT 1/3 DISK......    .0%
         DISK 3............ 19.1%     DISK 2 LT 1/3 DISK......    .0%
         DISK 4............  5.4%     DISK 2 GT 1/3 DISK......    .0%
         DISKETTE..........   .0%     DISK 3 LT 1/3 DISK......    .0%
         TOTAL UTILIZATION. 35.1%     DISK 3 GT 1/3 DISK......    .0%
                                      DISK 4 LT 1/3 DISK......100.0%
                                      DISK 4 GT 1/3 DISK......    .0%

      COMMUNICATION LINE DATA -

         LINE NUMBER.......................        1                   2                   3
         LINE PROTOCOL.....................      SDLC                SDLC                SDLC
         LINE USER.........................    SDLC-P              SDLC-P              SDLC-P
         PRODUCTIVE LINE TURN AROUNDS......        0                   0                  31
         AVG PRODUCTIVE T/A TIME (MS)......      .00                 .00               32.25
         NON-PRODUCTIVE LINE TURN AROUNDS..     2644                   0                 773
         AVG NON-PRODUCTIVE T/A TIME (MS)..     4.70                 .00               21.54
         BYTES TRANSMITTED.................        0                   0                6186
         SDLC 'I' FRAMES TRANSMITTED.......        0                   0                  45
         ERROR BYTES TRANSMITTED...........        0                   0                   0
         TRANSMIT LINE ERRORS..............        0                   0                   0
         BYTES RECEIVED....................       97                   0                6933
         SDLC 'I' FRAMES RECEIVED..........        1                   0                  51
         ERROR BYTES RECEIVED..............        0                   0                   0
         RECEIVE LINE ERRORS...............        0                   0                   0

      COMMUNICATION LINE UTILIZATION -

         RECEIVING SYSTEM TURN AROUND......      .0 %*               .0 %*               .5 %
         LINE TURN AROUNDS.................      .0 %                .0 %               1.1 %
         ERRORS............................      .0 %                .0 %                .0 %
         TRANSMITTED DATA..................      .0 %                .0 %              17.0 %
         RECEIVED DATA.....................      .1 %                .0 %              19.1 %
           TOTAL LINE UTILIZATION..........      .1 %                .0 %              37.7 %
```

Task Status Information Heading

Utilization Rate Information

Task Status Information

Figure 4-2. Task Status Information of an ALL Report

5 *Priority:* The priority of the task.
User Priorities:

- HIGH: The task was run as part of a user-assigned, high-priority job.
- INTER: The task was assigned interactive priority by the system or was run as part of a user-assigned, medium-priority job.
- BATCH: The task was assigned batch priority by the system or was run as part of a user-assigned, normal-priority job.
- LOW: The task was run as part of a user-assigned, low-priority job.

System Priorities:

- SYSTEM: The task ran at system priority.

Notes:
1. The tasks are listed on the report in order of decreasing priority.
2. The system can assign a priority other than what you may have specified. This priority assignment is temporary and is used to accommodate special situations, such as termination of a task.
3. A system task, such as SDLC, is dispatched before any user tasks.

6 *User ID:* The user ID of the operator that submitted the job. If the task is an MRT program, the user ID is eight asterisks (********). For some system tasks, this field is blank. The blank entries are system subtasks. These subtasks are created to support other tasks. The SDLC and the SNA tasks created as part of the remote work station support are examples of system subtasks.

7 *WSID:* The work station ID of the display station from which the job was submitted or the SSP-ICF session ID. This field is blank for tasks that have a system type attribute. See the description of item **4** for information about system type attributes.

8 *Swap:* The swapping status of each task at the time of the sample:

- IN: The task is currently in main storage.
- OUT: The task is currently swapped out.
- NSW: The task is currently in main storage and is nonswappable.

Note: If the task is nonswappable, an asterisk follows the storage size. This indicates that the space occupied by that task has been temporarily subtracted from the currently available user storage.

9 *Wait:* The wait status of each task at the time of the sample. This field might indicate a problem area if a given task has the same wait status for many time intervals.

- TA: The task is waiting for the transient area. The transient area is the work area in the nucleus that is used by the SSP for certain functions applicable to your program. For example:
  - The task caused a halt message to be displayed.
  - The task is retrieving a message from a message member (for example, RPG II SUBR23).
  - The task is reading or updating the UPSI switches or local data area.
  - An I/O operation (EC) or a delayed SVC request (ID) has been issued by a transient running under this task. The transient was refreshable at the point where the I/O request was issued, and the transient area was given to another task that was waiting for it.

  If a TA wait condition is indicated for any task, and that task also has another wait condition indicated, the task does not need the transient area until the second wait condition is satisfied. Also, a task in a wait condition may still occupy the transient area if no one else is ready to use it when the SMF snapshot is taken. The task is still flagged as waiting for the transient area even though it still owns the area by default.

- ID: The task is waiting for an internal delayed supervisor call (SVC). This can occur when:
  - The task is accessing the local data area.
  - The task is writing a message to a work station using the system log function of SYSLOG (for example, the COBOL DISPLAY command).

- EC: The task is waiting for an I/O event completion from the disk, printer, work station, or some other device.

- SU: The task is suspended. For example:
  - The operator interrupted the task by pressing the Attn (inquiry) key.
  - The system operator entered the STOP command.

- TM: The task has set the interval timer and is waiting for it to elapse. An assembler subroutine is required for RPG II, COBOL, and FORTRAN programs to do this.

- GP: The task is waiting for a general post. For example:
  - The task is waiting for a block of shared disk file data that is currently held for updating by another task.
  - The task is waiting for a nonshared file that is allocated to another task.
  - The task is waiting for a resource that is owned by another task.

- DT: The system is waiting for internal communications between tasks.

- blank: Not waiting.

10 *Schd:* The scheduler status of the task at the time of the sample:

- INQ: The task has been suspended while the display station is in inquiry mode.

- INIT: The task is being started (initiated).

- TERM: The task has ended and termination functions are being performed.

- blank: The task is in execution.

11 *Swap Ins:* The number of times the task was swapped in since the last sample.

Notes:
1. When a task is started, its swap-in counter will be set to 1.
2. A nonswappable task can have a swap-in value greater than one. This can happen because a nonswappable task becomes temporarily swappable when it causes the system to acquire additional storage for the task.

12 *W/S Ops:* The number of work station I/O operations performed since the last sample. This number includes operations for the display stations that were attached to the task when the sample was taken, and for the work station printers. If this number is high and work station data management is transient or partially resident, you might want to make it more resident to reduce disk operations and possibly improve response times.

Note: This number may not be equal to the number of operator actions at the display station because an activity (such as inquiry) may cause several display station operations to occur.

13 *Req Cnt:* The number of workstations or SSP-ICF sessions attached to this task. If you have a MRT program, the value shown can exceed the MRTMAX value assigned to the program. If this happens, you should increase the MRTMAX value or consider running two copies of the MRT program.

UTILIZATION RATE INFORMATION

System utilization rate information is printed for each sampling interval if the DETAIL or ALL print option was selected. Figure 4-3 shows the system utilization rate information section of a report when ALL was specified. The time when the sample was taken is listed. The utilization rates follow the time. The listed numbers indicate the percentage of time that the resources were used during the sample (between the last sampling period and the current time printed). The utilization percentages are computed by various methods. They are not intended to be exact values of device or resource utilization, but they can be used to identify trends in system usage. You could also vary the job mix and run SMF to evaluate the effect of program and scheduling changes.

1 *Time:* The listed time is the time the sample was taken. The time is based on a 24-hour clock, which is set by the system operator during IPL. The time is listed in hours, minutes, seconds, and milliseconds. You can use the time to relate the SMF output to actual operating events and to determine the exact sampling interval.

2 *Main Storage Processor (MSP):* This value indicates the percentage of the interval during which the main storage processor was busy (asterisks are printed if MSP utilization data was not collected). Some tasks use the main storage processor to a much greater extent than others. Sorts and program compiles are examples of such programs. This value might also help you identify programs that are processor bound. This percentage value is available only if you select the Collect Main Storage Processor Utilization Data prompt on the SMFSTART procedure display.

3 *Control Storage Processor (CSP):* This value indicates the percentage of the interval during which the control storage processor was busy. System functions such as task dispatching, swapping, disk I/O, and work station I/O use the control storage processor. In addition, programs that use the scientific instruction set (for example, FORTRAN programs), programs that use data communications, and programs that use the diskette drive can increase control storage processor utilization significantly.

4 *Task Work Area (TWA):* This value indicates the percentage of the current total task work area that was being used at the time of the sample. The task work area is an area on the disk that contains control information and work areas for the active tasks. The required size of the task work area depends on the number of display stations and the number of tasks to be run. This percentage value can indicate how well you chose the size of the task work area. If the utilization value is consistently low, you might want to reload the system and reduce the size of this area. Reducing the size of the task work area makes more disk space available for your files and libraries. The task work area can be dynamically increased by the system. You should avoid reducing the size to the point where such task work area extensions occur frequently.

For further information about the task work area, see the description of the task work area size under *System Configuration Information* earlier in this chapter. For information about determining the size of the task work area, see Appendix B of the *Installation and Modification Reference Manual.*

5 *Communications Line 1 (CL1):* This value indicates the percentage of the interval during which user data was being transferred on communications line 1. (Asterisks are printed if the line is not active.)

6 *Communications Line 2 (CL2):* This value indicates the percentage of the interval during which user data was being transferred on communications line 2. (Asterisks are printed if the line is not active.)

7 *Communications Line 3 (CL3):* This value indicates the percentage of the interval during which user data was being transferred on communications line 3. (Asterisks are printed if the line is not active.)

8 *Communications Line 4 (CL4):* This value indicates the percentage of the interval during which user data was being transferred on communications line 4. (Asterisks are printed if the line is not active.)

9 *Assign/Free Area (A/F):* This value indicates the percentage of the current total assign/free area that was being used at the time of the sample. The size of the assign/free area is specified during system configuration or during IPL. This space is used for system and task control information for all system activity. This percentage value can indicate how well you chose the size of the assign/free space. If the utilization percentage is consistently low, you might want to reconfigure your system and reduce the size of this area. Reducing the size of the assign/free area can make more main storage available for data communications buffers, spool buffers, and user programs (provided the reduction in assign/free space reduces the nucleus size to a 2 K boundary). You should avoid reducing the size to the point where assign/free area retries occur. Reducing the area to that point can cause unnecessary waiting and reduce system throughput because of unscheduled increases in assign/free space.

For further information about the assign/free area, see the description of assign/free space size under *System Assign/Free Size* earlier in this chapter. For information about determining the size of the assign/free area see Chapter 12 of the *Planning Guide.*

10 *Work Station Buffer:* This value indicates the percentage of the work station buffer (WSB) that is being used at the time of the sample. The work station buffer is an area in main storage used by work station data management for work station operations. The size of the work station buffer is specified during system configuration. The size of the work station buffer can affect system performance. If the buffer is larger than necessary, the amount of storage available for user programs is decreased, and more swapping might take place. If, on the other hand, the buffer size is too small, a program may have to wait for a long time before buffer space is available. Work station data management writes a portion of the user program to disk and uses the freed area as work station buffer space. This will cause additional disk operations to be performed and the space occupied by the user task becomes nonswappable until the display station operation is complete. For more information about the work station buffer, see Chapter 2 of the *IBM System/34 Concepts and Design Guide.*

11 *I/O Data Channel (IOC):* The listed value reflects the percentage of the SMF timed interval required for both disk drives and the diskette drive. The I/O channel is shared primarily by the disk drive and the diskette drive. This value will increase whenever the diskette drive is being used heavily at the same time that the disk is being used heavily. Rescheduling diskette usage to periods of lower disk activity could improve performance.

12 *Disk Drive 1 (D1):* This value indicates the percentage of the interval during which disk drive 1 was busy. This value includes wait times on the channel in addition to normal disk I/O times. Swapping occurs on the first disk, the system library is on the first disk, and transients are loaded from the first disk by program initiation.

13 *Disk Drive 2 (D2):* This value indicates the percentage of the interval during which disk drive 2 was busy. This value includes wait times on the channel in addition to normal disk I/O times.

14 *Disk Drive 3 (D3):* This value indicates the percentage of the interval during which disk drive 3 was busy. This value includes wait times on the channel in addition to normal disk I/O times.

15 *Disk Drive 4 (D4):* This value indicates the percentage of the interval during which disk drive 4 was busy. This value includes wait times on the channel in addition to normal disk I/O times.

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                              PAGE   42

      ------------------------------------ T A S K   S T A T U S ------------------------------------
                           PROG                                               ---- STATUS ---  SWAP   W/S    REQ
      PROCEDURE  PROGRAM   SIZE  TYPE      PRIORITY  USER ID  WSID  SWAP WAIT  SCHD   INS   OPS    CNT

[1]13.39.10.784
     UTILIZATION RATES -[2]MSP- 43%[3]CSP- 49%[4]TWA- 13%[5]CL1-  0%[6]CL2-  1%[7]CL3-  0%[8]CL4- **%
                        [9]A/F- 72%[10]WSB- 20%[11]IOC- 70%[12]D1- 47%[13]D2-  0%[14]D3-  0%[15]D4- 65%

      SMFSTART   $SMFML      4 K  NRT       SYSTEM    RCB       W1    IN
                 SYS TASK   12*K  SDLC-P    SYSTEM                    NSW  EC
                 SYS TASK    8 K  SNA       SYSTEM                    IN   EC
      LISTLIBR   $MAINT     14 K  SRT       INTER     RCB       W1    IN   TA EC                        1
      CATALOG    $LABEL     14 K  SRT       BATCH     RCB       W1    IN   SU    INQ                    1
      STATS      #GSORT     14 K  SRT       BATCH     RRR       S1    IN                         6      1
      BASICT     SCHEDULR   10 K  SRT       LOW       MERK      R1    IN   TA EC INIT                   1
        STORAGE: [16]USED -   64 K[17]AVAILABLE - 202 K[18]STORAGE COMMITMENT:  TOTAL -   31%  ACTUAL -   31%

        SYSTEM ASSIGN/FREE DATA -       TOTAL A/F SIZE..................    8192 BYTES
                                        TOTAL A/F AVAILABLE.............    2328 BYTES
                                        LARGEST AVAILABLE A/F SEGMENT....   1888 BYTES
                                        NUMBER OF A/F SEGMENTS AVAILABLE.     11

        WORKSTATION BUFFER DATA -       TOTAL WSB SIZE..................    6144 BYTES
                                        TOTAL WSB AVAILABLE.............    4888 BYTES
                                        LARGEST AVAILABLE WSB SEGMENT....   4824 BYTES
                                        NUMBER OF WSB SEGMENTS AVAILABLE.      2

        TASK WORK AREA DATA -           TOTAL TASK WORK AREA SIZE........   1203 BLOCKS
                                        TOTAL TASK WORK AREA AVAILABLE...   1043 BLOCKS
                                        NUMBER OF TASK WORK AREA EXTENTS.      0

        SYSTEM EVENT COUNTERS -                                          I/O COUNTERS -

          INTER/BCH TIME/OUTS.     3   TRANSIENT CALLS.....    255      DISK 1 RD VERIFIES..    155  DISKETTE READS......     48
          GENERAL WAITS.......     0   TRANSIENT LOADS.....    186      DISK 1 WRITES.......    155  DISKETTE WRITES.....      0
          RESOURCE TIME/OUTS..   156   TRANSIENT PREEMPTS..      1      DISK 1 READS........    530  DISKETTE SEEKS......      8
          SPOOL BUFFER SPLITS.     0   TWA EXTENSIONS......      0      DISK 1 SEEKS........    443  72MD AUTO LOADER REQ      1
          SPOOL INDEX ENTRIES.     0   SECTOR ENQ RETRIES..      0      DISK 2 RD VERIFIES..      0  WORKSTATION OPS.....      8
          SPOOL EXTENTS.......     0   A/F ASSIGN RETRIES..      0      DISK 2 WRITES.......      0  LINE PRINTER OPS....      0
          SWAP INS............     0   WSB RETRIES.........      0      DISK 2 READS........      0  1255 MICR OPS.......      0
          SWAP OUTS...........     0   WSB READ RETRIES....      0      DISK 2 SEEKS........      0  SWAP-IN/MINUTE......      0
          SWAP OUTS, NET......     0   WSB WRITE RETRIES...      0      DISK 3 RD VERIFIES..      0
          SWAP OUTS, FORCED...     0   UNUSED..............      0      DISK 3 WRITES.......      0
          TASK DISPATCHES.....  3474   UNUSED..............      0      DISK 3 READS........      0
          TASK SWITCHES.......  3442   UNUSED..............      0      DISK 3 SEEKS........      0
                                                                        DISK 4 RD VERIFIES..    382
                                                                        DISK 4 WRITES.......    395
                                                                        DISK 4 READS........    505
                                                                        DISK 4 SEEKS........    660

        CHANNEL/SEEK UTILIZATION -
```

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REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                              PAGE   43

          ----- DATA CHANNEL -----       ----- SEEK DISTRIBUTION ------
          DISK 1............ 21.4%       DISK 1 LT 1/3 DISK...... 86.5%
          DISK 2............   .0%       DISK 1 GT 1/3 DISK...... 13.5%
          DISK 3............   .0%       DISK 2 LT 1/3 DISK......   .0%
          DISK 4............ 36.9%       DISK 2 GT 1/3 DISK......   .0%
          DISKETTE.......... 12.0%       DISK 3 LT 1/3 DISK......   .0%
          TOTAL UTILIZATION. 70.3%       DISK 3 GT 1/3 DISK......   .0%
                                         DISK 4 LT 1/3 DISK...... 81.5%
                                         DISK 4 GT 1/3 DISK...... 18.5%

        COMMUNICATION LINE DATA -

          LINE NUMBER......................         1                 2                 3
          LINE PROTOCOL....................       SDLC              SDLC              SDLC
          LINE USER........................      SDLC-P            SDLC-P            SDLC-P
          PRODUCTIVE LINE TURN AROUNDS......         1                 6                 1
          AVG PRODUCTIVE T/A TIME (MS)......      6.00             23.50             39.00
          NON-PRODUCTIVE LINE TURN AROUNDS..      3180              3505              1354
          AVG NON-PRODUCTIVE T/A TIME (MS)..      5.04             19.94             20.08
          BYTES TRANSMITTED................         20               378                19
          SDLC 'I' FRAMES TRANSMITTED.......         1                 6                 1
          ERROR BYTES TRANSMITTED...........         0                 0                 0
          TRANSMIT LINE ERRORS..............         0                 0                 0
          BYTES RECEIVED....................       173               138                23
          SDLC 'I' FRAMES RECEIVED..........         1                 6                 1
          ERROR BYTES RECEIVED..............         0                 0                 0
          RECEIVE LINE ERRORS...............         0                 0                 0

        COMMUNICATION LINE UTILIZATION -

          RECEIVING SYSTEM TURN AROUND......      .0 %              .0 %              .0 %
          LINE TURN AROUNDS.................      .0 %              .2 %              .0 %
          ERRORS............................      .0 %              .0 %              .0 %
          TRANSMITTED DATA..................      .0 %              .5 %              .1 %
          RECEIVED DATA.....................      .2 %              .2 %              .1 %
            TOTAL LINE UTILIZATION..........      .2 %              .9 %              .2 %
```

Figure 4-3. System Utilization Rate Information and Storage Information of an ALL Report

STORAGE INFORMATION

The following items describe the storage required for all swappable tasks, the amount of storage available for your jobs, and the ratio of storage used to user area available. See Figure 4-3 for the storage information format in an ALL report.

16 *Used:* The total amount of main storage required for all swappable tasks. If this number is larger than the available user area, then swapping is occurring.

17 *Available:* The amount of main storage available for use by your jobs. The amount of user area can vary during execution of SMF.

For example:

- A nonswappable function or program, like BSC data management, decreases the available storage.
- The common queue space used by SSP-ICF subsystems decreases the available storage.

The user area size is very significant because, as the user area becomes smaller, more swapping may be required to run a given mix of jobs.

Note: SSP-ICF queue spaces are figured into the amount of main storage available for use by user jobs, even though this space is not available for user jobs.

18 *Storage Commitment:*

- Total: The percentage of user area required if all active tasks were in main storage at the same time. A percentage greater than 100% means that swapping is taking place.
- Actual: The percentage of main storage user area occupied by tasks when the sample was taken. This number is significant only when swapping is taking place. In general, the closer this number is to 100%, the more efficiently your jobs are using main storage.

DETAILED SYSTEM INFORMATION

For each sampling interval, detailed system information can be printed. This information is printed as part of the SMF summary information, and on the ALL reports. Figure 4-4 shows the detailed system information section on a page from an ALL report. The following paragraphs describe the detailed system information.

1 *System Assign/Free Data:* This data defines the characteristics of the system assign/free area at the time of the sample. The following information is listed:

2 *Total A/F Size:* The total number of bytes of system assign/free space. If this value is larger than the configured system assign/free size, the system has had to dynamically increase the size of the assign/free area.

3 *Total A/F Available:* The number of available bytes in the system assign/free area.

4 *Largest Available A/F Segment:* The number of bytes in the largest available segment of assign/free area.

5 *Number of A/F Segments Available:* The number of available segments in the assign/free area. This value shows the partial segments of the assign/free area. Each active task requires a contiguous segment of the assign/free area for the task's control information. If the assign/free area is fragmented (the free space is in many partial segments), enough contiguous space might not be available for a new task. When this situation occurs, the system allocates an additional 2 K bytes to the assign/free area. You can minimize the fragmentation of the assign/free area by initially loading all NEP-MRTs and by scheduling the initiation of long-running programs.

6 *Work Station Buffer Data:* This data defines the characteristics of the work station buffer area (WSB) at the time of the sample. The following information is listed:

7 *Total WSB Size:* The total number of bytes of work station buffer area. The size of the work station buffer is specified during system configuration. If this value is larger than the configured work station buffer size, the system has had to dynamically increase the size of the work station buffer area.

8 *Total WSB Available:* The number of available bytes in the work station buffer area.

9 *Largest Available WSB Segment:* The number of bytes in the largest available segment of the work station buffer area.

10 *Number of WSB Segments Available:* The number of available segments in the work station buffer area. This value shows the partial segments of the work station buffer area. Each active task requires a contigous segment of the work station buffer area. If the work station buffer area is fragmented (the free space is in many partial segments), enough contiguous space might not be available for a new task. When this happens, and depending upon whether you have local display stations or remote display stations, the system will write a portion of the user program to disk and use the freed area as work station buffer area. You can minimize the fragmentation of WSB by initially loading all NEP-MRTs and by scheduling the introduction of long-running programs into the job mix.

11 *Task Work Area Data:* This data defines the characteristics of the task work area (TWA) at the time of the sample. The following information is listed:

12 *Total Task Work Area Size:* The total number of blocks in the task work area. If this value is larger than the configured task work area size, the system has had to expand the task work area. The additional disk space is returned to the user when an IPL is performed or when the COMPRESS procedure is run.

13 *Total Task Work Area Available:* The number of available blocks in the task work area. If the utilization of the task work area is consistently low, you might want to reduce the size of the task work area. Normally, you should not reduce the task work area by more than the average number of blocks available.

14 *Number of Task Work Area Extents:* The total number of times the system has had to expand the task work area. The system allocates a contiguous segment of the task work area for each swappable task. If the task work area is fragmented so that enough contiguous space does not exist for a new task, the system will expand the task work area. You can minimize unnecessary fragmentation of the task work area by initiating all NEP-MRTs before any other programs begin running.

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                                  PAGE    16

   ---------------------------------------- T A S K   S T A T U S ----------------------------------------
                          PROG                                                ---- STATUS ----  SWAP   W/S    REQ
   PROCEDURE  PROGRAM     SIZE  TYPE     PRIORITY  USER ID  WSID  SWAP WAIT   SCHD   INS    OPS    CNT

13.26.08.288
  UTILIZATION RATES -  MSP- 94%  CSP- 56%  TWA- 14%  CL1-  7%  CL2-  0%  CL3-  0%  CL4- **%
                       A/F- 68%  WSB-  0%  TOC- 24%   D1- 31%   D2-  0%   D3-  0%   D4-  8%

   SMFSTART   $SMFML      4 K  NPT       SYSTEM    RCB      W1    IN
              SYS TASK   12*K  SDLC-P    SYSTEM                   NSW  EC
              SYS TASK    8 K  SNA       SYSTEM                   IN   EC
   CATALOG    $LABEL     14 K  SRT       INTER     RCB      W1    IN   SU TA INQ                        1
   HELP       $HELP      14 K  SRT       INTER     GRC      T1    IN   TA EC                            1
   HELP       $HELP      14 K  SRT       INTER     RCB      W1    IN   TA EC              1      26     1
   STATS      REDUCE     18 K  SRT       BATCH     RRR      S1    IN                                    1
   BASICT     SCHEDULR   14 K  SRT       LOW       MERK     R1    IN          INIT        1      14     1
     STORAGE    USED -   86 K  AVAILABLE - 202 K  STORAGE COMMITMENT   TOTAL -  42%  ACTUAL -   42%

 [1] SYSTEM ASSIGN/FREE DATA -     [2] TOTAL A/F SIZE...................   8192 BYTES
                                   [3] TOTAL A/F AVAILABLE..............   2600 BYTES
                                   [4] LARGEST AVAILABLE A/F SEGMENT....   2088 BYTES
                                   [5] NUMBER OF A/F SEGMENTS AVAILABLE.     16

 [6] WORKSTATION BUFFER DATA -     [7] TOTAL WSB SIZE...................   6144 BYTES
                                   [8] TOTAL WSB AVAILABLE..............   6144 BYTES
                                   [9] LARGEST AVAILABLE WSB SEGMENT....   6144 BYTES
                                  [10] NUMBER OF WSB SEGMENTS AVAILABLE.      1

[11] TASK WORK AREA DATA -        [12] TOTAL TASK WORK AREA SIZE........   1203 BLOCKS
                                  [13] TOTAL TASK WORK AREA AVAILABLE...   1036 BLOCKS
                                  [14] NUMBER OF TASK WORK AREA EXTENTS.      0

     SYSTEM EVENT COUNTERS -                                             I/O COUNTERS -

        INTER/BCH TIME/OUTS.     3   TRANSIENT CALLS.....    177    DISK 1 RD VERIFIES..   127  DISKETTE READS......      0
        GENERAL WAITS.......     0   TRANSIENT LOADS.....    190    DISK 1 WRITES.......   127  DISKETTE WRITES.....      0
        RESOURCE TIME/OUTS..   121   TRANSIENT PREEMPTS..      6    DISK 1 READS........   533  DISKETTE SEEKS......      0
        SPOOL BUFFER SPLITS.     0   TWA EXTENSIONS......      0    DISK 1 SEEKS........   458  72MD AUTO LOADER REQ      0
        SPOOL INDEX ENTRIES.     1   SECTOR ENQ RETRIES..      0    DISK 2 RD VERIFIES..     0  WORKSTATION OPS.....     40
        SPOOL EXTENTS.......     0   A/F ASSIGN RETRIES..      0    DISK 2 WRITES.......     0  LINE PRINTER OPS....      0
        SWAP INS............     3   WSB RETRIES.........      0    DISK 2 READS........     0  1255 MICR OPS.......      0
        SWAP OUTS...........     0   WSB READ RETRIES....      0    DISK 2 SEEKS........     0  SWAP-IN/MINUTE......      3
        SWAP OUTS, NET......     0   WSB WRITE RETRIES...      0    DISK 3 RD VERIFIES..     0
        SWAP OUTS, FORCED...     0   UNUSED..............      0    DISK 3 WRITES.......     0
        TASK DISPATCHES.....  2089   UNUSED..............      0    DISK 3 READS........     0
        TASK SWITCHES.......  1987   UNUSED..............      0    DISK 3 SEEKS........     0
                                                                    DISK 4 RD VERIFIES..    74
                                                                    DISK 4 WRITES.......    74
                                                                    DISK 4 READS........    89
                                                                    DISK 4 SEEKS........    31

     CHANNEL/SEEK UTILIZATION -


REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                                  PAGE    17

        ----- DATA CHANNEL  ----       ------ SEEK DISTRIBUTION ------
        DISK 1............ 18.4%       DISK 1 LT 1/3 DISK...... 98.3%
        DISK 2............   .0%       DISK 1 GT 1/3 DISK......  1.7%
        DISK 3............   .0%       DISK 2 LT 1/3 DISK......   .0%
        DISK 4............  5.4%       DISK 2 GT 1/3 DISK......   .0%
        DISKETTE..........   .0%       DISK 3 LT 1/3 DISK......   .0%
        TOTAL UTILIZATION. 23.8%       DISK 3 GT 1/3 DISK......   .0%
                                       DISK 4 LT 1/3 DISK...... 61.3%
                                       DISK 4 GT 1/3 DISK...... 38.7%

     COMMUNICATION LINE DATA -

        LINE NUMBER.......................        1                 2                 3
        LINE PROTOCOL.....................     SDLC              SDLC              SDLC
        LINE USER.........................   SDLC-P            SDLC-P            SDLC-P
        PRODUCTIVE LINE TURN AROUNDS......       14                 0                 0
        AVG PRODUCTIVE T/A TIME (MS)......    11.57               .00               .00
        NON-PRODUCTIVE LINE TURN AROUNDS..     1745                 0                 0
        AVG NON-PRODUCTIVE T/A TIME (MS)..     5.20               .00               .00
        BYTES TRANSMITTED.................     3967                 0                 0
        SDLC 'I' FRAMES TRANSMITTED.......       24                 0                 0
        ERROR BYTES TRANSMITTED...........        0                 0                 0
        TRANSMIT LINE ERRORS..............        0                 0                 0
        BYTES RECEIVED....................      845                 0                 0
        SDLC 'I' FRAMES RECEIVED..........       15                 0                 0
        ERROR BYTES RECEIVED..............        0                 0                 0
        RECEIVE LINE ERRORS...............        0                 0                 0

     COMMUNICATION LINE UTILIZATION -

        RECEIVING SYSTEM TURN AROUND......       .1 %              .0 %*             .0 %*
        LINE TURN AROUNDS.................       .1 %              .0 %              .0 %
        ERRORS............................       .0 %              .0 %              .0 %
        TRANSMITTED DATA..................      5.5 %              .0 %              .0 %
        RECEIVED DATA.....................      1.2 %              .0 %              .0 %
          TOTAL LINE UTILIZATION..........      6.9 %              .0 %              .0 %
```

Figure 4-4. Detailed Information on an ALL Report

SYSTEM EVENT COUNTERS

System event counters (SECs) maintain a count of all system activities performed on the system. The following information is reported on the ALL report. The information is also printed on the SUMMARY report for the total time printed. The names in parentheses ( ) are the names used in the *IBM System/34 Data Areas and Diagnostic Aids Manual.* Figure 4-5 shows the format of the system event counter information on an ALL report.

1 *Inter/Bch Time/Outs (Task dispatch conv/batch/time-outs):* The number of times the system lowered the priority of a task from interactive to batch. This is a measure of the amount of processing interactive tasks do. If this number is high, you may want to examine your programs to possibly shift processing to later job steps so that interactive priority can be maintained. If an interactive program executes longer than its interactive time limit without performing a display station read operation, the system lowers the priority of the task task to batch priority. The interactive time limit for a task is (N + 1) x 500 milliseconds, where N is the number of display stations attached to the task. (The interactive time limit includes I/O processing time as well as main storage processor time.) The system restores the interactive priority when a work station input operation is requested.

I/O operations, to certain peripheral devices, cause a fixed amount of time to be subtracted from the 500-milliseconds resource time per work station attached to the task. The approximate values are listed below:

Time Subtracted	Peripheral Device
24	Disk
496	33FD diskette
398	53FD diskette
398	73MD diskette
382	5211 160 lines per minute printer
195	5211 300 lines per minute printer
89	3262 650 lines per minute printer

The resource time is not affected by any other peripheral devices.

2 *General Waits (Resource general waits):* The sum of the following waits or retries are reported:

- A/F assign retries (additional 2 K byte allocations)
- Task work area allocation retries (additional allocations)
- Control block lock retries via the test and set SVC function (For example, the system was performing normal maintenance of control blocks.)
- Resource enqueue retries (For example, a nonspooled printer or other nonsharable resource was requested but was owned by another task.)
- WSB retries (The WSB was too small.)
- Miscellaneous device contention waits (For example, a diskette.)

This information can be used to identify resource contention problems.

3 *Resource Time/Outs (Task dispatch timeouts):* The number of times a task was put in a wait state (resource time-out) occurred. A resource time-out occurs whenever a task executes longer than 500 milliseconds (0.5 seconds) per work station assigned to the task without performing a display station read operation. The resource time-out limit for a task is (N + 1) x 500 milliseconds, where N is the number of work stations attached to the task. (The 500 milleseconds include I/O processing time as well as main storage processor time.) The same amount of time is subtracted from the 500 millisecond resource time when you do I/O operations to certain peripheral devices. Refer to the *Inter/Bch Time/Outs* description in this section for more information. When a task exceeds its resource time-out limit, the system treats the task as a batch (heavy amount of disk or CPU processing) type of program. It might also reduce the task's priority (if it had an interactive or work station priority) to a batch priority. This may cause unacceptable response times. If this is the case, you may want to reduce the amount of processing either in another job step or move it to a part of the program that executes after the operator response is returned. If this is not the case, the program may be looping either in calculations or in disk operations.

Note: If you are collecting main storage processor utilization data, the task that collects this data can time out frequently, causing a large number of resource time-outs. Therefore, the number of resource time-outs should be ignored when main storage utilization data is collected.

```
 REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                                  PAGE     26

   ------------------------------------ T A S K   S T A T U S ------------------------------------
                          PROG                                          ---- STATUS ---  SWAP    W/S    REQ
   PROCEDURE  PROGRAM     SIZE  TYPE      PRIORITY  USER ID  WSID  SWAP WAIT  SCHD   INS     OPS    CNT

13.31.09.128
 UTILIZATION RATES -  MSP- 94%  CSP- 59%  TWA- 16%  CL1- 14%  CL2-  0% . CL3-  0%  CL4- **%
                      A/F- 72%  WSB-  0%  IOC- 34%   D1- 49%   D2-  0%   D3-  0%   D4-  8%

   SMFSTART   $SMFML       4 K  NRT       SYSTEM    RCB       W1   IN
              SYS TASK    12*K  SDLC-P    SYSTEM                   NSW  EC
              SYS TASK     8 K  SNA       SYSTEM                   IN   EC
   HELP       $HELP       14 K  SRT       INTER     GBC       T1   IN   TA EC                            1
   CATALOG    $LABEL      14 K  SRT       INTER     RCB       W1   IN   SU TA INQ        1               1
   SDA        SCHEDULR    14 K  SRT       BATCH     MERK      R1   IN   GP    INIT               16      1
   LISTLIBR   $MAINT      10 K  SRT       BATCH     RCB       W1   IN   ID               1       61      1
   STATS      REDUCE      18 K  SRT       BATCH     RRR       S1   IN                                    1
   BASICT     SCHEDULR    10 K  SRT       LOW       MERK      R1   IN   SU TA INQ                        1
     STORAGE:   USED -    92 K  AVAILABLE - 202 K  STORAGE COMMITMENT:  TOTAL -   45%  ACTUAL -   45%

     SYSTEM ASSIGN/FREE DATA -       TOTAL A/F SIZE..................   8192 BYTES
                                     TOTAL A/F AVAILABLE.............   2272 BYTES
                                     LARGEST AVAILABLE A/F SEGMENT....  1408 BYTES
                                     NUMBER OF A/F SEGMENTS AVAILABLE.    16

     WORKSTATION BUFFER DATA -       TOTAL WSB SIZE..................   6144 BYTES
                                     TOTAL WSB AVAILABLE.............   6144 BYTES
                                     LARGEST AVAILABLE WSB SEGMENT....  6144 BYTES
                                     NUMBER OF WSB SEGMENTS AVAILABLE.     1

     TASK WORK AREA DATA -           TOTAL TASK WORK AREA SIZE........  1203 BLOCKS
                                     TOTAL TASK WORK AREA AVAILABLE...  1011 BLOCKS
                                     NUMBER OF TASK WORK AREA EXTENTS.     0

     SYSTEM EVENT COUNTERS -                                             I/O COUNTERS -

  1 INTER/BCH TIME/OUTS.      6 13 TRANSIENT CALLS.....    325    DISK 1 RD VERIFIES..   161  DISKETTE READS......    0
  2 GENERAL WAITS.......      1 14 TRANSIENT LOADS.....    383    DISK 1 WRITES.......   161  DISKETTE WRITES.....    0
  3 RESOURCE TIME/OUTS..    120 15 TRANSIENT PREEMPTS..     18    DISK 1 READS........   862  DISKETTE SEEKS......    0
  4 SPOOL BUFFER SPLITS.      0 16 TWA EXTENSIONS......      0    DISK 1 SEEKS........   801  72MD AUTO LOADER REQ    0
  5 SPOOL INDEX ENTRIES.      1 17 SECTOR ENQ RETRIES..      0    DISK 2 RD VERIFIES..     0  WORKSTATION OPS.....   77
  6 SPOOL EXTENTS.......      0 18 A/F ASSIGN RETRIES..      0    DISK 2 WRITES.......     0  LINE PRINTER OPS....    0
  7 SWAP INS............      2 19 WSB RETRIES.........      0    DISK 2 READS........     0  1255 MICR OPS.......    0
  8 SWAP OUTS...........      0 20 WSB READ RETRIES....      0    DISK 2 SEEKS........     0  SWAP-IN/MINUTE......    2
  9 SWAP OUTS, NET......      0 21 WSB WRITE RETRIES...      0    DISK 3 RD VERIFIES..     0
 10 SWAP OUTS, FORCED...      0    UNUSED..............      0    DISK 3 WRITES.......     0
 11 TASK DISPATCHES.....   3101    UNUSED..............      0    DISK 3 READS........     0
 12 TASK SWITCHES.......   2936    UNUSED..............      0    DISK 3 SEEKS........     0
                                                                  DISK 4 RD VERIFIES..    75
                                                                  DISK 4 WRITES.......    75
                                                                  DISK 4 READS........    85
                                                                  DISK 4 SEEKS........    32
```

```
 REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                                  PAGE     27

     CHANNEL/SEEK UTILIZATION -

        ----- DATA CHANNEL -----      ----- SEEK DISTRIBUTION ------
        DISK 1............ 28.8%      DISK 1 LT 1/3 DISK...... 98.8%
        DISK 2............   .0%      DISK 1 GT 1/3 DISK......  1.2%
        DISK 3............   .0%      DISK 2 LT 1/3 DISK......   .0%
        DISK 4............  5.4%      DISK 2 GT 1/3 DISK......   .0%
        DISKETTE..........   .0%      DISK 3 LT 1/3 DISK......   .0%
        TOTAL UTILIZATION. 34.2%      DISK 3 GT 1/3 DISK......   .0%
                                      DISK 4 LT 1/3 DISK...... 87.5%
                                      DISK 4 GT 1/3 DISK...... 12.5%

     COMMUNICATION LINE DATA -

        LINE NUMBER.......................        1                 2                 3
        LINE PROTOCOL.....................      SDLC              SDLC              SDLC
        LINE USER.........................    SDLC-P            SDLC-P            SDLC-P
        PRODUCTIVE LINE TURN AROUNDS......       18                 0                 0
        AVG PRODUCTIVE T/A TIME (MS)......    11.83               .00               .00
        NON-PRODUCTIVE LINE TURN AROUNDS..     1318                 0                 0
        AVG NON-PRODUCTIVE T/A TIME (MS)..     5.30               .00               .00
        BYTES TRANSMITTED.................     5855                 0                 0
        SDLC 'I' FRAMES TRANSMITTED.......       35                 0                 0
        ERROR BYTES TRANSMITTED...........        0                 0                 0
        TRANSMIT LINE ERRORS..............        0                 0                 0
        BYTES RECEIVED....................     3720                 0                 0
        SDLC 'I' FRAMES RECEIVED..........       28                 0                 0
        ERROR BYTES RECEIVED..............        0                 0                 0
        RECEIVE LINE ERRORS...............        0                 0                 0

     COMMUNICATION LINE UTILIZATION -

        RECEIVING SYSTEM TURN AROUND......      .2 %              .0 %*             .0 %*
        LINE TURN AROUNDS.................      .2 %              .0 %              .0 %
        ERRORS............................      .0 %              .0 %              .0 %
        TRANSMITTED DATA..................     8.1 %              .0 %              .0 %
        RECEIVED DATA.....................     5.2 %              .0 %              .0 %
          TOTAL LINE UTILIZATION..........    13.7 %              .0 %              .0 %
```

Figure 4-5. System Event Counter Information of an ALL Report

4 *Spool Buffer Splits (Spool split intercept buffer):* The number of times the spool intercept buffer was divided to support multiple tasks. This value reflects additional space acquired from system assign/free space to support additional tasks. Buffer splits decrease the efficiency of the spool intercept routines. The fewer the splits, the more efficiently data can be blocked before being written to the spool queue. This efficiency is reflected in fewer disk operations. For further information, refer to the description of spool intercept buffer size earlier in this chapter.

5 *Spool Index Entries (Spool allocate index entry):* The number of jobs placed in the spool file during the time interval.

6 *Spool Extents (Spool allocate extent):* The number of times the spool file has been extended, during the time interval, to hold spooled output. This value and the number of spool index entries can be used to determine the optimum spool file size.

7 *Swap Ins (Swap ins):* The number of swap-ins that occurred. Whenever a new task is initiated, a *pseudo swap-in* is done to get the task running. This causes the swap-in counter to be incremented. This happens even if no actual swapping is taking place on the system.

8 *Swap Outs (Swap outs):* The number of times a task or portion of a task was selected to be swapped out and the swap-out operation started.

9 *Swap Outs, Net (Net Swapouts):* The number of times swap-outs actually completed. By subtracting this value from the number of swapouts (**8**), you can determine the number of times tasks to be swapped out were reclaimed. A reclaim occurs when a task or a portion of a task that was in the process of being swapped out becomes ready to run; the swap-out is stopped and the task is redispatched. If the net number of swap-outs is high, you should examine your job mix (schedule) to see if you can shift work to other times of the data processing cycle when the system usage is lower. This would reduce the storage used and perhaps improve throughput. In addition, where a common function exists, you may want to consider combining some tasks into an MRT. This would reduce the number of tasks being run and may reduce swapping. However, heavy use of an MRT may cause work stations to queue their requests and result in response times that are longer than those experienced with swapping of SRTs.

10 *Swap Outs, Forced (Forced Swaps):* The number of times a task was ready to execute but was swapped out for a higher priority task. If this number is high and your interactive programs are having their priority lowered, you can shift processing from these tasks to later jobs and maintain their priority, combine functions where applicable into MRTs to reduce memory requirements and swapping, or assign the more important interactive jobs high priority using the PRIORITY OCL statement. See item **1** in this section for information about lowering priority of tasks.

11 *Task Dispatches (Task dispatches):* The number of times the dispatcher was called. The dispatcher is called after any I/O operation, after any operation that requires the user task to wait, and when resource time-outs occur.

12 *Task Switches (Task switches):* The number of times control was given to a different task following a task dispatch. If main storage utilization information is being collected, the number of task switches is approximately equal to the number of task dispatches. Both values are about twice as high as they would be if main storage processor statistics were not being collected. If main storage utilization information is not being collected, the ratio of task switches to task dispatches indicates the approximate degree of main storage processor utilization. A low number of task switches, compared to the number of task dispatches, indicates that whenever a task was put into a wait state because of an I/O operation, no other task was ready to run. The MSP, therefore, was left in a stopped condition. If any task had been ready, a task switch would have been made and the MSP started to execute the second task. There is no way to determine an actual percentage of MSP utilization from these values, only an approximation.

13 *Transient Calls (Main storage transient calls):* The number of times an SVC (supervisor call) was issued to call a transient routine. See note following **15**.

14 *Transient Loads (Main storage transient loads):* The number of times a new transient was loaded either to satisfy a call, because of a preempt, or to reload a transient after a refresh transient call. See note following **15**.

15 *Transient Preempts (Main storage transient preempts):* The number of times an executing transient was not allowed to complete processing because of a higher priority transient. If the transient version of WSDM is being used, a higher number of transient preempts is normal because work station operations are waited on in the transient area and the transient expects to be preempted.

Note: The items pertaining to transients (**13**, **14**, and **15**) refer to the number of times nonresident system functions (and therefore disk operations) were requested. Considerations affecting these steps are:

- Nonresident work station data management: The more resident WSDM is, the less transient activity it requires.
- Program initiation: If you are using RUF (Read Under Format) processing, consider making the programs NEP-MRTs to avoid constant program initiation.
- Logging procedure statements to the history file: If you are concerned only about job start and stop times, consider specifying LOG-NO for procedures. Also, consider using print option 3 for sorts.
- Use of the COBOL DISPLAY and ACCEPT verbs.
- Displaying OCL messages (// *) and halts (for example, // PAUSE or ?R?) on the work station: If you have many comments to display to the operator, and you wish to have a response, consider using the // PROMPT statement.

Reducing transient activity reduces disk activity and improves disk availability for additional application work.

16 *TWA Extensions (TWA extensions):* The number of times the system had to extend the task work area in order to continue processing. Every extension is a high-priority activity that takes time away from your application activity and is an unscheduled reduction in disk space. Increasing the task work area should provide more processing time for your applications and eliminate the unscheduled allocations of additional disk space.

17 *Sector Enq Retries (Sector enqueue retries):* The number of times a task had to wait for a record that was in a protected (enqueued) sector. If this number is high, you may wish to analyze your job processing to see if any programs are holding a record longer than necessary. Also, possibly your job mix could be varied so that programs that tend to queue on the same records in a file are run at different times.

18 *A/F Assign Retries (Resource assign retries—SQS):* The number of times that required system assign/free area was not available. When an A/F assign retry occurs, the executing task or the command processor must wait until space is available. Space can be made available either via dynamic expansion of the system assign/free area or via other tasks releasing enough assign/free space. If many retries occur, consider increasing the size of the assign/free area.

19 *WSB Retries (Resource assign retries—WSQS):* The number of times a task using a display station had to wait for work station buffer (WSB) space. Normally on an output operation, work station data management (WSDM) attempts to assign space from WSB space to satisfy the storage requirements for the operation. If there is insufficient space available, WSDM attempts to acquire the space by freeing work station buffer space assigned to other tasks. The additional disk activity required to free work station buffer space causes the performance of your work stations to be degraded. If there is still insufficient WSB space to satisfy the requirement, the WSB assign-retries counter is incremented by one and the task is put into a wait state until the required amount of WSB space can be made available. If this value is large, consider increasing the size of the WSB.

Note: If any buffer space that was freed belonged to a remote work station, the data in the buffer is written to the disk before the buffer space is freed. The data is retrieved from the disk later by the remote work station data management routines.

20 *WSB Read Retries (Work station WSQS read into):* The number of times that a local work station had data to be read in, but there was insufficient space available in the WSB space. When this happens for a local work station, WSDM reads the input data directly into the user's buffer. This requires that the user task be in main storage while the data is being read in. If this number is large, consider increasing the size of the WSB.

Note: For remote work stations the data is written to disk and is retrieved from the disk when requested by the user task.

21 *WSB Write Retries (Work station WSQS write from):* The number of times that a user requested a format to be written to the work station that was larger than the configured size of WSB space. When this happens, a portion of the user program is written to the disk and the desired screen format is read into the user area. The user's execution time data is then placed in the format, and the entire data stream is written to the work station from the buffer in the user area. Because of increased disk activity for recovery from WSB write retries, a large amount of system overhead is required. You should configure your WSB space as large as your largest format size. You can determine your largest format size from the output reports generated by $SFGR or SDA. The format size in bytes is shown on these reports. If the number of retries is large, consider increasing the size of the WSB.

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I/O COUNTERS

This data reflects the I/O activity for the disk, diskette, and any other device supported on the system. Figure 4-6 shows the format of the I/O counter information on an ALL report. Following is a summary of the information that is reported:

1 *Disk I/O Information:* The disk I/O activity on each spindle. This information can be valuable in balancing the work load between the spindles. Spindles that are unused on your system will have zeros shown on the report.

2 *Diskette I/O Information:* The diskette I/O activity. This information can help you identify requirements for scheduling diskette activity.

72MD Auto Loader Req refers to the number of times that the system readies a diskette for use from one of the 23 diskette locations.

3 *I/O Information for Other Devices:* I/O activity for work stations, the printer, and the 1255 Magnetic Character Reader.

4 *Swap-In/Minute:* This gives you an indication of the swapping activity per minute, on the system and is based on the number of swap ins divided by the time interval that you have selected on the SMFSTART procedure. You can use this counter to compare swapping activity between different mixes of programs or tasks.

Note: The swap-in/minute statistic appears in two places on the SMF summary report. The swap-in/minute statistic appears in the summary utilization section and in the I/O counter section of the summary report. The statistic may be different in both sections because of the method the SMF report writer calculates the value. The value in the summary utilization section is computed by adding all swap-in/minute values for each SMF time interval and then dividing by the total number of SMF time intervals. The value in the I/O counter section of the summary report is computed by dividing the total number of swap ins by the total elapsed time of the SMF run.

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                              PAGE    34

   ------------------------------------------- T A S K  S T A T U S -----------------------------------------------
                               PROG                                              ---- STATUS ---   SWAP    W/S    REQ
   PROCEDURE  PROGRAM          SIZE  TYPE      PRIORITY  USER ID  WSID  SWAP WAIT  SCHD   INS     OPS    CNT

13.35.09.928
 UTILIZATION RATES -   MSP- 21%  CSP- 23%  TWA- 16%  CL1-  0%  CL2-  9%  CL3-  3%  CL4- **%
                       A/F- 75%  WSB-  0%  IOC- 21%   D1- 25%   D2-  3%   D3-  5%   D4-  1%

   SMFSTART   $SMFML        4 K  NRT       SYSTEM    RCB      W1    IN
              SYS TASK     12*K  SDLC-P    SYSTEM                   NSW  EC
              SYS TASK      8 K  SNA       SYSTEM                   IN   EC
   LISTLIBR   $MAINT       14 K  SRT       INTER     RCB      W1    IN   TA EC                            1
   BLDFILE    SCHEDULR     10 K  SRT       INTER     RRR      S1    IN   EC     INIT     1      14        1
   CATALOG    $LABEL       14 K  SRT       BATCH     RCB      W1    IN   SU     INQ                       1
   STATS      REDUCE       18 K  SRT       BATCH     RRR      S1    IN   SU     INQ                       1
   BASICT     SCHEDULR     10 K  SRT       LOW       MERK     R1    IN   SU TA INQ                        1
     STORAGE:   USED -     78 K  AVAILABLE - 202 K  STORAGE COMMITMENT:  TOTAL -   38%  ACTUAL -   38%

     SYSTEM ASSIGN/FREE DATA -       TOTAL A/F SIZE..................   8192 BYTES
                                     TOTAL A/F AVAILABLE.............   2088 BYTES
                                     LARGEST AVAILABLE A/F SEGMENT....  1664 BYTES
                                     NUMBER OF A/F SEGMENTS AVAILABLE.    13

     WORKSTATION BUFFER DATA -       TOTAL WSB SIZE..................   6144 BYTES
                                     TOTAL WSB AVAILABLE.............   6144 BYTES
                                     LARGEST AVAILABLE WSB SEGMENT....  6144 BYTES
                                     NUMBER OF WSB SEGMENTS AVAILABLE.     1

     TASK WORK AREA DATA -           TOTAL TASK WORK AREA SIZE........  1203 BLOCKS
                                     TOTAL TASK WORK AREA AVAILABLE...  1011 BLOCKS
                                     NUMBER OF TASK WORK AREA EXTENTS.     0

     SYSTEM EVENT COUNTERS -                                      I/O COUNTERS -

        INTER/BCH TIME/OUTS.      2   TRANSIENT CALLS.....   103  [1]DISK 1 RD VERIFIES..    95[2]DISKETTE READS......    0
        GENERAL WAITS.......      0   TRANSIENT LOADS.....   126     DISK 1 WRITES.......    95   DISKETTE WRITES.....    0
        RESOURCE TIME/OUTS..    118   TRANSIENT PREEMPTS..    10     DISK 1 READS........   337   DISKETTE SEEKS......    0
        SPOOL BUFFER SPLITS.      0   TWA EXTENSIONS......     0     DISK 1 SEEKS........   306   72MD AUTO LOADER REQ    0
        SPOOL INDEX ENTRIES.      0   SECTOR ENQ RETRIES..     0     DISK 2 RD VERIFIES..     0[3]WORKSTATION OPS.....   22
        SPOOL EXTENTS.......      0   A/F ASSIGN RETRIES..     0     DISK 2 WRITES.......    17   LINE PRINTER OPS....    0
        SWAP INS............      1   WSB RETRIES.........     0     DISK 2 READS........     0   1255 MICR OPS.......    0
        SWAP OUTS...........      0   WSB READ RETRIES....     0     DISK 2 SEEKS........     1[4]SWAP-IN/MINUTE......    1
        SWAP OUTS, NET......      0   WSB WRITE RETRIES...     0     DISK 3 RD VERIFIES..     0
        SWAP OUTS, FORCED...      0   UNUSED..............     0     DISK 3 WRITES.......    24
        TASK DISPATCHES.....   1510   UNUSED..............     0     DISK 3 READS........     0
        TASK SWITCHES.......   1409   UNUSED..............     0     DISK 3 SEEKS........     1
                                                                     DISK 4 RD VERIFIES..     9
                                                                     DISK 4 WRITES.......     9
                                                                     DISK 4 READS........    13
                                                                     DISK 4 SEEKS........     7

     CHANNEL/SEEK UTILIZATION -
```

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                              PAGE    35

        ----- DATA CHANNEL -----      ----- SEEK DISTRIBUTION ------
        DISK 1............ 12.9%      DISK 1 LT 1/3 DISK......100.0%
        DISK 2............  3.0%      DISK 1 GT 1/3 DISK......   .0%
        DISK 3............  4.1%      DISK 2 LT 1/3 DISK......100.0%
        DISK 4............   .6%      DISK 2 GT 1/3 DISK......   .0%
        DISKETTE..........   .0%      DISK 3 LT 1/3 DISK......   .0%
        TOTAL UTILIZATION. 20.6%      DISK 3 GT 1/3 DISK......100.0%
                                      DISK 4 LT 1/3 DISK...... 85.7%
                                      DISK 4 GT 1/3 DISK...... 14.3%

     COMMUNICATION LINE DATA -

        LINE NUMBER.......................          1                 2                 3
        LINE PROTOCOL.....................        SDLC              SDLC              SDLC
        LINE USER.........................       SDLC-P            SDLC-P            SDLC-P
        PRODUCTIVE LINE TURN AROUNDS......          0                14                 8
        AVG PRODUCTIVE T/A TIME (MS)......        .00             26.85             34.62
        NON-PRODUCTIVE LINE TURN AROUNDS..          0              3249               565
        AVG NON-PRODUCTIVE T/A TIME (MS)..        .00             20.09             20.60
        BYTES TRANSMITTED.................          0              2699               790
        SDLC 'I' FRAMES TRANSMITTED.......          0                20                 8
        ERROR BYTES TRANSMITTED...........          0                 0                 0
        TRANSMIT LINE ERRORS..............          0                 0                 0
        BYTES RECEIVED....................          0              3624               267
        SDLC 'I' FRAMES RECEIVED..........          0                25                 8
        ERROR BYTES RECEIVED..............          0                 0                 0
        RECEIVE LINE ERRORS...............          0                 0                 0

     COMMUNICATION LINE UTILIZATION -

        RECEIVING SYSTEM TURN AROUND......        .0 %*             .2 %              .2 %
        LINE TURN AROUNDS.................        .0 %              .5 %              .3 %
        ERRORS............................        .0 %              .0 %              .0 %
        TRANSMITTED DATA..................        .0 %             3.7 %             2.2 %
        RECEIVED DATA.....................        .0 %             5.0 %              .7 %
          TOTAL LINE UTILIZATION..........        .0 %             9.4 %             3.4 %
```

Figure 4-6. I/O Counters Information on an ALL Report

CHANNEL/SEEK UTILIZATION

The channel/seek utilization data summarizes the disk and diskette drive utilization statistics for the sample. Figure 4-7 shows the channel/seek utilization portion of an ALL report. For each drive, the following information is listed:

1 *Data Channel Utilization:* This data summarizes the data channel utilization statistics for the sample. The data channel is shared by the disk drive(s) and the diskette drive to transfer data to system storage (main or control). The percentage is reported for each disk drive on the system and also the diskette. Total utilization of the disk drive(s) and diskette is also printed. Refer to *Utilization Rate Information* earlier in this chapter for more information on data channel utilization.

2 *Seek Distribution:* The following information is printed for each disk drive on the system:

- *Disk An LT 1/3 Disk:* The percentage of seek operations that spanned less than one-third of the cylinders on the disk. (n is the spindle number.)
- *Disk An GT 1/3 Disk:* The percentage of seek operations that spanned one-third or more of the cylinders on the disk. (n is the spindle number.)

The ideal situation, of course, is (1) to have no seeks that span more than one-third of the disk and (2) to locate your files to minimize the number of cylinders spanned by a seek.

Note: Four spindles are shown on the SMF report in Figure 4-7. If you have fewer than four spindles on your system, values of zero appear for data channel utilization and for seek distribution on the SMF report for the unused spindles.

```
REPORT DATE  7/29/80     SMF FILE - SMFRUN          SYSTEM/34 MEASUREMENT FACILITY                                          PAGE     34

     ------------------------------------ T A S K   S T A T U S ------------------------------------
                                PROG                                         ---- STATUS ---   SWAP    W/S     REQ
     PROCEDURE   PROGRAM        SIZE   TYPE      PRIORITY   USER ID   WSID   SWAP WAIT  SCHD    INS    OPS     CNT

13.35.09.928
     UTILIZATION RATES -   MSP- 21%   CSP- 23%   TWA- 16%   CL1-  0%   CL2-   9%   CL3-   3%   CL4- **%
                           A/F- 75%   WSB-  0%   IOC- 21%    D1- 25%    D2-   3%    D3-   5%    D4-  1%

     SMFSTART    $SMFML         4 K   NRT        SYSTEM     RCB        W1    IN
                 SYS TASK      12*K   SDLC-P     SYSTEM                      NSW   EC
                 SYS TASK       8 K   SNA        SYSTEM                      IN    EC
     LISTLIBR    $MAINT        14 K   SRT        INTER      RCB        W1    IN    TA EC                            1
     BLDFILE     SCHEDULR      10 K   SRT        INTER      RRR        S1    IN    EC     INIT       1      14      1
     CATALOG     $LABEL        14 K   SRT        BATCH      RCB        W1    IN    SU     INQ                       1
     STATS       REDUCE        18 K   SRT        BATCH      RRR        S1    IN    SU     INQ                       1
     BASICT      SCHEDULR      10 K   SRT        LOW        MERK       R1    IN    SU TA  INQ                       1
       STORAGE:    USED -      78 K   AVAILABLE - 202 K   STORAGE COMMITMENT:   TOTAL -     38%    ACTUAL -     38%

       SYSTEM ASSIGN/FREE DATA -            TOTAL A/F SIZE...................     8192 BYTES
                                            TOTAL A/F AVAILABLE..............     2088 BYTES
                                            LARGEST AVAILABLE A/F SEGMENT....     1664 BYTES
                                            NUMBER OF A/F SEGMENTS AVAILABLE.       13

       WORKSTATION BUFFER DATA -            TOTAL WSB SIZE...................     6144 BYTES
                                            TOTAL WSB AVAILABLE..............     6144 BYTES
                                            LARGEST AVAILABLE WSB SEGMENT....     6144 BYTES
                                            NUMBER OF WSB SEGMENTS AVAILABLE.        1

       TASK WORK AREA DATA -                TOTAL TASK WORK AREA SIZE........     1203 BLOCKS
                                            TOTAL TASK WORK AREA AVAILABLE...     1011 BLOCKS
                                            NUMBER OF TASK WORK AREA EXTENTS.        0

       SYSTEM EVENT COUNTERS -                                               I/O COUNTERS -

          INTER/BCH TIME/OUTS.      2    TRANSIENT CALLS.....     103           DISK 1 RD VERIFIES..     95   DISKETTE READS......      0
          GENERAL WAITS.......      0    TRANSIENT LOADS.....     126           DISK 1 WRITES.......     95   DISKETTE WRITES.....      0
          RESOURCE TIME/OUTS..    118    TRANSIENT PREEMPTS..      10           DISK 1 READS........    337   DISKETTE SEEKS......      0
          SPOOL BUFFER SPLITS.      0    TWA EXTENSIONS......       0           DISK 1 SEEKS........    306   72MD AUTO LOADER REQ      0
          SPOOL INDEX ENTRIES.      0    SECTOR ENQ RETRIES..       0           DISK 2 RD VERIFIES..      0   WORKSTATION OPS.....     22
          SPOOL EXTENTS.......      0    A/F ASSIGN RETRIES..       0           DISK 2 WRITES.......     17   LINE PRINTER OPS....      0
          SWAP INS............      1    WSB RETRIES.........       0           DISK 2 READS........      0   1255 MICR OPS.......      0
          SWAP OUTS...........      0    WSB READ RETRIES....       0           DISK 2 SEEKS........      1   SWAP-IN/MINUTE......      1
          SWAP OUTS, NET......      0    WSB WRITE RETRIES...       0           DISK 3 RD VERIFIES..      0
          SWAP OUTS, FORCED...      0    UNUSED..............       0           DISK 3 WRITES.......     24
          TASK DISPATCHES.....   1510    UNUSED..............       0           DISK 3 READS........      0
          TASK SWITCHES.......   1409    UNUSED..............       0           DISK 3 SEEKS........      1
                                                                                DISK 4 RD VERIFIES..      9
                                                                                DISK 4 WRITES.......      9
                                                                                DISK 4 READS........     13
                                                                                DISK 4 SEEKS........      7

       CHANNEL/SEEK UTILIZATION -
```

```
REPORT DATE  7/29/80     SMF FILE - SMFRUN          SYSTEM/34 MEASUREMENT FACILITY                                          PAGE     35

   [1]----- DATA CHANNEL -----     [2]----- SEEK DISTRIBUTION ------
      DISK 1............ 12.9%        DISK 1 LT 1/3 DISK......100.0%
      DISK 2............  3.0%        DISK 1 GT 1/3 DISK......    .0%
      DISK 3............  4.1%        DISK 2 LT 1/3 DISK......100.0%
      DISK 4............   .6%        DISK 2 GT 1/3 DISK......    .0%
      DISKETTE..........   .0%        DISK 3 LT 1/3 DISK......    .0%
      TOTAL UTILIZATION. 20.6%        DISK 3 GT 1/3 DISK......100.0%
                                      DISK 4 LT 1/3 DISK...... 85.7%
                                      DISK 4 GT 1/3 DISK...... 14.3%

     COMMUNICATION LINE DATA -

        LINE NUMBER.......................            1                   2                   3
        LINE PROTOCOL.....................         SDLC                SDLC                SDLC
        LINE USER.........................       SDLC-P              SDLC-P              SDLC-P
        PRODUCTIVE LINE TURN AROUNDS......            0                  14                   8
        AVG PRODUCTIVE T/A TIME (MS)......          .00               26.85               34.62
        NON-PRODUCTIVE LINE TURN AROUNDS..            0                3249                 565
        AVG NON-PRODUCTIVE T/A TIME (MS)..          .00               20.09               20.60
        BYTES TRANSMITTED.................            0                2699                 790
        SDLC 'I' FRAMES TRANSMITTED.......            0                  20                   8
        ERROR BYTES TRANSMITTED...........            0                   0                   0
        TRANSMIT LINE ERRORS..............            0                   0                   0
        BYTES RECEIVED....................            0                3624                 267
        SDLC 'I' FRAMES RECEIVED..........            0                  25                   8
        ERROR BYTES RECEIVED..............            0                   0                   0
        RECEIVE LINE ERRORS...............            0                   0                   0

     COMMUNICATION LINE UTILIZATION -

        RECEIVING SYSTEM TURN AROUND......         .0 %*               .2 %                .2 %
        LINE TURN AROUNDS.................         .0 %                .5 %                .3 %
        ERRORS............................         .0 %                .0 %                .0 %
        TRANSMITTED DATA..................         .0 %               3.7 %               2.2 %
        RECEIVED DATA.....................         .0 %               5.0 %                .7 %
          TOTAL LINE UTILIZATION..........         .0 %               9.4 %               3.4 %
```

Figure 4-7. Channel/Seek Utilization Information on an ALL Report

COMMUNICATIONS LINE DATA (NON-MLCA)

If either or both lines are activated, and utilization information is desired, communications line data for each line configures on the system is printed. The information is printed on the ALL report. Figure 4-8 shows the communications line data portion of an ALL report for non-MLCA communications.

The following paragraphs describe the information that is printed for each activated communication line and for which line utilization statistics are desired.

SMF File–XXXXXXXX: The name of the file that was specified in the SMFPRINT procedure.

Line Number: This item identifies, by line number, those active communications lines that were selected for communications utilization data.

Line Protocol: The communications link control you are using. This value is either BSC or SDLC.

Line User: What the line is being used for.

- BSC-B: Batch binary synchronous data communications (RPG II or Assembler)
- BSC-I: Interactive BSC
- BSC-EM: BSC 3270 emulation
- MRJE: BSC multi-leaving remote job entry
- SDLC-P: SDLC primary (remote work station or Peer or SNA finance)
- SDLC-S: SDLC secondary (SNA upline facility, Peer, SNA 3270 emulation, or SNA remote job entry)

Bytes Transmitted: The number of data bytes transmitted during the time interval.

- SDLC: This is an actual byte count.
- BSC: This is a calculated byte count based on line utilization samples. For information about how this value is calculated, see the note following the description of *Bytes Received,* which follows.

Bytes Received: The number of data bytes received during the SMF time interval.

- SDLC: This is an actual byte count.
- BSC: This is a calculated byte count based on line utilization samples.

Note: SMF determines line utilization values for BSC by sampling the status of the line every 8.192 milliseconds. SMF then converts the line utilization percentage value into a byte count by determining the line speed and then using that value to calculate how many bytes were transmitted or received based on the line utilization. Because the byte count is calculated in this manner, it is not a true byte count but an approximation based upon the line utilization value. No allowance is made for modem turnaround or for line errors that cause retransmission of the data. Take this fact into account when comparing the byte count shown to any other byte count statistics you are keeping.

BSC Line Turn Arounds: The number of times the line was switched between transmit and receive during the SMF time interval. SMF determines this value by sampling the status of the line. Large block lengths can reduce this number and might improve performance.

SDLC 'I' Frames Transmitted: This is an actual count of the number of information frames transmitted during the SMF time interval. By dividing the byte count value by this value you can determine the average frame size in bytes.

SDLC 'I' Frames Received: This is an actual count of the number of information frames received during the SMF time interval. By dividing the byte count value by this value you can determine the average frame size in bytes.

Transmit Line Utilization: The percentage of time the line was busy transmitting data.

- BSC: SMF determines this value by sampling the status of the line every 8.192 milliseconds. SMF reports the time the line was busy transmitting as a percentage of the total SMF time interval.
- SDLC: SMF calculates this value based on the number of bytes transmitted and the line speed. See the note that follows the description of *Total Line Utilization* for more information.

Receive Line Utilization: The percentage of time the line was busy receiving data.

- BSC: SMF determines this value by sampling the status of the line every 8.192 milliseconds and reporting the time the line was busy receiving as a percentage of the total SMF time interval.
- SDLC: SMF calculates this value based on the number of bytes received and the line speed. See the note that follows the description of *Total Line Utilization* for more information.

```
REPORT DATE  3/06/80     SMF FILE - SMFNMLCA       SYSTEM/34 MEASUREMENT FACILITY                                          PAGE    10

  ------------------------------------ T A S K   S T A T U S -----------------------------------
                           PROG                                                  ---- STATUS ---  SWAP    W/S    REQ
  PROCEDURE  PROGRAM       SIZE   TYPE     PRIORITY  USER ID  WSID   SWAP WAIT   SCHD   INS     OPS    CNT

       LINE NUMBER......................         2
       LINE PROTOCOL....................      SDLC
       LINE USER........................    SDLC-P
       BYTES TRANSMITTED................     21278
       BYTES RECEIVED...................     17482
       BSC LINE TURN AROUNDS............         0
       SDLC 'I' FRAMES TRANSMITTED......       122
       SDLC 'I' FRAMES RECEIVED.........       107

    COMMUNICATION LINE UTILIZATION -

       TRANSMIT LINE UTILIZATION........      29.5 %
       RECEIVE LINE UTILIZATION.........      24.2 %
         TOTAL LINE UTILIZATION.........      53.7 %
```

Figure 4-8. Communication Line Data of an ALL Report (NON–MLCA Communications)

Total Line Utilization: The composite percentage of transmit and receive line utilization values.

Notes:

1. If the line is being used by BSC, this value is the total of the transmit data and the receive data active times as determined by samplings. SMF determines line utilization values for BSC by sampling the status of the line every 8.192 milliseconds. SMF then converts the line utilization percentage value into a byte count by determining the line speed and then using that value to calculate how many bytes were transmitted or received based on the line utilization. Because the byte count is calculated in this manner, it is not a true byte count but an approximation based upon the line utilization value. No allowance is made for modem turnaround or for line errors that cause retransmission of the data.
2. If the line is being used by SDLC, SMF computes this value from the number of bytes sent and received during the time interval and from the number of bytes that could have been sent or received based on the line speed. The byte count that SDLC keeps for SMF is a count of the bytes that are sent or received in each I-frame. When data is being sent, the byte count for the I-frame being sent is added to the byte count total before the I-frame is actually transmitted. Because SMF samples data asynchronously to the SDLC data transmission, SMF might sample the byte count after the new I-frame byte count has been added but before the frame has been transmitted. For this reason, the calculated SDLC line utilization value might be greater than 100% for a time interval. If the calculated utilization value exceeds 99% for either line, the value printed in the utilization rate information section of the report will be 99%. In the Communication Line Data section of the report, the actual calculated utilization values will be printed. When you look at the line utilization values, be aware that the values can be affected by the method of collecting the byte count on the line. Also, no allowance is made for the line turnaround time required by the modems. This value varies depending on the modem you are using and the value that the modem is wired for.

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COMMUNICATIONS LINE DATA (MLCA)

If any of the four lines associated with MLCA communications are activated and communications utilization information is specified to be collected, communications line data for each line is printed on the ALL report. Figure 4-9 shows the communications line portion of an ALL report.

The SMF-MLCA communications data collection routine provides more comprehensive line utilization reporting for MLCA communications. By line protocol (BSC or SDLC), the conditions that call the communications data collection routine are:

- Before issuing a communications request (the request can be a transmit or a combination transmit/receive)
- Communications receive operation is posted complete
- Retransmission of bytes due to line errors
- A condition that causes unsuccessful transmission of the first try
- An error is detected on a receive operation
- An autopoll/response is terminated (for SDLC only)

The SMF-MLCA communications data collection routine collects communications information from the communications IOB and stores this information in one set of counters for each communications line. These counters are retrieved by the SMF data collection program at each time interval specified and are written to the SMF data collection file.

The following chart is a list of the various MLCA counters, their size, and the line protocol they are used by.

MLCA Counter Name	Size in Bytes	BSC Usage	SDLC Usage
Productive Turnaround Time[1]	3	Yes	Yes
Nonproductive Turnaround Time[1]	3	Yes	Yes
Productive Line Turnarounds	2	Yes	Yes
Nonproductive Line Turnarounds	2	Yes	Yes
Nonproductive Bytes Transmitted and Received[1]	3	Yes	No
Bytes Transmitted	3	Yes	Yes
SDLC I-Frames Transmitted	2	No	Yes
Error Bytes Transmitted	3	Yes	Yes
Transmit Line Errors	2	Yes	Yes
Bytes Received (autopoll/response)[1]	3	No	Yes
Bytes Received	3	Yes	Yes
SDLC I-Frames Received	2	No	Yes
Error Bytes Received	3	Yes	Yes
Receive Line Errors	2	Yes	Yes

The following paragraphs describe the communications line portion of an SMF-MLCA report. The information is printed for each line that is activated and selected for communications utilization data. (See Figure 4-9.) The definitions are valid for both BSC and SDLC lines unless otherwise noted.

Line Number: This item identifies by line number, those communications lines that are active and were selected for communications utilization data.

Line Protocol: This identifies the communications link control you are using. The values are either BSC or SDLC.

[1] These counters are used internally by SMF. See Appendix C for a full description of how the MLCA counters are used.

COMMUNICATION LINE DATA -

LINE NUMBER	1	3	4
LINE PROTOCOL	SDLC	SDLC	SDLC
LINE USER	SDLC-P	SDLC-P	SDLC-P
PRODUCTIVE LINE TURN AROUNDS	25	48	9
AVG PRODUCTIVE T/A TIME (MS)	7.40	19.70	209.11
NON-PRODUCTIVE LINE TURN AROUNDS	4347	1110	292
AVG NON-PRODUCTIVE T/A TIME (MS)	4.29	7.32	185.04
BYTES TRANSMITTED	5910	13296	465
SDLC 'I' FRAMES TRANSMITTED	38	84	9
ERROR BYTES TRANSMITTED	0	0	0
TRANSMIT LINE ERRORS	0	0	0
BYTES RECEIVED	4003	3066	490
SDLC 'I' FRAMES RECEIVED	34	54	8
ERROR BYTES RECEIVED	0	0	0
RECEIVE LINE ERRORS	0	0	0

COMMUNICATION LINE UTILIZATION -

RECEIVING SYSTEM TURN AROUND	.1 %	1.0 %	.4 %
LINE TURN AROUNDS	.2 %	.6 %	2.8 %
ERRORS	.0 %	.0 %	.0 %
TRANSMITTED DATA	8.2 %	36.8 %	.6 %
RECEIVED DATA	5.5 %	8.5 %	.7 %
TOTAL LINE UTILIZATION	14.0 %	46.9 %	4.5 %

Figure 4-9. Communications Line Data (MLCA)

Line User: What the line is being used for.

- BSC-B: Batch binary synchronous data communications (RPG II or Assembler)
- BSC-I: Interactive BSC
- BSC-EM: BSC 3270 emulation
- MRJE: BSC multi-leaving remote job entry
- SDLC-P: SDLC primary (remote work station or Peer or SNA finance)
- SDLC-S: SDLC secondary (SNA upline facility or Peer or SNA 3270 emulation or SNA remote job entry)

Productive Line Turn Arounds: The number of times that the line was changed from the transmission of data to the reception of data or vice versa.

Avg Productive T/A Time (MS): The average time in milliseconds to turn the line around when productive data is either being transmitted or received. Modem turnaround time, MLCA processing time, line propagation time, and the time the system at the other end of the line requires to process data are included in this time value.

Non-Productive Line Turn Arounds: The number of times that the line was changed from the transmission of nonproductive data to the reception of nonproductive data or vice versa. For BSC lines, anytime the data length is 5 bytes or less in both directions, the data is assumed to be nonproductive for that turnaround.

Avg Non-Productive T/A Time (MS): The average time in milliseconds to turn the line around when nonproductive data is either being transmitted or received. The same values are included for this as are included for average productive turnaround time.

Note: By subtracting this value from the average productive turnaround time, you can determine the average time required by the system at the other end of line to process the data being transmitted or received.

Bytes Transmitted: The number of productive and control bytes transmitted.

SDLC 'I' Frames Transmitted: The total number of SDLC I-frames transmitted.

Error Bytes Transmitted: The number of bytes that had to be retransmitted due to line errors.

Transmit Line Errors: The number of line errors that occurred during the transmission of data.

Bytes Received: The number of productive and control bytes received.

- SDLC: For SDLC lines, the bytes received is the sum of productive and control bytes received from another system plus the bytes received when in the autopoll/response mode.

SDLC 'I' Frames Received: The total number of SDLC I-frames received.

Error Bytes Received: The number of bytes that were received more than once due to such things as line errors or line noise.

Receive Line Errors: The number of line errors that occurred while the system was receiving data.

Note: You should be aware that certain conditions such as the work station being turned off in the middle of an operation are considered as receive line errors and are not included in productive line turnaround calculations. Therefore, the SMF reports could show more receive line errors than productive line turnarounds.

COMMUNICATIONS LINE UTILIZATION SECTION

Receiving System Turn Around: This item reflects the percentage of time that it took a system receiving communications data on the other end of the communications line to process productive data. The assumption is made that it takes the receiving system longer to turnaround the communications line when it has data to process than when it does not have data to process. SMF subtracts the average line turnaround time for nonproductive data from the average line turnaround time for productive data. The difference is the average processing time at the receiving system for processing productive data. This difference is also multiplied by the number of productive line turnarounds to compute the total time required by the receiving system.

When an asterisk (*) appears beside this value on the report, it indicates one of the following conditions:

- The number of productive turnarounds was zero.
- The number of nonproductive turnarounds was zero.
  - For the preceding two items, the total receiving system overhead cannot be calculated and is assumed to be zero.

- The calculated receiving system overhead was negative.
  - This indicates that more time was required to process nonproductive data at the receiving system than productive data.

A negative value can occur if the receiving system inserts time delays in the polling sequence when there is no data to be transmitted or received. SMF computes this delay as part of the nonproductive turnaround time. This causes the average nonproductive turnaround time to be higher than the average productive turnaround time. When this occurs the SMF report writer sets the receiving system turnaround percentage to zero. When the receiving system turnaround percentage is zero, the average receiving system processing time is included in the calculation of the line turnaround percentage.

Anytime the receiving system is inserting time delays in the polling sequence the percentage for receiving system turnaround as computed by the SMF report writer is the minimum percentage that the receiving system was taking to do a line turnaround. This condition occurs when the average nonproductive turnaround time is less than the average productive turnaround time and the receiving system is inserting time delays in the polling sequence. The SMF report writer calculates a value for the receiving system turnaround that is less than it would have been if the receiving system had not inserted the time delays. Any time that the receiving system spends to do a line turnaround is included in the line turnaround percentage by the SMF report writer.

Line Turn Arounds: This item represents the percentage of the total time it took the line to do a turnaround, and is comprised of the following categories:

- MLCA processing time
- Modem turnaround time
- Line propagation time

Under certain conditions, receiving system overhead time is included in the percentage calculation of the line turnarounds. See the paragraph on *Receiving System Turn Around* in this section for more information.

Under certain conditions, the percentage calculated for line turnarounds can be affected by the method SMF uses to compute error bytes. See the paragraph on *Errors* in this section for more information.

Errors: This percentage value is the total of the following error time calculations:

- The number of error bytes transmitted and received is divided by the line speed to calculate an error byte time.
- The number of transmit and receive line errors multiplied by the average productive line turnaround time. This value is representative of the additional turnaround time required for handling the errors. This total reflects the percentage of time the line had errors.

Notes:

1. Errors are only recorded for productive data.
2. The number of bytes in error cannot always be determined for BSC lines when a hardware error occurs that affects the fields SMF uses to determine the byte count. SMF inserts a zero for the affected byte count.
3. The number of error bytes received on a SDLC line is determined when the bytes are successfully received after a retransmission of data due to an error condition. Due to this fact and that SMF is asynchronous with the SMF-MLCA communications data collection routine, the error bytes could be included in a different time interval than the one in which the error occurred. This could result in an error byte time greater than the actual amount of time that the SMF-MLCA data communications collection routine found the line active. This situation causes the SMF report writer to report a negative figure for the line turnaround percentage. This is not an error but reflects the asynchronous manner in which SMF and the SMF-MLCA communications data collection routine collects data.

Transmitted Data: This value is the number of bytes transmitted divided by the line speed and reflects the percentage of time that the line was used to transmit data.

Received Data: This value is the number of bytes received divided by the line speed and reflects the percentage of time that the line was used to receive data.

Total Line Utilization: This percentage value is the sum of the five preceding categories. The percentage value can be over 100% due to the manner in which the SMF data collection program records the data.

For example, the SMF data collection program records the MLCA data at fixed time intervals specified by the user. The SMF-MLCA communications data collection routine is keeping track of MLCA data without regard to the user-specified time interval. This results in a condition whereby counts reported by the SMF report writer may reflect statistics that were computed previous to the specified report period, but are included in the current report time interval. The counts are logged by SMF at the time the line turnaround is completed. When an SMF time interval occurs during a line turnaround, the data for that turnaround will not be logged until the next SMF time interval.

These situations occur at every SMF time interval, but only cause utilization to exceed 100% when the communications line is heavily utilized and the SMF time interval specified is small. SMF reports the actual percentage calculated in the ALL report, with statistics for the particular line shown as 99% in the *Utilization Rate Information* section of the report. This is not an error but reflects the asynchronous characteristics of SMF and the MLCA line interrupts.

For a detailed list of the way the SMF report writer utilizes the various MLCA counters in reporting line utilization statistics, refer to Appendix C.

SMF SUMMARY INFORMATION

A summary of SMF information is printed at the end of each type of report. The summary includes:

- The file used as input to the report writer.
- The date of the report.
- The start time, stop time, and total elapsed time for the period covered by the report.
- A summary of the statistics for the period reported. For each value, the following statistics are reported:
  - The average value
  - The maximum or minimum value
  - The time at which the maximum or minimum value first occurred
- A summary of the disk spindle, I/O channel, storage requirements, swapping activity, and communications activity.
- Total system event counter and I/O counter values for the period reported.

Figure 4-10 shows the summary information from an SMF report.

Note: Not active/collected shown for communication lines means that the line was either not active or that SMF did not collect statistics for that line.

```
REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                    PAGE    72

SMF SUMMARY      START TIME  13.18.06.640
                 STOP TIME   13.53.09.816        ELAPSED TIME  00.35.03.176

    SUMMARY UTILIZATION -                                    AVERAGE      MAXIMUM      OCCURRED AT

                          MAIN STORAGE PROCESSOR.............     64%          97%      13.30.08.952
                          CONTROL STORAGE PROCESSOR..........     48%          84%      13.46.12.968
                          TASK WORK AREA.....................     13%          16%      13.31.09.128
                          COMMUNICATION LINE 1...............      6%          26%      13.29.08.792
                          COMMUNICATION LINE 2...............      1%          10%      13.50.14.136
                          COMMUNICATION LINE 3...............     13%          49%      13.45.12.736
                          COMMUNICATION LINE 4...............     **%          **%      NOT ACTIVE/COLLECTED
                          SYSTEM ASSIGN/FREE SPACE...........     64%          77%      13.27.08.448
                          WORKSTATION BUFFER (WSB)...........      5%          43%      13.47.13.168
                          I/O CHANNEL........................     25%          70%      13.39.10.784
                          DISK SPINDLE 1.....................     30%          79%      13.43.12.000
                          DISK SPINDLE 2.....................      0%           3%      13.35.09.928
                          DISK SPINDLE 3.....................      1%          20%      13.49.13.904
                          DISK SPINDLE 4.....................      7%          65%      13.39.10.784
                          STORAGE COMMITMENT.................     35%          58%      13.42.11.576
                          ACTUAL STORAGE COMMITMENT..........     35%          58%      13.42.11.576
                          SWAP-IN/MINUTE.....................      1            4       13.24.07.952
                          NUMBER OF AVAILABLE A/F SEGMENTS...     14           21       13.41.11.296
                          NUMBER OF AVAILABLE WSB SEGMENTS...      1            2       13.33.09.552

                                                             AVERAGE      MINIMUM      OCCURRED AT

                          AVAILABLE A/F SPACE................   2931         1848      13.42.11.576
                          LARGEST AVAILABLE A/F SEGMENT......   2352         1344      13.30.08.952
                          AVAILABLE WSB SPACE................   5861         3504      13.47.13.168
                          LARGEST AVAILABLE WSB SEGMENT......   5812         2976      13.47.13.168

    SYSTEM EVENT COUNTERS -                                  I/O COUNTERS -

       INTER/BCH TIME/OUTS.    102   TRANSIENT CALLS.....   5436      DISK 1 RD VERIFIES..   4804  DISKETTE READS......    244
       GENERAL WAITS.......     22   TRANSIENT LOADS.....   6505      DISK 1 WRITES.......   4845  DISKETTE WRITES.....      9
       RESOURCE TIME/OUTS..   4334   TRANSIENT PREEMPTS..    375      DISK 1 READS........  15735  DISKETTE SEEKS......    114
       SPOOL BUFFER SPLITS.      0   TWA EXTENSIONS......      0      DISK 1 SEEKS........  14096  72MD AUTO LOADER REQ     13
       SPOOL INDEX ENTRIES.      5   SECTOR ENQ RETRIES..      0      DISK 2 RD VERIFIES..      0  WORKSTATION OPS.....   1457
       SPOOL EXTENTS.......      0   A/F ASSIGN RETRIES..      0      DISK 2 WRITES.......     17  LINE PRINTER OPS....      0
       SWAP INS............     52   WSB RETRIES.........      0      DISK 2 READS........      0  1255 MICR OPS.......      0
       SWAP OUTS...........      0   WSB READ RETRIES....      0      DISK 2 SEEKS........      1  SWAP-IN/MINUTE......      1
       SWAP OUTS, NET......      0   WSB WRITE RETRIES...      0      DISK 3 RD VERIFIES..      4
       SWAP OUTS, FORCED...      0   UNUSED..............      0      DISK 3 WRITES.......    224
       TASK DISPATCHES.....  73829   UNUSED..............      0      DISK 3 READS........      0
       TASK SWITCHES.......  69313   UNUSED..............      0      DISK 3 SEEKS........      3
                                                                     DISK 4 RD VERIFIES..   1587
                                                                     DISK 4 WRITES.......   1678
                                                                     DISK 4 READS........   3266
                                                                     DISK 4 SEEKS........   1403

    CHANNEL/SEEK UTILIZATION -

REPORT DATE  7/29/80    SMF FILE - SMFRUN        SYSTEM/34 MEASUREMENT FACILITY                    PAGE    73

       ----- DATA CHANNEL -----      ----- SEEK DISTRIBUTION ------
       DISK 1..........  17.4%      DISK 1 LT 1/3 DISK.....  80.3%
       DISK 2..........    .1%      DISK 1 GT 1/3 DISK.....  19.7%
       DISK 3..........   1.1%      DISK 2 LT 1/3 DISK.....100.0%
       DISK 4..........   4.8%      DISK 2 GT 1/3 DISK.....    .0%
       DISKETTE........   1.4%      DISK 3 LT 1/3 DISK.....  33.3%
       TOTAL UTILIZATION. 24.8%     DISK 3 GT 1/3 DISK.....  66.7%
                                    DISK 4 LT 1/3 DISK.....  84.0%
                                    DISK 4 GT 1/3 DISK.....  16.0%
```

Figure 4-10. SMF Summary Information

Appendix A. Suggestions for Using SMF

When used properly, SMF can be a powerful tool. Two keys to using SMF are planning and establishing measurable performance goals. When planning your SMF runs, you should know what you want to measure and when you want to measure it. If your goal is to improve performance during peak load periods you might, for example, establish an average 2-second response time as the goal for your order entry application.

Keep in mind that you should know what the system variables look like during off-peak times as well as during peak periods. Therefore, you should start collecting data before the peak period so that the collected data can show what happens as the load develops. You should collect data past the peak period as well so that you can see what happens as the system returns to a lower level of activity.

Also, you should collect data for more than one time period. Collecting several sets of data will allow you to verify your findings. For example, if you think that the assign/free area is too small, you should be able to verify your opinion by looking at SMF data for the peak periods on several different days. By comparing the data from different days you might find that the size of the assign/free area was not really the problem. You might find that the real problem was disk contention and that repositioning your files will do more good than increasing the size of the assign/free area.

Once the data has been collected, you can run a SUMMARY report to determine the time at which the first maximums or minimums were reached. The SUMMARY report will also show totals for all counters and total utilization statistics for the data channel and the communication lines if they were active. To determine which values might be affecting performance, consider values where maximums or minimums occurred during the problem period. Also, consider values that changed greatly between off-peak periods and peak periods.

After you determine which values might be causing performance problems, you can use the DETAIL print option to list critical portions of the SMF data collection file. From the DETAIL report you can identify the periods where a maximum or minimum occurred for the data that you are tracking. You can then decide if you need an ALL report for those periods.

In general, analysis of SMF output might lead to the following types of changes:

- Changes to the system configuration. Many system configuration variables can be easily changed during IPL. Other system configuration variables require that the system be configured again or reloaded.
- Changes of file placement and application scheduling.
- Changes to program logic and application design.
- Changes to the hardware on your system.

The following sections give suggestions for evaluating SMF data. The categories (general response time problems, throughput/response time problems with a particular program, and general system tuning) are not intended to cover all situations, but are general enough to apply to many common situations.

GENERAL WORK STATION RESPONSE TIME PROBLEMS THAT OCCUR AT VARIOUS TIMES DURING THE DAY

For general response time problems, you probably should run SMF for the entire day. The sampling interval should be one minute or less depending on the amount of disk space available for the SMF data collection file. Note the times when critical response time problems occurred, and print SUMMARY and DETAIL reports for those periods.

The following utilization values for system resources appear on the SUMMARY report:

Main storage processor
Control storage processor
System assign/free space
Work station buffer
Task work area
I/O channel
Disk spindle 1
Disk spindle 2
Disk spindle 3
Disk spindle 4
Communication line 1
Communication line 2
Communication line 3
Communication line 4
Storage commitment ratio
Actual storage commitment ratio
Swap in rate per minute
Number of available assign/free segments
Number of work station buffer segments

In general, any utilization values that increase significantly during periods of poor performance might identify resources that are contributing to the performance problem. The following sections give suggestions that might help you use those resources more efficiently.

Main Storage Processor Considerations

Figure A-1 should help you identify actions that will help you use the main storage processor more efficiently.

Are any batch (noninteractive) programs running with high priority?

No Yes

Yes:
Reschedule execution of the program, or run with normal or low priority

No:
Have any interactive programs been assigned batch priority by the system? (The priority is printed in the task status section of DETAIL and ALL reports.)

No Yes

Yes:
Reschedule the program, or redesign the application to reduce the time between display station operations. You can reduce the time by performing calculations in a separate batch program or by moving the calculations to a later part of the program cycle.

No:
Are many batch programs running concurrently?

Yes

Yes:
Reschedule execution of some of the batch programs.

Note: A task's priority will not be reduced by the system, if you assign the task medium priority.

Figure A-1. Main Storage Processor Considerations

Control Storage Processor Considerations

Figure A-2 should help you identify actions that will help you use the control storage processor more efficiently.

Are you using large indexed files that are being processed randomly or within limits?

No Yes

Yes:
Use a main storage index in the program to shorten the scan read of the index.

No:
Are diskettes being used when the performance problem occurs?

No Yes

Yes:
Reschedule diskette use, consider using a diskette magazine dirve, or reduce diskette usage by saving files on disk (if you have space).

No:
Are programs being used that do a lot of computations (for example, Assembler or Fortran programs that use the scientific instruction set)?

Yes

Yes:
Reschedule the programs or redesign the programs to reduce the number of scientific instructions executed.

Figure A-2. Control Storage Processor Considerations

System Assign/Free Space Considerations

Figure A-3 should help you identify actions that will help you use the assign/free area more efficiently.

Was the average utilization of the assign/free area high?

No Yes

Was the number of assign/free area retries zero?

No

Were there a large number of assign/free area segments (high fragmentation)?

No Yes

Start long-running programs (for example, NEP-MRTs and long-running batch jobs) before starting any other jobs.

Did the total assign/free area size ever exceed the size specified during IPL?

Yes

Did the size of the assign/free area change occur periodically or often?

Yes No

See *Storage Commitment Considerations.*

Reschedule jobs to avoid the 2-second delay required for assign/free area extensions. Consider increasing the size of the assign/free area. See also *Storage Commitment Considerations.*

If the average utilization of the assign/free area was low, consider reducing the assign/free area by the average amount of unused assign/free area. See also *Storage Commitment Considerations.*

Figure A-3. Assign/Free Space Considerations

Work Station Buffer Space Considerations

Figure A-4 should help you identify actions that will help you use the work station buffer space more efficiently.

Was the average utilization of the work station buffer area high?

No Yes

Were there a large amount of read or write retries?

No Yes

Increase the size of work station buffer to reduce the number of read or write retries.

Was there a significant amount of swapping?

No Yes

Decrease the size of the work station buffer to increase the amount of main storage available for user programs.

See also *Storage Commitment Considerations.*

If the work station buffer utilization is low, consider reducing the size of the work station buffer by the unused amount. See also *Work Station Buffer* in the *Utilization Rate Information* section of Chapter 4.

Figure A-4. Work Station Buffer Space Considerations

Task Work Area Considerations

If task work area (TWA) utilization is usually low, disk space is being wasted. Consider decreasing the size of the task work area. If task work area extensions occur frequently, however, consider increasing the size of the task work area to reduce the system overhead required for the extensions. You can use the RELOAD procedure to change the task work area size.

I/O Channel Considerations

Figure A-5 should help you identify actions that will help you use the I/O channel more efficiently. Use Figure A-5 if I/O channel utilization is high.

Are the diskette I/O counters high?

No Yes

Reschedule diskette operations.

Are the disk I/O counters high?

No Yes

See *Disk Considerations*

Are diskette and disk I/O counters low?

Yes

If you are processing large indexed files, consider using a main storage index to reduce the length of scans for random processing and processing within limits. Also review blocking factors for unnecessarily large block lengths.

Figure A-5. I/O Channel Considerations

Disk Considerations

Figure A-6 should help you identify actions that will help you use the disk more efficiently.

Are the I/O counter values high for disk 1?

No Yes

Are the number of swap ins and swap outs low?

Yes No

Consider the following actions to reduce or control swapping:
- Reschedule jobs to reduce the number of jobs running.
- Increase the size of the user area (see *Storage Commitment Considerations).*
- Assign higher priority to critical programs.

Is the number of transient load operations low? A large amount of transient usage could indicate that a significant amount of disk time is spent in task initiation, allocation, and termination. Certain program designs (for example, a single-transaction SRT program) use more processor time than other designs (such as MRT or MRT-NEP programs that use read under format processing).

Yes No

Is there a large amount of work station activity?

No Yes

If work station data management is transient or partially resident, perform an IPL or reconfigure the system and make work station data management more resident.

Are you initiating programs that use many disk files and/or printers?

No Yes

Redesign your applications to reduce the number of times such programs are initiated (for example, make such programs MRTs or NEP-MRTs).

(1) (2) (3) (4)

Figure A-6 (Part 1 of 3). Disk Considerations

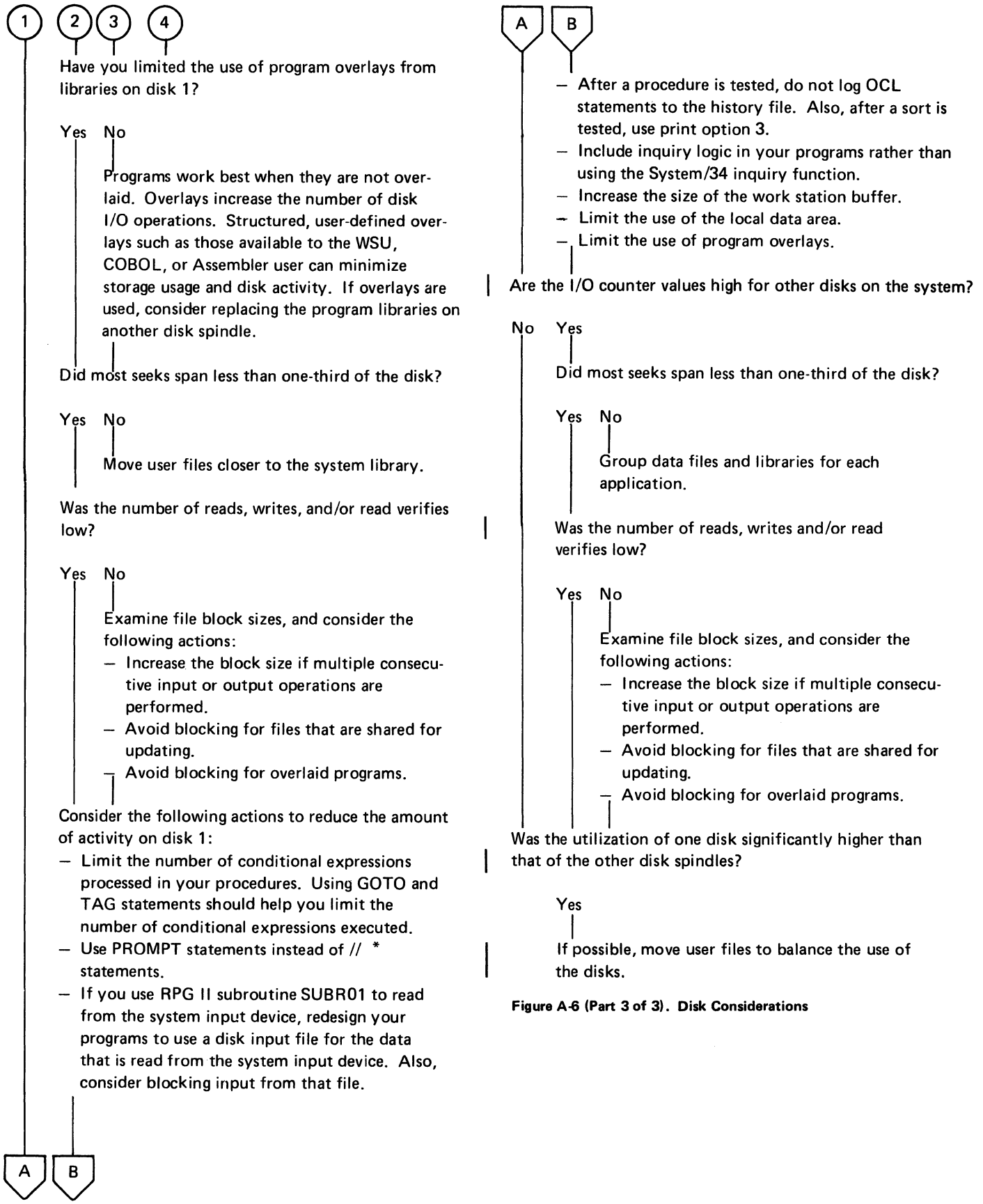


Figure A-6 (Part 2 of 3). Disk Considerations

Figure A-6 (Part 3 of 3). Disk Considerations

Communications Line Considerations

Figure A-7 should help you identify actions that will help you use the communications lines more efficiently.

Is line utilization high?

No Yes

Is remote work station response time acceptable?

Yes No

Consider the following application design changes to minimize the amount of data transmitted:
- Reduce the use of the inquiry function from the remote display stations.
- Reduce the use of // * OCL statements.
- Redesign screens.

For further information, see *Considerations for Remote Work Stations* in the *Concepts and Design Guide.*

If remote work station response time is not acceptable, you may be having problems on the communications line. Check the ERAP statistics for communications. If there are no errors indicated you may want to increase your line speed.

If line utilization is not zero, and if swapping is occurring, consider increasing the size of the user area. See *Storage Commitment Considerations.*

Figure A-7. Communications Line Considerations

Storage Commitment Considerations

Figure A-8 should help you identify actions that will help you use main storage more efficiently. Use Figure A-8 if the total storage commitment is greater than 100%.

Are you running batch jobs only, or are batch jobs of primary importance?

No Yes

Consider the following actions:
- Reschedule jobs.
- Increase the size of the user area. See note at the end of this figure.

Are interactive jobs of primary importance, with some concurrent batch jobs?

No Yes

Is swapping activity low?

Yes No

Consider the following actions:
- Reschedule the batch jobs. (You may want to run your interactive jobs without the batch jobs to determine the effect of the batch jobs on your interactive applications.)
- Increase the size of the user area. See note at the end of this figure.

Consider the following actions:
- Assign higher execution priority to the interactive programs.
- Decrease the size of the user area (to force batch jobs to swap out).

Are you running all interactive jobs?

No Yes

Is swapping activity low?

Yes No

Consider the following actions:
- Assign higher execution priority to the critical jobs.
- Increase the size of the user area. See note at the end of this figure.

Are the work station buffer counter values low?

Yes No

(1) (2) (3)

Figure A-8 (Part 1 of 2). Storage Commitment Considerations

Increase the size of the work station buffer.

Are the number of disk enqueues low?

Yes No

Review your program designs to eliminate sector lockout situations.

Is the main storage processor utilization value low?

Yes No

Review the design of your programs and procedures.

Is the disk utilization value low?

Yes No

Review the disk processing logic in your programs.

Is the actual storage commitment low?

Yes

Consider the following actions, which may reduce the size of your programs and possibly optimize program residency:

- Use shared I/O in interactive programs that have many files.
- Overlay noncritical programs (overlays should be used only if disk utilization is low).
- Increase the size of the user area. See note at the end of this figure.

Note: To use main storage more efficiently you often may want to increase the size of the user area. The following actions will increase the size of the user area:

- Reducing the assign/free area size if the area is underutilized.
- Reducing the work station buffer size if the number of work station buffer retries is zero.
- Reducing the size of the spool intercept buffer if the number of buffer splits is low.
- Reducing the size of the spool writer buffer if disk utilization is low.
- Reducing the trace buffer to a minimum size.
- Reconfiguring to remove remote work station support if remote work stations are not needed.
- Making work station data management less resident.
- Making the spool writer nonresident.

Figure A-8 (Part 2 of 2). Storage Commitment Considerations

THROUGHPUT OR RESPONSE TIME PROBLEMS FOR A PARTICULAR PROGRAM

When problems occur for a particular program, you should run the SMF data collection program in the following environments:

- The problem program is the only program running on the system. Data should be collected for the entire time the program is running.
- The problem program is running along with other programs. Data should be collected for periods where response time or throughput problems are occurring.

After the SMF data is collected, you can use the suggestions presented in *General Work Station Response Time Problems that Occur at Various Times During the Day* to help you analyze the results.

GENERAL SYSTEM TUNING

When you use SMF for general system tuning, you should collect data for several time periods. For example, you might want to collect data:

- Every day for two weeks
- Every Friday for a month
- During month end processing for three months

After all of the data is collected, you can print a SUMMARY report for each period and a DETAIL report for the periods desired. You can then evaluate the reports to determine which resources are underutilized and which resources are overutilized. You can then adjust those resources.

Consider using different system configurations for different periods of processing. For example, you might use a different system configuration for end-of-month processing than you use for daily processing. You might specify different values for the following items when performing end-of-month processing:

- Assign/free area size
- Task work area size
- Spool buffer sizes
- Work station buffer size
- Trace buffer size
- Work station data management mode (resident, resident/transient, or transient)
- Resident spool writers
- Remote work stations not active

You can also use the SMF reports to:

- Schedule jobs so that you can balance the work load in the following areas:
  - Processor utilization (both main storage and control storage)
  - Storage commitment (reduce swapping)
  - I/O channel utilization (reduce disk and diskette contention)
  - Disk sector enqueue retries
  - Spool extents
  - Task work area extensions
  - Assign/free area extensions
  - Work station buffer retries
  - Reduced assign/free fragmentation (the number of assign/free segments available)
- Evaluate file and library placement on disk. By relocating files and libraries, you can reduce the number of seeks that span more than one-third of the disk.
- Evaluate the need for additional hardware:
  - Larger memory
  - Diskette magazine drive
  - More disk
  - Faster communications line speed
  - An additional communications line

Appendix B. System Performance Considerations When Using SMF

The performance of SMF on your System/34 can be affected by various factors:

- User area size
- The type of programs you are executing
- The interval you specify for the data collection program

These factors can lead to increased overhead on your system when you are running SMF and can cause some degradation of performance. In the worst case, no more than 5% will be added to the amount of main storage processor utilization.

USER AREA SIZE

Swapping is determined by the amount of user area that is available for your programs. If the amount of user area is large enough to hold all your programs plus SMF, no swapping occurs. Consequently, there will be no performance degradation due to increased swapping caused by the introduction of SMF to the job mix.

Your hardware configuration and the options that you select on SMFSTART determine the amount of main storage used by SMF. Figure B-1 shows the hardware configuration, the SMF option, and the amount of main storage SMF will use.

Configuration	SMF Option	SMF Program Size	User Area Reduction
–	No communications	2 K	0 K
Non-MLCA communications	Collect communications	4 K	0 K
MLCA communications	Collect communications	4 K	2 K

Figure B-1. SMF Configuration Considerations

Figure B-1 shows that the greatest impact occurs to your system when you are running MLCA communications and have selected SMF to run. SMF requires 6 K bytes of main storage when collecting data from MLCA communications. Of this 6 K, 4 K bytes are swappable and need only be resident for each SMF time interval. This 4 K increase may cause swapping to occur if the user area space is exceeded with the addition of SMF. The 2 K bytes of main storage required for collecting MLCA communications data causes a reduction of the user area by 2 K bytes. This reduction will have the greatest impact on performance if the user area was just large enough to hold all of your programs without running SMF.

The following are examples of the effect SMF can have on performance related to the size of the user area.

- SMF causes the storage commitment ratio to exceed 100%, which then causes swapping to begin.
- SMF running on a 64 K system with PEER processing could cause you to configure the PEER subsystem as swappable due to the reduction of 2 K in the user area.
- Running SMF on a system that is already swapping will change the swapping patterns and could result in performance degradation due to increased swapping.

TYPE OF PROGRAM

The type of program you are running can have an effect on your system performance while you are executing SMF. The effect SMF will have on your performance will be more pronounced if swapping is already occurring. For example:

- You are executing batch type programs and you start SMF to collect data at 10-second intervals.
- You are executing interactive type programs and you start SMF to collect data at 10-second intervals.

When using interactive programs, there will be very little impact on execution time by SMF. Both main storage processor and disk I/O time are required by the SMF and batch type programs, resulting in some loss of processing time to the batch programs.

For MLCA communications programs, total SMF overhead for MLCA data collection will be approximately 2 milliseconds for each SMF-MLCA call. Refer to the *Communications Line Data (MLCA)* section for the conditions under which the SMF-MLCA communications data collection routine is called.

The following chart illustrates additional overhead considerations when using MLCA communications and SMF. The chart shows the percentage of overhead time added by SMF to the time required to transmit or receive data over various MLCA lines. The time added to the main storage processor as overhead is approximately 2 milliseconds.

Line Speed	Number of Bytes (Transmit/ Receive)	Transmit Time (Milliseconds)	Overhead (%)
5600 bps	256	36.6	5.46
9600 bps	256	213.3	0.93
56000 bps	4096	585.1	0.34
9600 bps	4096	3413.3	0.05

Note: There is an additional overhead time of 100 microseconds to move SMF-MLCA counters to the SMF output data disk buffer for each time interval selected.

DATA COLLECTION PROGRAM TIME INTERVAL

SMF performs four disk read operations and one or two disk write operations for each time interval selected. Each disk operation is approximately 3 sectors in length. The data collection program takes approximately 200 milliseconds of main storage processing time to record the data for a sampling interval. For the smallest sampling interval (10 seconds), there will be approximately 2% added to the amount of main storage processor utilization.

If you have selected the minimum time interval (10 seconds), the overhead considerations are greater than if you had selected the maximum time interval (5 minutes). You should be aware of the effect on system overhead caused by the time interval selected and select a time interval that satisfies your data collection requirements and has a negligible effect on your system performance.

Appendix C. SMF-MLCA Line Utilization Information

The SMF report writer uses data contained in the SMF counters for reporting on line utilization for each active MLCA line. Information contained in the counters can be used to evaluate MLCA communications performance on the system. The following are items that the SMF report writer calculates about MLCA line utilization on System/34.

Productive Turnaround Time: The length of time between the issuing of a transmit IOB to the MLCA device until the corresponding receive IOB is posted complete. Productive turnaround refers to user data being sent or received on a line.

- BSC lines: The line is productive if the data being transmitted or received has a length of 6 bytes or more.
- SDLC lines: The line is productive when the transmit and receive operations are passed to the SDLC line controller. The MLCA device handles all automatic polling and responses on the line.

Nonproductive Turnaround Time: The length of time it takes for any nonproductive data to be posted complete between a transmit and receive operation.

- BSC lines: The line is nonproductive if the data being transmitted or received has a length of 5 bytes or less. When both transmit and receive data are nonproductive, the time is added to a nonproductive turnaround time counter kept by SMF.
- SDLC lines: The length of time between the start of an autopoll or response command and the time that it is posted complete. The MLCA device transmits and receives control characters to keep the communications line up. The SDLC interrupt handler does not receive control of the line until the receiving system has transmitted data or the autopoll/response is interrupted.

Notes:

1. The time required by the receiving system to process data is the difference between the average productive and average nonproductive line turnaround times.
2. The nonproductive turnaround time value is adjusted to account for a 20-millisecond delay between polls when there is no line activity. The SMF-MLCA communications data collection routine determines how many devices are on the poll list and divides the number of nonproductive turnarounds by the number of devices. This value is then multiplied by 20 milliseconds and represents the total time between polling intervals. This total time between polling intervals is subtracted from the nonproductive turnaround time.

Nonproductive Bytes Transmitted and Received (BSC): The number of bytes transmitted and received and classified as nonproductive.

Bytes Received in Autopoll/Response Mode (SDLC): The number of bytes received in autopoll/response mode before the IOB was posted complete.

Note: Nonproductive bytes transmitted and received and bytes received in autopoll/response mode are equivalent depending upon the type of data communications you are using.

SMF uses these values as a starting point for reporting MLCA line utilization. The following equations represent items SMF computes for MLCA line utilization as shown on the MLCA communications section of an ALL report (see Figure 4-9).

$$\text{Time Necessary to Transmit and Receive All Productive Bytes} = \frac{\text{Bytes Transmitted} + \text{Bytes Received} + \text{Error Bytes Transmitted} + \text{Error Bytes Received}}{\text{Line Speed (bits per second)}}$$

$$\text{Error Byte Time} = \frac{\text{Error Bytes Transmitted} + \text{Error Bytes Received}}{\text{Line Speed (bits per second)}}$$

$$\text{Productive Line Turnaround Time} = \text{Productive Turnaround Time} - \text{Time Necessary to Transmit and Receive All Productive Bytes} - \text{Error Byte Time}$$

$$\text{Average Productive Line Turnaround Time} = \frac{\text{Productive Line Turnaround Time}}{\text{Number of Productive Line Turnarounds}}$$

$$\text{Error Turnaround Time} = \frac{(\text{Transmit Line Errors} + \text{Receive Line Errors}) * \text{Average Productive Line Turnaround Time}}{2}$$

$$\text{Error Time} = \text{Error byte time} + \text{Error Turnaround Time}$$

$$\text{Time to Transmit and Receive all Nonproductive Bytes} = \frac{\text{Nonproductive Bytes Transmitted and Received}}{\text{Line Speed (bits per second)}}$$

Note: For SDLC communications the time to transmit and receive all nonproductive bytes is:

$$\frac{(\text{Number of Nonproductive Line Turnarounds} * 12) + \text{Bytes Received in Autopoll/Response mode}}{\text{Line Speed (bits per second)}}$$

This determines how much of the nonproductive line turnaround time was data byte time.

$$\text{Nonproductive Line Turnaround Time} = \text{Nonproductive Turnaround Time} - \text{Time to Transmit and Receive All Nonproductive Bytes}$$

$$\text{Average Nonproductive Line Turnaround Time} = \frac{\text{Nonproductive Line Turnaround Time}}{\text{Number of Nonproductive Line Turnarounds}}$$

$$\text{Average Receiving System Overhead Time} = \text{Average Productive Line Turnaround Time} - \text{Average Nonproductive Line Turnaround Time}$$

Note: The value calculated is the average receiving system overhead for each productive turnaround.

$$\text{Total Receiving System Overhead Time} = \text{Average Receiving System Overhead Time} * \left(\text{Number of Productive Line Turnarounds} - \left(\frac{\text{Transmit Line Errors} + \text{Receive Line Errors}}{2}\right)\right)$$

$$\text{Line Turnaround Time} = \text{Productive Line Turnaround Time} - \text{Total Receiving System Overhead Time} - \text{Error Time}$$

$$\text{Data Transmit Time} = \frac{\text{Bytes Transmitted}}{\text{Line Speed (bits per second)}}$$

$$\text{Data Receive Time} = \frac{\text{Bytes Received}}{\text{Line Speed (bits per second)}}$$

Total line utilization is computed by adding the categories SMF computed. The values are converted to percentage figures by dividing the time per category by the time interval specified on the SMFSTART procedure.

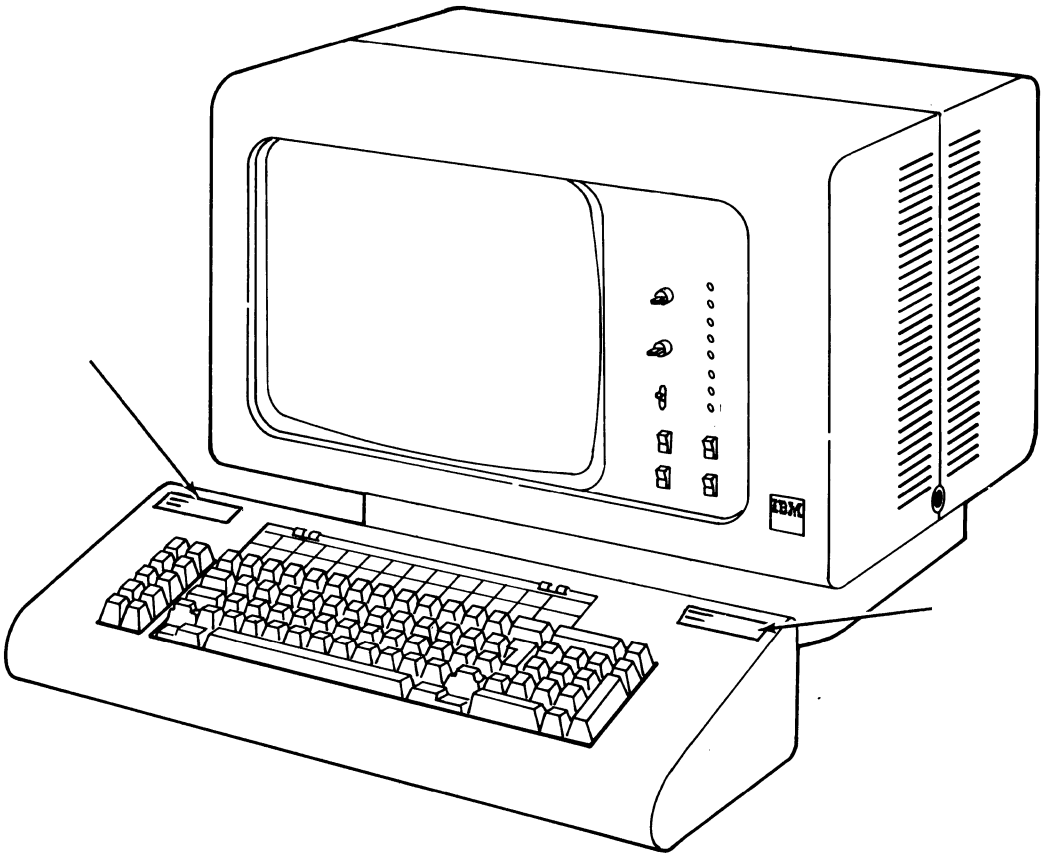
	Receiving System Overhead	XX%
+	Line Turnaround Time	XX%
+	Error Time	XX%
+	Data Transmit Time	XX%
+	Data Receive Time	XX%
=	Total Line Utilization	XX%

Note: The line utilization figures for MLCA lines are higher than for non-MLCA lines since all utilization time, including error time and line turnaround time, is included in the various MLCA counters by SMF.

Appendix D. Labels for Line Speed Information

The labels in this appendix can provide an instant reference for your line speeds. SMF depends on your entering the correct line speed for a particular line in order to provide accurate statistics about your data communications environment. Space is provided on the labels for four communications lines.

You should cut out the attached labels and affix them to the work station or work stations that will be used to enter line speed information for the SMF data collection program. The figure suggests places on your work station where you can affix the labels.



LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

LINE SPEED INFORMATION

LINE 1 ________________ bits/second
LINE 2 ________________ bits/second
LINE 3 ________________ bits/second
LINE 4 ________________ bits/second

Work Station ID ________

A/F area: Assign/free area. Also referred to as system queue space.

application: A particular data processing task such as inventory control or payroll.

assign/free area (A/F area): An area of main storage that contains system and task control information for all system activity and for each job that is active.

autocall: In data communications, the capability of a station to initiate, without operator intervention, a call over a switched line.

batch classification: A classification assigned to programs by the System/34 swapping function. A program is assigned the batch classification when it executes for longer than a system-determined time limit without accepting input from a display station. This is equivalent to a user-assigned normal priority. See also *interactive classification.*

batch processing: A method of running jobs that does not require continuous operator attention; that is, processing that is not interactive. Contract with *interactive processing.*

binary synchronous communications (BSC): A flexible form of line control that provides a set of rules for transferring data over a communications line connecting two or more devices that use a communications adapter.

bit: The smallest unit of data in a computer. Represented by a 1 (one) or a 0 (zero).

bits per second (bps): A unit of measure for data transmission speed.

block: (1) A record or a collection of contiguous records recorded or processed as a unit. (2) In System/34, a 10-sector (2560 byte) unit of disk space.

bps: Bits per second.

BSC: Binary synchronous communications.

byte: (1) The hexadecimal representation of a character. (2) A sequence of 8 adjacent bits that are operated on as a unit and that constitute the smallest addressable unit in System/34.

control processor (CP): A group of programs that execute control storage instructions that determine channel data transfers and main storage assignment.

control storage: Storage that contains control processor instructions and data. Contrast with *main storage.*

CSP: Control processor.

dispatching function: The System/34 function that allows multiple programs in main storage to share processing time. The dispatching function is responsible for allocating the main storage processor to your program.

display screen format: A table that defines a display presented by work station data management.

extended character file: For System/34 ideographic support, an area on a disk that contains IBM-supplied characters and can contain user-generated characters.

ideographic: Consisting of both graphics and pictograms and, often, other types of symbols, such as Greek or Japanese characters.

ideographic character: For System/34 ideographic support, a graphic or pictogram that requires two bytes of storage.

ideographic field: For System/34 ideographic support, one or more ideographic characters of related information in a record bracketed by shift-out and shift-in control characters.

initial program load (IPL): A sequence of events that loads the system programs and prepares the system for execution of jobs.

input job queue: A list of jobs waiting to be processed by the system. The list is maintained on the disk. Each entry in the list references a procedure stored in a library on the disk.

interactive classification: A classification assigned to programs by the System/34 swapping function. If a program executes for longer than a system/determined time limit without accepting input from a display station, the program loses its interactive priority. This is equivalent to a user-assigned, medium priority. See *batch classification.*

interactive processing: A method of processing in which each operator action causes a response from the system or a program, as in an inquiry system or an airline reservation system. See *batch processing.*

IPL: Initial program load.

job: One or more related procedures or programs grouped into a first-level procedure.

K: 1024 bytes.

main storage: (1) General-purpose storage of a computer. (2) All storage that can be addressed by programs, from which instructions can be executed, and from which data can be loaded directly into registers. Contrast with *control storage.*

main storage processor (MSP): Hardware that executes machine instructions in main storage.

MLCA: Multiline communications adaptor.

MRJE: MULTI-LEAVING remote job entry.

MRT: Multiple requestor terminal.

MSP: Main storage processor.

MULTI-LEAVING Remote Job Entry (MRJE): An SSP function that allows the user to submit jobs to a system over a communications line using BSC.

multiline communications adapter (MLCA): A feature on System/34 supporting up to four communications lines. It allows a total speed of up to 65 600 bps.

multiple requestor terminal (MRT) program: A program that can process requests from more than one requesting display station concurrently. See *single requestor terminal (SRT) program.*

multipoint line: A line or circuit interconnecting several stations.

NEP: Never-ending program.

never-ending program (NEP): A program that will own system resources for a long period of time and defined as an NEP (NEP-YES) on the COMPILE OCL statement or the ATTR OCL statement.

nonrequesting terminal (NRT) program: A program that is not attached to a requesting display station.

NRT: Nonrequesting terminal.

point-to-point line: A data communications facility that connects a single remote station to a data processing system. A point-to-point line can be either switched or nonswitched.

polling: A method of checking station(s) on a point-to-point or multipoint line to see if they have anything to send.

post: A means of communicating between two tasks. It could be a response to a request or issuance of a request.

printer spooling: A part of the SSP that provides temporary storage of print data on disk.

propagation time: The time necessary for a signal to travel from one point on a circuit to another.

RWS: Remote work station support.

SDLC: Synchronous data link control.

SEC: System event counter.

sector: (1) An area on a disk or diskette track reserved to record a unit of data. (2) The smallest amount of data (256 bytes) that can be transferred to or from a disk or diskette by a single data transfer operation.

single requestor terminal (SRT) program: A program that can have only one requesting display station at a time. See *multiple-requestor terminal (MRT) program.*

SNA: System network architecture.

SNA peer subsystem: An SSP-Interactive Communications feature subsystem that supports program-to-program communications with another System/34 on a point-to-point SDLC line. Neither end of an SNA peer session is considered by SNA as the host.

SNA Remote Job Entry (SRJE): An SSP function that allows the user to submit jobs to a system in an SNA environment using SDLC line disciplines.

SNA upline facility (SNUF): An SSP-Interactive Communications feature subsystem that provides the application programmer the capability of using the interactive communications function in an SNA environment. The SNA upline facility provides various functions one of which is program-to-program communications with the CICS and IMS subsystems.

SNUF: SNA upline facility.

spool intercept buffer: An area of main storage that contains printer data that is being written to the spool file.

spool writer buffer: An area of main storage that contains data being printed on the line printer by a spool writer program.

SRJE: SNA remote job entry.

SSP: System Support Program Product.

SSP-ICF: System Support Program Interactive Communications Feature.

SSP-Interactive Communications Feature (SSP-ICF): A feature of the SSP that includes interactive support for BSC and SNA communications as well as communications between programs within the system.

swapping function: The System/34 function of placing executing programs temporarily on disk; swapping allows the total amount of user storage required by concurrently executing programs to exceed the amount of main storage normally available for user programs.

synchronous data link control (SDLC): A discipline for the management of information transfer over a data communications channel.

system library: The library that contains the members that are part of the SSP in addition to non-SSP members. The system library is labeled #LIBRARY and cannot be deleted from the disk.

task: A unit of work for the main storage processor; the basic multiprogramming unit under the control program.

task work area (TWA): An area on disk that contains control information and work areas for the active tasks.

TCB: Task control block.

transient area: A specific place in the nucleus that is used by the SSP for miscellaneous functions such as error recovery and file open.

TUB: Terminal unit block.

turnaround time: The time interval required to reverse the direction of transmission over a communication line.

TWA: Task work area.

WSB: Work station buffer.

WSDM: Work station data management.

work station buffer (WSB): An area of main storage that contains work station data. Also referred to as work station queue space (WSQS).

work station data management (WSDM): The SSP function that enables a program to present data on a display screen by providing a string of data fields and a format name.

3270 BSC Support Subsystem: An SSP-Interactive Communications feature subsystem that supports program-to-program communications with IMS/VS, CICS/VS, or System/3 CCP application programs using 3270 BSC protocols.

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